PB84-242130

# INDUSTRIAL HYGIENE SURVEY REPORT

## UNIT PARTS COMPANY

## OKLAHOMA CITY, OKLAHOMA
## JANUARY 15 - 19, 1973

Project No: 73-9
May 30, 1973

Survey Requested By:

Manager Employment
Security and Safety

Survey Conducted By:
National Institute for Occupational Safety and Health

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An industrial hygiene survey was conducted at the Unit Parts Company, Oklahoma City, Oklahoma in January, 1973. The survey was requested by the manager of Employment, Security, and Safety to determine if possible health hazards existed and if the company was in compliance with OSHA standards. Environmental and breathing zone samples were analyzed for total dusts and metal fumes, asbestos (1332214), and organic solvent vapors. Measurements for noise and environmental heat stress were also made. Total airborne dust samples ranged from 0.44 to 53.50 milligrams per cubic meter (mg/m3). The federal standard for total dust is 15mg/m3. The armature burnout vibration and undercutting operations had copper (7440508) dust concentrations in excess of the federal standard of 1mg/m3. All asbestos concentrations were below the federal standard. Toluene (108883) concentrations at the vinyl dip tank and isopropyl-alcohol (67630) concentrations at the brake shoe cleaning area exceeded the federal standards of 200 and 400 parts per million, respectively. Noise measurements showed several areas exceeding the federal standard of 90 decibels. Measurements for heat stress indicated no hazard. Recommendations include redesign or elimination of armature burnout operations, improved ventilation, and establishment of an effective hearing conservation program.

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SUMMARY

On January 15-19, 1973, personnel from the Industrial Hygiene Services Branch, National Institute for Occupational Safety and Health, conducted a survey at Unit Parts Company, Oklahoma City, Oklahoma.

A total of 38 samples were taken for dusts and fumes. Total airborne dust samples ranged from 0.44 mg/M$^3$ to 53.50 mg/M$^3$. Personal samples taken from the vibration operation in armature burnout and the stator grinding operation were in excess of the Federal Standard for total dust based on an eight-hour time-weighted exposure. Samples for metal fumes and dust ranged from trace concentrations to 11.34 mg/M$^3$. The armature burnout vibration and the armature undercutting operations yielded employee exposures at or above the Federal Standard for copper dust.

The six samples for airborne asbestos fibers showed concentrations ranging from 0.05 fibers/cc to 0.85 fibers/cc. None exceeded the Federal Standard of 5.0 fibers/cc.

A total of 22 samples were taken for various organic solvent vapors. Paint spray and dip room samples were analyzed chromatographically for 2-butanone (MEK), isopropyl alcohol, methyl isobutyl ketone (MIBK), toluene, xylene, and styrene. The two personal samples collected from the paint dip operator both yielded additive effects factors greater than 1.0 (the Federal Standard). The spray booth operator showed no significant exposure, and a general area sample in the drying room yielded a low concentration.

One personal sample and two general area samples in the brake shoe bonding area showed additive effects factors greater than or equal to 1.0 based on chromatographic analysis for 2-butanone (MEK), monochlorobenzene, toluene, and isopropyl alcohol.

Two employee samples collected during use of the toluene dip tank for rotors and stators averaged 145 ppm. Toluene vapor concentrations at the vinyl dip tank for water pumps (two personal samples) averaged 370 ppm, exceeding the Federal Standard of 200 ppm for an eight-hour time weighted exposure.

All four personal samples collected in the brake shoe cleaning area exceeded the Federal Standard for isopropyl alcohol vapors. The sampled concentrations ranged from 436 ppm to 569 ppm, averaging 505 ppm. The Federal Standard for eight-hour employee exposure is 400 ppm.

No significant vapor concentrations were detected near the styrene dip oven for rotors and stators, or the brake shoe grinding area.

Measurements for environmental heat stress indicated no existing problem.

Noise measurements throughout the plant showed areas exceeding 90 dBA, and noise dosimeters placed with ten employees indicated that currently recommended sound pressure levels are being exceeded at many locations. This is due to the existing method of material handling by the use of metal barrels, and specific high-noise operations and machines.

## INTRODUCTION AND PURPOSE

The Industrial Hygiene Services Branch, Division of Technical Services, NIOSH, conducted an industrial hygiene survey of Unit Parts Company at Oklahoma City, Oklahoma on January 15-19, 1973. The study was requested by ______, Manager Employment, Security and Safety. The purpose of the survey was to determine if possible health hazards existed at Unit Parts and to determine if Unit Parts was in compliance with the OSHA standards.

TOXICOLOGY AND HYGIENIC STANDARDS

The Federal Standards for eight-hour time-weighted exposures to the substances listed below are taken from the Federal Register, October 18, 1972, Volume 37, U.S. Department of Labor, Subpart G, Paragraph 1910.93.

Methyl ethyl ketone and methyl isobutyl ketone belong to a class of chemical compounds know as aliphatic ketones. In general, ketones exert a narcotic type action upon inhalation. The initial indications of exposure include irritation of the eyes, nose and throat. These aliphatic ketones, including MEK, have in general a relatively low order of toxicity and are excreted rapidly from the body. The effects most commonly seen are those of irritation. The Federal Standards for eight-hour time-weighted average exposures to these compounds are:

| | | | |
|---|---|---|---|
| 1. | Methyl ethyl ketone (2-Butanone) | 200 ppm | (590 mg/M$^3$) |
| 2. | Methyl isobutyl ketone (Hexone) | 100 ppm | (410 mg/M$^3$) |

Isopropanol is an alcohol which produces a narcotic effect more severe than ethyl alcohol. The Federal Standard for exposure to isopropyl alcohol is:

| | | |
|---|---|---|
| Isopropyl alcohol | 400 ppm | (980 mg/M$^3$) |

Toluene and xylene are from a group of chemical compounds know as aromatic hydrocarbons. These aromatic hydrocarbons, upon repeated or prolonged contact with the skin, will cause dermatitis due to their dehydrating and defatting action. Inhalation of vapors is the primary method of absorbtion. Some symptoms from the inhalation of the aromatic hydrocarbons are: headache, dizziness, nausea, and lack of coordination. Central nervous system and liver damage may also result from inhalation of these hydrocarbons. The existing Federal Standards for these compounds are listed below:

| | | | |
|---|---|---|---|
| 1. | Toluene | 200 ppm | (750 mg/M$^3$) |
| 2. | Xylene | 100 ppm | (435 mg/M$^3$) |

Chlorobenzene is a chlorinated aromatic hydrocarbon. It is a strong narcotic and a paralyzing poison of the nervous system. Some signs of acute poisoning are sleepiness, tremors and muscular spasms, frequently blue lips, fingertips, and ears, and red to chocolate-brown urine. Although inhalation of vapors is the primary method of contact, it is also absorbed through the intact skin and produces skin irritation. The present Federal Standard for chlorobenzene is:

| | | |
|---|---|---|
| Chlorobenzene | 75 ppm | (350 mg/$M^3$) |

Styrene monomer is a colorless organic liquid with a characteristically disagreeable odor. As a liquid or vapor, it is irritating to the eyes, respiratory tract, and produces a severe dermatitis. High exposures have a narcotic effect and may cause loss of consciousness. The Federal Standard for styrene exposure is:

| | | |
|---|---|---|
| Styrene | 100 ppm | (420 mg/$M^3$) |

Asbestos is a general name given to a variety of fiberous minerals including chrysolite, amosite, crocidolite, tremolite, anthophyllite and actinolite. Asbestosis, lung cancer, and pleural and peritoneal mesotheliomas may follow exposure to asbestos. The risk is related to the length of time of exposure and the concentration of the airborne fibers.

The Secretary of the United States Department of Labor promulgated standards for the exposure of employees to asbestos effective July 7, 1972.* The eight-hour time-weighted average airborne concentrations of asbestos fibers greater than five micrometers in length to which any employee may be exposed must not exceed five fibers per cubic centimeter of air. A ceiling concentration was also defined, viz., no employee shall be exposed at any time to airborne concentrations of asbestos fibers greater than five micrometers long in excess of ten fibers per cubic centimeter.

* Federal Register, Vol. 37, No. 202, October 18, 1972, U.S. Department of Labor, Subpart G, Paragraph 1910.93a.

The Federal Standard for inert or nuisance dusts which is 15 mg/$M^3$ total dust is not based on physiological responses such as scarring of lung tissue, as would be the case with fibrogenic dusts. When reasonable control is exercised, there is little likelihood of significant organic diseases or toxic effects arising from exposures to nuisance dusts. Dust levels above the Federal Standard may seriously reduce visibility in the workroom area, may cause unpleasant deposits in the ears, eyes and nasal passages, or cause injury to the skin and mucous membranes either directly or as a result of the vigorous cleaning action necessary to remove accumulation on the epidermis.

Copper, Iron, Lead, Nickel and Tin are all metals. The principle means of absorbtion is inhalation, either as the metal or metal oxides, of fumes produced by soldering or welding or as dusts from metal abrading. Inhalation of excessive amounts of copper fumes or dusts causes irritation of the upper respiratory tract, nausea, and possible pigmentation of the skin and hair. High exposure to dusts causes congestion of the nasal mucous membranes and ulceration of the nasal septum. Iron oxide exposure may result in siderosis. The symptoms are 1) the appearance of spots in the lungs 2) shortness of breath and 3) tendency toward coughing. Chronic lead poisoning may include the symptoms of metallic taste in the mouth, loss of appetite, indigestion, nausea, vomiting, abdominal cramps, nervousness and insomnia. Industrial experience with nickel and tin have shown these materials to be fairly innocuous. Extreme chronic exposures in metal refineries and smelters have shown some increase in nasal, sinus and lung cancer from nickel fumes and the appearance of stannosis from tin oxide exposures. The Federal standards for these metals are:

| | |
|---|---|
| Copper Dusts and Mists | 1 mg/$M^3$ |
| Iron oxide Fumes | 10 mg/$M^3$ |
| Lead | 0.2 mg/$M^3$ |
| Nickel | 1 mg/$M^3$ |
| Tin | 2 mg/$M^3$ |

NOISE

Temporary or permanent loss of hearing may result from exposure to excessive noise. Exposure to excessive noise for several hours may cause headaches, nausea, tenseness and dizziness.

Protection against the effects of noise shall be provided when the sound level exceeds the existing standard as shown in Table A, when measured on the A-scale of a standard sound level meter at slow response.

TABLE A

PERMISSIBLE NOISE EXPOSURE

| Duration per day hours | Sound Level dBA |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1 1/2 | 102 |
| 1 | 105 |
| 1/2 | 110 |
| 1/4 | 115* |

When employees are subjected to noise levels exceeding those listed in Table A, feasible engineering and administrative controls shall be utilized. If such controls fail to reduce the exposure to permissible levels as shown in the Table, personal protective equipment shall be provided and used.

In all cases where the sound levels exceed those shown in the Table, a continuing effective hearing conservation program shall be administered.

* Ceiling Value: No exposure in excess of 115dBA permitted.

## HEAT STRESS

The two sources of heat important to man working or living in a hot environment are the internally generated metabolic heat and the externally imposed environmental heat. Under conditions of work, heat must be removed from the body if an undesirable increase in body temperature is to be prevented. Environmental heat is important because it influences the rate of heat exchange between the body and the environment, and the ease with which the body can regulate and maintain a normal temperature. The heat produced by the body, which is related to the workload, and the environmental heat together determine the total heat stress.

The three major clinical disorders resulting from excessive heat stress on susceptible workers are: (1) heat stroke, from failure of the thermoregulatory center; (2) heat exhaustion, from depletion of body water and/or salt; (3) heat cramps, from salt loss and dilution of tissue fluid.

If work is to be performed under hot environmental conditions, the work load category of each job must be established and the heat exposure limit pertinent to the work load evaluated against the existing guidelines shown in Table B in order to protect the worker from exposure beyond these permissible limits.

TABLE B

PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUE
(Values are given in °F WBGT)

| WORK - REST REGIMEN | WORK LOAD Light | Moderate | Heavy |
|---|---|---|---|
| Continuous Work | 86 | 80 | 77 |
| 75% Work - 25% Rest, each hour | 87 | 82 | 79 |
| 50% Work - 50% Rest, each hour | 88 | 86 | 82 |
| 25% Work - 75% Rest, each hour | 90 | 88 | 86 |

## ENVIRONMENTAL STUDY PROCEDURE AND INSTRUMENTATION

Atmospheric samples for asbestos fibers and for copper, lead, tin and nickel fumes were collected on cellulose membrane filters with 0.8 micron pore size. Oil mist particulate samples were collected on pre-weighed silver membrane filters with 0.8 micron pore size. Samples for nuisance dust were collected on pre-weighed vinyl metricel membrane filters with 5.0 micron pore size. These 37 mm diameter filters were encased in 3-piece plastic aerosol field monitor cassettes with face caps removed and filters completely exposed. Samples were taken near the worker's breathing zone using battery powered Mine Safety Appliance (MSA) gravimetric pumps, Model G. The pumps were calibrated to operate at 1.7 liters/minute, and were worn by the employees.

Personal samples for atmospheric solvent vapors were taken using the same Model G pumps. Samples were collected at a flowrate of 1 liter/minute through organic vapor sampling tubes for a period of approximately ten (10) minutes.

Sound pressure level readings were taken with a General Radio (G.R.) Model 1565-B sound level meter using the A-weighted network with a slow meter response. Two DuPont Model D-100 audio dosimeters were used to measure an employee's cumulative daily noise exposure. The dosimeters utilize a non-directional microphone worn on the employee's collar to pick up sound pressure levels reaching the employee. Input data is electronically processed on a continuous basis. The ratios of actual exposure to established limits at every sound level between 90 and 115 dBA are calculated and integrated with time to give the actual exposure during the workday as a percentage of that permitted in the regulations established in the Occupational Safety and Health Act. (OSHA).

Currently, no Federal Standard for employee exposure to heat stress has been promulgated. In the interim, compliance with the recommendations presented by the American Conference of Governmental Industrial Hygienist (ACGIH) is urged. The means for assessing the thermal environment recommended by ACGIH is the wet bulb-globe temperature (WBGT) index.

The wet bulb-globe temperature index (WBGT) is a simple and suitable technique to measure environmental factors because it is determined from temperature alone. It eliminates the need to measure air velocity. The natural wet bulb (WB) temperature takes into account the air temperature, the humidity, and air velocity. The globe temperature (GT) takes into account air temperature, air velocity, and the radiant temperature. Since this study was of the indoor type where no solar radiation was present, only the black globe and natural wet bulb temperatures were needed for calculating the WBGT.

The WBGT is calculated by multiplying the WB by 0.7 and the GT by 0.3 and adding the two together. The equation used is:

$$WBGT = 0.7\ WB + 0.3\ GT$$

The overall exposure for an individual worker is evaluated as a time-weighted average of the various levels of WBGT to which he is exposed. The measurement technique employed during the course of this survey involves placement of the instrument stand, containing black globe thermometer, in the area where the employees work. The sensors are allowed to come to equilibrium and the readings are recorded. Observations are made concerning employee work habits, amount of time spent in cooler areas, type and intensity of the work being performed and protective clothing worn. Environmental measurements are repeated throughout the day to assess any changes which may occur either as a result of alterations in ambient conditions, or periodicity of the production cycle. A WBGT value is calculated for each set of conditions, and compliance or non-compliance with the existing recommendations is assessed.

## RESULTS OF STUDY

The results of the analysis for total dust at the workplace using pre-weighed filters and personal sampler pumps appear in Table C. The sampling time for each of these samples was approximately two hours. The table indicates that the areas of main concern were armature burnout and stator grinding, both of which yielded exposures to total airborne dust in excess of current Federal Standards.

Table D lists workplace concentrations of metal fumes and dusts. The vibration operation in armature burnout again yielded levels of copper dust well in excess of the Federal Standard. This operation was not performed on a continuous basis, and when it was undertaken, respiratory protection was utilized. Areas of possible concern listed in the Table include: armature undercutting, and the knockout operation in the armature burnout department. Both operations produced samples only slightly below the Federal Standard for copper dust. Soldering operations throughout the plant did not appear to produce significant levels of lead or tin fumes, although several areas appeared to have poorly-designed local exhaust equipment which permitted an annoying buildup of smoke from the soldering process.

Table K verifies that the problem of airborne asbestos fiber is minimal. It appears that present controls for this contaminent are sufficient.

Table M indicates that the potential for environmental heat stress was not clearly demonstrated at the time of the study. The work/rest regimens and ambient conditions at rest sites were reasonable for the conditions observed. A reassessment of these operations during the warmer summer months is indicated.

Data in Table E suggests that a definite health hazard to the paint dip operator exists. Personal samples collected in this area were analyzed quantitatively for six compounds contained in the paint and lacquer thinner. The constituent of main concern in all cases was toluene, and one personal sample showed a vapor concentration at the employee breathing zone of more than twice the Federal Standard for an eight-hour exposure. The additive effects incurred by the other components of the mixture tend to increase the potential for damage to the employee's health.

Table F compiles sample data collected in the brake shoe bonding area which also emerges as a potentially hazardous area. Three out of five samples collected in this area yielded levels of solvent vapors near or slightly in excess of Federal Standards. These figures are considered conservative because the laboratory analysis in four cases did not include isopropyl alcohol vapors.

The results of personal samples taken in the brake shoe cleaning area appear as Table H. Several employees in the area experienced exposures to isopropyl alcohol vapors in excess of the Federal Standard during the 10 minute sampling times.

Table G presents data collected from two dip tank areas containing toluene as the solvent. The toluene dip tank near the armature burnout area appears to cause employee exposures to toluene vapors in excessive amounts during its usage. The two 10 minute samples collected during the loading and unloading of rotors and stators in the tank were in excess of the American Conference of Governmental Industrial Hygienists (ACGIH) recommended threshold limit value (TLV) for toluene, but less than the current Federal Standard for an eight-hour exposure. Observations of the work routine in this area suggested that the employee exposure is brief, generally not exceeding an hour total exposure time during an eight-hour shift. The eight-hour time weighted exposure to vapors of toluene from this operation would therefore be expected to be considerably less than the current standard.

The vinyl dip tank for water pumps (toluene as the solvent carrier) appears to yield high intermittent exposures to toluene vapors. Two personal samples were taken in the area, one yielding a concentration more than three times the Federal Standard, and the other indicating a level one-tenth as severe. The sampling scheme did not include a sufficient number of samples to permit the calculation of an eight-hour time-weighted exposure for this employee, but it would appear that the potential for an excessive exposure is present. Current wording in the Federal Standard for exposure to vapors of toluene indicates that the maximum allowable concentration is 500 ppm for no more than ten minutes. This limit is being exceeded.

Table I list the results of samples taken in the area of the styrene dip and oven line for rotors and stators. The operation did not yield employee exposures to styrene at a significant level to warrant concern.

Results of three personal samples for airborne vapors taken in the brake shoe grinding area are presented as Table J. The bonding ovens adjacent to this operation were indicated as being responsible for the evolution of fumes to the area. Samples, however did not yield significant levels of any of the solvent vapors analyzed

Results of the noise dosimetry survey are presented as Table L. All but one sample suggest that the allowable exposure to noise for an eight-hour period would be exceeded if conditions remained the same throughout the entire work shift. Six of ten workers sampled experienced an exposure of 115 dBA or more at some time during the sampling period. The wheelabrator, brake shoe deriveter, and conveyor washer area personnel appear to be the most severly exposed among those sampled.

A general noise survey was also made throughout the plant. Spot measurements were made at dispersed locations, and a matrix of sound level measurements was constructed. The results of this plant-wide noise survey appear as Figure 1,2,3,4, and 5.

## DISCUSSION OF RESULTS AND RECOMMENDATIONS

Observations of the results presented in the Tables and Figures reveal that there are several areas where employee exposures are excessive. The problem of employee exposure to noise is largely a result of the parts-handling system presently in use. The metal barrels provide an almost constant background noise problem as parts are thrown into them. The wheelabrators and several other specialized pieces of equipment also contribute to the overall excessive plant levels.

It appears that the vibration operation in armature burnout represents an unnecessary opportunity for excessive employee exposures to copper and nuisance dust. Armature undercutting also appears to be an area where present control methods are inadequate.

The paint dip area is inadequately and improperly ventilated, as survey data indicates. An eight-hour exposure to paint room employees at survey conditions would clearly exceed Federal Standards.

It is probable that the employee operating the vinyl dip tank for water pumps would also incur an eight-hour exposure in excess of the present Federal Standards. In any case, the intermittent exposure is sufficiently severe as to exceed present standards for maximum allowable concentration of toluene vapors.

Employee samples taken in the brake shoe cleaning and bonding areas exhibited high concentrations of various solvent vapors, due in large part to the unvented isopropyl alcohol dip tanks in the area. Chlorobenzene vapors from the brake shoe bonding process also contribute to the problem.

On the basis of survey findings and laboratory analysis of samples it is recommended that:

1) The vibration operation in armature burnout be eliminated or redesigned.
2) Improved ventilation equipment be installed in the armature undercutting operation and the stator grinding process.
3) The present system of metal-drums for parts storage and handling be phased out.
4) The ventilation and hood design in the paint dip area be upgraded to control vapors generated during the dipping operation.
5) Additional make-up air be provided to the plant to remedy the sizeable negative pressure situation resulting from the present unbalanced system.

6) A ventilated dipping and drying area be installed for the brake shoe cleaning operation; approved respirators should be worn by employees in the interim.

7) Approved respirators for toluene be provided for vinyl dip tank operators in the water pump area.

8) Material storage be reevaluated to eliminate placement of combustibles in proximity to brake shoe burnout furnaces.

9) An effort be made to isolate individual sources of high noise by accoustical shielding.

10) Improved local exhaust systems be installed for the removal of smoke from soldering operations

11) An effective hearing conservation program be implemented.

12) The brake shoe burnout area be reevaluated for heat stress during the warmer summer months.

Report approved by:

Thomas [signature]

Report prepared by:

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Joseph A. Seta [signature]

[signature]

TABLE C

TOTAL DUST SAMPLES

UNIT PARTS COMPANY

JANUARY 15-19, 1973

| Sample Number | Location | Airborne dust (mg/M3) |
|---|---|---|
| 1 | Power Cylinder Breakdown | 1.54 |
| 2 | Clutch Plate Grinding | 1.56 |
| 3 | Pressure Plate Grinding | 0.90 |
| 4 | Pressure Plate Grinding | 0.44 |
| 5 | Armature Burn-out; Oven | 6.07 |
| 6 | Armature Burn-out; Vibration | 53.50 |
| 7 | Armature Burn-out; Knock-out | 1.47 |
| 8 | Stator Grinding | 33.30 |
| 9 | Armature Buffing | 1.51 |
| 10 | Clutch Teardown | 1.64 |
| 11 | Dust Collector Blowdown | 11.50 |
| 12 | Spindle Grinding | 0.93 |

Samples 1-4 collected on 37mm silver membrane filters (approved method for oil mist sampling)

Samples 5-12 collected on 37 mm VM-1 filters; 5 micron pore size (total dust samples)

DOL Standards for eight-hour time-weighted average airborne concentrations:

| | |
|---|---|
| Oil mist | 5 mg/M3 |
| Total dust | 15 mg/M3 |

TABLE D

METAL FUME AND DUST CONCENTRATIONS

UNIT PARTS COMPANY

JANUARY 15-19, 1973

| Sample No. | Location | Airborne Concentration (mg/M3) | Metal |
|---|---|---|---|
| 3786 | Clutch plate grinding | 0.04 | nickel |
| 3786 | Clutch plate grinding | 0.48 | iron |
| 103 | Welding | 0.64 | nickel |
| 3797 | Pressure plate grinding | 0.32 | iron |
| 3758 | Armature undercutting | 0.39 | copper |
| 3760 | Armature polishing | 0.34 | copper |
| 3776 | Armature undercutting | 0.99 | copper |
| 101 | Bolt polishing | 0.64 | copper |
| 3795 | Armature polishing | 0.01 | copper |
| 3753 | Armature burnout; knockout | 0.94 | copper |
| 3757 | Armature burnout; vibration | 11.34 | copper |
| 3761 | Field coil soldering | trace | lead, tin |
| 3759 | Field coil soldering | trace | lead, ti |
| 3756 | Field coil soldering | trace | lead, ti |
| 3775 | Soldering | trace | lead, ti |
| 3785 | Solenoid soldering | trace | lead, ti |
| 3794 | Solenoid soldering | trace | lead, ti |
| 3798 | Starter coil soldering | trace | lead, ti |
| 3793 | Armature solder dip | trace | lead, ti |
| 3796 | Armature solder dip | trace | lead, ti |

Federal Standards for eight-hour time-weighted average concentration:

| | |
|---|---|
| Nickel | 1 mg/M3 |
| Iron | 15 mg/M3 |
| Copper | 1 mg/M3 |

TABLE E

ORGANIC SOLVENT VAPOR CONCENTRATIONS

UNIT PARTS COMPANY

JANUARY 15-19, 1973

| Paint spray room | Paint dip operator | Paint dip operator | Spray booth operator | Drying room (general area) |
|---|---|---|---|---|
| 2 - Butanone (ppm) | 65 | 10 | 2 | 2 |
| Isopropyl alcohol (ppm) | 152 | 26 | 5 | 4 |
| Methyl isobutyl ketone (ppm) | 35 | 8 | 1 | - |
| Toluene (ppm) | 419 | 119 | 14 | 3 |
| Xylene (ppm) | 12 | 9 | 4 | 7 |
| Styrene (ppm) | 1 | 1 | 1 | 1 |
| Additive effects factor* | 3.3 | 1.1 | 0.1 | 0.1 |

TABLE F

ORGANIC SOLVENT VAPOR CONCENTRATIONS

UNIT PARTS COMPANY

JANUARY 15-19, 1973

| Brake Shoe Bonding | Brake shoe gluing (drying area) | Brake shoe bonding (general area) | Brake shoe bonding | Brake shoe bonding | Brake sh bonding |
|---|---|---|---|---|---|
| 2 - Butanone (ppm) | 126 | 148 | 25 | 18 | 173 |
| Monochlorobenzene (ppm) | 27 | 28 | 2 | 2 | 29 |
| Toluene (ppm) | - | - | - | - | 8 |
| Isopropyl alcohol (ppm) | - | - | - | - | 67 |
| Additive effects factor | 0.99 | 1.1 | 0.15 | 0.11 | 1.5 |

* Additive effects factor = $\frac{C_1}{TLV_1} + \frac{C_2}{TLV_2} + \frac{C_3}{TLV_3} + \ldots \frac{C_n}{TLV_n}$,

Where $C_1$, $C_2$, $C_3 \ldots C_n$ are the concentration (in ppm) of the constituents of the mixture, and $TLV_1$, $TLV_2$, $TLV_3 \ldots TLV_n$ are the corresponding threshold limit values of each constitue

TABLE G
ORGANIC SOLVENT VAPOR CONCENTRATIONS
UNIT PARTS COMPANY
JANUARY 15-19, 1973

| Sample Number | Location | Toluene (ppm) |
|---|---|---|
| 3770 | Toluene dip for rotor, stator | 174 |
| 3762 | Unloading toluene dip tank | 117 |
| 3766 | Vinyl dip for water pump | 67 |
| 3790 | Vinyl dip for water pump | 679 |

TABLE H

ORGANIC SOLVENT VAPOR CONCENTRATIONS
UNIT PARTS COMPANY
JANUARY 15-19, 1973

| Sample Number | Location | Isopropyl Alcohol (ppm) |
|---|---|---|
| 3771 | Brake shoe cleaning | 436 |
| 3764 | Brake shoe cleaning | 559 |
| 3765 | Brake shoe cleaning | 569 |
| 3773 | Brake shoe cleaning | 457 |

TABLE I
ORGANIC SOLVENT VAPOR CONCENTRATIONS
UNIT PARTS COMPANY
JANUARY 15-19, 1973

| Sample Number | Location | Styrene (ppm) |
|---|---|---|
| 3772 | Styrene dip oven, rotors & stators | 3 |
| 3769 | Styrene dip oven, rotors & stators | 2 |

## TABLE J

### ORGANIC SOLVENT VAPOR CONCENTRATION
### UNIT PARTS COMPANY
### JANUARY 15-19, 1973

| Sample Number | Location | 2-Butanone (ppm) | Monochloro-benzene (ppm) | Toluene (ppm) | Addit effec facto |
|---|---|---|---|---|---|
| 3778 | Brake shoe grinding | 2 | - | 3 | .03 |
| 3779 | Brake shoe grinding | 1 | - | 3 | .02 |
| 3789 | Brake shoe grinding | 1 | - | 2 | .01 |

## TABLE K

### AIRBORNE FIBER CONCENTRATIONS, ASBESTOS
### UNIT PARTS COMPANY
### JANUARY 15-19, 1973

| Sample Number | Location | Concentration (fiber/cc) |
|---|---|---|
| 3751 | De-rivet machine | 0.35 |
| 3752 | De-rivet machine | 0.20 |
| 3754 | Brake shoe grinding | 0.20 |
| 3755 | Brake shoe riveting & grooving | 0.85 |
| 3774 | Brake shoe grinding | 0.25 |
| 3777 | Brake shoe grinding | 0.05 |

TABLE L
NOISE DOSIMETRY
UNIT PARTS COMPANY
JANUARY 15-19, 1973

| Sample Number | Location | Sample Time (min) | % allowable exposure | Exceeded *115 dBA |
|---|---|---|---|---|
| 29 | Brake shoe de-riveter | 48 | 65 | no |
| 45 | Blasting machine | 126 | 35 | yes |
| 66 | Generator tear-down | 126 | 57 | no |
| 69 | Clutch plate area (near conveyor wash) | 135 | 63 | no |
| 96 | Conveyor washer area | 136 | 96 | yes |
| 81 | Wheelabrator | 120 | 41 | yes |
| 28 | Clutch assembly beat-out | 150 | 50 | no |
| 11 | Tractor generator field coil assembly | 118 | 18 | yes |
| 62 | Wheelabrator (near clutch plates) | 125 | 58 | yes |
| 6 | Wheelabrator (near water pumps) | 120 | 70 | yes |

* 115 dBA is the ceiling value for allowable noise exposure

TABLE M
HEAT STRESS MEASUREMENTS
UNIT PARTS COMPANY
JANUARY 15-19, 1973

| Location | WBGT (°F) |
|---|---|
| Brake shoe burnout (morning) | 81 |
| Brake shoe burnout (afternoon) | 89 |
| Brake shoe burnout rest area | 67 |
| Armature burnout | 76 |
| Armature burnout rest area | 67 |
| Brake shoe curing oven | 83 |
| Truck brake shoe curing oven | 76 |

Figure 1

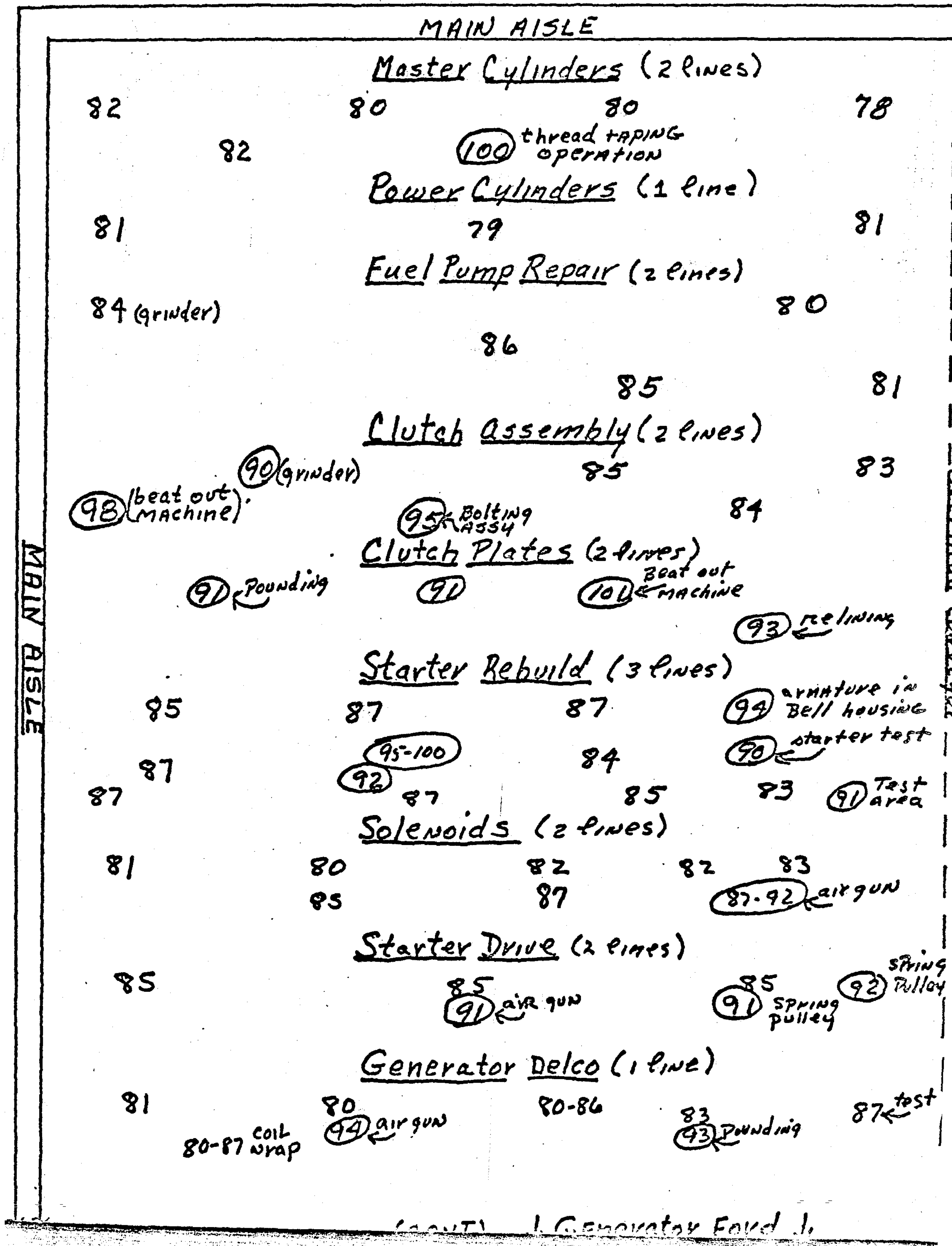

MAIN AISLE
Master Cylinders (2 lines)
82
80
80
78
82
100 thread taping operation
Power Cylinders (1 line)
81
79
81
Fuel Pump Repair (2 lines)
84 (grinder)
80
86
85
81
Clutch Assembly (2 lines)
90 (grinder)
85
83
98 (beat out machine)
95 Bolting assy
84
Clutch Plates (2 lines)
91 Pounding
91
101 Beat out machine
93 relining
Starter Rebuild (3 lines)
85
87
87
94 armature in Bell housing
95-100
92
84
90 starter test
87
87
87
85
83
91 Test area
Solenoids (2 lines)
81
80
82
82
83
85
87
87-92 air gun
Starter Drive (2 lines)
85
85
91 air gun
85
91 spring pulley
92 spring pulley
Generator Delco (1 line)
81
80
94 air gun
80-86
83
93 Pounding
87 test
80-87 coil wrap
MAIN AISLE
Overhead conveyor

Figure 1 (cont.)

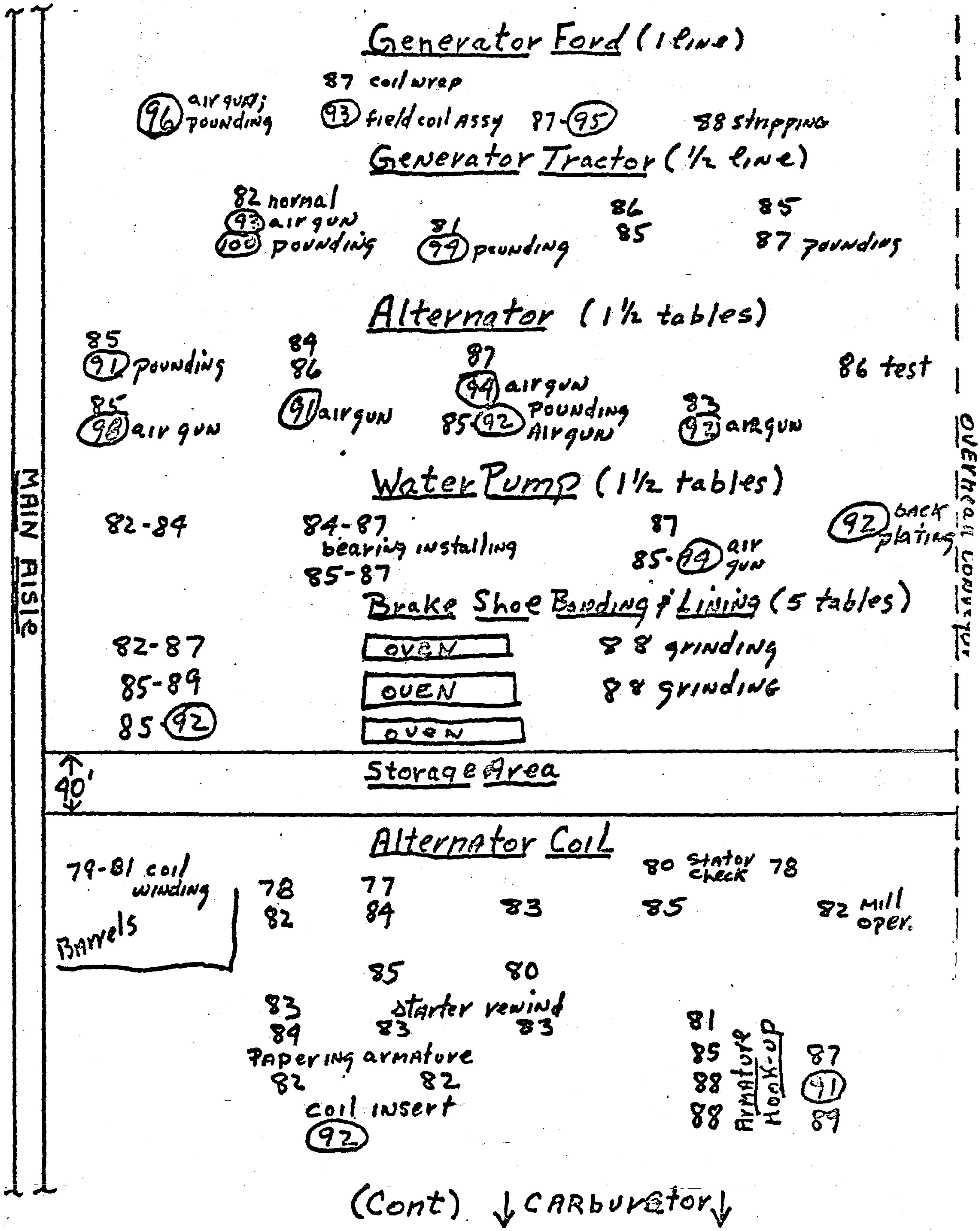
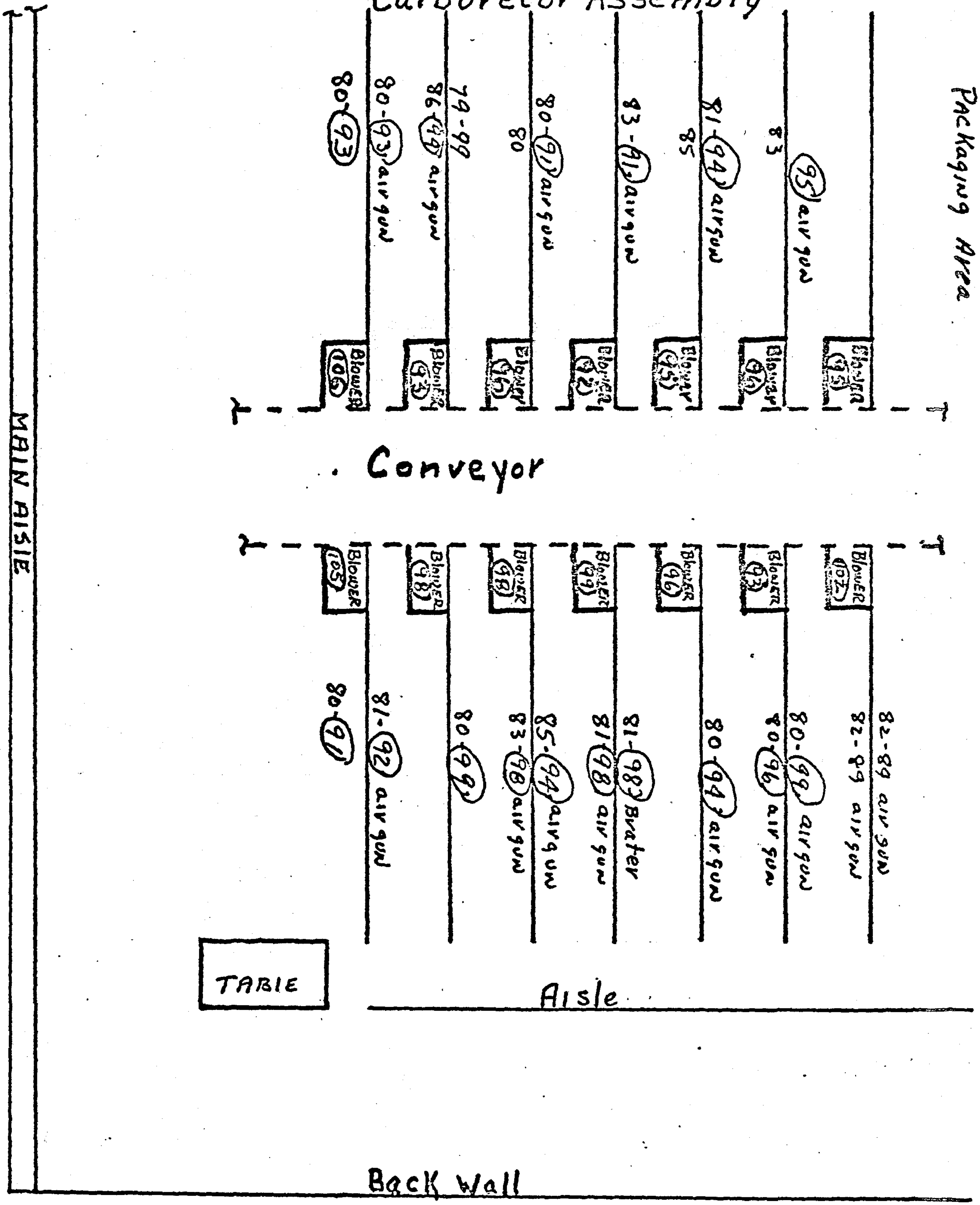


Figure 1 (cont.)

Carburetor Assembly



# Figure 2

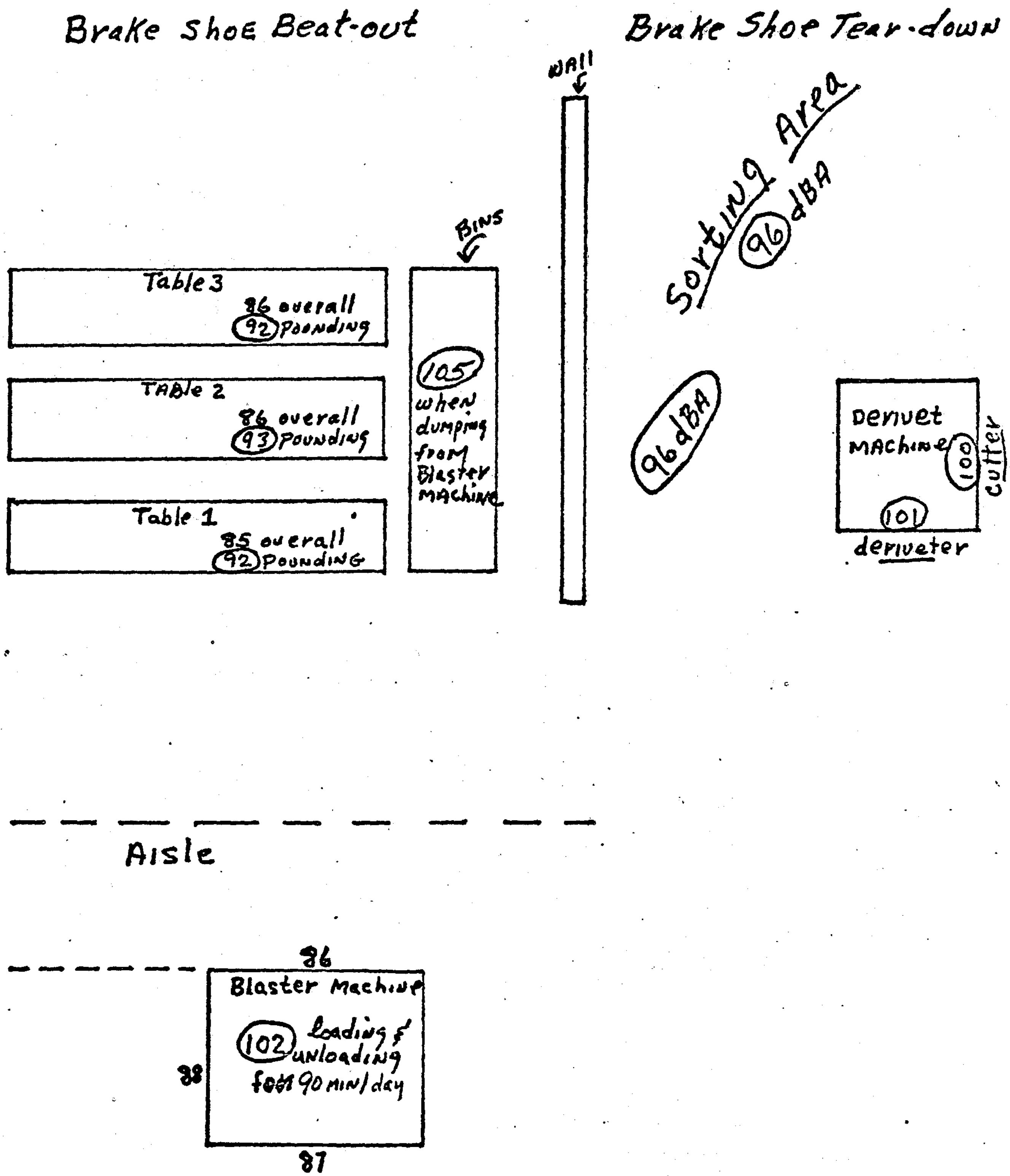

Brake Shoe Beat-out
Brake Shoe Tear-down
WAll
Sorting Area
96 dBA
BINS
Table 3
86 overall
92 pounding
TABLE 2
86 overall
93 pounding
Table 1
85 overall
92 pounding
105
when dumping from Blaster machine
96dBA
Derivet machine
100
cutter
101
deriveter
Aisle
86
Blaster Machine
102
loading & unloading for 90 min/day
88
87

Figure 3

Armature Burn Area

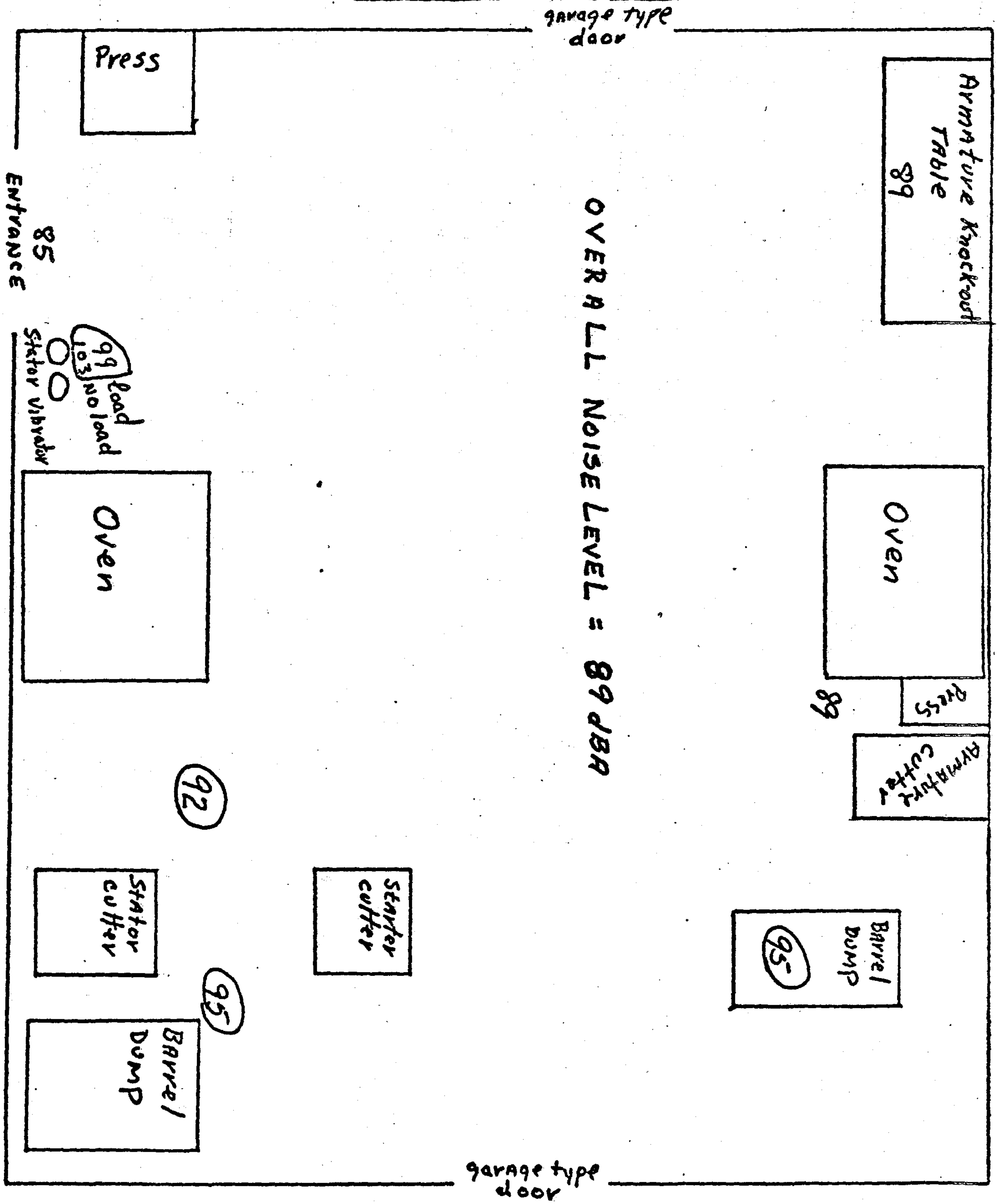


Figure 4

Reclaim Area

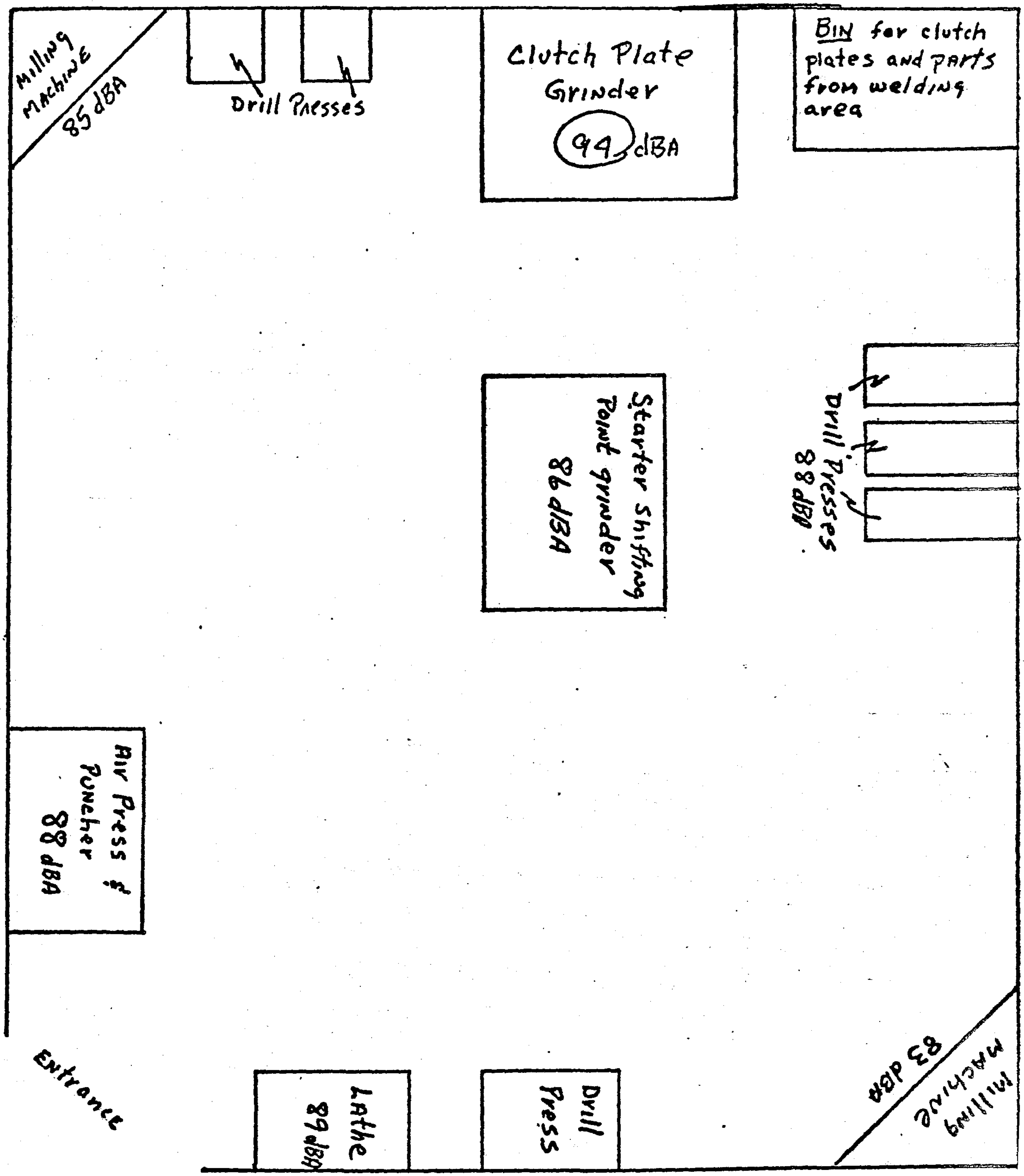


Figure 5
Tear Down