5.0

EMISSION INVENTORY RESULTS

5.1 SURVEY RESPONSE

5.1.1 Response Rate

Table 5-1 summarizes the response to the survey as of May 17, 2000, the date that the last reply was received. The table includes the five strata in Sampling Frame II (Groups 1-5), as well as the single stratum in Sampling Frame I (Group 6). For the purpose of the remainder of this report, the "**survey sample**" is defined as the responses for which some data were obtained, including those that indicated that a facility was ineligible for the emission inventory.

On the basis of their responses, 1,671 facilities (52 percent of those that were mailed survey packages) were eliminated from the emission inventory. Another 143 facilities returned questionnaires with metal welding, cutting, and/or spraying data. Thus, the survey sample consisted of 1,814 responses out of 3,217 surveys mailed (56 percent). Responses with data comprised 8 percent of the survey sample.

Table 5-1

OVERALL RESPONSE RATE, BY SURVEY STRATUM

		Survey Responses			
Group	Surveys Mailed	Eliminated	Returned With Data	Total Response	Total Response Percent
1	636	342	50	392	**61.6**
2	607	168	41	209	**34.4**
3	1,313	761	35	796	**60.6**
4	275	158	7	165	**60.0**
5	344	237	5	242	**70.3**
6	42	5	5	10	**23.8**
Totals	3,217	1,671	143	1,814	**56.4**

Figure 5-1 shows how the survey response rate for each group was divided between facilities that were eliminated and those that submitted emission inventory data. The overall response rate ranged from 34 percent (Group 2) to 70 percent (Group 5). For Sampling Frame II, Groups 1 and 2 provided the highest percentages of inventory data responses. This was expected, since, as was discussed in Section 3.1.2, facilities in these two groups were believed *a priori* to have the highest "welding intensity." One disappointment was that the overall response rate for Group 2 was only 34 percent, inasmuch

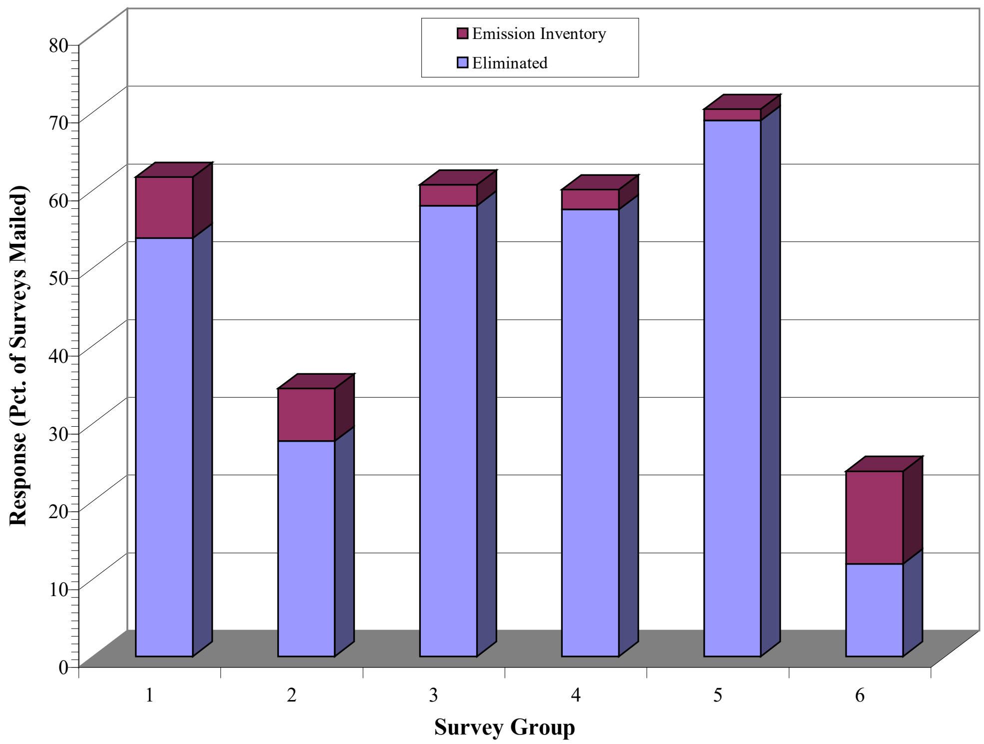

Figure 5-1. Overall Response Rate, by Survey Group.

as about 20 percent of those that did respond used the metalworking processes of interest.[1] Also, of the ten respondents that had AQMD permits for metal spraying, five were ineligible.[2]

5.1.2 Reasons for Elimination of Facilities

Figure 5-2 shows the relative frequency of each of the major reasons why facilities were eliminated from the emission inventory. Almost half the eliminated facilities were manufacturers, but did not perform any metal welding, cutting or spraying on-site. The second largest group comprised facilities that were sales or administrative offices, and did no manufacturing. About 12 percent of the facilities surveyed were apparently out of business, and another 7 percent explicitly refused to participate.

5.1.3 Distribution of the Survey Sample by Group and County

Table 5-2 compares the actual survey response by group with that which would be expected if the responses had been in proportion to the numbers of survey packages mailed to each group.[3] A chi-square test shows that the actual distribution is significantly

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[1] This is discussed further in Section 6.1.
[2] One was out of business, one reported no metal spraying and two reported spraying only for internal maintenance. One stated that it was ineligible but did not give a reason.
[3] For example, Group 1 represents 19.8% of the surveys mailed. The expected number of total responses in that group would be 0.198 x 1814 = 359.

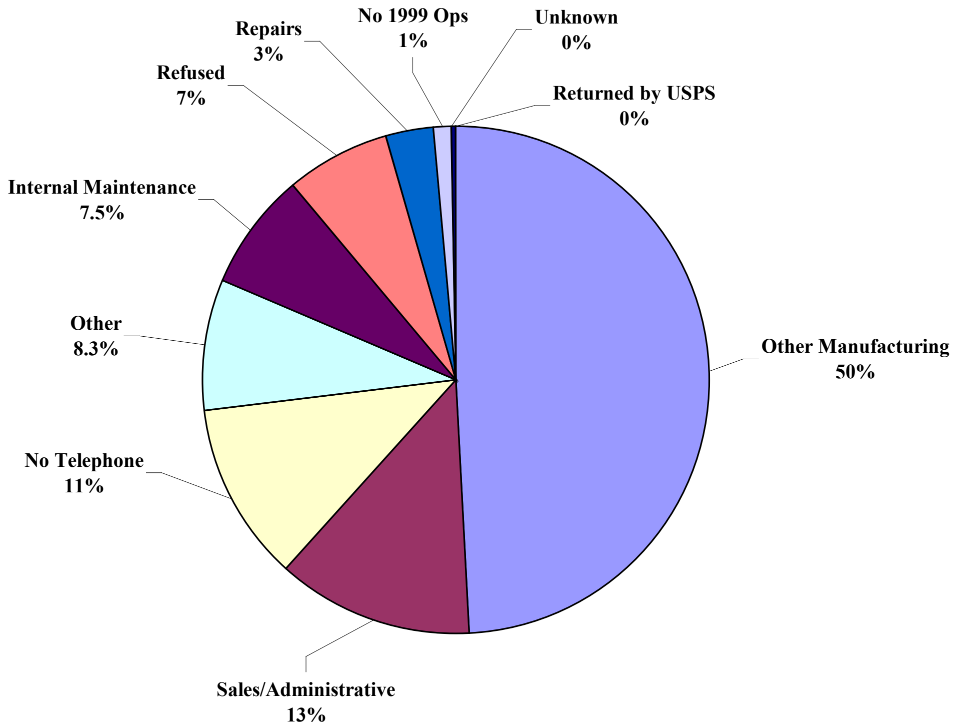

Figure 5-2. Reasons for Eliminating Facilities From the Emission Inventory.

Table 5-2

ACTUAL AND EXPECTED SURVEY RESPONSE RATES, BY GROUP

Group	Surveys Mailed	Total Responses		Data Responses	
		Expected Response	Actual Response	Expected Response	Actual Response
1	636	359	392	28.3	50
2	607	342	209	27.0	41
3	1,313	740	796	58.4	35
4	275	155	165	12.2	7
5	344	194	242	15.3	5
6	42	24	10	1.9	5
Totals	3,217	1,814	1,814	143	143

different from the expected one ($\chi^2 = 79.682$, d.f. = 5, $p < 0.001$). A major reason for this is that the overall response rate for Group 2 was very low, despite deliberate steps to increase it. The table also compares the number of responses with data with those expected. Again, the actual distribution is significantly different from the expected one ($\chi^2 = 47.483$ d.f. = 5, $p < 0.001$).

Table 5-3 compares the actual survey response by county with that which would be expected if the responses had been in proportion to the numbers of survey packages mailed to facilities in each county. A chi-square test shows that the actual distribution is *not* significantly different from the expected one ($\chi^2 = 1.943$, d.f. = 3, $p < 0.58$). This means that the survey response is geographically representative. The table also compares the number of responses with data with those expected. The actual distribution is significantly different from the expected one ($\chi^2 = 17.670$ d.f. = 3, $p < 0.0005$). Therefore the distribution of facilities that have welding, cutting and/or spraying processes is higher than expected in two counties (Riverside and San Bernardino) and lower than expected in the two others (Los Angeles and Orange). Figure 5-3 shows the distribution of total responses by county.

Table 5-3

ACTUAL AND EXPECTED SURVEY RESPONSE RATES, BY COUNTY

County	Surveys Mailed	Total Responses		Data Responses	
		Expected Response	Actual Response	Expected Response	Actual Response
Los Angeles	1,974	1,113	1,112	88	82
Orange	742	418	420	33	21
Riverside	195	110	121	9	17
San Bernardino	306	173	161	14	23
Totals	3,217	1,814	1,814	143	143

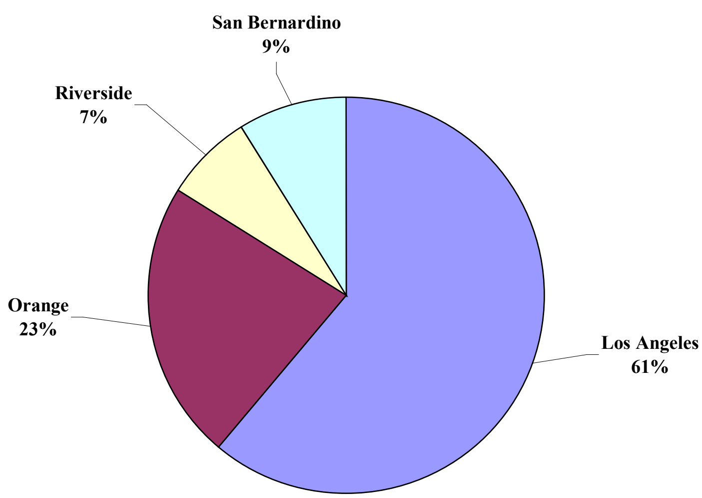

Figure 5-3. Distribution of Survey Sample by County.

5.1.4 Distribution of Responses by Industry

Table 5-4 shows the distributions of the survey sample and the responses with inventory data by two-digit standard industrial classification (SIC) code.[4] About 82 percent of the responses with emission inventory data are from fabricated metal products and industrial and commercial machinery manufacturers.

Table 5-4

DISTRIBUTION OF THE SURVEY RESPONSE BY INDUSTRY

SIC	Description	Total Responses		Data Responses	
		Number	Percent	Number	Percent
26	Paper & Allied Products Mfrs.	1	0.1	0	0.0
28	Chemicals & Allied Products Mfrs.	1	0.1	0	0.0
33	Primary Metal Industries	91	5.0	7	4.9
34	Fabricated Metal Products Mfrs.	495	27.3	67	46.9
35	Industrial & Commercial Machinery Mfrs.	793	43.7	51	35.7
36	Electronic & Other Electrical Equipment Mfrs.	211	11.6	7	4.9
37	Transportation Equipment Mfrs.	165	9.1	11	7.7
38	Measuring and Analyzing Instruments Mfrs.	57	3.1	0	0.0
Totals		1,814	100.0	143	100.0

5.2 WELDING EMISSION INVENTORY

5.2.1 Welding Processes Used in the AQMD

Survey respondents reported use of 11 types of welding at 138 facilities. Table 5-5 shows how many facilities in each survey group reported each type of welding process. Note that many facilities used more than one type of welding. The total numbers of reported processes of each type are shown in Figure 5-4. The most common types of welding reported are gas metal arc welding (GMAW or MIG), gas tungsten arc welding (GTAW or TIG), and shielded metal arc welding (SMAW). These were reported by 58, 41, and 35 percent, respectively, of the facilities that do welding.

[4] There would be too many codes if three- or four-digit SIC codes were used.

Table 5-5

FREQUENCY OF OCCURRENCE OF WELDING PROCESSES AMONG FACILITIES IN THE SURVEY SAMPLE THAT DO WELDING

Type	Name	Survey Group						Total
		1	2	3	4	5	6	
EGW	Electrogas	1	1					2
ESW	Electroslag	2						2
FCAW	Fluxed Cored Arc	9	10	4	3		1	27
GMAW	Gas Metal Arc	30	31	11	4	2	2	80
GTAW	Gas Tungsten Arc	18	7	24	2	3	3	57
LAS	Laser	1				1		2
OXY	Oxyfuel	6	2	3	1	2	1	15
PAW	Plasma Arc			1			1	2
RES	Resistance	12	3	5	1	1	1	23
SAW	Submerged Arc	5		1	1			7
SMAW	Shielded Metal Arc	18	13	13		2	2	48
Totals		102	67	62	12	11	11	265

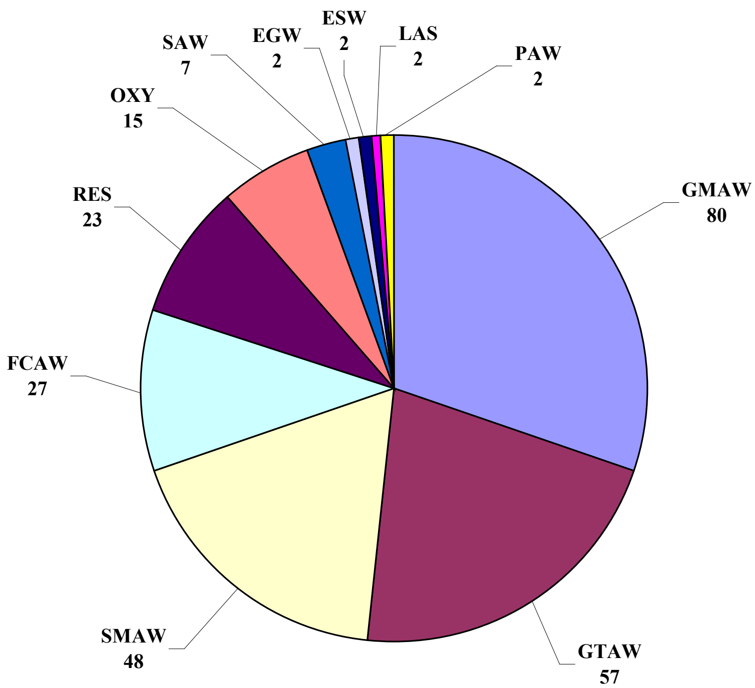

Figure 5-4. Reported Occurrences of Each Type of Welding Process.

The results shown in Table 5-5 were used to estimate 95-percent confidence limits for the number of facilities in the AQMD that use each type of welding. These estimates are shown in Table 5-6.

Table 5-6

ESTIMATED NUMBER OF FACILITIES IN THE AQMD THAT PERFORM EACH TYPE OF WELDING

Welding Type	No. of Facilities	95% Confidence Interval	
		Minimum[a]	Maximum
Electrogas	5	2	10
Electroslag	3	2	6
Fluxed Cored Arc	118	63	174
Gas Metal Arc	305	225	384
Gas Tungsten Arc	294	210	377
Laser	14	2	36
Oxyfuel	79	31	127
Plasma Arc	11	2	26
Resistance	93	47	140
Submerged Arc	29	7	59
Shielded Metal Arc	190	131	249

[a]Where calculation yielded a lower bound <0, the number of facilities reporting the process was used.

5.2.2 Welding Material Use in the AQMD

The mass of electrode consumed (e.g. as rod or wire) per facility in the survey sample was calculated for each welding type and then was extrapolated to the AQMD as a whole. Table 5-7 shows the projected AQMD-wide mass of electrode consumed by each welding type, and the average electrode consumption per reporting facility. Figure 5-5 shows the percentage distribution by welding type. The projected total annual AQMD-wide consumption of electrode is about 1.5 million lb. The four main processes, GMAW (MIG), FCAW, SMAW, and GTAW (TIG), account for 87 percent of this consumption. It is interesting to note that the average consumption per facility varies considerably by process. For the four major types of welding, the per-facility average ranges from 468 lb/yr (GTAW) to 5,700 lb/yr (FCAW).

Table 5-7

ANNUAL CONSUMPTION OF ELECTRODE MATERIAL, BY WELDING TYPE

Welding Type	Basin-Wide Consumption (lb/yr)	Consumption per Reporting Facility (lb/yr)
Electrogas	11,100	3,345
Electroslag	8,520	2,625
Fluxed Cored Arc	402,670	5,700
Gas Metal Arc	407,790	2,332
Gas Tungsten Arc	183,040	468
Laser	1,200	100
Oxyfuel	6,200	161
Plasma Arc	3,420	265
Resistance	121,660	9,331
Submerged Arc	35,540	2,099
Shielded Metal Arc	319,560	3,191
Total	1,500,700	

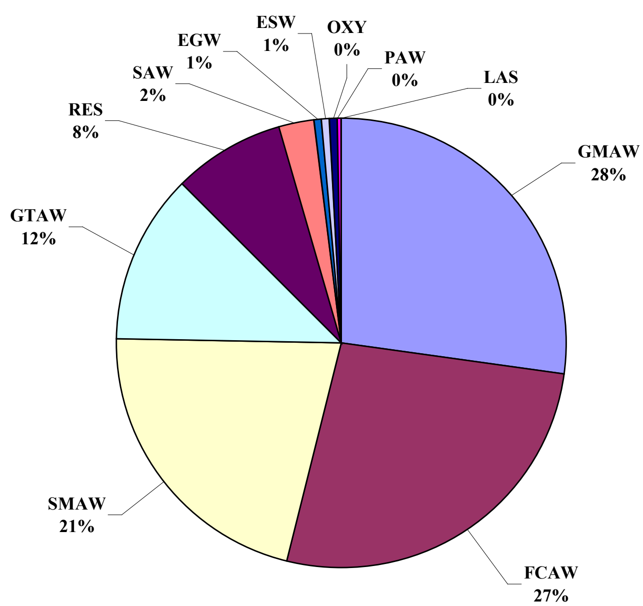

Figure 5-5. Distribution of Annual Electrode Material Use in the AQMD, by Welding Type.

For each welding type, the distribution of welding substrates was calculated. The distributions are weighted averages, the weights being the pounds of electrode material consumed. Table 5-8 shows the welding substrate distributions. For six of the eleven welding types, over 90 percent of the welding is performed on mild steel.[5] Stainless steel is an important substrate for GTAW, laser welding, oxyacetylene welding, and SMAW. Welding on aluminum is significant only for GTAW and laser welding. Plasma arc welding is the only type performed to any significant extent on copper. PAW, along with laser welding, is also used on nickel. Only a small amount of welding on lead was reported.

Table 5-8

DISTRIBUTION OF WELDING SUBSTRATE, BY WELDING TYPE

Welding Type	Type of Metal on Which Welding is Performed (as a Percent of All Metals)						
	Aluminum	Copper	Nickel	Mild Steel	Stainless Steel	Lead	Other[a]
Electrogas	1.0	0.0	0.0	95.1	3.9	0.0	0.0
Electroslag	1.0	0.0	0.0	94.1	4.9	0.0	0.0
Fluxed Cored Arc	2.4	0.0	0.4	93.4	3.7	0.0	0.1
Gas Metal Arc	1.2	0.0	0.3	96.4	1.7	0.0	0.4
Gas Tungsten Arc	23.2	0.2	6.0	38.7	30.5	0.0	1.5
Laser	55.5	0.9	18.5	0.9	23.3	0.0	0.9
Oxyfuel	5.7	0.2	1.8	35.6	56.6	0.0	0.1
Plasma Arc	0.0	23.1	43.4	0.9	0.0	0.9	0.0
Resistance	0.2	0.0	0.0	96.7	3.1	0.0	0.0
Submerged Arc	0.2	0.0	0.0	95.5	4.3	0.0	0.0
Shielded Metal Arc	1.9	0.0	0.3	56.7	41.0	0.0	0.0

[a]Other substrates reported included brass, bronze, magnesium and silver (brazing). Seven facilities reported "other" but did not identify the metal(s).

5.2.3 Emissions From Welding at Facilities in the AQMD

Welding emissions were calculated by the methods described in Section 4.1. They were then extrapolated to the AQMD as a whole by the methods presented in Section 4.3. Table 5-9 summarizes the total extrapolated emissions by welding process. Note that one facility that reported using gas tungsten arc welding had emissions that were so much higher than those of the rest of the survey sample that they were not included in the extrapolation calculation. However, the emissions from that facility were added to the result of the extrapolation, so that all known emissions would be accounted for.

[5] Mild steel has a carbon content of 0.15 to 0.30 percent (Jeffus, 1999). In this report, “mild steel” refers to all types of steel except stainless.

Table 5-9

ESTIMATED ANNUAL AQMD TOXIC METAL EMISSIONS FROM WELDING OPERATIONS AT FACILITIES

	Emissions (lb/yr)			
Welding Type	Nickel	Chromium	Zinc	Lead
Fluxed Cored Arc	3.9	20.2	3.7	0.0
Gas Metal Arc	11.1	7.9	3.1	0.0
Gas Tungsten Arc[a]	26.0	26.8	0.7	0.0
Oxyfuel	0.0	2.6	0.0	0.0
Plasma Arc	0.3	0.2	0.0	0.0
Shielded Metal Arc	19.0	57.5	330.0	32.7
Total	60.3	115.1	337.5	32.7

[a]Emissions from one very large facility were omitted for the extrapolation but are included in the totals.

It is estimated that welding processes in SIC codes 3310 – 3869 result in emissions of 60 lb/yr of nickel, 115 lb/yr of total chromium, 337 lb/yr of zinc and 33 lb/yr of lead. Using the percentages reported in Section 2.4, it is estimated that hexavalent chromium emissions are about 10 to 97 lb/yr. Figures 5-6 through 5-8 show the distributions of annual emissions of nickel, total chromium and zinc, respectively, by process. All the lead emissions are from shielded metal arc welding. SMAW is also responsible for almost all the zinc emissions and slightly over half the total chromium emissions.

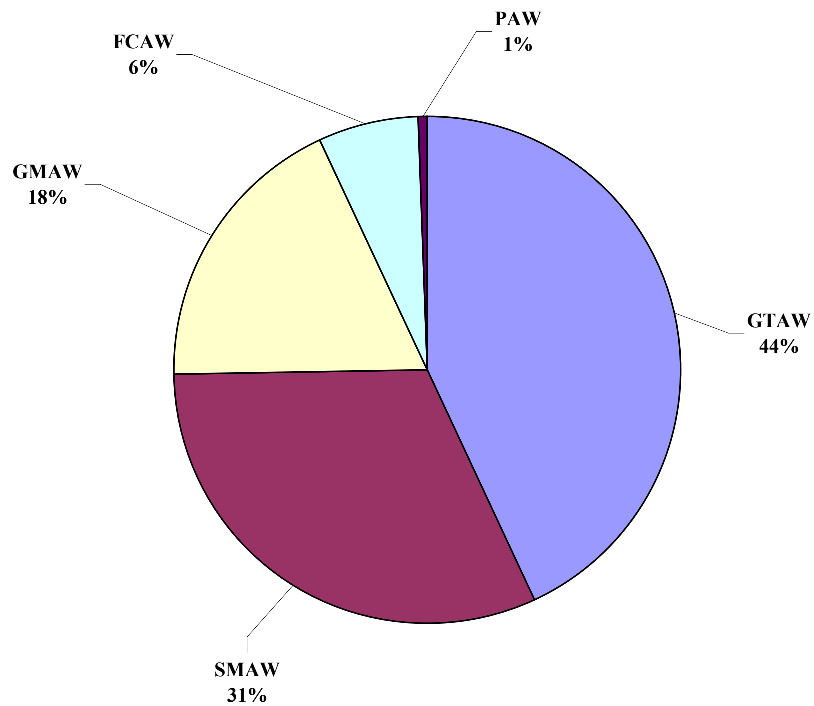

Figure 5-6. Distribution of Annual Nickel Emissions From Welding, by Process.

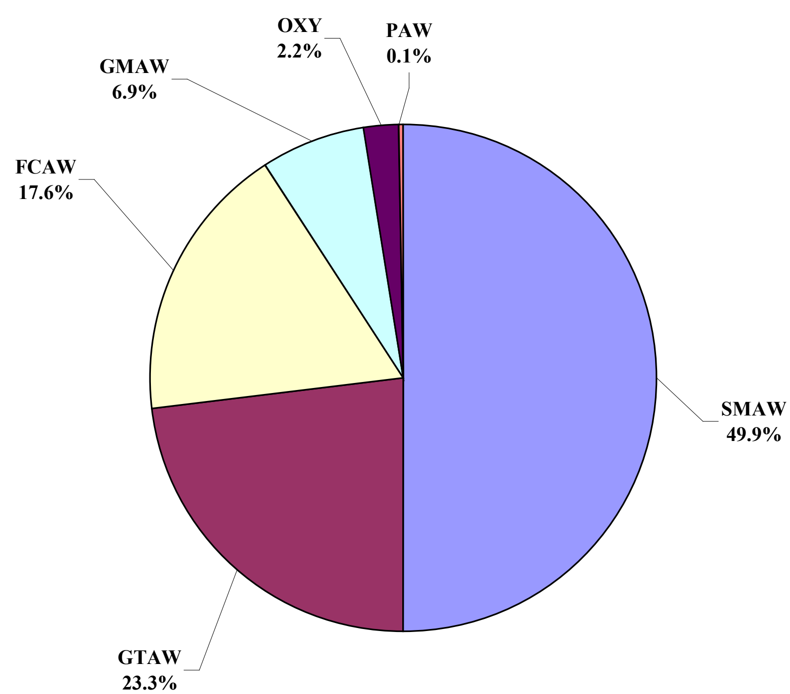

Figure 5-7. Distribution of Annual Total Chromium Emissions From Welding, by Process.

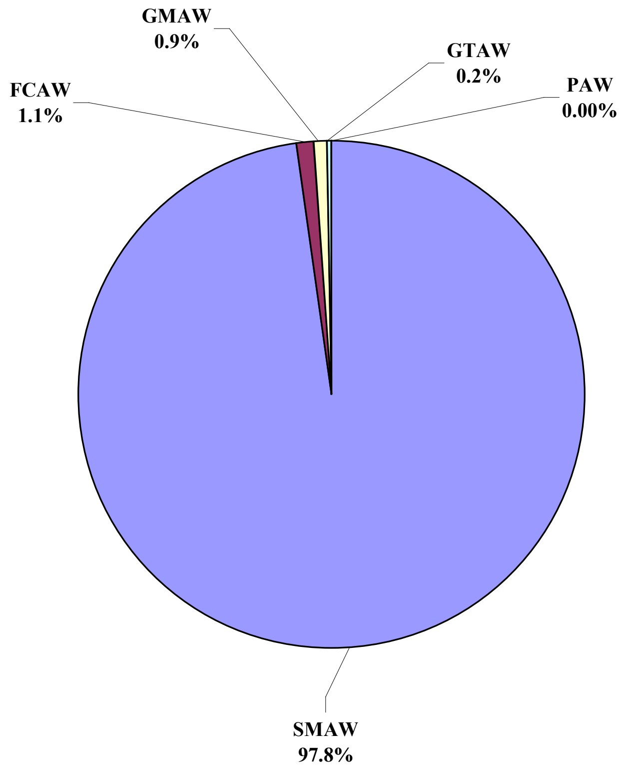

Figure 5-8. Distribution of Annual Zinc Emissions From Welding, by Process.

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5.3 METAL CUTTING EMISSION INVENTORY

5.3.1 Metal Cutting Processes Used in the AQMD

Survey respondents reported use of 7 types of high-temperature metal cutting at 75 facilities.[6] Table 5-10 shows how many facilities in each survey group reported each type of cutting process. Note that many facilities used more than one type of cutting. The total numbers of reported processes of each type are shown in Figure 5-9. The most common types of cutting reported are oxyfuel cutting (OXY), plasma arc cutting (PAC), and air carbon arc cutting (CAC-A). These were reported by 52, 49, and 21 percent, respectively, of the facilities that do cutting.

The results shown in Table 5-10 were used to estimate 95-percent confidence limits for the number of facilities in the AQMD that perform each type of metal cutting. These estimates are shown in Table 5-11.

[6] Metal cutting at construction sites is not included.

Table 5-10

FREQUENCY OF OCCURRENCE OF CUTTING PROCESSES AMONG FACILITIES IN THE SURVEY SAMPLE THAT DO CUTTING

Type	Name	Survey Group						Total
		1	2	3	4	5	6	
CAC-A	Air Carbon Arc	3	4	6			3	16
CAC	Carbon Arc	2		1			1	4
GMAC	Gas Metal Arc	3		1	2		1	7
LAS	Laser	2		1			1	4
OXY	Oxyfuel	15	11	10		2	1	39
OAC	Oxygen Arc	2	2	1			2	7
PAC	Plasma Arc	20	4	9	1	1	2	37
Totals		47	21	29	3	3	11	114

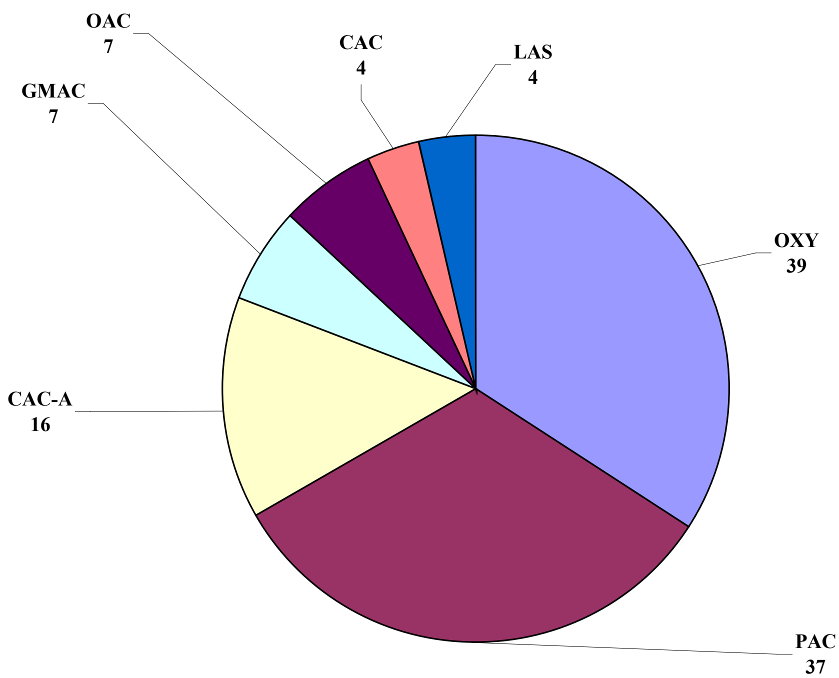

Figure 5-9. Reported Occurrences of Each Type of Metal Cutting Process.

Table 5-11

ESTIMATED NUMBER OF FACILITIES IN THE AQMD THAT PERFORM EACH TYPE OF METAL CUTTING

Cutting Type	No. of Facilities	95% Confidence Interval	
		Minimum[a]	Maximum
Air Carbon Arc	71	37	105
Carbon Arc	14	4	29
Gas Metal Arc	45	4	85
Laser	14	4	29
Oxyfuel	154	100	208
Oxygen Arc	24	7	42
Plasma Arc	141	88	195

[a]Where calculation yielded a lower bound <0, the number of facilities reporting the process was used.

5.3.2 Metal Cutting Substrate

For each cutting type, the distribution of cutting substrates was calculated. The distributions are weighted averages, the weights being the hours per year engaged in metal cutting. Table 5-12 shows the cutting substrate distributions. Mild steel is the predominant substrate for all the cutting techniques. Stainless steel is an important substrate for CAC-A and laser welding. Cutting on aluminum is significant only for GMAC and laser cutting. Only minor amounts of cutting on copper, nickel, lead or other substrates were reported.

Table 5-12

DISTRIBUTION OF CUTTING SUBSTRATE, BY CUTTING TYPE

Cutting Type	Type of Metal on Which Cutting is Performed						
	Aluminum	Copper	Nickel	Mild Steel	Stainless Steel	Lead	Other
Air Carbon Arc	0.2	0.0	0.0	71.6	28.1	0.0	0.0
Carbon Arc	7.8	0.0	0.0	84.2	8.0	0.0	0.0
Gas Metal Arc	14.8	0.7	0.4	73.8	10.0	0.4	0.0
Laser	17.3	0.0	0.4	42.4	39.8	0.0	0.0
Oxyfuel	5.1	0.0	0.1	80.6	8.6	0.0	5.6
Oxygen Arc	1.4	0.0	0.1	98.3	0.1	0.0	0.0
Plasma Arc	7.6	0.0	0.0	81.5	10.9	0.0	0.0

5.3.3 Metal Cutting Emissions

Cutting emissions were calculated by the methods described in Section 4.1. They were then extrapolated to the AQMD as a whole by the methods presented in Section 4.3. Note that total chromium emissions from one facility using plasma arc cutting were so much higher than those from the rest of the sample that they were excluded from the AQMD-wide extrapolation. However, that facility's emissions are included in the total. Table 5-13 summarizes the total extrapolated emissions by cutting process.

It is estimated that cutting processes result in emissions of 3 lb/yr of nickel, 140 lb/yr of chromium, and 20 lb/yr of zinc. *Note that the chromium value was calculated with an emission factor based on a single source test, and should be used with caution.* Figures 5-10 through 5-12 show the distributions of annual emissions of nickel, total chromium and zinc, respectively, by process. Plasma arc cutting is responsible for most of the chromium emissions. CAC-A, PAC and oxyfuel cutting represent most of the nickel and zinc emissions.

Table 5-13

ESTIMATED ANNUAL AQMD-WIDE TOXIC METAL EMISSIONS FROM CUTTING OPERATIONS

	Emissions (lb/yr)		
Cutting Type	Nickel	Chromium	Zinc
Air Carbon Arc	0.9	3.7	4.7
Carbon Arc	0.0	0.0	0.1
Gas Metal Arc	0.1	0.0	0.6
Laser	0.4	0.1	2.5
Oxyfuel	0.8	0.3	5.8
Oxygen Arc	0.1	0.0	0.5
Plasma Arc	0.8	136.2	5.9
Total	3.1	140.4	20.1

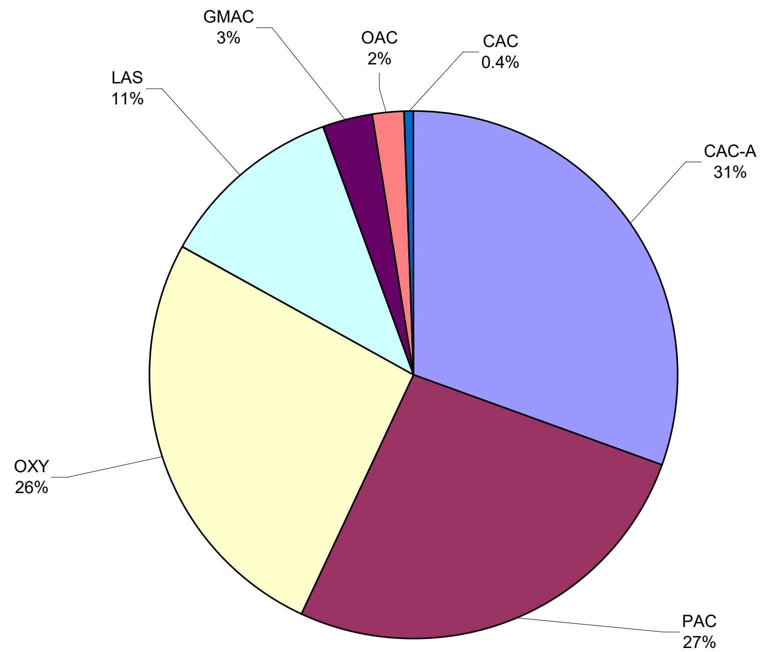

Figure 5-10. Distribution of Annual Nickel Emissions From Cutting, by Process.

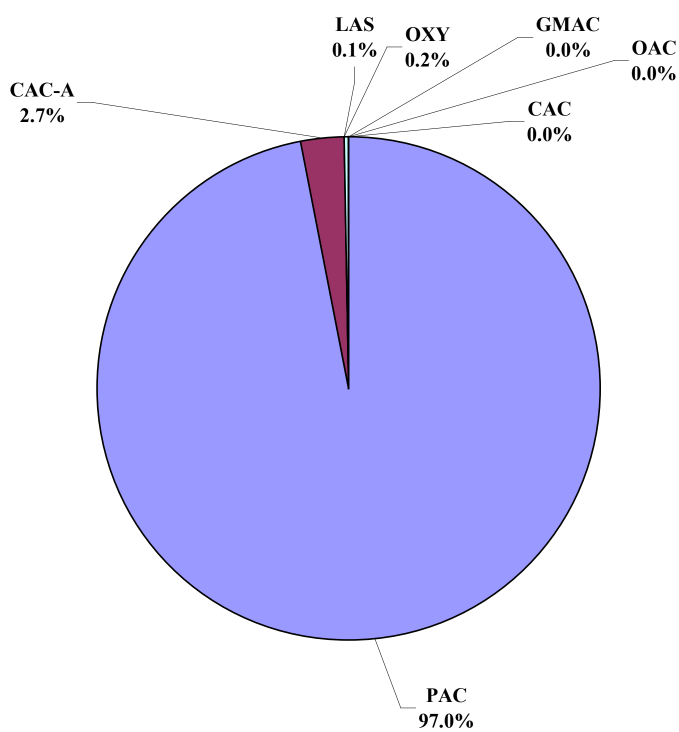

Figure 5-11. Distribution of Annual Total Chromium Emissions From Cutting, by Process.

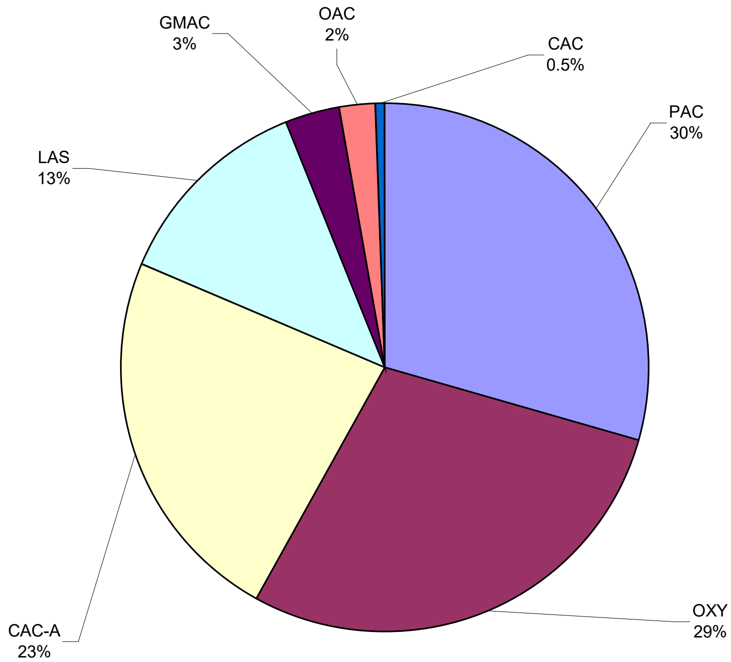

Figure 5-12. Distribution of Annual Zinc Emissions From Cutting, by Process.

5.4 METAL SPRAYING EMISSION INVENTORY

Only six facilities provided data on their metal spraying operations. Table 5-14 summarizes the information obtained.

Table 5-14

SUMMARY OF METAL SPRAYING SURVEY RESPONSE DATA

Facility[a]	Spray Type	Amount Sprayed (lb/yr)	Composition	
			Element	Pct
1	Thermal	1500	Zn	100
2	Thermal	1000	Zn	99.9
3	Thermal	50	Al	100
4	Plasma	3000	Cr	29
			Co	57.5
			Ni	2.8
5	Plasma	1	Y	7
			Zr	93
		0.5	Al	10
			Cr	10
			Y	1
		4	Co	12
			Fe	1
			W	87
		35	Ca	5
			Hf	2
			Zr	93
		10	Cr	22
			Fe	2
			Ni	75
6	Thermal	Nd[a]	Cr	13
			Ni	0.5
		ND	Cr	17
			Ni	12
		ND	Al	20
			Ni	80
		ND	Mo	99.9
		ND	Al	9
			Cu	90

[a]Numbering is for this table only; these are not survey ID numbers.

[b]ND = No data provided.

Of the fourteen spraying operations,[7] only six use one of the two toxic metals for which pollutant-specific emission factors were developed (nickel or total chromium). Of these six, the amount sprayed was known for only three. Estimated uncontrolled emissions from these three spraying operations are 5.0 lb/yr of nickel and 44 lb/yr of total chromium. Two of the processes used substantial amounts of zinc, but emission factors were unavailable for that pollutant.

5.5 EMISSION CONTROLS

Nine survey respondents (out of 143 with emission inventory data) reported having some type of particulate emission controls. Table 5-15 summarizes the information obtained.

Table 5-15

SUMMARY OF EMISSION CONTROLS REPORTED FOR METAL WELDING, CUTTING AND SPRAYING

Facility[a]	Process[a]	Venting	Emission Control Equipment
1	C	Vented apparatus	Inertial separator (cyclone)
2	W	Hooded exhaust	Baghouse
3	C	Hooded exhaust	Fabric filter
4	W & C	Spray booth	Fabric filter
5	W	Hooded exhaust	Baghouse
6	S	Spray booth	Fabric filter
7	S	Hooded exhaust	Fabric filter and HEPA filter
		Spray booth	Water scrubber
8	W & C	Vented apparatus	Fabric filter
9	W & C	Room exhaust	HEPA filter

[a]Numbering is for this table only. These are not survey ID numbers.

[b]C = cutting, W = welding, S = metal spraying.

To estimate the effect of emission controls on the AQMD-wide emission estimates, it was assumed that the average capture and removal efficiency of the controls was 90 percent. The emission estimates for the nine facilities were revised and the AQMD-wide totals were re-extrapolated. Table 5-16 shows estimated absolute and relative changes in the AQMD-wide emission estimates for the affected welding processes. For zinc and lead, the effect of the existing emission controls would be minor. For total chromium, the existing controls are estimated to reduce the AQMD-wide emissions by

[7] A "spraying operation" is defined here as use of a particular type of wire or powder in combination with a particular spraying process (i.e. thermal or plasma).

about 41 percent, to about 47 lb/yr. AQMD-wide nickel emissions are about 10 percent smaller because of the existing controls.

Table 5-16

DECREASES IN AQMD-WIDE WELDING EMISSIONS, ASSUMING 90-PERCENT CONTROL

Welding Type	Nickel		Chromium		Zinc		Lead	
	Lb/Yr Reduced	Pct Reduced	Lb/Yr Reduced	Pct Reduced	Lb/Yr Reduced	Pct Reduced	Lb/Yr Reduced	Pct Reduced
Gas Metal Arc	0.1	0.6	0.1	1.9	0.0	0.1	0.0	0.0
Gas Tungsten Arc	1.0	3.7	1.9	7.1	0.0	0.0	0.0	0.0
Oxyfuel	0.0	0.0	1.0	38.7	0.0	0.0	0.0	0.0
Shielded Metal Arc	4.8	0.0	43.6	75.8	7.6	2.3	0.7	2.2
Total Reductions	5.8	9.7	46.6	40.5	7.6	2.3	0.7	2.2

Table 5-17 shows the estimated absolute and percentage reductions in emissions from cutting processes subject to emission controls. The total reductions in the AQMD-wide emission inventory for nickel, total chromium and zinc would be about 23, 40 and 21 percent, respectively, if the controls had 90-percent efficiency.

Table 5-17

DECREASES IN AQMD-WIDE CUTTING EMISSIONS, ASSUMING 90-PERCENT CONTROL

Cutting Type	Nickel		Chromium		Zinc	
	Lb/Yr Reduced	Pct Reduced	Lb/Yr Reduced	Pct Reduced	Lb/Yr Reduced	Pct Reduced
Air Carbon Arc	0.33	35.5	1.33	35.5	1.66	35.5
Laser	0.26	75.0	0.11	75.0	1.90	75.0
Plasma Arc	0.10	12.1	38.99	28.6	0.71	12.1
Total Reductions	0.7	22.6	40.4	28.8	4.3	21.2