

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) presents, in specific terms, the policies, organization, functions, and Quality Assurance/Quality Control (QA/QC) requirements designed to achieve the data quality goals for the following Petroleum Contaminated Sites (Petroleum, Oil and Lubricant program sites), Delivery Order 143 under the contract N62470-93-D-4020 for the Navy Atlantic Division (LANTDIV) at the MCAS New River and MCB Camp Lejeune, North Carolina.

Sites:

- Building AS-822
- Building STT-69
- Building TT-2477/2478
- Berkeley Manor Underground Storage Tank (UST) 820

This SAP integrates the required components of a quality assurance project plan (QAPP) and a field sampling plan (FSP). This document has been developed to meet the needs of each of the four POL sites. Site specific sampling and analysis requirements for the sites are presented in Section 3.0. Included is site specific sampling text, Table A-1 Sampling Summary, decision tree changes if required for Table 2.1 and any additional Project Quality Control Objectives for Table A-2.

This document shall be implemented by the Project Manager, Project QC Manager, Project Chemist, Field Chemist/Scientist, and Sample Technicians. Any field changes shall be approved by the Navy's Technical Representative (NTR), OHM Project Manager, and OHM Project Chemist. These changes shall be documented by the Field Chemist/Scientist and distributed to the appropriate persons as amendments to the SAP.

2.0 PROJECT MANAGEMENT

2.1 PROJECT OBJECTIVE AND SCOPE OF WORK

The remedial objective of the project is to mitigate gasoline, diesel, and other petroleum product releases which have impacted soil and groundwater at these POL sites. OHM's work will include design, installation, start-up and operation and maintenance of several integrated Soil Vapor Extraction (SVE) and Air Sparging (AS) systems at four locations listed above.

The remediation technologies selected for each of these sites are presented below.

Sites:

- Building TT-2477/2478 SVE/AS Systems
- Berkeley Manor UST 820 SVE/AS Systems
- Building STT-69 SVE/AS System
- Building AS-822 AS System

OHM will operate and maintain the system for 6 months after system start-up.

2.2 PROJECT TASK DESCRIPTIONS

The project tasks applicable to the SAP are the following:

- Monitor field activities for organic vapor emissions and personnel health and safety using direct-reading instruments (FID, OVA etc.)
- Sample and analyze groundwater from existing monitoring wells
- Sample and analyze the surface water from the Northeast Creek
- Sample and analyze soil vapor extraction system effluent of the treatment system
- Sample and analyze the liquids from the individual SVE liquid /vapor separators
- Sample and analysis contractor generated waste water and collected rain and/ or surface run-off water

- Perform surveillance and technical audits of site sampling activities

In the event that drums or potentially off-spec soils are encountered during the course of these tasks, the Navy Technical Representative (NTR) will be informed and consulted for further actions.

2.3 PROJECT ORGANIZATION

The project manager is the primary focal point for control of the project activities. The project manager will be supported by the QA Management team which will provide reviews, guidance, and technical advice on project execution issues. Members of this staff will be on an "as-needed" basis to assist in smooth project execution. The project manager will be supported by the project team consisting of a supervisory, health and safety, technical, and QA/QC staff to ensure that the project is safely executed in compliance with applicable laws, regulations, statutes, and industry codes. Individuals of the project team are responsible for fulfilling appropriate portions of the project QA program, in accordance with assignments made by the project manager. The project manager is responsible for satisfactory completion of the project QA program. Specific responsibilities may be assigned by the project manager to the deputy project manager and other members of the project staff.

The responsibilities of the key members in the project organization are:

Project Manager - James A. Dunn, Jr.

The project manager is responsible for the overall direction of this project executed under his supervision. He provides the managerial administrative skills to ensure that resource allocations, planning, execution, and reporting meet contract requirements. He is ultimately accountable for all work activities undertaken on this project. The global quality-related responsibilities of the project manager can include, but are not limited to, the following:

- Organization of the project staff and assignment of responsibilities.
- Understanding of contract and scope of work for a specific project.
- Communication to the project staff regarding client requirements and QA practices.
- Identification, documentation, and notification to the client and project staff and QA personnel of changes in the scope of work, project documentation and activities.

- Supervision of preparation and approval of project-specific procedures, work plans, and QA project plans.
- Approval of project design bases, design parameters, drawings, and reports.
- Approval of project remedial action/construction methodologies.
- Dissemination of project-related information from the client such as design bases, input parameters, and drawings.
- Liaison for communications with the client and subcontractors. Liaison between the project staff and other internal groups.
- Decision of whether or not drawings require independent review.
- Investigation of nonconformances, notification of QA personnel, and implementation of corrective actions.
- Determination of the effect of nonconformances on the project and the appropriateness for reporting such items to the client, and providing appropriate documentation for reporting.
- Determination that changes, revisions, and rework are subject to the same QC requirements as the original work.
- Serve as final reviewer prior to release of project information.
- Approve and sign outgoing correspondence.
- Custodian of all project related documents.

Some of these responsibilities may be assigned by the project manager to the Site Supervisor, who will remain on site throughout the project field activities.

Site Supervisor - Randy Smith

The site supervisor is responsible for the day-to-day management of this specific delivery order. He will ensure sufficient resource allocations to maintain project schedule and budget. He will provide

daily feedback to the project manager on project progress, issues requiring resolution, etc. The quality-related responsibilities of the site supervisor include, but are not limited to, the following:

- Notification to the project manager if the project cannot be completed with regard to quality, schedule, or cost
- Oversight and control of subcontractor services
- Liaison for communications with OHM project staff and other internal groups as well as with the NTR and on-site inspector
- Supervision of day-to-day site activities in accordance with project and program requirements
- Preparing the Contractor Production Report
- Preparing the Quality Control Reports
- Initiating corrective actions for non-conformance identified on-site.

Project Chemical QA Officer - Theresa D. Rojas

The chemical QA officer is responsible for implementing the project chemical QA program. She is responsible for informing the project manager of any site-specific QA issues. Her responsibilities include, but is not limited to, the following:

- Reviewing subcontractor's QA Manuals and/or Laboratory Quality Management Plans (LQMPs) and if possible, performing audits on the labs.
- Certifying the level of QA that has been achieved during the generation of analytical data.
- Initiating and overseeing all audit functions.
- Stopping work if quality objectives are not being met.
- Initiating investigations for nonconformances, identifying appropriate corrective actions, and performing follow-up audits to ensure that the corrective actions were successful.

Project Chemist - Sushama Paranjape

The project chemist is responsible for implementing the project plans and ensuring that the quality assurance and data quality objectives are being met for the project. She is also responsible for informing the chemical QA officer of any site-specific problems and for coordinating QA efforts with the contracted laboratory. Her specific responsibilities include, but are not limited to, the following:

- Determining if the project and data quality objectives are being met.
- Evaluating chemical data for technical validity and ensuring adherence to published guidelines.
- Analyzing and interpreting all subcontracted technical and laboratory results.
- Implementing QA/QC procedures.
- Assuring the continuity of chain-of-custody evidence
- Working with the QC engineer to compile and submit required QA Reports (QARs).
- Compiling, revising, updating, and submitting SAPs
- Implementing corrective actions as required by the QC engineer or chemical QC officer.
- Ongoing QA/QC training of new and current personnel.
- Reviewing laboratory invoices for completeness and accuracy.

Laboratory Coordinator - Missy Art

The laboratory coordinator is responsible for procuring a certified laboratory based on the requirements needed for the project. Her responsibilities include, but are not limited to, the following:

- Selection of qualified laboratories and control of laboratory services requests.
- Assist coordination of laboratory with field sample shipments.

- Management of laboratory data in conjunction with the project and field chemist.
- Liaison between the field and the laboratories when changes are required in the SAP and Purchase Orders.

Field Chemist - To Be Determined

The field chemist will:

- Implement the SAP and designated QA/QC procedures.
- Oversee all field sampling activities.
- Report all QC data to the project chemist for review.
- Implement corrective actions as required by the project chemist.
- Perform on-site screening and analyses of samples, if needed.
- Fill out sample tracking forms and related analytical and QC forms and logbooks.
- Ensuring that the samples are handled, packaged, and shipped according to the SAP.
- Ensuring that the laboratory supplies the sample containers, shipping supplies, chain-of-custody records, and the required QC samples (i.e., trip blanks).

Sample Technician - To Be Determined

The sample technician will be responsible for:

- Field sampling in accordance with approved procedures and methodologies as defined in the SAP.
- Generating field blanks, equipment rinsate blanks, and acquiring field duplicate samples as required by the SAP.
- Completing sampling logbooks, sampling forms, labels, custody seals, and chain-of-custody forms and other paperwork as required by the SAP.

- Packaging and Shipping of samples to appropriate laboratories.

2.4 DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

Data generated from those tasks described in Section 2.2 will be used to make the decisions that are listed in Table 2.1. The criteria by which these decisions will be based and the persons responsible for making the decisions are also listed. Project-specific quality objectives are listed in Appendix A, Table A-2. These include the quantitation, project action, accuracy, precision, and completeness limits by which the data will be evaluated.

A Naval Facilities Engineering Service Center (NFESC), Port Hueneme, California certified laboratory will be used for all water, liquid, and vapor sample analyses. The laboratory will also be North Carolina-approved. A copy of the laboratory's QA Manual, statement of qualifications, and appropriate certificates of approval are kept on file in the Norcross office and are available upon request from the NTR, LANTDIV, or other regulatory agencies. A copy of the approved Sampling and Analysis Plan will be forwarded to the laboratory selected to perform chemical analysis of the samples.

As directed by the NTR, all samples will meet, at a minimum, Level E requirement for the QA/QC as specified in NEESA 20.2-047B. Although NFESC 1996 document replaces NEESA 20.2-047B document, for the continuity of the QA/QC levels, NEESA 20.2-047B will be used for determining QA/QC levels of these samples. All sampling and analytical activities will be in accordance with federal, state, and local regulations. A summary of the field QC sampling requirements is shown in Table A-1.1, "Sampling Summary" in Appendix A.

Data evaluation will be performed by the project chemist on all data. Data review procedures specified in Navy Installation Restoration Laboratory Quality Assurance Guide, February 1996 by NFESC and the National Functional Guidelines for validation of organics and inorganics will be followed to ensure that raw data are not altered and that an audit trail is developed for those data which require reduction. Data evaluation results will be provided in the project closeout report.

Table 2-1 - Action Items			
Project Task	Decision Maker	Criteria	Decision
Sampling of groundwater in existing monitoring wells	OHM and NTR	If: the groundwater exceeds the target cleanup criteria for groundwater.	Then: the remediation system will continue to operate. If not then: the NTR will be notified.
Sampling of soil vapor extraction system effluent	OHM and NTR	If: the effluent meets the discharge criteria for the release.	Then: the unit will continue to operate. If not then: the NTR will be notified.
Sampling of liquid from liquid/vapor separators	OHM and NTR	If: the water meets criteria for treatment at the Lot 203 groundwater treatment plant	Then: it will be transported to the treatment plant if not then: the NTR will be notified.

3.0 SAMPLING

3.1 SAMPLING METHODS AND PROCEDURES

The following sections describe sampling locations, frequencies, sample matrices, and measurements of parameters of interest. Table A-1 "Sampling Summary" in Appendix A presents a summary of these items. All samples will be collected using clean sampling equipment. Sampling equipment will be thoroughly cleaned between samples using decontamination procedures described in Section 3.5. Field sampling personnel will wear disposable sampling gloves during sampling and will change gloves between sample locations to minimize the potential for cross-contamination. Other PPE may be required for sampling per the site HASP. Contact with sample will be avoided to minimize the potential for cross-contamination.

The expected sample types for the POL sites are discussed in the next sections. Not all sites will have all sample types. The specific site sampling will be summarized in Section 3.2, Tables A-1 and A-2 amendments.

Groundwater Sampling

Ground water samples will be collected on quarterly basis after initial start-up and for the period of six months after initial start-up. Each well will be purged to pump out three well casing volumes before collecting samples. Grab samples will then be collected by a Teflon bailer. Samples for analysis of volatile constituents will be collected first, followed by samples for analysis of semivolatile organics and other parameters. Appropriate sample containers will be filled and sent off-site for analysis as specified in Appendix A, Table A-1. Two additional sets of sample containers will be filled for samples selected for Matrix Spike/ Matrix Spike Duplicate analysis.

Surface Water

Surface water samples will be collected from the Northeast Creek. Sampling will be performed on a quarterly basis for two quarters. Samples will be collected by a direct fill method. The appropriate sample containers will be filled and sent off-site for analysis as specified in Table A-1, Appendix A.

Liquid samples from the Liquid Vapor Separator Tank

Contents of each Liquid Vapor Separator Tank will be sampled once during the remediation effort. Grab samples will be collected from each tank. The appropriate sample containers will be filled and sent off-site for analysis as specified in Table A-1, Appendix A.

Soil Vapor

Gaseous effluents from each SVE system will be sampled on a monthly basis for six months.. Grab samples will be collected from the sampling port using a container equipped with pressure gauge (e.g. SUMMA canister). The sampling port will be purged with the contents until a fresh sample is obtained. The appropriate sample containers will be filled and sent off-site for analysis as specified in Table A-1, Appendix A.

Disposal Samples

Miscellaneous disposal samples as needed will be collected. These may include: PPE, asphalt/construction debris, trenching spoils (soil), well cuttings, well development water, and other miscellaneous wastes. Sampling techniques will vary depending on the waste material. Typically composite samples are used in the disposal waste sampling. The appropriate sample containers will be filled and sent off-site for analysis as specified in Table A-1, Appendix A. .

3.2 SITE SPECIFIC SAMPLING AND ANALYSIS REQUIREMENTS

3.2.1 Site AS-822

The only sampling planned for the Site Building AS-822 is groundwater sampling. A total of three monitoring wells will be sampled for the parameters listed in Table A-1, Appendix A. Sampling will be performed once for the baseline and then quarterly for two quarters to monitor the remediation process. The well identification numbers for the three sample points are MW2, MW4, and MW8. In addition to the field sample, QA/QC samples will be collected as presented in Table A-1, Appendix A. Additional monitoring points may be substituted or added at the discretion of the NTR as required by the project. Amendments to the SAP will be required for all changes. SOP QP-618 for sampling with bailers is included in Appendix C.

3.2.2 Site Building STT-69

Groundwater, liquid from the liquid vapor separator, and soil vapors from individual well heads and system effluent are planned to be sampled for this site. The following sections describe the frequency for each type of sampling.

Groundwater: A total of five monitoring wells will be sampled for the parameters listed in Table A-1, Appendix A. Groundwater samples will be collected once before the startup for establishing the baseline, and quarterly after that for two quarters to monitor the remediation process. The well identification numbers for the five sample points are:

- STT69-7
- STT69-10

- STT69-11
- STT69-12
- STT69-12

Liquid from Liquid Vapor Separator: Liquids from the liquid vapor separator will be sampled for the parameters listed in Table A-1, Appendix A. Liquid samples will be collected once before the startup to evaluate remediation process, and once during the operation of the system to monitor the remediation process.

Soil Vapor: Soil vapor samples will be collected from the system effluent port for the parameters listed in Table A-1, Appendix A. The vapor samples will be collected on a monthly basis for the first six months of the operation to evaluate and monitor remediation process. In addition to these samples, vapor samples will be collected from each individual well head, and from the system effluent for the field screening for volatile organic analytes using portable organic vapor analyzers (OVAs). A Standard Operating Procedure SOP QP-627 for using OVAs is included in Appendix C.

In addition to this field samples, QA/QC samples will be collected as presented in Table A-1, Appendix A. Additional sampling points may be added or substituted based on project needs, and at the discretion of the NTR.

3.2.3 Building TT2477/2478 Site

Groundwater surface water, liquid from the liquid vapor separator and soil vapors from the system effluent are planned to be sampled for this site. The following sections describe the frequency for each type of sampling.

Groundwater: A total of ten monitoring wells will be sampled for the parameters listed in Table A-1, Appendix A. Groundwater samples will be collected once before the start-up for establishing the baseline and quarterly after that for two quarters to monitor the remediation process. The specific wells to be monitored will be determined at a later time prior to system start-up. OHM will select representative monitoring wells following a visual survey of existing wells at the site. One or more new monitoring wells may be installed based on this survey.

Surface water: A total of two surface water samples will be collected from the Northeast Creek. One upstream and one downstream sample will be collected from the creek quarterly for two quarters to monitor the surface waters to ensure a quality consistent with North Carolina Surface Water Quality Standards outlined in NCAC, Title 15 A, Subchapter 2B for receptor protection. Surface water samples will be analyzed for the parameters listed in Table A-1, Appendix A.

Liquid From Liquid Vapor Separator: Liquids from the liquid vapor separator will be sampled for the parameters listed in Table A-1, Appendix A. Liquid samples will be collected once during start-up and once thereafter during this effort to determine any changes in water quality.

Soil Vapor: Soil vapor samples will be collected from the system effluent port for the parameters listed in Table A-1, Appendix A. The vapor samples will be collected on a monthly basis for the first six months of the operation to evaluate and monitor the remediation process.

Soil vapor samples will also be obtained from each individual well head, and from the system effluent for the field screening of volatile organics analytes using portable organic vapor analyzers (OVAs). A Standard Operating Procedures SOP QP-627 for using OVAs is included as Appendix C.

Carbon Effluent: The SVE discharge will be treated with vapor phase activated carbon. The system discharge will be monitored periodically with the OVA to determine carbon break-through and to schedule spent carbon replacement services.

3.2.4 Berkeley Manor UST 820 Site

Groundwater, liquid from the liquid vapor separator and soil vapors from the system effluent are planned to be sampled for this site. The following sections describe the frequency for each type of sampling.

Groundwater: A total of ten monitoring wells will be sampled for the parameters listed in Table A-1, Appendix A. Groundwater samples will be collected once before the start-up for establishing the baseline and quarterly after that for two quarters to monitor the remediation process. The specific wells to be monitored will be determined at a later time prior to system start-up. OHM will select representative monitoring wells following a visual survey of existing wells at the site. One or more new monitoring wells may be installed based on this survey.

Liquid From Liquid Vapor Separator: Liquids from the liquid vapor separator will be sampled for the parameters listed in Table A-1, Appendix A. Liquid samples will be collected once during start-up and once thereafter during this effort to determine any changes in water quality. Liquids from the separator will be temporarily stored in a holding tank before transportation and treatment at the Lot 203 groundwater treatment plant.

Soil Vapor: Soil vapor samples will be collected from the system effluent port for the parameters listed in Table A-1, Appendix A. The vapor samples will be collected on a monthly basis for the first six months of the operation to evaluate and monitor the remediation process.

Soil vapor samples will also be obtained from each individual well head, and from the system effluent for the field screening of volatile organics analytes using portable organic vapor analyzers (OVAs). A Standard Operating Procedures SOP QP-627 for using OVAs is included as Appendix C.

Carbon Effluent: The SVE discharge will be treated with vapor phase activated carbon for at least the first three months of operation. The system discharge will be monitored periodically with the OVA to determine carbon break-through and to schedule spent carbon replacement services.

In addition to these field samples, QA/QC samples will be collected as presented in Table A-1, Appendix A. Additional sampling points may be added or subtracted based on project needs, and at the discretion of the NTR.

3.3 SAMPLE IDENTIFICATION

The samples collected on-site will be provided with a unique sample designation. The number will serve to identify the site, location, and specific sample identification number. The sample designation format will be as follows:

CLXXX-YY-NNN

where:

CL = Camp Lejeune
XX = Delivery Order for the project (143)
YY = Sample Source:
GW - Ground Water
SW - Surface Water
LV - Liquid from Liquid Vapor Separator
SV - Soil Vapor
DS - Disposal Sample

NNN = Sequential number starting at 001

If sample is a field QC sample, the following designations will be added as a suffix

FB - Field Blank
TB - Trip Blank
RB - Equipment Rinsate Blank

3.4 SAMPLE PRESERVATION AND HOLDING TIMES

Samples collected for off-site analyses will be sent to the laboratory within 24 hours after collection to ensure that the most reliable and accurate answers will be obtained as a result of the analysis. The holding time begins from the date of collection in the field.

All environmental and treatment system samples, except for aqueous samples for metals, as well as QA/QC samples, will be preserved to a temperature of 4°C prior to shipment to the analytical laboratory, using ice or refrigeration. This temperature should be maintained during shipment by placing ice in leak-proof containers, and placing it above and below the sample containers. Other sample preservation requirements and holding times applicable to the sample matrix and analyses are listed in Appendix A, Table A-1. Sample bottles will come pre-preserved from the contract laboratory. Temperature blanks will also originate from the contract laboratory.

3.5 FIELD QC SAMPLES

The appropriate number of field QC samples, as specified in the NFESC, 1996 document will be collected during this project. These samples will include field blanks, equipment rinsate blanks and field duplicate samples. These samples will be collected at the following frequencies and analyzed for the parameters listed in Appendix A, Table A-1:

- **Field Blanks (Ambient Blanks)** – Field blanks , sometimes referred to as ambient blanks, are samples of contaminant-free media (reagent grade water) which are prepared at the site and handled in the field in the same manner as all other field samples. Field blanks are collected during the course of field sampling and, to the extent possible, in the actual sampling locations. Field blanks are collected by placing contaminant-free medium (reagent grade water) in the same type of container as field sample. Field blanks are preserved and stored in the same manner as field samples. At a minimum, one field blank per contiguous site from each sampling event is collected and is analyzed for those interfering contaminants that could potentially be present in ambient air at the sampling site. Approximate number of field blank samples planned to be collected is presented in Appendix A, Table A-1
- **Equipment Rinsate Blank** – Equipment rinsate blanks are the final analyte-free water rinse from equipment cleaning collected daily for each matrix sampled. An equipment rinsate blank is collected in the same type of sample containers, and in all other ways is handled in the same manner as other field samples. The equipment rinsate blank must be collected

during the sampling event, after collection of at least one field sample, after the sampling equipment has been decontaminated, and prior to collection of the next field sample. The contract laboratory will supply the analyte-free water for the rinsate blanks.

All equipment that comes into contact with field samples must be decontaminated prior to use. The use of disposable equipment is acceptable, but does not obviate the requirement for decontamination prior to use, or the requirement for collection of equipment rinsate blanks. Equipment rinsate blanks for disposable equipment are collected by passing contaminant-free medium through or over the decontaminated equipment. One equipment rinsate blank is collected per day, per sampling event for each matrix sampled that day.

Equipment rinsates are analyzed for the same parameters as the sample collected that day. Approximate number of equipment blank samples planned to be collected is presented in Table A-1, Appendix A.

- **Field Duplicate** – Duplicates for soil samples are collected, homogenized, and split. All samples except volatiles are homogenized and split. Volatiles are not mixed, but select segments of soil are taken from the length of the core and placed in 4 oz glass jars. The duplicates for water samples are collected simultaneously. Field duplicates must be collected at a frequency of one sample per day per matrix or 5% of the field samples per matrix for NEESA Level E QC requirements. All the duplicates should be sent to the primary laboratory responsible for analysis, along with the samples. The field duplicates should be used by the laboratory to prepare the laboratory duplicate or matrix spikes and designated on the COC as such. Duplicate samples will be analyzed for the same parameters as its original field sample. Approximate number of field duplicates planned to be collected are presented in Table A-1, Appendix A.
- **Trip Blank** -- Trip blanks are defined as samples which originate from analyte-free water taken from the laboratory to the sampling site and returned to the laboratory with the volatile samples. One trip blank should accompany each cooler containing aqueous and non-aqueous volatile samples, should be stored at the laboratory with the samples, and analyzed by the laboratory. Trip blanks are only analyzed for volatile organic compounds. Approximate number of trip blank samples planned to be analyzed is presented in Table A-1, Appendix A.

3.6 DECONTAMINATION

All sampling equipment (hand augers, spoons, stainless steel/glass mixing bowls, etc.) will be decontaminated before sampling commences, between each sample location, and prior to leaving the

site. The procedures for decontamination of equipment according to NEESA 20.2-047B are as follows.

- 1) Remove gross contamination by scraping or brushing.
- 2) Clean with tap water and phosphate-free laboratory detergent (liquinox), using a stiff brush to remove all surface contaminants.
- 3) Rinse thoroughly with tap water.
- 4) Rinse with 1:1 nitric acid (HNO₃) metals grade (for metals analysis only).
- 5) Rinse thoroughly with tap water.
- 6) Rinse thoroughly with ASTM Type I deionized/distilled water.
- 7) Rinse twice with reagent grade isopropanol or methanol.
- 8) Rinse thoroughly with organic-free (ASTM Type I reagent grade) water and allow to air dry. (Do not rinse with deionized/distilled water. If organic-free water is not available, allow equipment to air dry.)
- 9) Wrap equipment with aluminum foil prior to storage or transportation to sample locations.

Decontamination fluids will be collected in properly labeled 55-gallon drums, and staged in a secure area until final disposal.

3.7 CROSS-CONTAMINATION MINIMIZATION

Cross-contamination is the introduction of contaminants into the sample through the sampling and/or sample-handling procedures. It can cause an otherwise representative sample to become non-representative. The most important means of minimizing cross-contamination are as follows:

- Sampling expendables, i.e., sample gloves, pipettes, string, dip jars, etc., must not be reused. Used expendables should be labeled so they are not confused with non-contaminated trash

- Minimum contact should be made between the sampler and the sample medium. For example, a sampler should not touch the sample during while loading the sample in the container.
- Sample collection activities should proceed progressively from the least contaminated area to the most contaminated area.
- Sampling equipment should be constructed of Teflon, stainless steel, or glass that has been properly precleaned for collecting samples. Equipment constructed of plastic or PVC should not be used to collect samples for trace organic analyses.
- Any tools used in sampling must be carefully decontaminated prior to first use and after each use.
- Activities that could contaminate samples are prohibited in the sample handling and preparation area. These activities and the possible contaminants include:
- The area used for preparing the samples for shipment must be clean and separate from break and eating areas.

Activity	Possible Contaminants
Smoking	Polynuclear Aromatic Hydrocarbons
Spraying for insects	Pesticides, oils, solvents
Spraying for weeds	Herbicides, oils, solvents
Refueling	BTEX, hydrocarbons
Painting and paint stripping	Solvents

3.8 SAMPLE LOG BOOK

It is necessary for the sampling crew to maintain daily field notes. Items that must be included are sampling protocol, any changes to the procedures, meetings, instructions, safety precautions, personnel protection, and activities pertaining to the samples. The person taking notes must be knowledgeable enough about these activities to know which details are important.

Repetition of information recorded in other permanent logs should be avoided, but enough should be recorded to present a clear and accurate picture of technical activities. At a later date, should a

question arise concerning a specific event or a procedure used, it will be answered from these notes. The following information should be logged into the logbooks and/or database:

- Date and time of sampling
- Sample number, locations, type, matrices, volumes, sample ID and descriptions, type and number of sample containers, names and signatures of individuals performing sampling tasks, Chain-Of-Custody (COC) and air bill numbers, preservatives, and date samples were sent
- Name of laboratories and contacts to which the samples were sent, turn around time (TAT) requested, and data results, when possible
- Termination of a sample point or parameter and reasons
- Unusual appearance or odor of a sample
- Measurements, volume of flow, temperature, and weather conditions
- Additional samples and reasons for collecting them
- Levels of protection used (with justification)
- Meetings and telephone conversations held with LANTDIV, NTR, regulatory agencies, project manager, or supervisor
- Details concerning any samples split with another agency
- Details of QC samples collected

These notes must be dated and signed (each page) for validity. All logbooks will be bound and pre-numbered. All log book entries will be made with indelible ink and legibly written. The language will be factual and objective. No erasures will be permitted. If an incorrect entry is made, the error will be crossed out with a single strike mark, initialed, and dated. When audits are performed, the auditor's remarks and decisions must also appear in these notes. These audits should be followed up by written report submitted by the auditor, including opinions and conclusions. A copy of this report should be placed in the project file and one copy kept in the sampling file for easy reference. This information will also be entered in to the data base program that been prepared for the site. It

will be entered daily by the field chemist or sample technician. This person will be the point of contact for all sampling and analytical information. Report outputs from the database is and acceptable substitute for the sample logbook.

3.9 SAMPLE LABELS

Any samples placed into a sample container will be identified by a sample label. Sample labels will identify the following information:

1. PROJECT NUMBER
2. DATE- Month, day, year
3. TIME- Military time
4. SAMPLE NUMBER- See Section 3.2 for designations
5. SAMPLE DESCRIPTION
6. SAMPLER- Sampler's name
7. PRESERVATIVES
8. ANALYSIS REQUIRED- See Appendix A, Table A-1

The information described above should be printed neatly using an indelible marker. After the sample is taken and the label is securely attached, the sample is logged into the sample log book. An example of a sample label is presented in Appendix B.

3.10 CUSTODY SEALS

Custody seals are narrow strips of adhesive tape of glass fiber used to demonstrate that no tampering has occurred. They may be used on sampling equipment, sample transport containers, and individual sample containers. They should be signed and dated by the sampler and placed from one side, across the top, and to the other side of the sample container or across the openings of the sample transport containers. An example custody seal is presented in Appendix B.

3.11 CHAIN-OF-CUSTODY PROCEDURES

In order to generate legally defensible data of the samples collected throughout the project, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. To maintain and document sample possession, chain-of-custody procedures are followed as described below:

A sample is under your custody if:

1. It is in your actual possession, or
2. It is in your view, after being in your physical possession, or
3. It was in your physical possession and then you locked it up to prevent tampering, or
4. It is in a designated secure area

An example of a COC form is presented in Appendix B. The following information is required on the COC:

1. OHM's laboratory coordinator - Missy Art, Southern Region
2. Laboratory coordinator phone - (770) 734-8060
3. Laboratory coordinator fax - (770) 453-7716
4. Project name -
5. Project location - city and state in which the project is located
6. Project number
7. Project contact - OHM employee responsible for overseeing the sampling operation
8. Project phone number - telephone of on-site trailer or number where person responsible for samples can be contacted
9. Project fax - same as phone
10. Project address - Fed Ex address for site
11. City, state and zip code
12. Client -
13. Project manager -
14. Project manager's phone -
15. Project manager's fax -
16. Laboratory service identification number - (to be completed by the laboratory for their job number)
17. Laboratory contact
18. Laboratory phone
19. Laboratory fax
20. Laboratory address - address of laboratory where samples are sent
21. City, state and zip code
22. Mail report - reports will be mailed to OHM
23. Recipient name - reports will be mailed to Missy Art
24. Address - 5335 Triangle Parkway, Suite 450
25. City, state and zip code - Norcross, GA 30091
26. Sample identifier - sample number/location
27. Matrix - soil, water, wipes, etc.
28. Date - date that the samples were collected MM/DD/YY

29. Time - time samples were collected (military time)
30. Preserved - preservatives used - yes or no
31. Number of containers - number of containers per sample
32. QC level - QC level required
33. TAT - TAT requested
34. Analyses - list all parameters and method numbers
35. Comments
36. Samples collected by - signed by person who collected samples
37. Courier and air bill number -
38. Relinquished by -
39. Received by -
40. Date - date samples sent to laboratory
41. Time - time samples sent to laboratory
42. Sample point location - sample number
43. Sample type - check if the sample is grab, composite, field or QC
44. Comments - any additional comments
45. Laboratory name

The COC will be sealed in a ziploc bag and taped in place on the underside of the top of the sample transport container (cooler). A copy of a COC form is included in Appendix B.

3.12 PACKAGING, HANDLING, AND SHIPMENT OF SAMPLES

Samples will be packaged as to minimize shifting of the samples during shipment. An absorbent, such as vermiculite or kitty litter, will be placed at the bottom of the shipment container in order to absorb any liquids in the event of sample breakage. All samples will be individually placed into appropriately sized ziploc bags and sealed.

Samples, which must be kept at 4°C will be shipped on ice in insulated containers. Ice will be placed in a container such as a ziploc bag and sealed so that water will not fill the shipping container as the ice melts. The ice will be double bagged to insure the ice does not leak. Aqueous samples for metals analysis, except hexavalent chromium, **shall not be shipped or stored under refrigeration.**

Samples will be shipped via an overnight shipping agency to the appropriate laboratory. IATA regulations will be followed as they are more applicable to OHM's method of sample shipment. Instructions for filling out shipment documentation are included in Appendix B. These instructions are for shipping samples with unknown or limited hazards. All information will be entered as

directed No changes or substitutions to these instruction will be made irrespective of their significance. A copy of the OHM sample shipping label is included in Appendix B.

4.0 DATA ACQUISITION

4.1 ANALYTICAL METHOD REQUIREMENTS

Analytical requirements for this project are listed in Appendix A, Table A-1. All samples will be analyzed according to *USEPA SW-846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* whenever possible. Alternative methods of analysis from other sources (ASTM, NIOSH, Standard Methods, etc.) may also be used.

4.2 QUALITY CONTROL REQUIREMENTS

Project Quality Control (QC) requirements for precision, accuracy, completeness, and quantitation limits are listed in Appendix A, Table A-2. QC procedures and acceptance limits must be met as specified in the individual methods. In addition, the laboratory must meet the specification and requirements as described in the NFESC, 1996 document.

4.3 INSTRUMENT TESTING, INSPECTION, AND MAINTENANCE

Proper maintenance is critical to the performance of minimization of downtime of all equipment, whether it be for measurement or support. Inspection will be performed, at a minimum, prior to use of the instruments. Preventive maintenance will be performed as recommended by the manufacturer of the respective equipment. All routine maintenance and major repairs performed on field screening or analytical equipment will be recorded in bound maintenance logbooks that have been specifically designated for that instrument. Equipment that fails calibration or becomes inoperable during use will be removed from service and segregated to prevent inadvertent use, or will be tagged to indicate that it is out of calibration. Such equipment will be repaired and recalibrated or completely replaced.

4.4 INSTRUMENT CALIBRATION

All calibrations on field instruments will be performed, as a minimum, on a daily basis. Every calibration will be recorded in the maintenance logbook for each instrument. Quality control check standards from a separate source will be used to check initial calibration, and acceptance and rejection criteria.

Monitoring instruments, such as the OVA or FID, O₂/LEL meter, Monitox, etc. will be calibrated as specified in the SSHP. Off-site analytical instruments will be calibrated according to the method specifications and the laboratory's QA Manual.

5.0 DATA MANAGEMENT

Data management is the system by which data is reduced, reviewed, validated, reported, distributed, and finally archived. The criteria in this system are designed to meet the project objectives.

5.1 LABORATORY DATA REDUCTION

Data reduction includes the identifications and calculations necessary to convert the raw instrument readings to the final reported compounds and their respective concentrations.

Responsibilities of Analyst

Each analyst is responsible for converting raw data into reportable values. These specific duties include:

- Proper identification of the analyte
- Generation of calculations
- Checking associated calibrations to ensure support of data
- Associated QA/QC checks are supportive of data
- Associated documentation is complete and accurate in respective log books
- Associated chromatograms and strip chart recordings are labeled with data, instrument number, run parameters and analyst

5.2 LABORATORY DATA VALIDATION

All data generated for the project within the laboratory will be extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, and three levels of review.

The analyst who generates the raw data has the prime responsibility for the correctness and completeness of the data. All data generated and reduced will follow protocols specified in the laboratory (SOP). Each analyst reviews the quality of his work based on an established set of guidelines. The guidelines are:

- Sample preparation information is correct and complete
- Analysis information is correct and complete
- The appropriate Standard Operating Procedures have been followed
- Analytical results are correct and complete
- Analysis is performed within prescribed holding times.
- QC samples are within established control limits
- Blanks are within appropriate QC limits
- Special sample preparation and analytical requirements have been met
- Documentation is complete

The next level of review is performed by the section supervisor or data review specialist. The review is structured to ensure that:

- Calibration data are scientifically sound, appropriate to method, and completely documented.
- QC results are within established limits.
- Reporting units are consistent with the method and the matrix.
- Quantitative results are correct.
- Data results are consistent with information on the COC.
- Documentation is complete.
- The data is ready for incorporation into a final report.
- The data package is complete and ready for data archive.

The second level of review is structured to ensure all calibration data and QC sample results are reviewed and all of the analytical results from 10 percent of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is complete. If problems exist, an additional 10 percent is reviewed, the process continues until no errors are found or the package has been reviewed in its entirety.

The final level of review by the laboratory comes from the program administrator or laboratory QA Officer. He/she reviews the report to ensure that the data meets the overall objectives of the project.

Once the data has been validated, it is ready for report production. The report will contain:

- Description of sample types
- Tests performed, problems encountered during testing
- Dates sampled

- Date received
- Date extracted
- Date analyzed
- Analytical results
- Reportable limits
- QC information: percent recovery, relative percent difference, control limits, blanks analyses, matrix spikes, and other additional special QC information
- Qualifiers for data falling outside of QC limits
- Methodology
- Name of the analyst
- Signature of laboratory representative
- Dual column confirmation results
- Calibrations (when requested)
- Instrument performance checks (when requested)
- QC Batch number

The report from the laboratory will be paginated and will also include a copy of the original COC for the samples analyzed.

5.3 PROJECT DATA REVIEW

Project Chemist Data Review Responsibilities

The project chemist is responsible for initial review of the data from the laboratory. This review includes:

- Verifying that all requested data are reported
- Verifying that samples are analyzed according to the contract specified method
- Verifying that all analytes requested are reported
- Verifying that holding times are not exceeded
- Verifying that matrix spike, matrix spike duplicate, and surrogate recoveries fall within the laboratory's acceptable criteria
- Reviewing blank data for contamination
- Reviewing field quality control results for inconsistencies
- Verifying that the data generated meet the project Data Quality Objectives.

The project chemist is responsible for informing the Project Manager and Project Chemical QA/QC Officer of any laboratory and/or sampling deficiencies or issues. These issues and subsequent decisions will be documented on the data evaluation report produced by the Project Chemist for each data package.

Project QC Engineer Data Review Responsibilities

The Project QC Officer is responsible for interfacing with the project chemist, project manager, and the laboratory's QA Officer to resolve any QA/QC issues affecting the data. He/she is also responsible for finalizing any QA/QC issues with the laboratory and/or the project chemist. This includes obtaining a corrective action from the parties involved.

5.4 DATA REPORTING

The preliminary data will be faxed to the project chemist. This data may or may not have undergone the full laboratory review process and may contain errors and discrepancies. Prior to the use of data results for any decisions, the data will be reviewed by the project chemist and assessed against the

project goals and data quality objectives. A copy of the preliminary data, including review comments from the project chemist will be submitted to the site and/or the project manager.

The hard and final copy data will be evaluated by the project chemist and assessed against the project goals and data quality objectives. Any errors, discrepancies, and nonconformances will be brought to the laboratory's and project manager's attention.

When QA issues have been satisfactorily settled and data evaluation has been completed, the project manager may release the data to the client and/or regulating agencies.

5.5 DATA STORAGE AND ARCHIVE

After OHM has completed its work for the project, all documents generated will be assembled in the project file. Individuals may retain clean (no handwritten comments) copies of documents for their personal files but only after personally verifying that the original or similar copy is in the project file. The project manager/supervisor is responsible for ensuring the collection, assembly, and inventory of all documents relative to the project at the time the objectives are met. The file then becomes accountable. Any records leaving the file must be signed out.

When a contractor has completed the project objectives, all file documents are reviewed and submitted to the central file. The project file contains the following document classes:

- A. Project logbooks
- B. Drum logs and other forms
- C. Sample identification documents
- D. Chain-of-custody records
- E. Analytical logbooks, laboratory data, calculations, graphs, etc.
- F. Correspondence
 - Inter-office
 - Client
 - Regulating agencies
 - Record of confidential material
- G. Report notes, calculations, drafts
- H. References, literature
- I. Sample (on-hand) inventory
- J. Check-out logs
- K. Litigation documents
- L. Miscellaneous – photographs, maps, drawings, etc.

Once deposited in the file, documents must be checked out.

The final report is usually generated by use of computer. A back-up copy of the report on diskette is filed along with the project file. The original report remains in the hard drive of the computer until such a time is required to download it on a diskette. This diskette is also archived.

All information under the corresponding project number is maintained in the archive system for five years. All archives are accessed by the archives file master list which is maintained in a separate location from the archives.

6.0 DATA ASSESSMENT PROCEDURES

Reliability in analytical determination is maintained through strict adherence to quality control procedures. Procedures are designed to control both the accuracy and precision of analytical results. For the validation of the data, a known method spike is routinely analyzed to ensure the accuracy of results. The procedure is to run the standard QA/QC and sample analysis with each lot of samples sent to the laboratory. If more than ten individual analyses are made, additional standards will be analyzed at a rate of one standard per ten analyses. Some procedures call for the use of either a surrogate spike or the standard addition of a known quantity of the analyte to a split of the sample being analyzed.

Control charts will be prepared using an estimate of the spike recovery obtained from the literature or determined by repeated analyses run in the laboratory. Each time the analyst runs a method spike, the results is entered on the control table. If a standard addition technique is used, a plot of instrument response versus added analyte concentration is made in order to determine analyte concentration in the original sample. These are further explained in the laboratory's QAM.

Replicate analyses will be performed on at least 10 percent of the samples processed by the laboratory. A record of the precision of most analyses is kept by calculating and plotting the industrial statistic I (which is equivalent to the coefficient of variation). Blanks are also run with each batch of samples or individual sample analyzed regardless of the level of certification of the data.

The purpose of spikes, blanks, and replicates is to provide a sound scientific basis from which the degree of certification of the resultant data can be objectively concluded. These are not management decisions, but follow naturally from the results of the above QC procedures.

6.1 ACCURACY

Data accuracy is a reflection of the efficiency of the analytical procedure. It is determined by use of spiked samples and standard reference materials or laboratory control samples performed at the rate of one set every 20 samples. A control chart is generated using historical laboratory data where warning and control limits are established to assess data accuracy.

The accuracy (check standards) samples will have concentration values of the mid-standard. During analysis, a minimum of 10 percent of samples are accuracy samples. The accuracy samples are staggered through the analysis, not placed one after another. After a minimum of seven accuracy samples are analyzed, the percent recovery is calculated for each sample.

The accuracy criteria is determined by calculating the standard deviation of seven or more percent recovery values and setting the upper and lower control limits using the following equations:

$$\text{Upper control limit} = p + 3 \text{ SD}$$

$$\text{Lower control limit} = p - 3\text{SD}$$

Where:

p = Average percent recovery

SD = Standard deviation

After the standard deviation, for the seven or more samples has been calculated, the accuracy control limits are generated and are then used to determine if the analysis is out of control. This is done by checking the results against the control limits. If any values are above the upper control limit or below the lower control limit, all sample results after the last qualifying accuracy sample must be repeated or discarded. If seven consecutive values fall below the lower control limit, new limits are calculated using the new accuracy check values. If the values fall between the upper and lower limits, then conditions are reported as "within limits."

6.1.1 Recovery Control

Recovery control is necessary to determine if the sample matrix is interfering with the constituent being analyzed. A minimum 5 percent of samples will be recovery check samples (matrix spikes). Samples involving different types of matrices will have at least one recovery check sample for each matrix.

Control limits will be determined for each matrix, determining the deviation for seven or more percent recovery values.

6.2 PRECISION

Duplicate and replicate samples analyzed by the laboratory assess the precision of the sampling effort. Control limits for duplicate/replicate RPDs are listed in Appendix A, Table A-2. Once a sufficient amount of replicate data becomes available, field precision control charts are constructed similar to the laboratory precision charts. For any given concentration, the mean and the standard deviation(s) of the replicates are calculated. Data from each sample set are pooled with the previous sample sets to generate control and warning limits for the next set. Control and warning limits for water samples are set at $\pm 2s$ and $\pm 3s$, respectively. Control limits for solid samples are more liberally established due to matrix heterogeneity. Data outside any control limit are subject to QA review.

Precision is based upon the results of the relative percent differences as calculated from the percent recoveries of the matrix spike and duplicate samples. The control limits for precision is based on historical laboratory data.

MS and MSD samples on a per batch or a minimum frequency of 5 percent are analyzed to assess precision. Duplicate results are compared and the relative percent difference (RPD) is then determined. The RPD will be entered into the laboratory's data system and will be used to define the precision of the analysis. Minimum limits are listed in Appendix A, Table A-2.

6.3 COMPLETENESS

The field supervisor must ensure all sites are sampled for all the specified analyses, that sufficient sample volume has been provided to complete those analyses, and that all of the QA samples have been included with each sample set. The goal for completeness for each sample set shipped to the laboratory is 100 percent. Minimum limits are listed in Appendix A, Table A-2.

Completeness is expressed as the percentage of the amount of valid data obtained to the amount of data expected. For a set of data to be considered complete, it must include all QC data verifying its accuracy and precision.

If samples analyzed do not meet all QC requirements in terms of accuracy and precision for any specific parameter, the sample preparation and analysis will be repeated pending adequate volume.

6.4 CRITERIA FOR REJECTION OF OUTLYING MEASUREMENTS

There are many statistical tests for rejection of outlying data points obtained from a set of measurements from a single population. A test recommended in "Statistical Manual of the Associate of Official Analytical Chemists," 2nd Edition, W. J. Youden and E. H. Steiner, 1975, pg. 86, is the Dixon Test. This test is not dependent on the distribution of the data and can be used for as few as three measurements. A more complete description for this broadly applicable test can be found in the referenced text.

Another reference is the USEPA National Functional Guidelines for Data Validation of Organics and Inorganics. Also, specific programs may have quality objectives with criteria for rejection of outlying measurements.

6.5 METHOD DETECTION LIMITS AND PRACTICAL QUANTITATION LIMITS

Method detection limits (MDLs) must be established by the laboratory. This should, at a minimum, be established on a yearly basis. MDL is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

Practical quantitation limit (PQL) is the lowest level that can be reliably determined within specified limits of precision and accuracy during routine laboratory operating conditions. The PQLs are generally 5-10 times the MDL. The PQL is the most applicable limit of reporting for this program.

6.6 LABORATORY AND FIELD CONTAMINATION

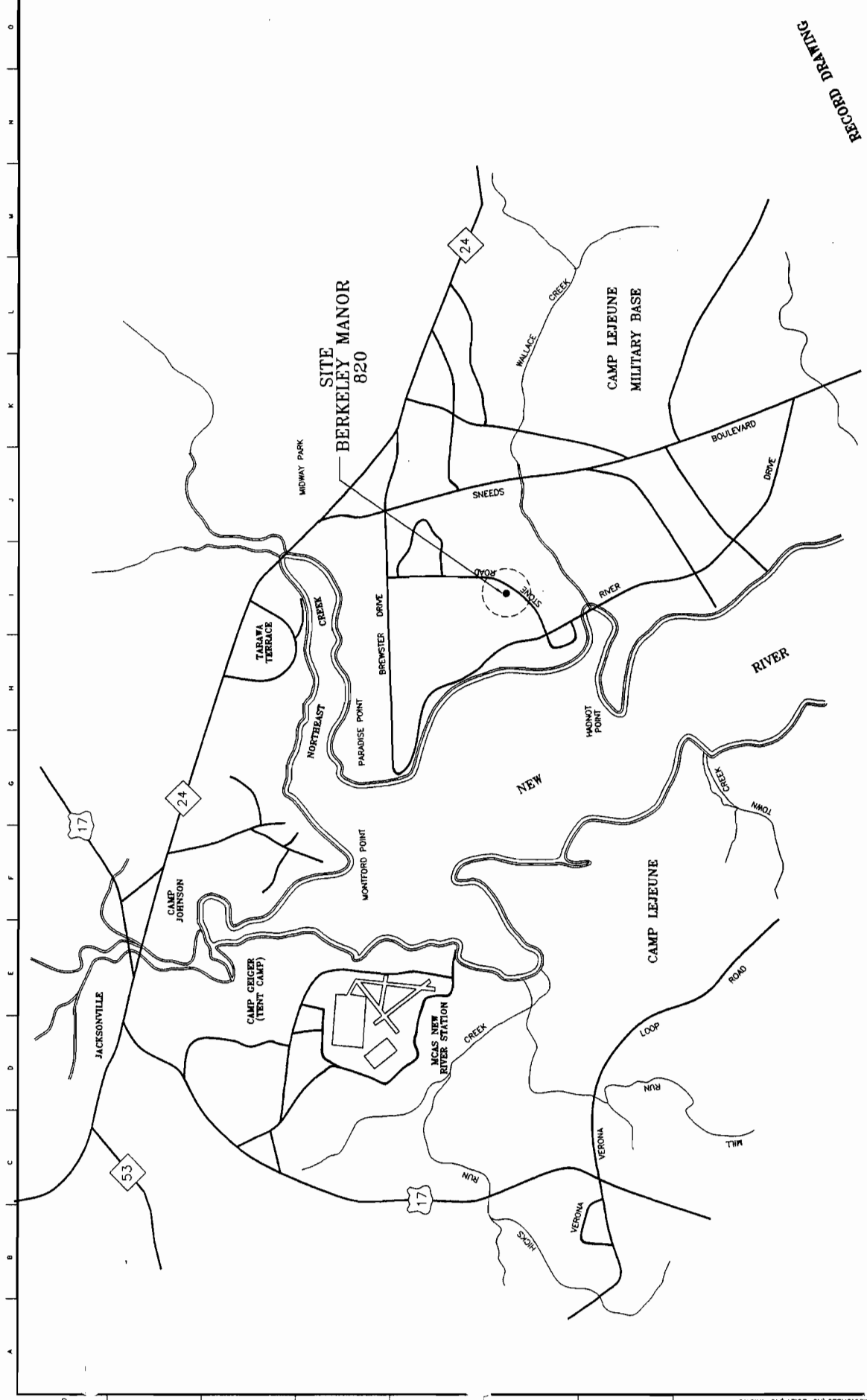
It is not unusual to find the following analytes at trace levels in the samples:

- Methylene chloride
- Acetone
- Freon (1,1,2-trichlorotrifluorethane)
- Bis(2-ethylhexyl)phthalate
- Hexane
- Isopropanol
- 2-Butanone

These are common solvents used in the field and in the laboratory.

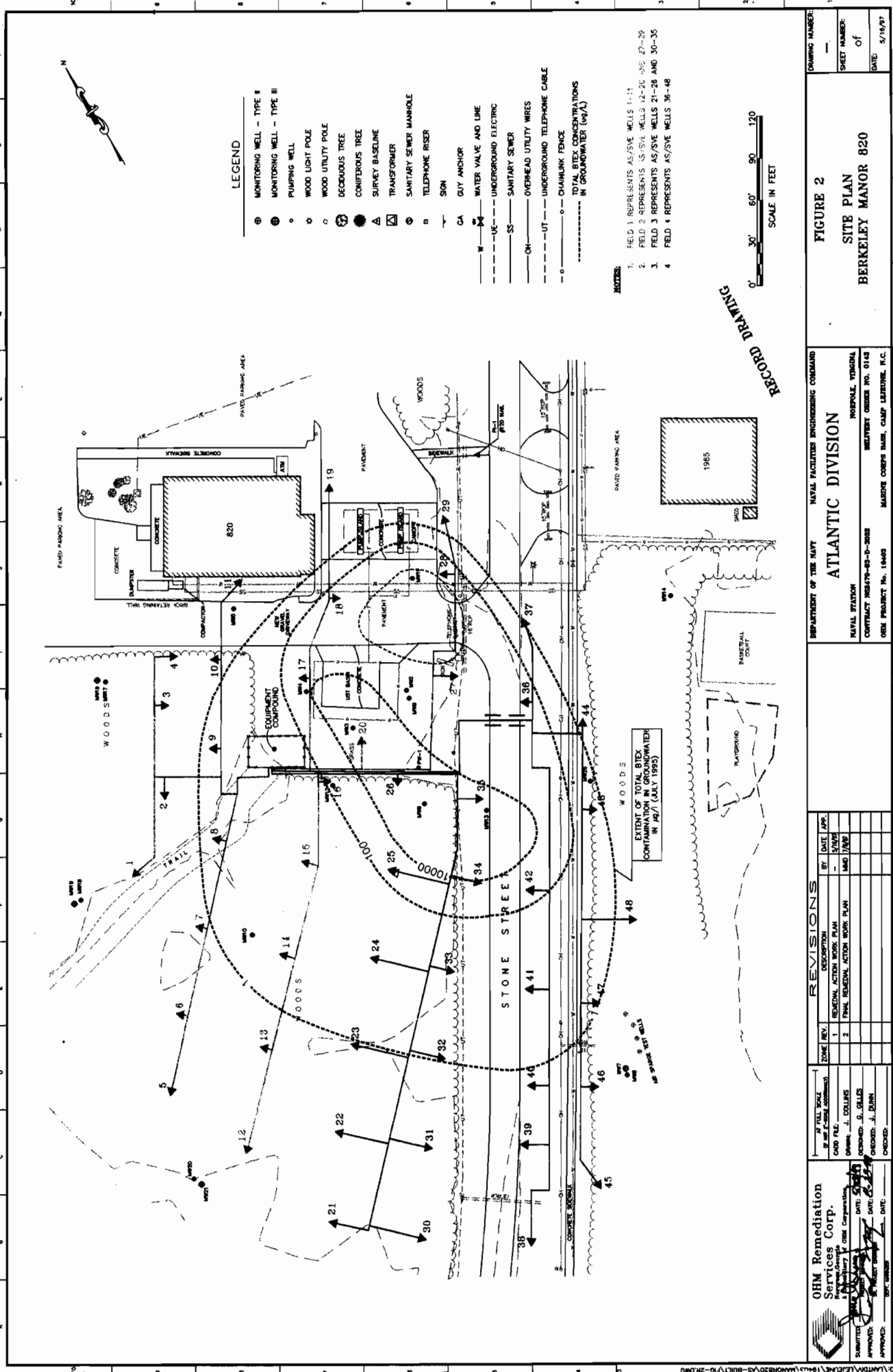
In order to fully evaluate data containing trace levels of these contaminants, one must have data from trip blanks, field blanks, equipment blanks, and all applicable laboratory blanks for that batch of samples.

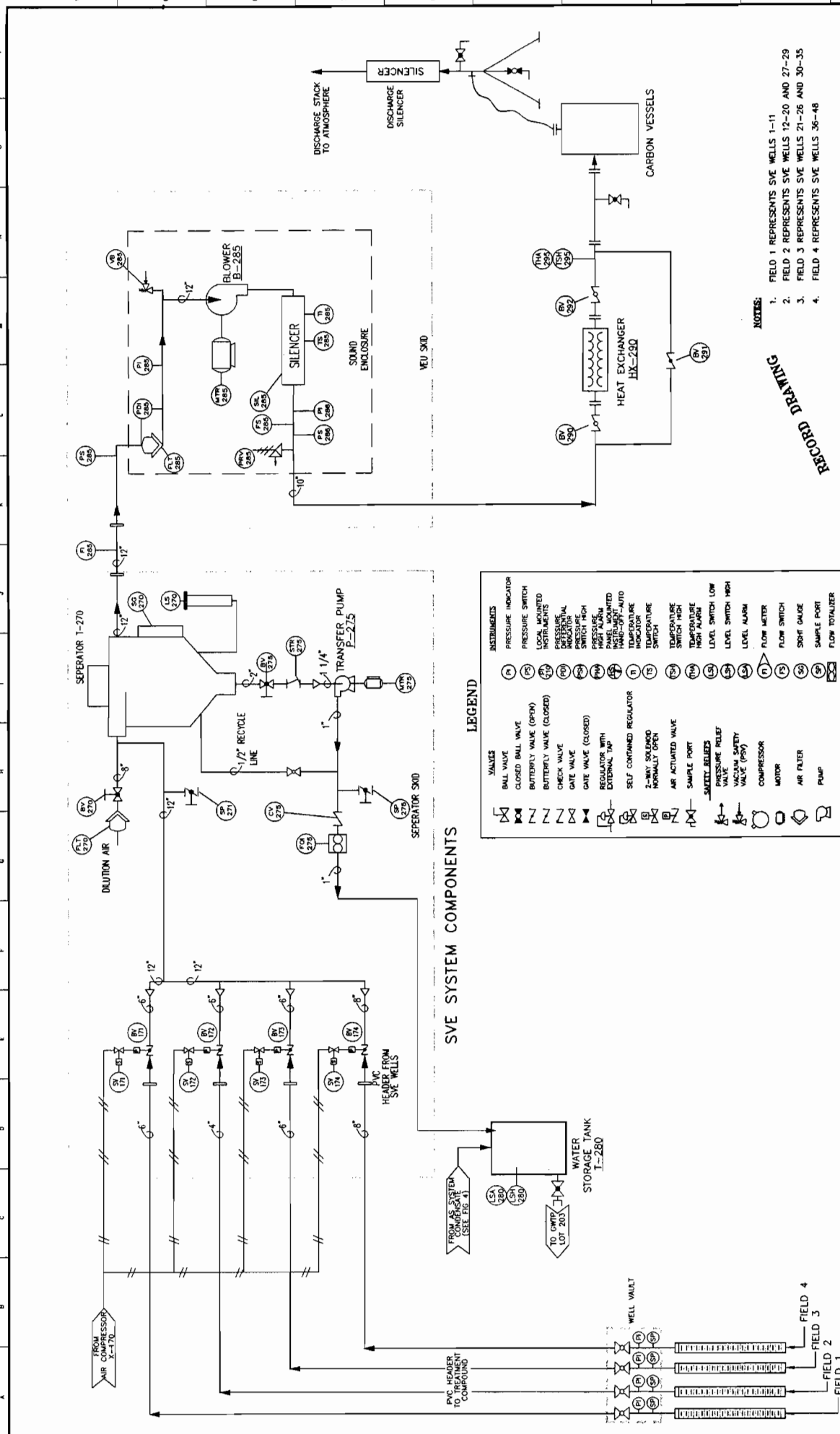
The determination on the use of the data will be made during the Data Validation process.



OHM Remediation Services Corp. 15100 W. 10th Ave., Suite 100 Denver, CO 80202 PHONE: (303) 751-1000 FAX: (303) 751-1001 E-MAIL: info@ohmremediation.com WWW: www.ohmremediation.com		APPROVED: <i>[Signature]</i> DATE: 5/16/97 PREPARED: <i>[Signature]</i> DATE: 5/16/97																									
AT FULL SCALE 1" = 100'		REVISIONS <table border="1"> <thead> <tr> <th>ZONE</th> <th>REV.</th> <th>DESCRIPTION</th> <th>BY</th> <th>DATE</th> <th>APP.</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>REMEDIAL ACTION WORK PLAN</td> <td>SMITH</td> <td>5/16/97</td> <td></td> </tr> <tr> <td>2</td> <td>2</td> <td>FINAL REMEDIAL ACTION WORK PLAN</td> <td>SMITH</td> <td>5/16/97</td> <td></td> </tr> <tr> <td>3</td> <td>3</td> <td>RECORD DRAIVING</td> <td>SMITH</td> <td>5/16/97</td> <td></td> </tr> </tbody> </table>		ZONE	REV.	DESCRIPTION	BY	DATE	APP.	1	1	REMEDIAL ACTION WORK PLAN	SMITH	5/16/97		2	2	FINAL REMEDIAL ACTION WORK PLAN	SMITH	5/16/97		3	3	RECORD DRAIVING	SMITH	5/16/97	
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3	3	RECORD DRAIVING	SMITH	5/16/97																							
CARD REC. J. COLLINS DRAWN: J. COLLINS CHECKED: J. DUNN		DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION NAVAL STATION NORFOLK, VIRGINIA CONTRACT N6479-00-9-3032 GEN SUBJECT No. 19403 MAINE CORPS BASE, CAMP LEJEUNE, N.C.																									
DRAWING NUMBER: 1 SHEET NUMBER: 1 OF: 1 DATE: 5/16/97		FIGURE 1 VICINITY MAP BERKELEY MANOR 820																									

RECORD DRAIVING





RECORD DRAFTING

- NOTES:**
1. FIELD 1 REPRESENTS SVE WELLS 1-11
 2. FIELD 2 REPRESENTS SVE WELLS 12-20 AND 27-29
 3. FIELD 3 REPRESENTS SVE WELLS 21-26 AND 30-35
 4. FIELD 4 REPRESENTS SVE WELLS 36-48

LEGEND

VALVES		INSTRUMENTS	
	BALL VALVE		PRESSURE INDICATOR
	CLOSED BALL VALVE		LOCAL MOUNTED PRESSURE SWITCH
	BUTTERFLY VALVE (OPEN)		PANEL MOUNTED PRESSURE SWITCH
	CHECK VALVE		PANEL MOUNTED HIGH/LOW PRESSURE SWITCH
	GATE VALVE (CLOSED)		PANEL MOUNTED HIGH/LOW TEMPERATURE SWITCH
	REGULATOR WITH EXTERNAL T.M.		PANEL MOUNTED HIGH/LOW LEVEL SWITCH
	SELF CONTAINED REGULATOR		PANEL MOUNTED HIGH/LOW LEVEL ALARM
	2-WAY SOLENOID VALVE NORMALLY OPEN		PANEL MOUNTED HIGH/LOW FLOW METER
	AIR ACTUATED VALVE		PANEL MOUNTED HIGH/LOW FLOW SWITCH
	SAMPLE PORT		PANEL MOUNTED HIGH/LOW FLOW GAUGE
	SAFETY BELLOWS		PANEL MOUNTED HIGH/LOW FLOW TOTALIZER
	PRESSURE RELIEF VALVE		
	VACUUM SAFETY VALVE (PSV)		
	COMPRESSOR		
	MOTOR		
	AIR FILTER		
	PUMP		

OHM Remediation Services Corp.
 14003 W. LEBANON RD., SUITE 200, LEBANON, OH 45031
 PHONE: (614) 475-1234 FAX: (614) 475-1235
 SUBMITTED: 12/15/97 BY: J. DUNN
 APPROVED: 12/15/97 DATE: 12/15/97

REVISIONS

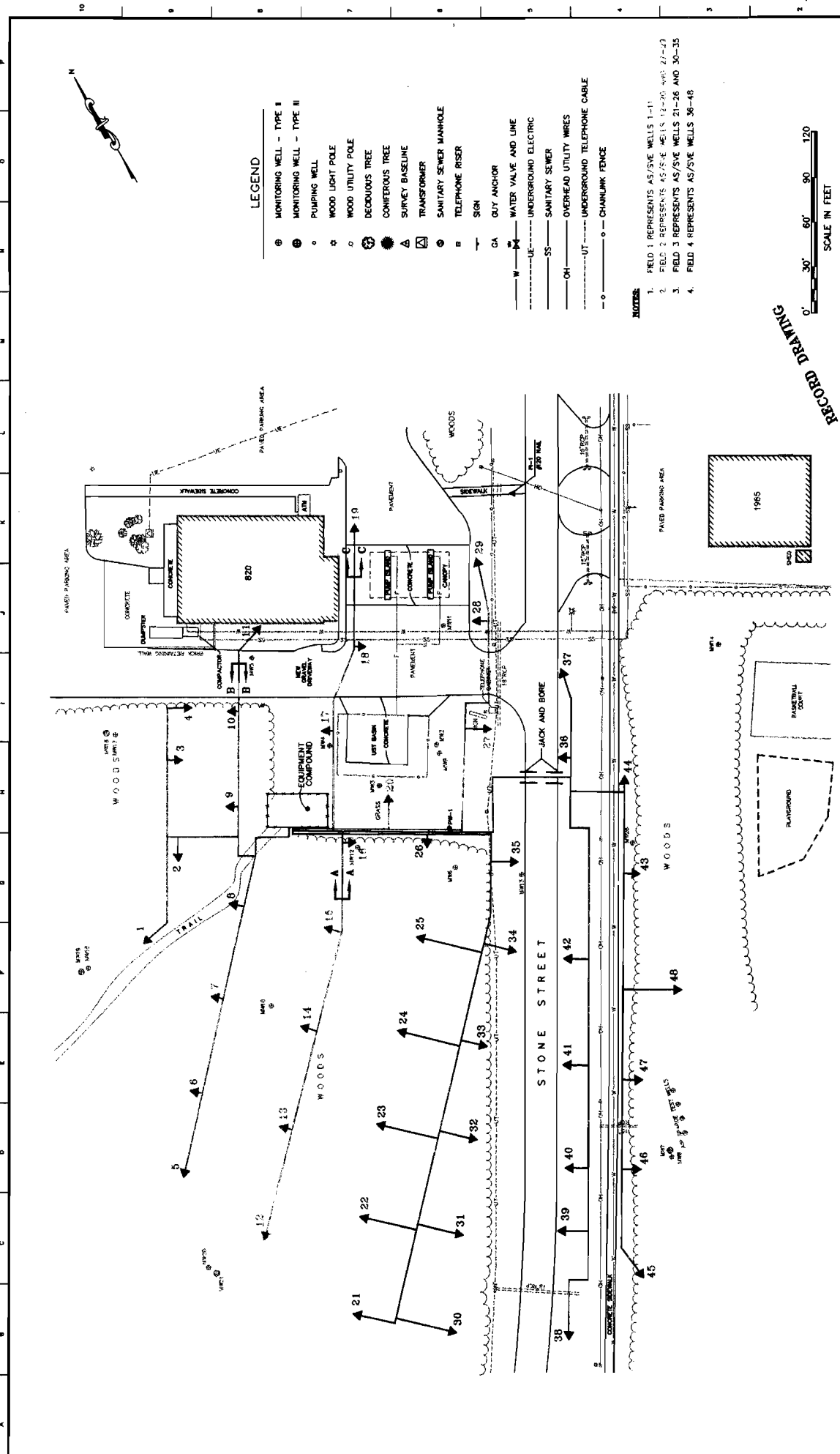
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2	FINAL REVISIONAL ACTION WORK PLAN	7/1/97	J. DUNN
3	RECORD DRAFTING	12/15/97	J. DUNN

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
 NAVAL STATION
 CONTRACT NO. 1413
 DELIVERY ORDER NO. 0143
 USN PROJECT NO. 14403

FIGURE 3
PROCESS AND INSTRUMENTATION
DIAGRAM
SOIL VAPOR EXTRACTION SYSTEM
BERKELEY MANOR 820

RECORD DRAFTING

DRIVING NUMBER
 SHEET NUMBER
 OF
 DATE: 5/16/97



- LEGEND**
- ⊙ MONITORING WELL - TYPE I
 - ⊕ MONITORING WELL - TYPE II
 - PUMPING WELL
 - ☆ WOOD LIGHT POLE
 - ⊙ DECIDUOUS TREE
 - ⊙ CONIFEROUS TREE
 - △ SURVEY BASELINE
 - ⊠ TRANSFORMER
 - ⊙ SANITARY SEWER MANHOLE
 - ⊠ TELEPHONE RISER
 - SIGN
 - GA GUY ANCHOR
 - WATER VALVE AND LINE
 - UNDERGROUND ELECTRIC
 - SS SANITARY SEWER
 - OH OVERHEAD UTILITY WIRES
 - UT UNDERGROUND UTILITY CABLE
 - CHAINLINK FENCE

- NOTES**
1. FIELD 1 REPRESENTS AS/SVE WELLS 1-11
 2. FIELD 2 REPRESENTS AS/SVE WELLS 12-20 AND 27-29
 3. FIELD 3 REPRESENTS AS/SVE WELLS 21-26 AND 30-35
 4. FIELD 4 REPRESENTS AS/SVE WELLS 36-48

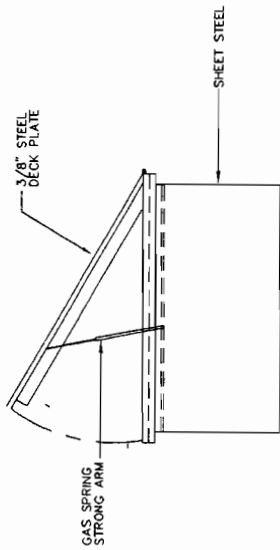
RECORD DRAFTING

SCALE IN FEET

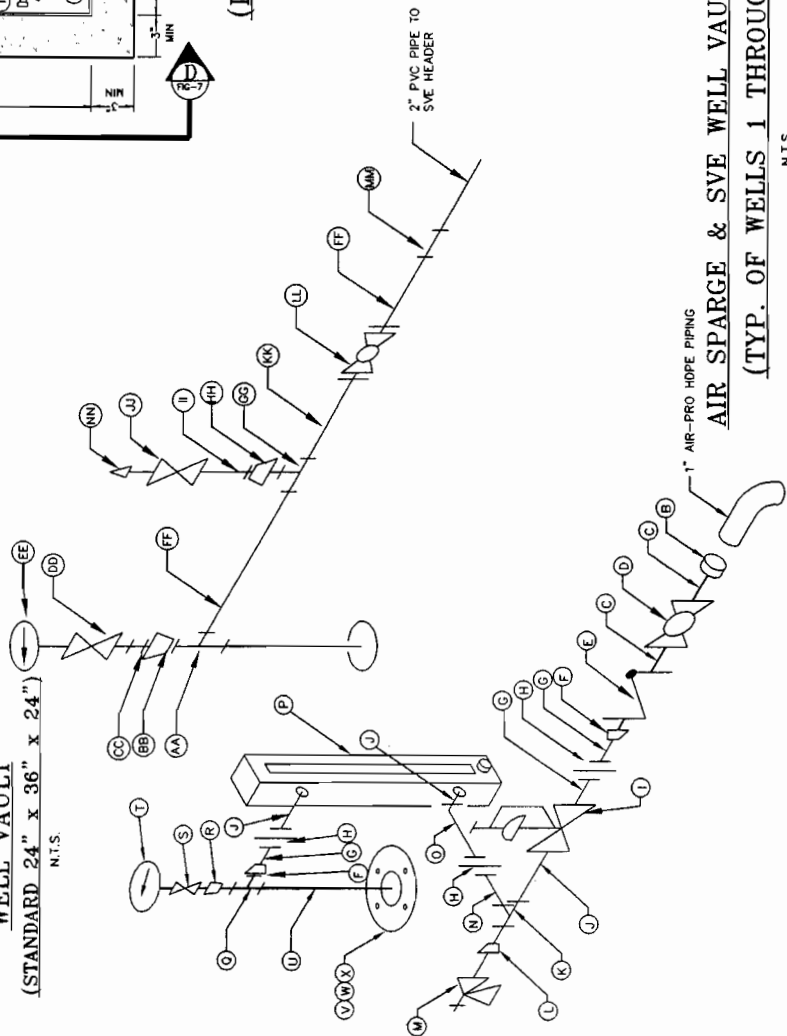
0' 30' 60' 90' 120'

		OHM Remediation Services Corp. Remediation Services Corporation 10000 Wilshire Blvd., Suite 1000 Los Angeles, CA 90024 (213) 475-1000		REVISIONS		REVISIONS		REVISIONS	
DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE	DATE
5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97	5/16/97
APPROVED	APPROVED	APPROVED	APPROVED	APPROVED	APPROVED	APPROVED	APPROVED	APPROVED	APPROVED
SUBMITTED BY: <i>[Signature]</i> DATE: 5/16/97		CHECKED BY: <i>[Signature]</i> DATE: 5/16/97		DRAWN BY: <i>[Signature]</i> DATE: 5/16/97		DESIGNED BY: <i>[Signature]</i> DATE: 5/16/97		PROJECT NO.: 19403	
CONTRACT NO.: 93-D-3028 MARIETTA CORP. BASE CAMP LEBRON, N.C.				NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION NAVY STATION NORFOLK, VIRGINIA				FIGURE 5 PIPING LAYOUT SVE AND AIR SPARGING SYSTEM BERKELEY MANOR 820	





WELL VAULT
(STANDARD 24" x 36" x 24")
N.T.S.



(DETAIL 2) AIR SPARGING & SVE WELL VAULT
PLAN VIEW
N.T.S.

PIPING LEGEND

TAG NUMBER	DESCRIPTION	QUANTITY
A	36" x 24" x 24" WELL VAULT	1
B	1" HOPE (AIR-PRO) TRANSITION UNION	1
C	1" x 2" PIPE NIPPLE	2
D	1" CHECK VALVE	1
E	1" x 1/2" REDUCING BUSHING	2
F	1" x 1/2" CLOSE PIPE NIPPLE	3
G	1" x 1/2" REGULATOR	1
H	1" x 2" PIPE NIPPLE	4
I	1" x 1/2" TEE	1
J	1" x 1/2" TEE REDUCING BUSHING	1
K	SAFETY VALVE	1

TAG NUMBER	DESCRIPTION	QUANTITY
L	1/2" x 3/4" PIPE NIPPLE	1
M	1/2" 90 DEGREE STREET ELBOW	1
N	1/2" FLOW METER (0-200 SCFM)	1
O	1" TEE	1
P	1" x 1/4" REDUCING BUSHING	1
Q	1" x 1/4" GAUGE VALVE	1
R	1" x 1/4" GAUGE VALVE	1
S	PRESSURE GAUGE 0-60 PSI	1
T	1" x 1/2" PIPE NIPPLE	1
U	1" x 1/2" TEE	1
V	1" x 1/2" TEE	1
W	1" ISOLATE FLANGE WITH 800 PSI GASKET	1
X	1" ISOLATE FLANGE SCHEDULE 40 PVC	1
Y	1" x 1/2" TEE	1
Z	1" x 1/2" TEE	1

TAG NUMBER	DESCRIPTION	QUANTITY
AA	2" x 2" x 1/2" SCH 40 PVC TEE (SSSP)	1
AB	2" x 2" x 1/2" SCH 40 PVC TEE (SSSP)	1
AC	2" x 1/4" SCH 40 PVC REDUCING BUSHING (SPG X NPT)	1
AD	1/4" GAUGE VALVE	1
AE	1/4" GAUGE VALVE	1
AF	SCHEDULE 40 PVC NIPPLE (OUT TO LENGTH)	4
AG	2" x 2" x 1/2" SCHEDULE 40 PVC TEE (SSSP)	1
AH	1/2" x 1/4" SCH 40 PVC REDUCING BUSH (NPT X NPT)	1
AI	1" x 1/2" TEE	1
AJ	1/4" BRASS BALL VALVE	1
AK	2" SCHEDULE 40 CLEAR PVC	2
AL	2" SCHEDULE 40 CLEAR PVC	2
AM	2" SCHEDULE 40 CLEAR PVC	2
AN	1/4" BRASS HOSE NIP	1

RECORD DRAWING

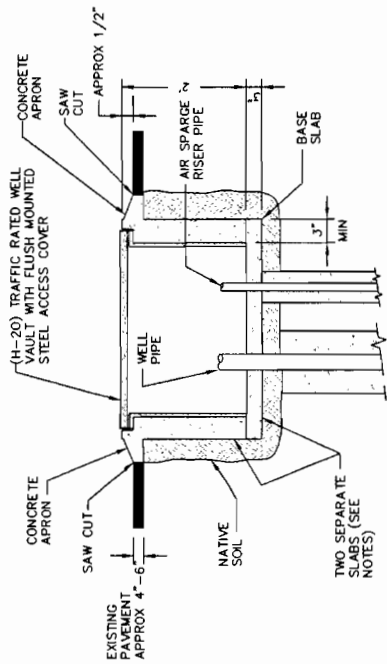
AIR SPARGE & SVE WELL VAULT PIPING
(TYP. OF WELLS 1 THROUGH 48)
N.T.S.

OHM Remediation Services Corp.		DATE: 5/16/97	
SUBMITTED BY: J. COLLINS		DATE: 5/16/97	
APPROVED BY: J. DUNN		DATE: 5/16/97	
REVISIONS		DATE	
1	INITIAL ACTION WORK PLAN	5/16/97	
2	FINAL REMEDIAL ACTION WORK PLAN	5/16/97	

DEPARTMENT OF THE NAVY		NAVAL FACILITIES ENGINEERING COMMAND	
ATLANTIC DIVISION		NAVAL STATION	
NAVY PROJECT NO. 19403		MARINE CORPS BASE, CAMP LEJEUNE, N.C.	
CONTRACT NO. 19403-93-D-3052		DELIVERY ORDER NO. 0143	
NAVAL PROJECT NO. 0143		NOVALE, VIRGINIA	

DRAWING NUMBER: 1	
SHEET NUMBER: of	
DATE: 5/16/97	

FIGURE 6
AIR SPARGING AND SVE WELL DETAILS
BERKELEY MANOR 820

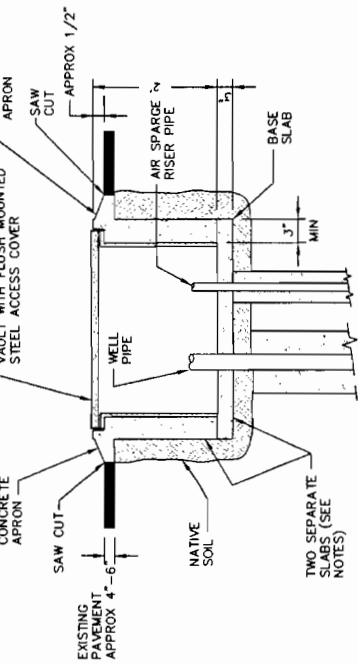


TRAFFIC AREA WELL VAULT INSTALLATION PROCEDURE

1. AN OPENING IN THE CONCRETE OR PAVEMENT SLIGHTLY LARGER THAN THE CONCRETE OR ASPHALT BASE SLAB IS SAW CUT THROUGH THE EXISTING PAVEMENT OR CONCRETE.
2. A HOLE LARGE ENOUGH FOR THE BASE SLAB AND THE WELL IS DRILLED TO THE APPROPRIATE DEPTH. THE WELL DEPTH TAKES INTO ACCOUNT THE SURFACE CONTOURS. IT IS DEEP ENOUGH SO THAT THE BASE SLAB CAN BE POURED ON A STABLE COMPACTED BASE OF NATIVE SOILS, AND WHEN THE WELL VAULT IS SET ON FINISHED BASE SLAB IT ENDS UP APPROXIMATELY $1\frac{1}{2}$ " ABOVE THE EXISTING GRADE.
3. THE NATIVE SOILS UNDER THE BASE SLAB ARE COMPACTED AND THE BASE SLAB IS POURED FINISHED AND ALLOWED TO SET. THE SLAB IS POURED AROUND THE RISER PIPES.
4. THE WELL VAULT IS PLACED ON THE BASE SLAB.
5. THE SIDE WALLS ARE FORMED, POURED AND ALLOWED TO SET.
6. THE FORMS ARE REMOVED AND NATIVE SOILS ARE FILLED BACK IN AND COMPACTED AROUND THE VAULT.
7. A CONCRETE APRON IS POURED AROUND THE VAULT AND FINISHED TO PROVIDE A TRANSITION TO THE EXISTING GRADE.

7. A CONCRETE APRON IS POURED AROUND THE VAULT AND FINISHED TO PROVIDE A TRANSITION TO THE EXISTING GRADE.

RECORD DRAWING



ENDING

© DRAK

SCORE

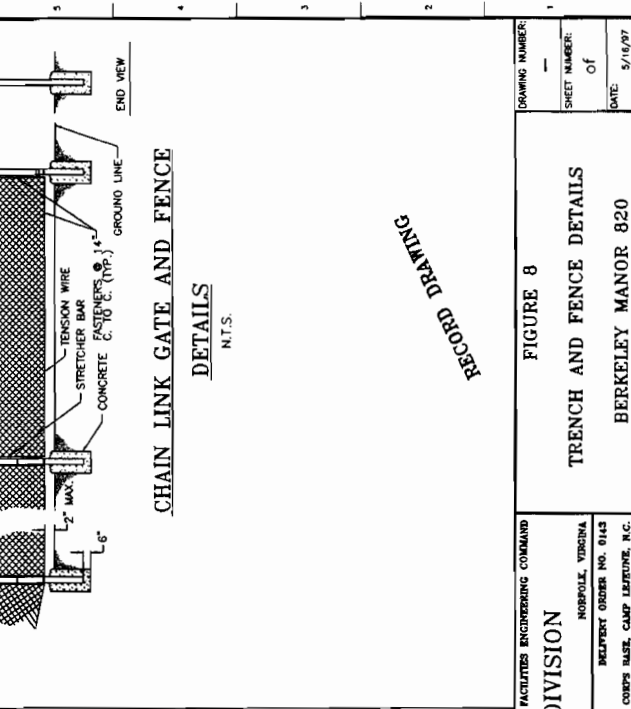
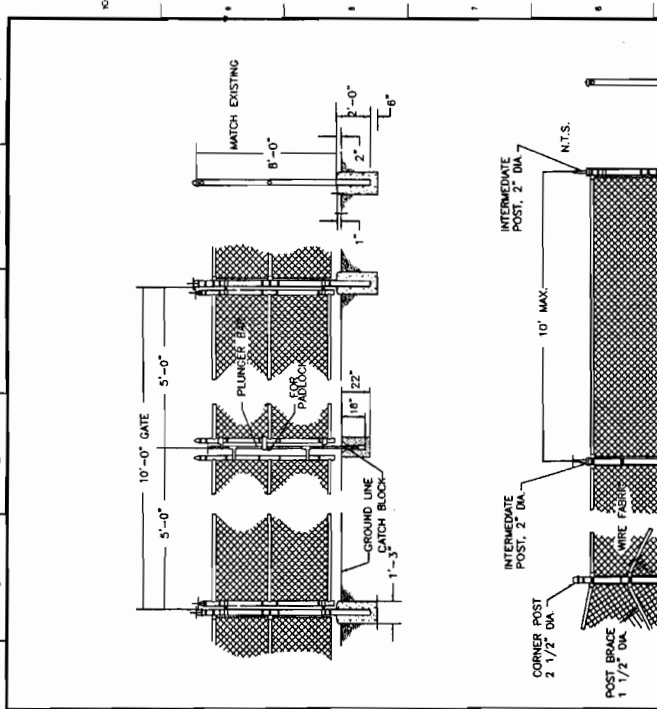
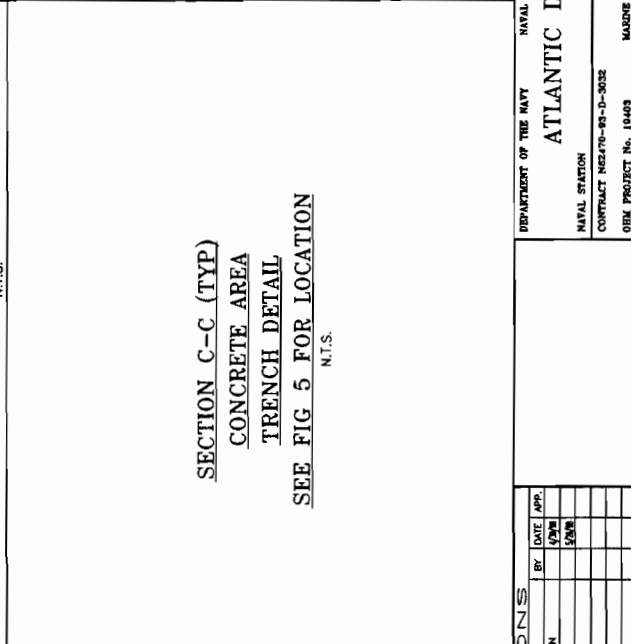
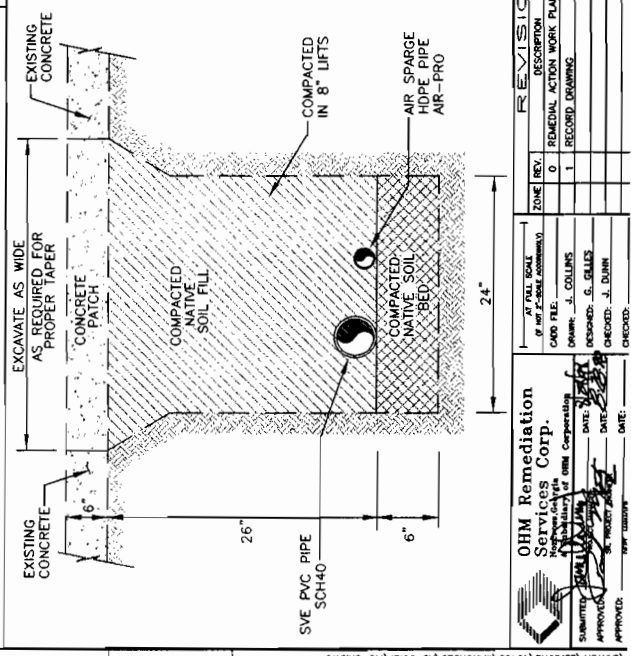
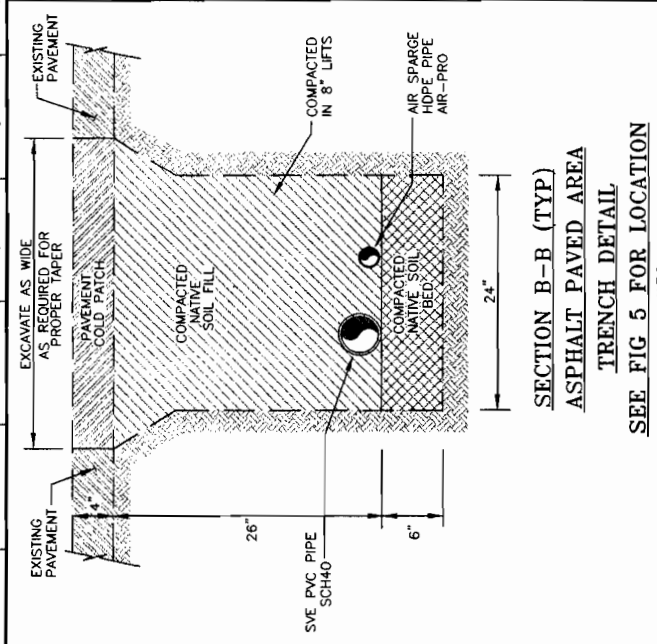
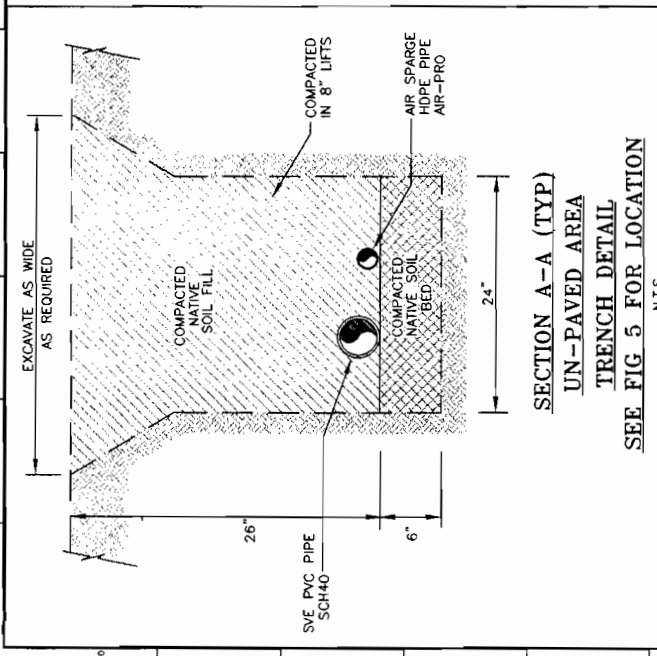
Page

UNITED STATES ENGINEERING COMMAND	FIGURE 7	DRAWING NO.

VISION		FIGURE 7	
NORFOLK VIRGINIA		AIR SPARGING/SVE WELL AND TRENCHING DETAILS	
DELIVERY ORDER NO. 0143		BERKLEY MANOR 920	
SHEET NUMBER		—	
DATE: 6/16/07			

PLATES ENGINEERING COMMAND FIGURE 7	DRAWING N

VISION		NORFOLK, VIRGINIA	
DELIVERY ORDER NO. 0143		AIR SPARGING/SVE WELL AND TRENCHING DETAILS	
BY DATE: 4/16/2017		SHEET NUMBER: of	
BERKLEY MANOR 920		DATE: 4/16/2017	



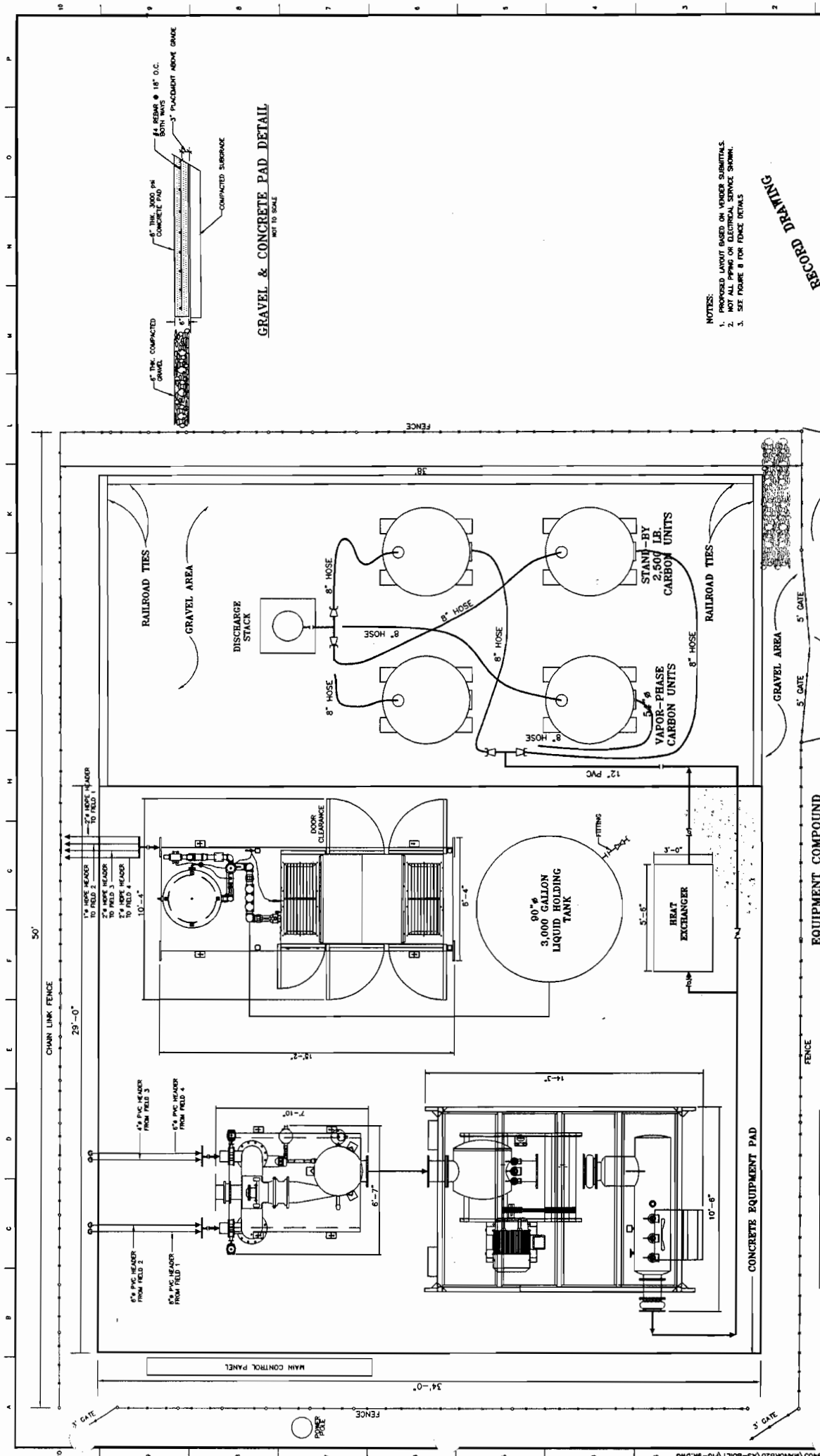
OHM Remediation Services Corp.
 19403 MANOR 820 V5-BULL/P3-BE-DWG
 DATE: 5/16/97
 APPROVED: [Signature]
 CHECKED: J. DUNN
 DRAWN: J. COLLINS
 DESIGNED: S. GILLES
 PROJECT NO. 16409

ZONE	REV.	DESCRIPTION	DATE	BY
0	1	RECORD DRAWING	5/16/97	J. DUNN
1	1	RECORD DRAWING	5/16/97	J. DUNN

DEPARTMENT OF THE NAVY
 NAVAL FACILITIES ENGINEERING COMMAND
 ATLANTIC DIVISION
 NAVAL STATION
 CONTRACT NS4470-93-D-3032
 PROJECT NO. 16409
 MADEIRA CORPS BASE, CAMP LEFLORE, N.C.

FIGURE 8
 TRENCH AND FENCE DETAILS
 BERKELEY MANOR 820
 SHEET NUMBER: 1
 OF: 1
 DATE: 5/16/97

RECORD DRAWING



**OHM Remediation
Services Corp.**

Northcross, Georgia
A Subsidiary of OHM Corporation

DATE 8/26

DEPT. MANAGER _____ DATE: _____

REVISIONS

DESCRIPTION	AL ACTION WORK PLAN	SUBJECTUAL ACTION WORK IN AN

NARRATIVE ACTION WORK PLAN

100

2	4	6	8	10

BY	DATE	APP.
-	5/10/97	
WMC	7/20/97	

[illegible]

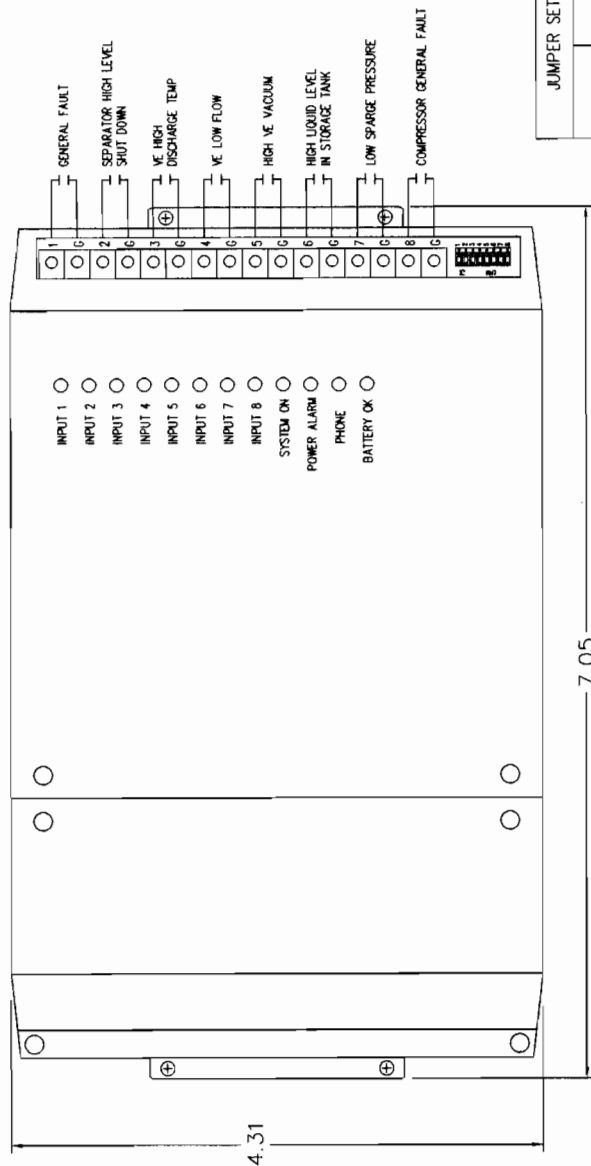
Age Group	Percentage
18-24	10%
25-34	20%
35-44	30%
45-54	25%
55-64	15%
65-74	10%
75-84	5%
85+	5%

DEPARTMENT OF THE NAVY

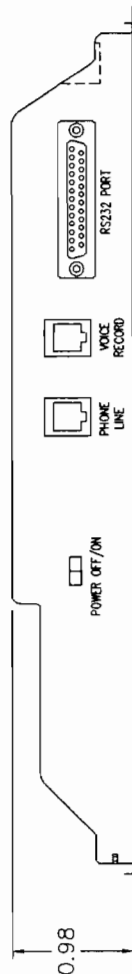
ATLANTIC DIVISION

NAVAL STATION	NORFOLK, VIRGINIA
COLLECTOR'S MAILING ADDRESS	NAVY MAILING ADDRESS

CONTRACT NO. 62-470-W-3-B-3052
DELIVERY ORDER NO. 0193
OEM PROJECT No. 19403
MARINE CORPS EAST, CAMP LEJEUNE, N.C.



JUMPER SETTINGS	
JUMPER	
NO AC DRY CONTACT, THERMISTOR, RUN TIME, PULSE COUNT	
4-20mA TRANSDUCER	
0-5 VDC TRANSDUCER	



RECORD DRAFTING

 OHM Remediation Services Corp. 10000 North Georgia Atlanta, Georgia 30328 (404) 412-1000	AT FULL SCALE OF AND 1/2-SHALE ADJUSTMENTS	DATE: <u>7/2/89</u> DRAWN: <u>G. GILLES</u> CHECKED: <u>J. DUNN</u> SECOND: _____ DATE: _____	BY _____ DATE _____ APP. _____	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS
OHM Remediation Services Corp. 10000 North Georgia Atlanta, Georgia 30328 (404) 412-1000	AT FULL SCALE OF AND 1/2-SHALE ADJUSTMENTS	DATE: <u>7/2/89</u> DRAWN: <u>G. GILLES</u> CHECKED: <u>J. DUNN</u> SECOND: _____ DATE: _____	BY _____ DATE _____ APP. _____	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS
OHM Remediation Services Corp. 10000 North Georgia Atlanta, Georgia 30328 (404) 412-1000	AT FULL SCALE OF AND 1/2-SHALE ADJUSTMENTS	DATE: <u>7/2/89</u> DRAWN: <u>G. GILLES</u> CHECKED: <u>J. DUNN</u> SECOND: _____ DATE: _____	BY _____ DATE _____ APP. _____	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS	REVISIONS

RECORD DRAFTING

DRAWING NUMBER
SHEET NUMBER
of
DATE 5/16/97

FIGURE 13
SITE CONTROL PANEL
125 HP COMPRESSOR, 125 HP SVE
WITH REMOTE START/STOP
BERKELEY MANOR 920

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION
CONTACT MSG470-93-9-3033
ORD PROJECT No. 14403
MARINE CORPS BASE, CAMP LEJEUNE, N.C.
HOSPITAL VIRGINIA
DELIVERY ORDER NO. 0145

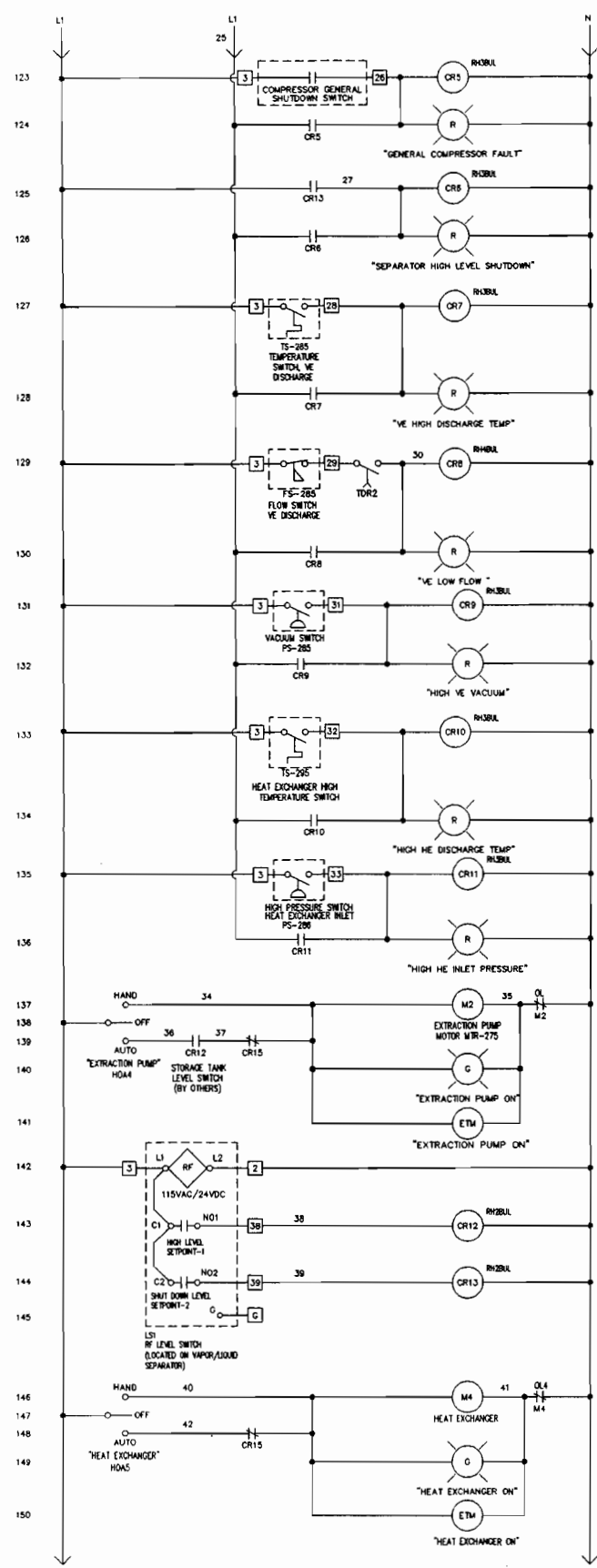


FROM MCS950000

REV.	BY	DATE	APP.	DESCRIPTION
A	ESM	1/2/97		ADDED TERMINAL & LINE NUMBERS.
B	AS	5/1/97		AS BUILT

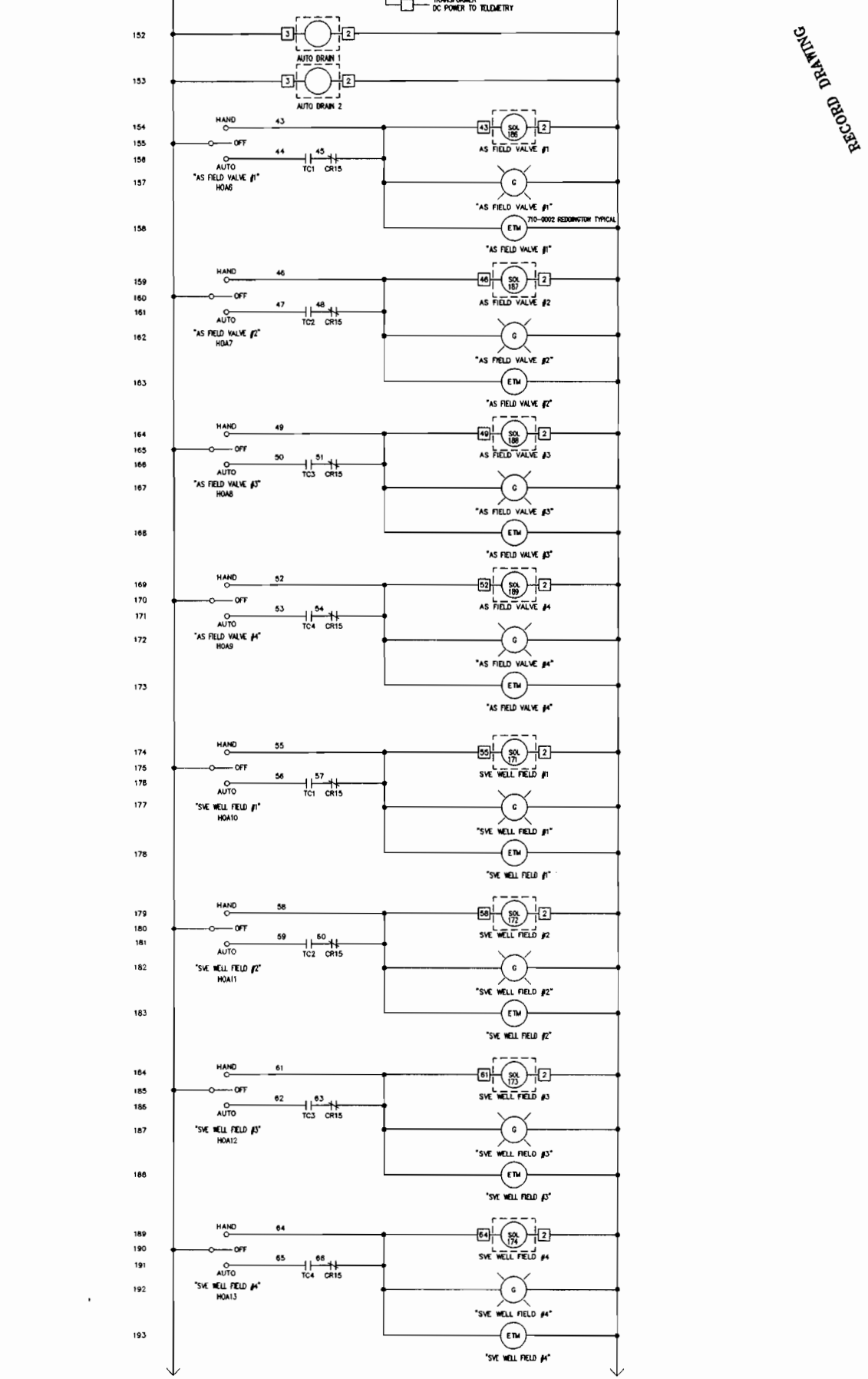
AT FULL SCALE	BY	DATE	APP.
NO NOT TO SCALE	ESM	1/2/97	

OHM Remediation Services Corp.
Nacogdoches, Georgia
A subsidiary of OHM Corporation
SUBMITTED: 5/16/97
APPROVED: [Signature]
DATE: 5/16/97
CHECKED: J. DUINN
DATE: 5/22/97



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RECORD DRAFTING

OHM Remediation Services Corp.
Remediation Services
10000 W. 10th Ave., Suite 100
Denver, CO 80202
Tel: 303.733.8800
Fax: 303.733.8801
Web: www.ohmrem.com

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.
A	1	ADDED TERMINAL & LINE NUMBERS	ESM	1/2/98	
B	2	AS BUILT	BLJ	1/1/98	

AT FULL SCALE
OF NOT 2-1/2" AS SHOWN

CADD FILE
DRAWN: J. COLLINS
DESIGNED: S. GILES
CHECKED: J. QUINN
DATE: 1/2/98

DATE: 1/2/98

OHM Remediation Services Corp.
10000 W. 10th Ave., Suite 100
Denver, CO 80202
Tel: 303.733.8800
Fax: 303.733.8801
Web: www.ohmrem.com

APPROVED: [Signature]
DATE: 1/2/98

DATE: 1/2/98

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION
CONTRACT N64790-95-D-5002
OEM PROJECT No. 18403

NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NORFOLK, VIRGINIA
DELIVERY ORDER NO. 0143
MARINE CORPS BASE, CAMP LEJEUNE, N.C.

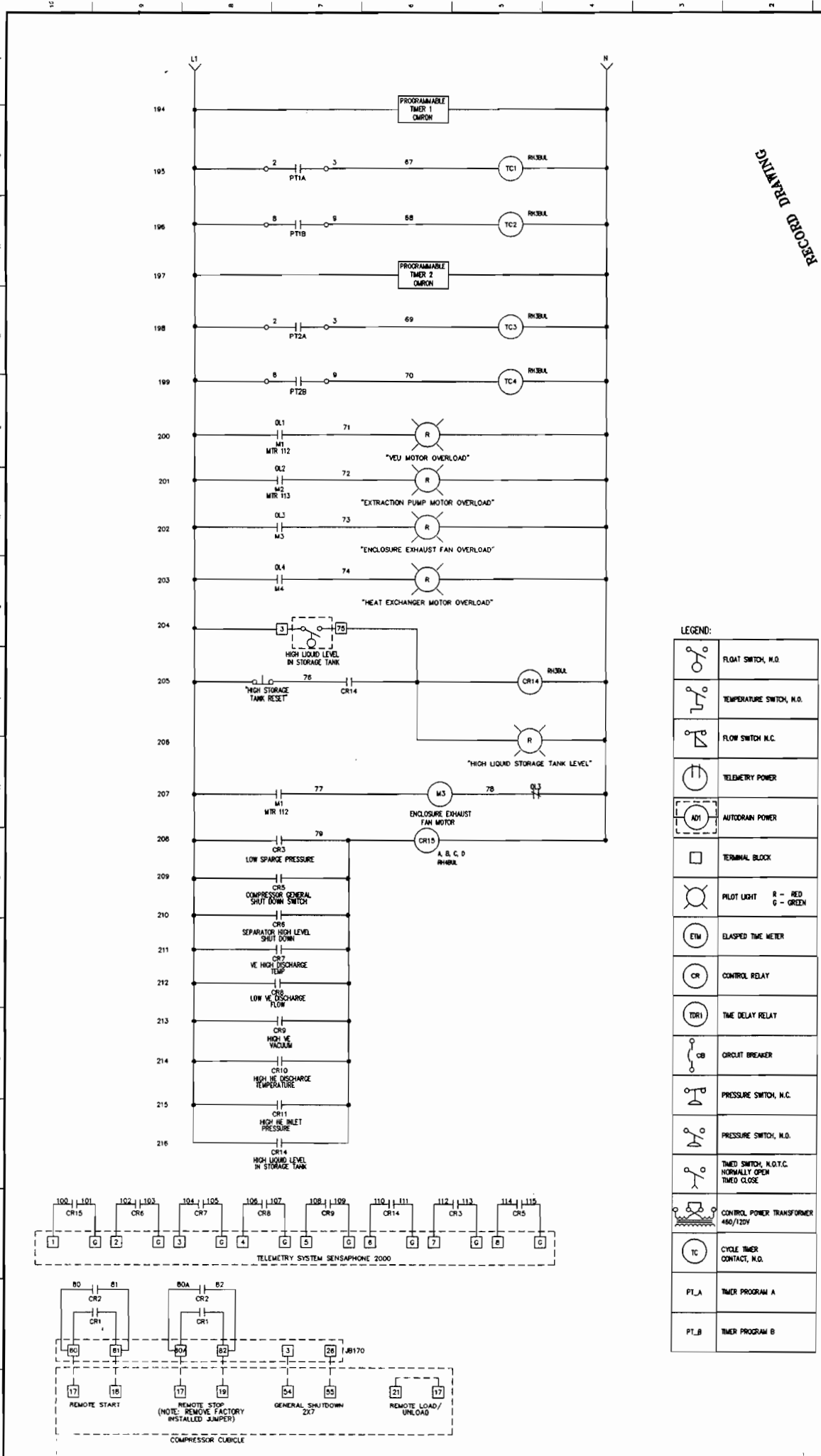
DRAWING NUMBER: 14
SITE CONTROL PANEL
125 HP COMPRESSOR, 125 HP SVE
WITH REMOTE START/STOP
BERKELEY MANOR 820

SHEET NUMBER:
OF

DATE: 5/18/97



FROM NCT03880000



RECORD DRAFTING

LEGEND:

	FLOAT SWITCH, N.O.
	TEMPERATURE SWITCH, N.O.
	FLOW SWITCH, N.C.
	TELEMETRY POWER
	AUTODRAIN POWER
	TERMINAL BLOCK
	PILOT LIGHT R - RED G - GREEN
	ELAPSED TIME METER
	CONTROL RELAY
	TIME DELAY RELAY
	CIRCUIT BREAKER
	PRESSURE SWITCH, N.C.
	PRESSURE SWITCH, N.O.
	TIMED SWITCH, N.O.T.C. NORMALLY OPEN TIMED CLOSE
	CONTROL POWER TRANSFORMER 480/120V
	CYCLE TIMER CONTACT, N.O.
	TIMER PROGRAM A
	TIMER PROGRAM B

FIGURE 15

SITE CONTROL PANEL

125 HP COMPRESSOR, 125 HP SVE

WITH REMOTE START/STOP

BERKELEY MANOR 820

DRAWING NUMBER: 15

SHEET NUMBER: 1 of 1

DATE: 5/16/97

DEPARTMENT OF THE NAVY

NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION

CONTRACT N68170-80-B-3032

ORD PROJECT No. 14403

MAINE COMPS BASE CAMP LEBOWNE, N.C.

REP

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.
A	1	ADDED TERMINAL & LINE NUMBERS.	ESM	7/2/97	
B	1	CORRECT LOGIC ON LEVEL CONTROL	BMJ	5/16/97	
B	2	AS BUILT			

OHM Remediation Services Corp.

10000 Highway 100, Suite 100, Raleigh, NC 27607

TELEPHONE: (919) 876-1000

FAX: (919) 876-1001

DATE: 5/16/97

DATE: 5/16/97

DATE: 5/16/97

AT FULL SCALE (or not F-scale as noted)

CADD FILE: J. COLLINS

DRAWN: J. COLLINS

REVIEWED: S. COLLINS

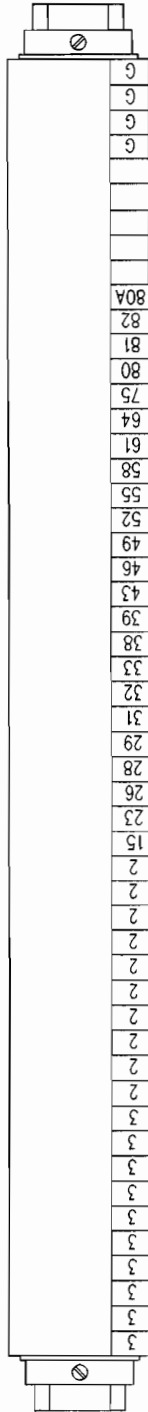
CHECKED: J. COLLINS

DATE: 5/16/97

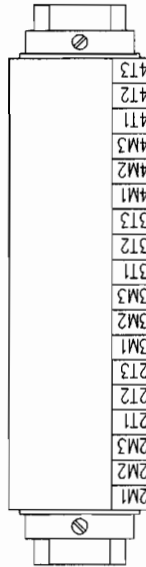
DATE: 5/16/97

DATE: 5/16/97

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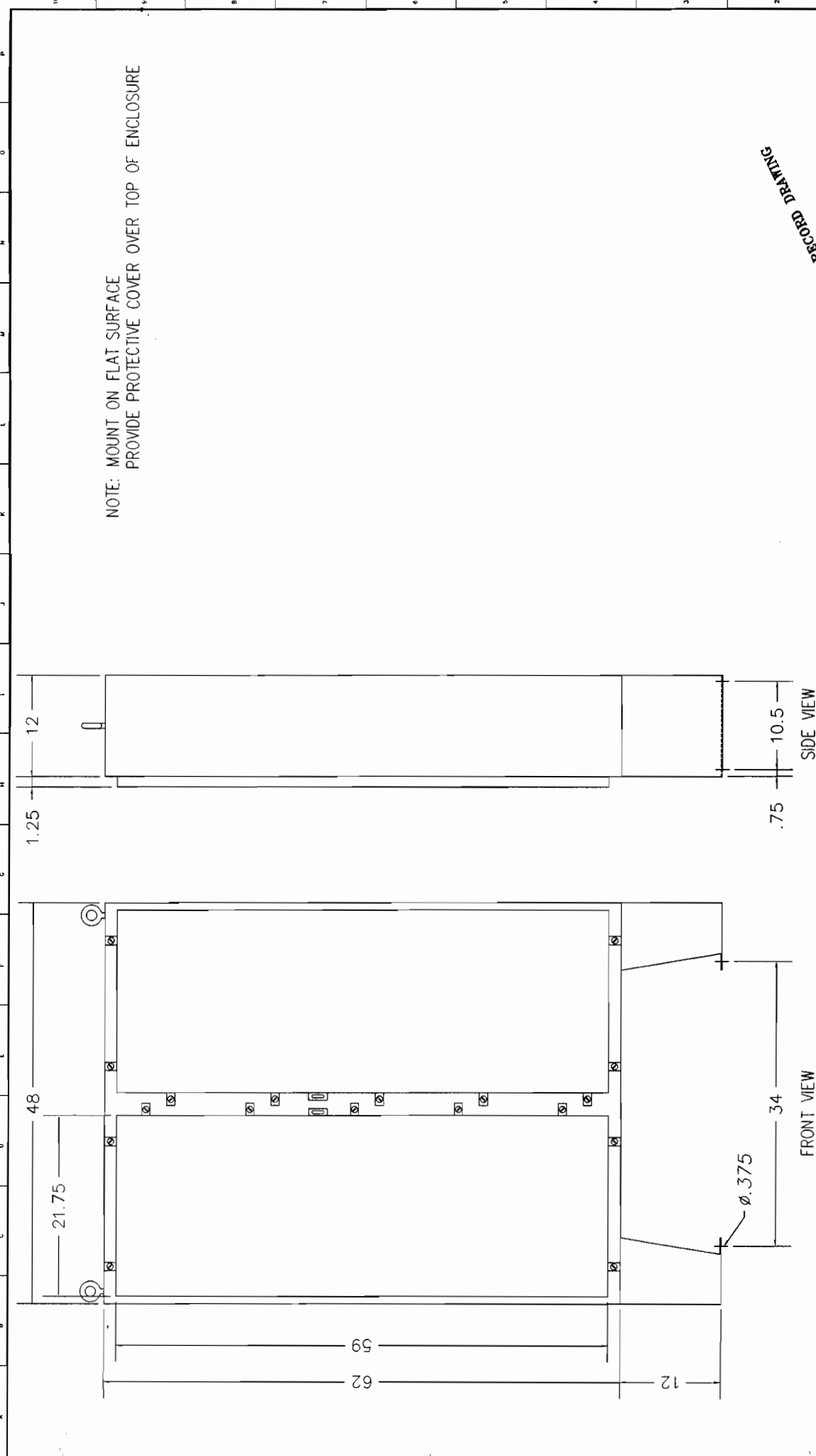


TB2



RECORD DRAFTING

OHM Remediation Services Corp. Nuclear Services Division 10000 W. 10th Avenue, Suite 100 Denver, CO 80231 DATE: 12/17/93 APPROVED: [Signature] SUBMITTED: [Signature]		REVISIONS DATE: 12/17/93 BY: [Signature] DESCRIPTION: [Signature]		ATLANTIC DIVISION NAVAL FACILITIES ENGINEERING COMMAND NAVAL STATION CONTRACT N6470-93-D-3023 OEM PROJECT No. 19403		FIGURE 16 SITE CONTROL PANEL UST820 TERMINAL BLOCKS BERKELEY MANOR 820		DRAWING NUMBER: 1 SHEET NUMBER: of DATE: 5/16/97	
FROM M003906090		REP INC.		ATLANTIC DIVISION		ATLANTIC DIVISION		ATLANTIC DIVISION	
AT FULL SCALE DRAWN: J. COLLINS CHECKED: J. DUNE		ZONE REV.		DATE		BY		DATE	
2M1		2M2		2M3		2T1		2T2	
3M1		3M2		3M3		3T1		3T2	
4M1		4M2		4M3		4T1		4T2	
4T3		4T2		4T1		4T3		4T2	

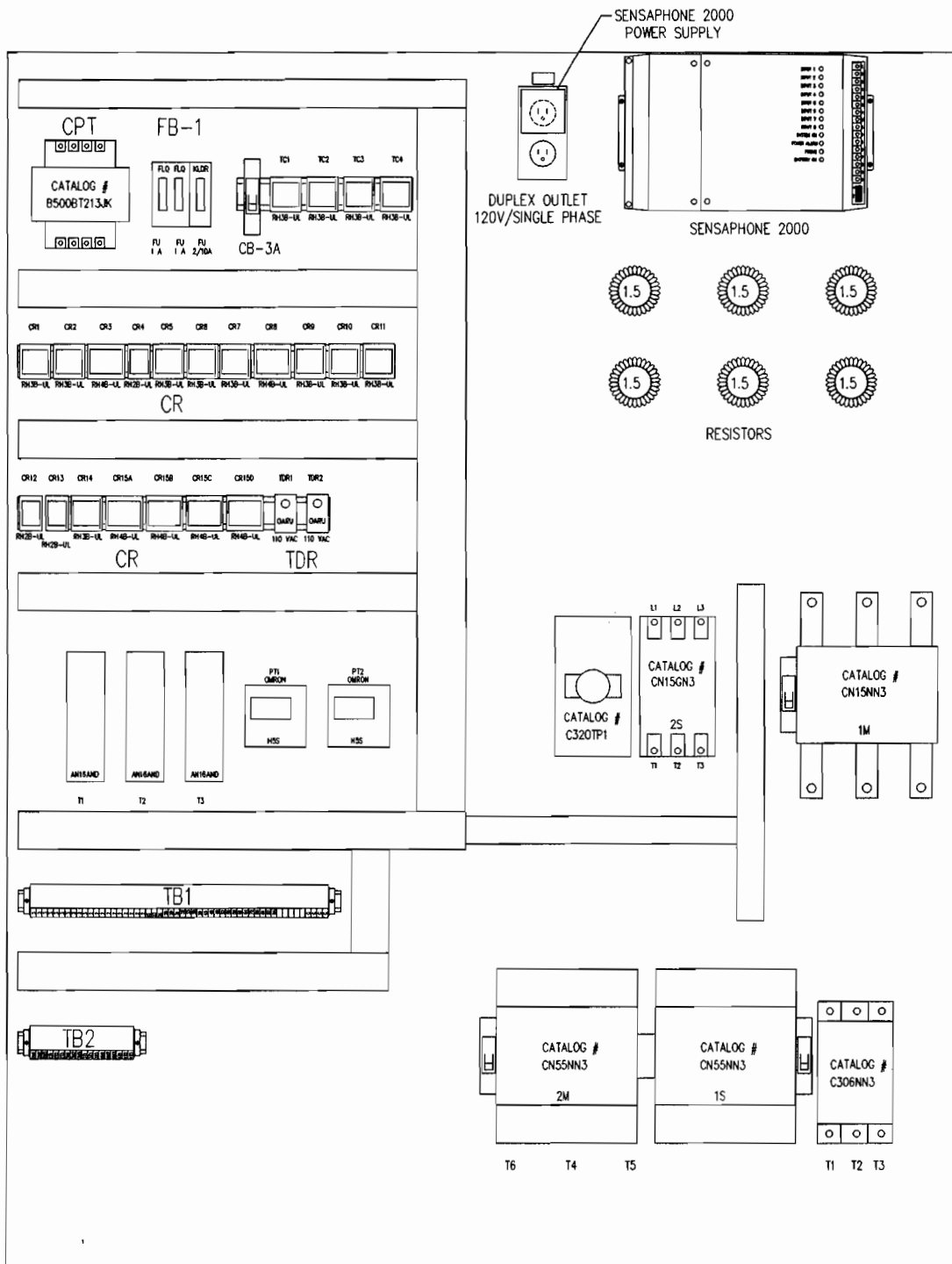


NOTE: MOUNT ON FLAT SURFACE
PROVIDE PROTECTIVE COVER OVER TOP OF ENCLOSURE

RECORD DRAFTING

OHM Remediation Services Corp. 1400 S. 17TH AVE. SUITE 100 DENVER, CO 80202 PHONE: (303) 733-1100 FAX: (303) 733-1101 E-MAIL: SALES@OHMREMEDIATION.COM WWW.OHMREMEDIATION.COM		REVISIONS <table border="1"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>DESCRIPTION</th> <th>BY</th> <th>DATE APP.</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>		NO.	DATE	DESCRIPTION	BY	DATE APP.																																																			ATLANTIC DIVISION NAVAL FACILITIES ENGINEERING COMMAND 1000 W. 10TH AVE. NORFOLK, VIRGINIA 23504 CONTRACT NO. 64170-92-B-3002 ODM PROJECT NO. 19405		FIGURE 17 SITE CONTROL PANEL UST820 ENCLOSURE OUTLINE BERKELEY MANOR 820		DRAWING NUMBER: — SHEET NUMBER: of DATE: 5/18/97	
NO.	DATE	DESCRIPTION	BY	DATE APP.																																																												





RECORD DRAFTING

DRAWING NUMBER: 18
SHEET NUMBER: of
DATE: 5/16/97

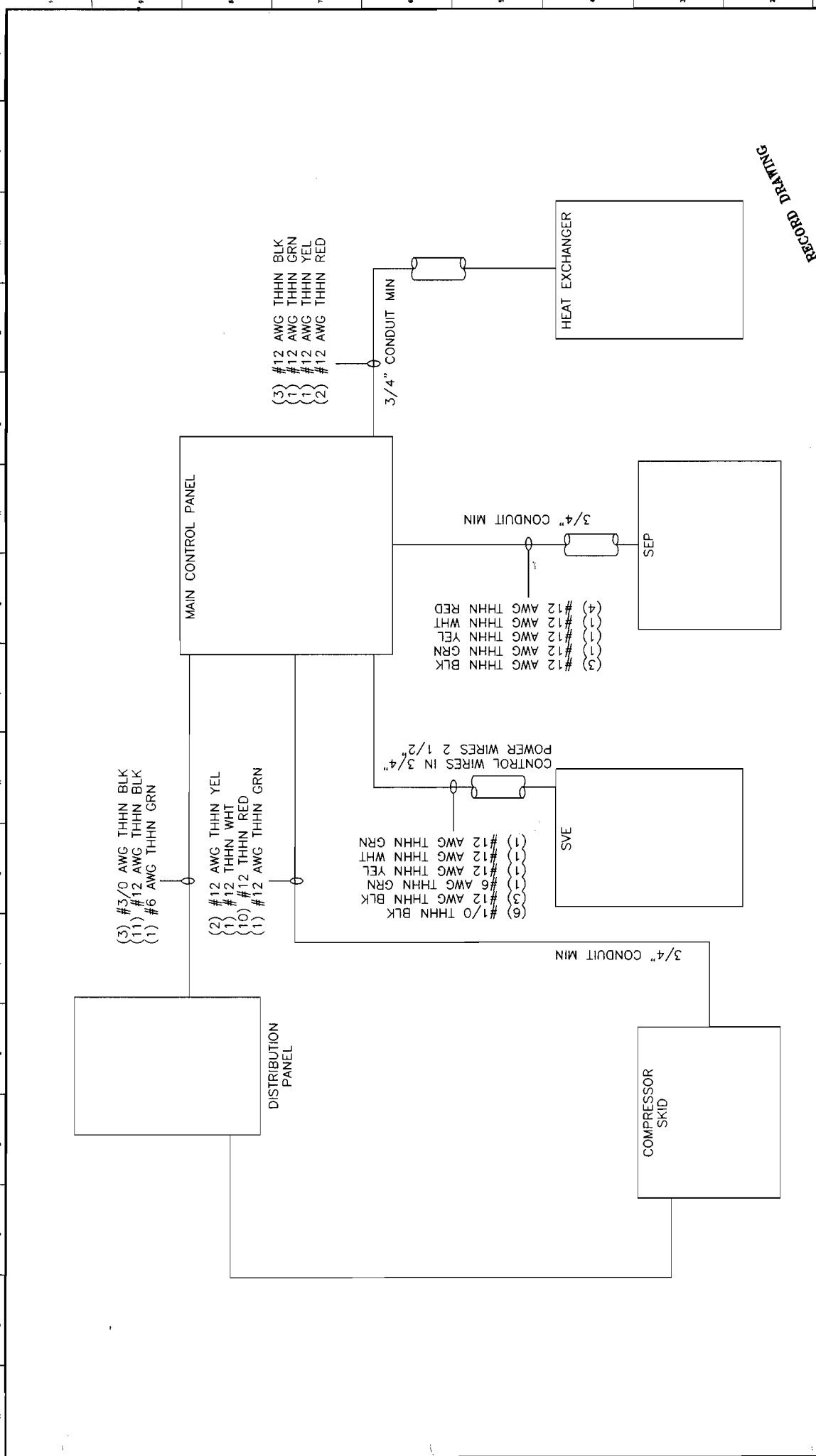
FIGURE 18
SITE CONTROL PANEL
UST820
INTERNAL PANEL ARRANGEMENT
BERKELEY MANOR 820

NAVY FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NAVAL STATION
CONTACT ME470-95-D-3032
OEM PROJECT No. 19403
MARINE CORPS BASE, CAMP LEJEUNE, N.C.



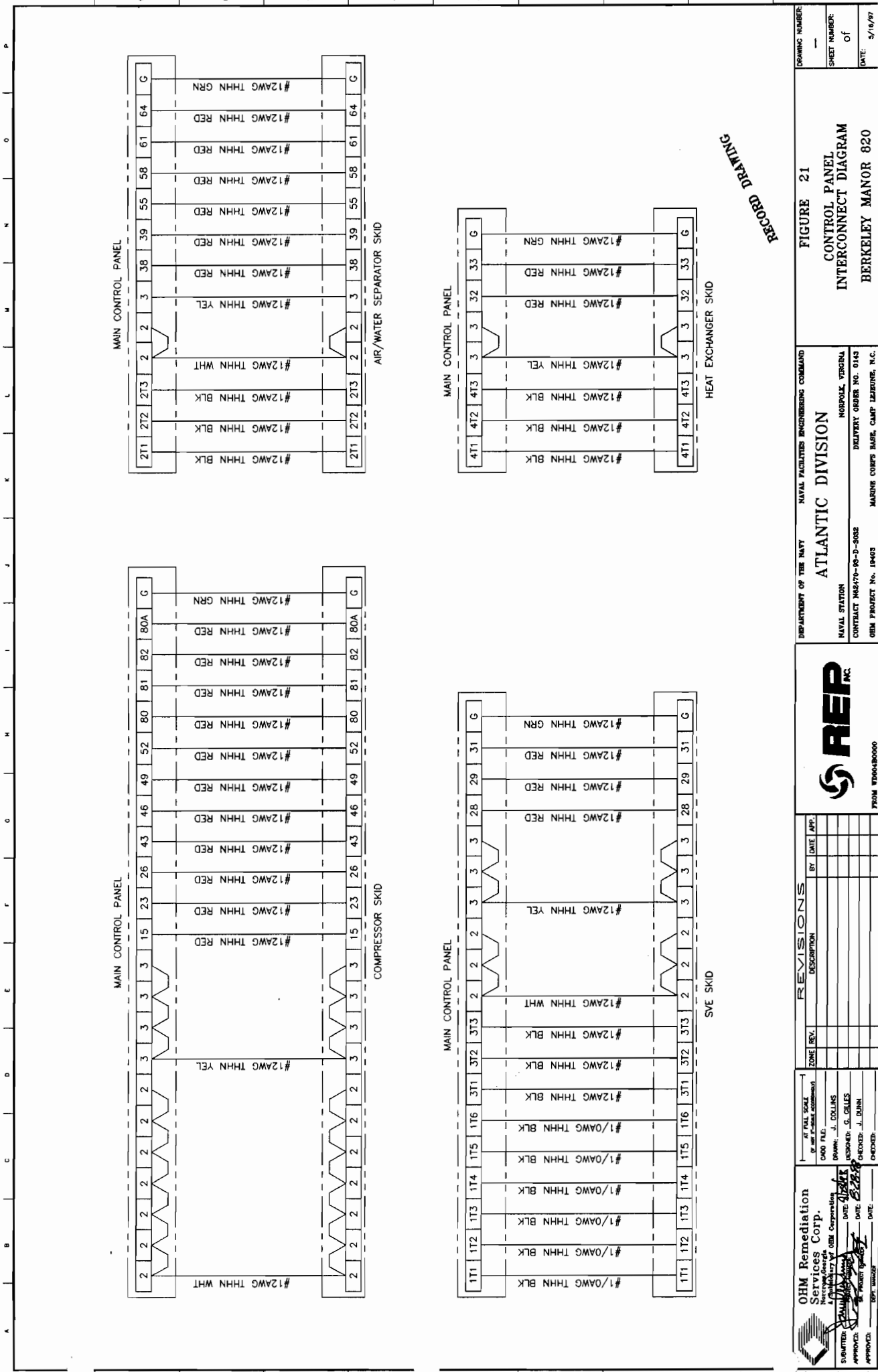
REVISIONS	DATE	BY	APP.

OHM Remediation Services Corp.
10000 LEBLANC (19403) MANOR820-V5-BUE T/F/C-19-0000
DATE: 5/16/97
APPROVED: [Signature]
DATE: 5/16/97



RECORD DRAFTING

OHM Remediation Services Corp. A subsidiary of OHM Corporation SUBMITTED: <i>[Signature]</i> DATE: <i>02/20/01</i> APPROVED: <i>[Signature]</i> DATE: <i>02/20/01</i> APPROVED: <i>[Signature]</i> DATE: <i>02/20/01</i>		AT FULL SCALE (or as noted otherwise) CAD FILE: <i>[Signature]</i> DRAWN: J. COLLINS DESIGNED: S. GILES CHECKED: J. DUNN CHECKED:		REVISIONS <table border="1"> <thead> <tr> <th>ZONE</th> <th>REV.</th> <th>DESCRIPTION</th> <th>BY</th> <th>DATE</th> <th>APP.</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>		ZONE	REV.	DESCRIPTION	BY	DATE	APP.																															REP INC. FROM W00480000		DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION NORFOLK, VIRGINIA NAVAL STATION CONTRACT N6470-95-D-3002 DELIVERY ORDER NO. 0143 OBM PROJECT No. 14403 MARINE CORPS BASE, CAMP LEJEUNE, N.C.		DRAWING NUMBER: <i> </i> SHEET NUMBER: <i> </i> of <i> </i> DATE: 5/16/97	
ZONE	REV.	DESCRIPTION	BY	DATE	APP.																																										
FIGURE 20 CONTROL PANEL INTERCONNECT DIAGRAM BERKELEY MANOR 820																																															



7.0 PERFORMANCE AND SYSTEM AUDITS

Audit is defined as systematic check to determine the quality of operation of field and laboratory activities. It is comprised of the following:

- Performance audit
- System audits

These include a detailed review of each operating component of the network. Auditing will ultimately assist in determining if each element within a system is functioning appropriately per the QA program requirements.

7.1 FIELD PERFORMANCE AUDITS

Field performance audits are performed on an ongoing basis during the project as field data is generated, reduced, and analyzed. All numerical analyses, including manual calculations are documented. All records of numerical analysis are legible, of reproduction quality, and supporting to complete permit logical reconstruction by a qualified individual other than the originator.

Other indicators of the level of field performance are the analytical results of the blank, duplicate, and replicate samples. Each blank analysis is an indirect audit of effectiveness of measures taken in the field to ensure sample integrity. The results of the field duplicate and replicate analysis is an indirect audit of the ability of each field team to collect representative sample portions of each matrix type.

7.2 FIELD SYSTEM AUDITS

System audits of site activities are accomplished by an inspection of all field activities by the Project Chemical QC Officer. This audit is composed of comparisons between current field practices and standard procedures. The following is a list of criteria to be used in the evaluation of field activities:

-
- Overall level of organization and professionalism
- All activities conducted in accordance with work plan
- All procedures and analyses conducted according to procedures outlined in this document
- Sample collection techniques versus the site sampling and analysis plan

- Level of activity and sample documentation
- Working order of instruments and equipment
- Level of QC conducted by each field team
- Contingency plans in case of equipment failure or other event preventing the planned activity from proceeding
- Decontamination procedures
- Level of efficiency which each team conducts planned activities at the site
- Sample packaging and shipment

After the audit, any deficiencies are discussed with the field staff, and corrections are identified. If any of these deficiencies might affect the integrity of the samples being collected, the QA Officer informs the field staff immediately, so corrections can be made. The field performance audit will be conducted at the start of the project, one before the end of the project, and as directed by the project manager.

OHM will also submit to all requests by regulatory agencies, or other clients for external field systems audits.

7.3 LABORATORY PERFORMANCE AUDIT

The laboratory performance audit verifies the ability of the laboratory to correctly identify and quantitate compounds in blind check samples submitted by an auditing agency. If the laboratory participates in Performance Evaluation (PE) programs such as USEPA WS/WP studies, AIHA, PAT studies, etc., results from these studies will be generally acceptable by OHM. However, during the course of the project, it may be necessary for the Project QA/QC Officer to send PE samples to the laboratory to evaluate specific parameters.

The contracted laboratories will undergo performance audits throughout the project consisting of field QC samples. Occasionally PE samples will be supplied by the client or external organizations which will be spiked with the same analytical parameters that are being investigated on site. External laboratory performance audits by auditing agencies such as the USEPA, USACE-MRD, DOD,

NFESC, etc., are not routinely scheduled. However OHM and its subcontracted laboratories will submit to any external audit upon request by the USEPA or the client.

7.4 LABORATORY SYSTEM AUDITS

The laboratory system audit is a review of analytical laboratory operations to verify that the facility has the necessary equipment, staff, and procedures in place to generate acceptable data. It is also to determine that each element within an activity is functioning appropriately and within the guidelines of applicable methodology, approved procedures, and the site QAPP. An on-site inspection is routinely performed by the laboratory's QA Manager and may also be frequently performed by the OHM Project Chemical QA/QC Officer. If the laboratory participates in certification programs, audits performed by the certifying agencies may satisfy the criteria of systems audits for the project.

If the laboratory is in question, a system audit can be directed by the client and performed by OHM or the client's representative. Any recommendations made will be considered for implementation and any corrective actions will be taken to correct any deficiencies found. Project-specific audit reports will be placed in the project files and laboratory audit reports will be kept by the laboratory for future reference.

8.0 CORRECTIVE ACTION

This Corrective actions may be necessary as a result of the following QA activities:

- Field and laboratory performance audits
- Field and laboratory system audits
- Inter-laboratory comparison studies
- Calibration data fall out of specified limits
- Failure to adhere to the CQMP
- Failure to adhere to the site
- Failure to adhere to standard operating procedures and methods
- Data completeness below required limits
- Control limits are exceeded for QC samples

If, during system and performance audits, deficiencies or problems are discovered, corrective action will be initiated immediately. The appropriate field and laboratory personnel will be notified immediately and an investigative process will be implemented immediately to find solutions to these issues. The investigative process will consist, but is not limited to, the following:

- Determining when the problem occurred
- Determining which systems were affected by the problem
- Determining the cause of the problem
- Determining a corrective action to eliminate the problem
- Assigning the responsibility for implementing the corrective action
- Implementing the corrective action
- Evaluating the effectiveness of the corrective action
- Investigating alternative corrective actions if the original action was not sufficient in eliminating the problem
- Documenting that the corrective action has eliminated the problem

The Project Chemical QC Officer has the authority to require that all site activities threatened by the problem be stopped or limited until the corrective action has been implemented and satisfactorily verified to eliminate the problem.

Corrective actions may include, but is not limited to:

- Modifications to procedures
- Recalibration of instruments

- Replacement of solvents, reagents, and/or standards
- Additional training of personnel
- Reassignment of personnel

8.1 CORRECTIVE ACTION REPORT

A Corrective Action Report (CAR) is necessary documentation of the investigative process. Depending on the issues, the CAR may be generated by the laboratory or the field personnel. Copies of the CAR will be given to the Project QC Officer and Project Manager, who will distribute it to the client. A copy of the CAR will be placed in the project files for future reference.

The CAR should include, but is not limited to:

- A description of the problem, deficiency, or issue
- Proposed resolutions
- Resulting actions
- Effectiveness of the resolutions
- Personnel responsible for implementation of the corrective actions
- Personnel responsible for monitoring the effectiveness of the actions.

8.2 QUALITY ASSURANCE REPORT

The Project Manager, Project QC Officer, and Project Chemist will converse on a regular basis to review possible and potential problem areas and to ensure that all QA/QC procedures are being carried out. It is important that all data abnormalities be investigated to ensure that they are not a result of operator or instrument deviation but are a true reflection of the methodology or task function. The project final report will contain a separate section that covers the data quality and validity. At a minimum, the following information will be included in the report:

- Assessment of measurement data precision, accuracy, and completeness
- System and performance audit results
- Significant QA problems and corrective actions implemented
- Copies of documentation such as memos, reports, etc.

The Project QC Officer will be responsible for preparing this report weekly or daily, as well as monthly written QA reports to OHM QA management. The Regional QA/QC Director will be responsible for reviewing and approving these monthly reports. Verbal reports will be made on a more frequent basis. All reports will be made available to the Project Manager, client, and regulating

agencies. If no project audits were performed and no significant QA/QC problems occurred, a letter stating these facts will be submitted to the referenced parties in lieu of a QA Report.

Appendix A

Table A-1 Sampling Summary **Table A-2.1 Project Quality Control Objectives**

BUILDING AS-822

Sample Location	Sample Point	Matrix	Sampling Frequency	Approx. Number of Samples	Sample Type	Sampling Method	TAT	QC Level	Required Analysis	Analytical Method	Holding Time	Preservatives	Containers for each sample**
Groundwater	Monitoring Wells (3)	Aqueous	1 Each	17 (a)	Grab	Direct Fill	21Days	NEESA Level E	Volatile Organic Analytes	602 Mod.	14 Days	HCl. to pH 2 Cool to 4o C	2 X 40 ml Vials with Teflon Septac Cap
				13 (b)	Grab	Direct Fill	21Days	NEESA Level E	PAH	610	7 Days Ext/ 14 Days Analy.	Cool to 4o C	2 X 1L Amber Glass
				As Needed	Grab	Direct Fill	ASAP	NEESA Level E	Dissolved Oxygen (c)	Field Test	Analyze Immediately	None	1 X 250 ml Plastic
Notes: Method 602 is modified to include xylenes and MTBE (a) 17 samples include 9 field samples (3 wells sampled quarterly for 2 quarters) + 1 duplicate + 3 rinsates + 1 field blank + 3 trip blanks (b) 13 samples include 9 field samples (3 wells sampled quarterly for 2 quarters) + 1 duplicate + 3 rinsates (c) Dissolved Oxygen will be tested in the field													

BUILDING STT-69

Sample Location	Sample Point	Matrix	Sampling Frequency	Approx. Number of Samples	Sample Type	Sampling Method	TAT	QC Level	Required Analysis	Analytical Method	Holding Time	Preservatives	Containers for each sample**
Groundwater	Monitoring Wells (5)	Aqueous	Baseline + Quarterly for two quarters	2025 (a)	Grab	With disposable bailer	21 Days	NEESA Level E	Volatile Organic Analytes	602 Mod.	14 Days	HCL to pH 2 Cool to 4° C	2 X 40 ml Vials with Teflon Septac Cap
				1619 (b)	Grab	With disposable bailer	21 Days	NEESA Level E	PAHs	610	14 Days	Cool to 4° C	2 X 1-L amber glass
				As needed	Grab	In-situ	ASAP	NEESA Level E	Dissolved Oxygen	Field Test	Analyze Immediately	None	1 X 250 ml plastic
Liquid	Liquid/Vapor Separator (1)	Aqueous	Once for start-up and once during this effort	8 (c) (c)	Grab	With disposable bailer	21 Days	NEESA Level E	Volatile Organic Analytes	602 Mod.	14 Days	HCL to pH 2 Cool to 4° C	2 X 40 ml Vials with Teflon Septac Cap
				3 (d)	Grab	With disposable bailer	21 Days	NEESA Level E	Total Metals (As, Ba, Be, Ca, Cr, Fe, Pb, Mn, Hg, V)	6010A/ 7060A/7421/ 7470A	180 Days/ Hg-28 Days	INO ₃ to pH 2 Cool to 4° C	1 X 1-L Polyethylene
Soil Vapor	System Effluent (1)	Gaseous	Monthly	7 (e)	Grab	Direct Fill	21 Days	NEESA Level E	Volatile Organic Analytes	Method 18 (SUMMA) TO14 M/ 8260A	Analyze Immediately	None	SUNMA Canister
Soil Vapor	Individual well head (3 SVE wells) and System Effluent (1)	Gaseous	During startup	As needed	Grab	Direct Fill	ASAP	NEESA Level E	Volatile Organic Analytes	Field Test	Analyze Immediately	None	SUNMA Canister

Notes:

Method 602 is modified to include xylenes and MTBE

Metals list include metals required by WWTTP under project 16032 + Calcium.

(a) 23 samples include 15 field samples (5 wells sampled at start up and quarterly for 2 quarters) + 1 duplicate + 3 rinsates + 1 field blank + 3 trip blanks

(b) 19 samples include 15 field samples (5 wells sampled at start up and quarterly for 2 quarters) + 1 duplicate + 3 rinsates

(c) 6 samples include 2 field samples (1 during start up and 1 during operation) + 1 field blank every sampling effort + 1 trip blank every sampling effort

(d) 3 samples include 2 field samples (1 during start up and 1 during operation) + 1 duplicate

(e) 7 samples include 6 field samples (1 every month for 6 months) + 1 duplicate

Building TT 2477-2478

Sample Location	Sample Point	Matrix	Sampling Frequency	Approx. Number of Samples	Sample Type	Sampling Method	TAT	QC Level	Required Analysis	Analytical Method	Holding Time	Preservatives	Containers for each sample**
Groundwater	Monitoring Wells (10)	Aqueous	Baseline + Quarterly for two quarters	39 (a)	Grab	With disposable bailer	21 Days	NEESA Level E	Volatile Organic Analytes	602 Mod.	14 Days	HCL to pH 2 Cool to 4° C	2 X 40 ml Vials with Teflon Septae Cap
				35 (b)	Grab	With disposable bailer	21 Days	NEESA Level E	PAHs	610	14 Days	Cool to 4° C	2 X 1-L amber glass
Surface water	Northeast Creek (2)	Aqueous	Quarterly for two quarters	4 (c)	Grab	Direct fill	21 Days	NEESA Level E	Volatile Organic Analytes	602 Mod.	14 Days	HCL to pH 2 Cool to 4° C	2 X 40 ml Vials with Teflon Septae Cap
				4 (c)	Grab	Direct fill	21 Days	NEESA Level E	PAHs	610	14 Days	Cool to 4° C	2 X 1-L amber glass
Liquid	Liquid/Vapor Separator (1)	Aqueous	Once during system start-up and once thereafter	6 (d)	Grab	With disposable bailer	21 Days	NEESA Level E	Volatile Organic Analytes	602 Mod.	14 Days	HCL to pH 2 Cool to 4° C	2 X 40 ml Vials with Teflon Septae Cap
				2 (e)	Grab	With disposable bailer	21 Days	NEESA Level E	Metals (As, Ba, Be, Ca, Cr, Fe, Pb, Mn, Hg, V)	8010A/ 7060A/7421/ 7470A	180 Days/ Hg-28 Days	IIINO ₃ to pH 2	1 X 1-L Polyethylene

Building TT 2477-2478 (Continued)

Sample Location	Sample Point	Matrix	Sampling Frequency	Approx. Number of Samples	Sample Type	Sampling Method	TAT	QC Level	Required Analysis	Analytical Method	Holding Time	Preservatives	Containers for each sample**
Soil Vapor	System Effluent (1)	Gaseous	Monthly	7 (f)	Grab	Direct Fill	21 Days	NEESA Level E	Volatile Organic Analytes	Method 18 (SUMMA) TO14 M/ 8260A	Analyze Immediately	None	SUMMA Canister
Soil Vapor	Individual well head (32 wells), System Effluent (1), and effluent from carbon cell	Gaseous	Periodically	As needed	Grab	Direct fill	ASAP	NEESA Level E	Volatile Organic Analytes	Field Test	Analyze Immediately	None	SUMMA Canister

Notes:

Method 602 is modified to include xylenes and MTBE

Metals list include metals required by WWTP under project 16032 + Calcium.

(a) 39 samples include 30 field samples (10 wells sampled for baseline and quarterly for 2 quarters) + 2 duplicates + 3-rinsates + 1 field blank + 3 trip blanks

(b) 35 samples include 30 field samples (10 wells sampled for baseline and quarterly for 2 quarters) + 2 duplicates + 3-rinsates

(c) 4 samples include 2 field samples (one upstream and one downstream) quarterly for 2 quarters, with NO QA/QC samples

(d) 6 samples include 2 field sample + 1 duplicate + 1 field blank + 2 trip blank

(e) 2 samples include 1 field sample + 1 duplicate

(f) 7 samples include 6 field samples (1 effluent sample per month for six months) + 1 duplicate

Berkeley Manor UST 820

Sample Location	Sample Point	Matrix	Sampling Frequency	Approx. Number of Samples	Sample Type	Sampling Method	TAT	QC Level	Required Analysis	Analytical Method	Holding Time	Preservatives	Containers for each sample**
Groundwater	Monitoring Wells (10)	Aqueous	Baseline + Quarterly for two quarters	39 (a)	Grab	With disposable bailer	21 Days	NEESA Level E	Volatile Organic Analytes	602 Mod.	14 Days	HCL to pH 2 Cool to 4° C	2 X 40 ml Vials with Teflon Septae Cap
				39 (b)	Grab	With disposable bailer	21 Days	NEESA Level E	PAHs	610	14 Days	Cool to 4° C	2 X 1-L amber glass
Liquid	Liquid/Vapor Separator (1)	Aqueous	Once during system start-up and once thereafter	6 (c)	Grab	With disposable bailer	21 Days	NEESA Level E	Volatile Organic Analytes	602 Mod.	14 Days	HCL to pH 2 Cool to 4° C	2 X 40 ml Vials with Teflon Septae Cap
				2 (f)	Grab	With disposable bailer	21 Days	NEESA Level E	Metals (As, Ba, Be, Ca, Cr, Fe, Pb, Mn, Hg, V)	6010A/ 7060A/7421/ 7470A)	180 Days/ Hg-28 Days	HNO ₃ to pH 2	1 X 1-L Polyethylene
Soil Vapor	System Effluent (1)	Gaseous	Monthly	7 (e)	Grab	Direct Fill	21 Days	NEESA Level E	Volatile Organic Analytes	Method 18 (SUMMA)/ TO 14 M/ 8260A	Analyze Immediately	None	SUMMA Canister
Soil Vapor	Individual well head (48 wells), System Effluent (1), and effluent from carbon cell	Gaseous	Periodically	As needed	Grab	Direct fill	ASAP	NEESA Level E	Volatile Organic Analytes	Field Test	Analyze Immediately	None	SUMMA Canister

Notes:

Method 602 is modified to include xylenes and MTBE

Metals list include metals required by VWWTP under project 16032 + Calcium.

(a) 39 samples include 30 field samples (10 wells sampled for baseline and quarterly for 2 quarters) + 2 duplicates + 3 rinsates + 1 field blank + 3 trip blanks

(b) 35 samples include 30 field samples (10 wells sampled for baseline and quarterly for 2 quarters) + 2 duplicates + 3 rinsates

(c) 6 samples include 2 field samples and 1 duplicate and 1 field blank and 2 trip blanks

(d) 2 samples include 1 field sample + 1 duplicate

(e) 7 samples include 6 field samples (1 every month for 6 months) + 1 duplicate

Table A-2.1 Project Quality Control Objectives

Method No	Analyte / Component	Project Action Limits		Minimum PQL		Accuracy Limits MS/MSD Recoveries		Precision Limits MS/MSD Deviation		Accuracy Limits LCS Recoveries		Precision Limits Field Dup Deviation		Completeness Limits	
		Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil
AROMATIC VOLATILES															
602	Benzene	1	NS	0.5	2	40-140	30-170	<30	<50	76-125	76-125	<50	<75	95	90
602	Chlorobenzene	50	NS	5	2	40-140	30-170	<30	<50	76-129	76-129	<50	<75	95	90
602	1,2-Dichlorobenzene	620	NS	5	4	40-140	30-170	<30	<50	61-134	61-134	<50	<75	95	90
602	1,3-Dichlorobenzene	620	NS	5	4	40-140	30-170	<30	<50	70-131	70-131	<50	<75	95	90
602	1,4-Dichlorobenzene	75	NS	5	3	40-140	30-170	<30	<50	76-126	76-126	<50	<75	95	90
602	Ethylbenzene	29	NS	5	2	40-140	30-170	<30	<50	71-129	71-129	<50	<75	95	90
602	Toluene	1000	NS	5	2	40-140	30-170	<30	<50	70-125	70-125	<50	<75	95	90
602	Xylenes	530	NS	5	2	40-140	30-170	<30	<50	71-133	71-133	<50	<75	95	90
602	Methyl tert butyl ether	200	NS	5	2	40-140	30-170	<30	<50	44-165	44-165	<50	<75	95	90
POLYAROMATIC HYDROCARBONS															
610	Acenaphthene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Acenaphthylene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Anthracene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Benzo (a) anthracene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Benzo (p) pyrene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Benzo (b) fluoranthene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Benzo (j) fluoranthene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Benzo (k) fluoranthene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Benzo (g,h,i) perylene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Chrysene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Dibenz (a,h) acridine	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Dibenz (a,i) acridine	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Dibenzo (a,h) anthracene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	7H-dibenzo (c,g) carbazole	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Dibenzo (a,e) pyrene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Dibenzo (a,i) pyrene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Dibenzo (a,h) pyrene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Fluoranthene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Fluorene	280	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Indeno (1,2,3-cd) pyrene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90

Table A-2.1 Project Quality Control Objectives

Method No	Analyte / Component	Project Action Limits		Minimum PQL		Accuracy Limits MS/MSD Recoveries		Precision Limits MS/MSD Deviation		Accuracy Limits LCS Recoveries		Precision Limits Field Dup Deviation		Completeness Limits	
		Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil	Water	Soil
610	3-Methylcholanthrene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Naphthalene	21	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Phenanthrene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	Pyrene	NS	NS	10	670	60-140	20-150	<30	<50	60-120	60-120	<50	<75	95	90
610	1-Methylnaphthalene	NS	NS	10	670	60-141	20-151	<30	<50	60-120	60-120	<50	<75	95	90
610	2-Methylnaphthalene	NS	NS	10	670	60-142	20-152	<30	<50	60-120	60-120	<50	<75	95	90

Appendix B

Custody Seal

Chain-of-Custody Record

OHM Shipping Label

Shipping Instructions for Sending Samples to the Laboratory

Client _____

Sample ID _____

Location _____

Analysis _____

Preservative _____

Collection Date/Time _____

Collected By _____

CUSTODY SEAL

Person Collecting Sample _____ Sample No. _____

(signature)

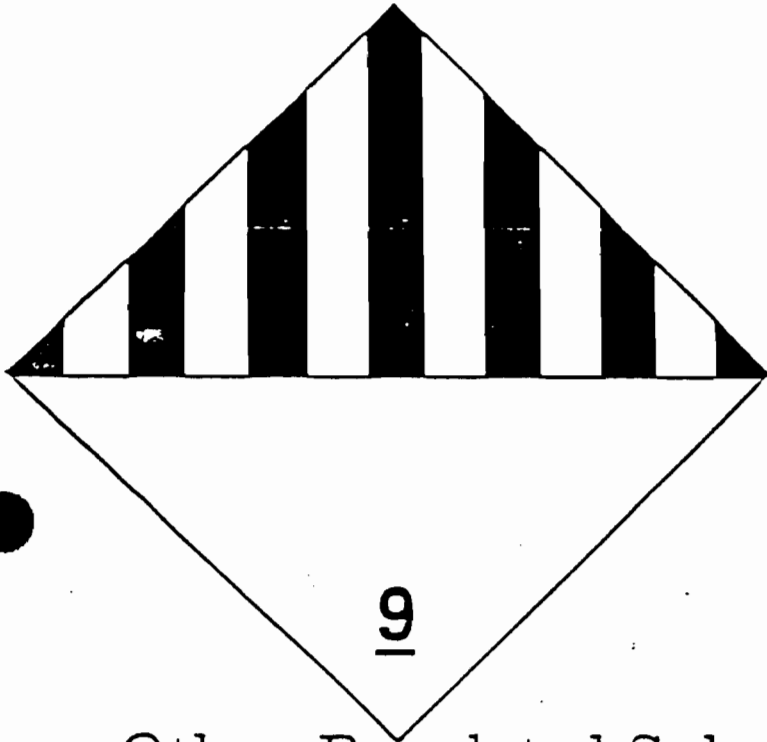
Date Collected _____ Time Collected _____

Custody Seal

Sample Label



OHM Remediation
Services Corp.



OHM Corporation



From:

Phone:

To:

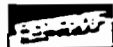
Phone:

Other Regulated Substances, ID# 8027

Class 9 Shipping Label



OHM Remediation
Services Corp.



USE THE FOLLOWING INFORMATION TO IDENTIFY YOUR SHIPMENT. IF YOU HAVE ANY QUESTIONS, CALL 800-234-5333 TOLL FREE.

AIRBILL
PACKAGE
TRACKING NUMBER

6729209572

30537

6729209572



4295

8124

124

36

100

1245-0597-0

From (Your Address/Shipping Point)

Company
C H A CORP

Street Address
5335 TRIANGLE PKWY STE 450

City
NORCROSS

State
GA

ZIP
30092

Country
USA

Phone Number (Country and Area Code)
404-729-3900

Service (Type of Service)
Standard

Weight (Lbs and Oz)
10.00

Dimensions (L x W x H)
12.00 x 12.00 x 12.00

Insurance (Type of Insurance)
None

Signature (Signature of Shipper)
[Signature]

SERVICES (Check one or more)

DELIVERY AND SPECIAL HANDLING (Check one or more)

SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY

SIGNATURE RELEASE UNAVAILABLE

6729209572 AIRBILL NUMBER

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS

CHECK ONE () AS CIP () IATA/CAO (TYPE OR PRINT)

DANGEROUS GOODS IDENTIFICATION

PROPER SHIPPING NAME

CLASS OR DIVISION

UN OR ID NO

QUANTITY AND TYPE OF PACKING

PICKING NET

AUTHORIZATION

ADDITIONAL HANDLING INFORMATION

TRANSPORT DETAILS

THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR

PASSENGER AIRCRAFT

CARGO AIRCRAFT ONLY

DELETE-NONAPPLICABLE

AIRPORT OF DEPARTURE

AIRPORT OF DESTINATION

SHIPMENT TYPE

NON-RADIOACTIVE

RADIOACTIVE

DELETE-NONAPPLICABLE

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS OR TREATMENT.

I HEREBY DECLARE THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME AND ARE CLASSIFIED, PACKED, MARKED, AND LABELED, AND ARE IN ALL RESPECTS IN PROPER CONDITION FOR TRANSPORT BY AIR ACCORDING TO THE APPLICABLE INTERNATIONAL AND NATIONAL GOVERNMENT REGULATIONS.

NAME AND TITLE OF SHIPPER

PLACE AND DATE

EMERGENCY TELEPHONE NUMBER

SIGNATURE OF SHIPPER

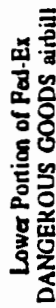
SEE WARNING ON BACK

Federal Express Airbill



OHM Corporation

Cooler lid is taped closed and additional tape should be used around the outside to act as strapping.

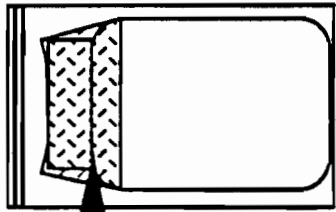


TRANSPORT DETAILS		Aspect of Reporting
For aircraft to which the following restrictions apply: 1. Passenger aircraft: 100 or more passengers 2. Freight aircraft: 100 or more passengers 3. Passenger aircraft: 100 or more passengers 4. Freight aircraft: 100 or more passengers	For aircraft to which the following restrictions apply: 1. Passenger aircraft: 100 or more passengers 2. Freight aircraft: 100 or more passengers 3. Passenger aircraft: 100 or more passengers 4. Freight aircraft: 100 or more passengers	Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal jurisdiction. This Declaration must not, in any circumstances, be completed unless signed by a responsible, forwarder or an IATA member.

[illegible]

The COC must be filled out completely, placed in a gallon zip-lock baggie, and taped to the inside lid of the cooler. A copy of the COC should be placed behind the airbill in the pouch on the outside of the cooler.

Lids are taped to prevent leaks or loosening. Entire jar is sealed in a zip-lock baggie



_____ x 1 kg for quart jars
 _____ x 500 g for 8 oz jars
 _____ x 40 g for VOA vials

**"Samples from OHAJ
Job # _____ see
attached chain of
custody. In case of
emergency refer to
ICAO Emergency
Response Guidance
for Aircraft Incidents
Involving Dangerous
Goods drill #9A"**

READ THE DIRECTIONS ON THE AIRBILL SO YOU UNDERSTAND WHAT YOU ARE FILLING OUT. Fill out the Fed-Ex airbill completely. Don't forget to sign the bottom and include the Emergency Response phone number. Changing even one thing from the example above may mean that Fed-Ex will refuse to accept the shipment. This procedure has been checked-out with Fed-Ex several times. If a driver refuses to pick it up make sure you have filled out the airbill right and followed ALL the instructions before you complain.

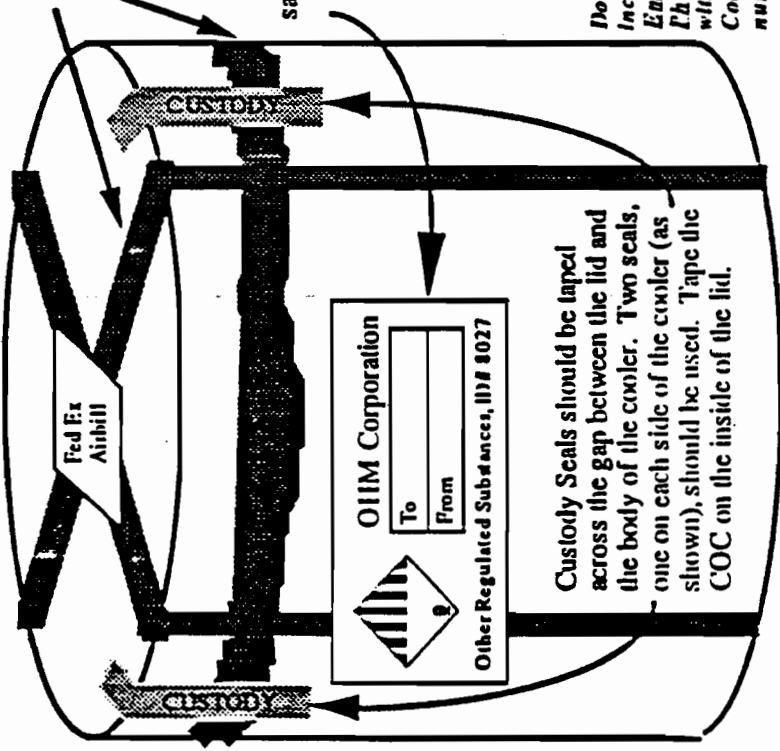


OIIM Remediation Services Corp

Shipping Instructions Treatability Study Samples

NOTE: These procedures are ONLY for shipping unknown wastes, sludge, soil, or water samples for laboratory analysis and identification; Materials which are known to be explosive, compressed gases, flammable, oxidizers, poisons, radioactive, or corrosive cannot be shipped by this method. Call the Regional T&D Coordinator for help in that case.

Tape the lid on tightly, use tape from top to bottom on the pail as strapping.



Lower Portion of Fed-Ex
DANGEROUS GOODS airbill

0792772120

TRANSPORT DETAILS

Report of Recipient

WARNING

For completed and signed copies of this Declaration must be attached to the shipment.

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be liable to the applicable law, subject to legal proceedings. This Declaration must not be altered, be completed, or signed by a non-authorized person, or be altered or signed by a non-authorized person.

Proper Shipping Name: **Other Regulated Substances**

Class: **9**

ID: **8027**

UN: **NA**

Quantity and type of packing: **906**

Packing: **906**

Authentication:

Don't forget to sign and include the 24-hr Emergency Response Phone number. Check with the Regional T&D Coordinator for this number

Fill in the Additional Handling space with:

"Samples from OIIM Job # see attached chain of custody. In case of emergency refer to ICAO Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods drill #9A"

Fill in this blank with either:

Steel Drum containing kg
or
Plastic Drum containing kg

You will have to weigh the pail before shipping and fill in the weight in the blanks above. To convert from pounds to kilograms multiply by 2.2.

READ THE DIRECTIONS ON THE AIRBILL, SO YOU UNDERSTAND WHAT YOU ARE FILLING OUT. Fill out the Fed-Ex airbill completely. Don't forget to sign the bottom and include the Emergency Response phone number. Changing even one thing from the example above may mean that Fed-Ex will refuse to accept the shipment. This procedure has been checked-out with Fed-Ex several times. If a driver refuses to pick it up make sure you have filled out the airbill right and followed ALL the instructions before you complain.

- 1) Samples must be shipped in "Strong outer packaging". Fed-Ex stated that a rigid plastic pail or steel pail with a secure lid is acceptable. Pails which meet the UN 1A1, 1A2, 1B1, or 1B2 specifications would be best. A minimum of 2 custody seals must be placed over the openings of the containers.
- 2) Use one of OIIM's custom sample shipping labels and a Fed-Ex dangerous goods airbill. The To/From address position of the label should be filled out completely including phone numbers. The airbill and OIIM label should be placed on last and cannot be covered by tape or other. The airbill should go on top and the OIIM label on the side.
- 3) Materials which are known to be explosive, compressed gases, flammable, oxidizers, poisons, radioactive, or corrosive cannot be shipped by this method. Call the Regional T&D Coordinator for assistance with these materials.
- 4) The materials must be shipped using a Federal Express Hazardous Materials Airbill. Use the example above or call the Hazardous Materials group at Federal Express at (800) GR-FED-EX for more instructions on filling out this form. Be sure to put your name, title, and office number at the bottom!

Appendix C

SOP QP-618 Bailers

STANDARD OPERATING PROCEDURE

Title: Bailers

Document #: QP-618

1.0 PURPOSE

To provide general information and procedures for the bailer sampling device.

2.0 APPLICABILITY

The bailer is designed for obtaining liquid samples. The bailer can be constructed of PVC, Teflon, stainless steel or a combination of these materials. Disposable bailers intended for one time use only are usually made from polyethylene plastic or Teflon.

3.0 RELATED DOCUMENTS

OHM Field Sampling Manual

4.0 GENERAL INFORMATION

The bailer is one of the oldest and simplest methods available. It consists of a container attached to a cable which is lowered into a well to retrieve a sample. Bailers can be of various designs. The simplest is a weighted bottle or basally capped length of pipe which fills from the top as it is lowered into the well. Top filling bailers are acceptable for well purging but not for sampling. More sophisticated bailers have a check valve located at the base which allows water to enter from the bottom as it is lowered into the well. When the bailer is lifted, the check valve closes, allowing water in the bailer to be brought to the surface. More sophisticated bailers are available that remain open at both ends while lowered into the well, but can be sealed at both top and bottom by activating a triggering mechanism from the

surface. This allows for more reliable sampling at discrete depths within a well. Perhaps the best known bailer of this design is the Kemmerer sampler.

Bailers generally provide an excellent means for collecting samples from monitoring wells. They can be constructed from a wide variety of materials compatible with the parameter of interest. Only Teflon and stainless steel bailers are acceptable for all parameters. Since they are relatively inexpensive, bailers can be easily dedicated to an individual well to minimize cross contamination during sampling. If not dedicated to a well, they can be easily cleaned to prevent cross contamination. Nylon sample string is commonly used to raise and lower bailers. Monofilament line (fishing line), however, is more acceptable.

5.0 DEFINITIONS

Representativeness - The sample should possess the same qualities or properties (which are relevant to the investigation) as the whole of the material under investigation.

Grab Sample - A single sample representative of a specific location at a given point in time.

Composite Sample - Combination of more than one sample collected at various sampling locations and/or different points in time.

Equipment (field) Blanks - Samples used to verify cleanliness of the sampling equipment. The piece of equipment in question is used to take a sample of distilled or deionized water. One per analyte per piece of equipment per day is recommended.

Cross Contamination - The introduction of contaminants into the sample through the sampling and/or sample-handling procedures which can cause an otherwise representative sample to become nonrepresentative.

6.0 RESPONSIBILITIES

The Sample Technician is responsible for all sample collection, documentation, and decontamination.

7.0 PROCEDURE

- 7.1 Assemble the decontaminated bailer (if necessary).
- 7.2 Securely attach sample string to the hole in the top of the bailer.
- 7.3 Slowly lower the bailer into the liquid to be sampled. Care should be taken not to drop the bailer into the structure being sampled.
- 7.4 Allow the bailer to fill with the liquid being sampled. Usually, a gurgling sound will be apparent when the bailer is filling.
- 7.5 When the bailer is full, remove it from the structure being sampled by pulling the string.
- 7.6 Position the hole on the bottom of the bailer over the appropriate sample container and push up on the Teflon ball to release the material. Alternatively the sample material can be poured from the top of the bailer into a sample container if the bailer design is an open top type.
- 7.7 After each use, the bailer must be decontaminated before using it again at a different sampling point. Check with the Project Chemist or the Site Supervisor for information on the correct decontamination procedures to use for the site where sampling was done.

8.0 EQUIPMENT

- Bailer
- Sample string or Nylon monofilament line
- Appropriate decontamination supplies

9.0 ATTACHMENTS

Figure 1.0 Teflon Bailer

Building 820 POL Site Equipment Data



**OHM Remediation
Services Corp.**
A Subsidiary of OHM Corporation

Component Group: Air Compressor

Equipment Data

Component Name Air Compressor
Manufacturer Atlas Copco
Model Number GA-90
Serial Number AIF043261
Description Rotary Screw Air Compressor

OEM Vendor Data

Original Vendor REP Inc.
Spare Part Vendor Atlas Copco
Service/Maintenance Vendor REP Inc.

Notes

Instruction book for

Stationary Compressors

GA 90, 110, 160, 200, 250 and 315

P/N 1310 9051 80 Ed. 0 1995-10

From Following serial number onwards:

All 024 378

Atlas Copco

Atlas Copco Compressors Inc.
161 Lower Westfield Road
Holyoke, MA 01041-0431



SAFETY PRECAUTIONS FOR STATIONARY COMPRESSORS & EQUIPMENT

Read and understand these precautions before installing your unit
and observe them during operation and maintenance.

This instruction book describes how to handle and operate the subject machine(s) to ensure safe operation, optimum working economy and long service life.

Read this book before putting the machine into operation to ensure correct handling, operating and proper maintenance from the beginning. Keep this book available for the operator(s). Make sure that the unit is operated and that the maintenance actions are carried out according to the instructions. Record all operating data, maintenance work, etc. in an operator's logbook available from Atlas Copco. Follow all applicable safety precautions.

Repair operations should be performed by qualified personnel, available at authorized Atlas Copco distributors and Regional Service Centers.

In all correspondence, always reference the unit type and the complete serial number, shown on the unit's data plate. The serial number is composed of three letters followed by six digits.

For specific data not mentioned in the text, consult sections "Preventive Maintenance Schedule" and "Principal Data".

Atlas Copco reserves the right to make changes without prior notice.

If any statement in this book, especially with regard to safety, does not comply with local regulations, the stricter of the two shall apply.

These precautions are general in nature, and cover several machine types and equipment; hence some statements may not apply to the unit(s) described in this book.

All responsibility for any damage or injury resulting from neglecting these precautions, or by non-observance of ordinary caution and due care required in handling, operating, maintenance or repair, even if not expressly mentioned in this book, will be disclaimed by Atlas Copco.

For breathing air applications, special filtering equipment and purifiers are required, with monitors, to assure that the breathing air quality is in compliance with local, state and federal standards such as, but not limited to OSHA29 CFR1910.134.

Should the purchaser and/or user of this compressor fail to include filtering and purifying equipment and proceeds to use the compressor for breathing air service, the purchaser/user assumes all liabilities from resulting

consequences with no responsibility to be assumed by Atlas Copco.

In addition to general safety rules which should be observed with air compressors and associated equipment, the following safety directions and precautions are of special importance.

When operating this unit, the operator is expected to employ safe working practices and to observe all related local work safety requirements and ordinances.

The owner is responsible for maintaining the unit in a safe operating condition. Parts and accessories must be replaced if unsuitable for safe operation.

Installation, operation, maintenance and repair should only be performed by authorized, trained, competent personnel.

Installation

Apart from general engineering practice in conformity with the local safety regulations, the following directives are specially stressed:

1. A compressor must be lifted only with adequate equipment in conformity with local safety rules.

Loose or pivoting parts must be securely fastened before lifting. Do not, under any circumstances, enter the risk zone under a lifted load. Lifting acceleration and retardation must be kept within safe limits.

2. Any blanking flanges, plugs, caps and desiccant bags must be removed before connecting up the pipes. Distribution pipes and connections must be correctly sized and suitable for the working pressure and flow.

3. Place the unit in a cool and clean environment. If necessary, install a suction duct. Never obstruct the air inlet.

4. The intake air shall be free from flammable fumes or vapors, e.g. paint solvents, that can lead to internal fire or explosion.

5. Install air-cooled units in such a way that an adequate flow of cooling air is available and that the exhausted air does not recirculate to the inlet.

6. Arrange the air intake so that loose items, such as clothing, cannot be sucked in.

7. Ensure that the discharge pipe from the compressor to the

(continued on back cover)

OWNERSHIP DATA

Unit model: _____

Owner's machine no.: _____

Electric motor type: _____

Unit service no.: _____

Delivery date: _____

Motor serial no.: _____

Service plan: _____

First start-up date: _____

Selected Lubricants

Compressor: _____

Capacity: _____

Bearing grease type, electric motor: _____

Printed Matter Nos.

Atlas Copco instruction book: _____

Atlas Copco logbook: _____

Atlas Copco parts list: _____

Motor parts list: _____

Local Atlas Copco Representative

Name: _____

Address: _____

Telephone: _____

Contact persons: Service: _____

Telefax: _____

Parts: _____

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1 Leading particulars

1.1 General description

GA are stationary, single-stage, oil-injected screw compressors driven by an electric motor. GA 90 up to GA 315 are air-cooled, where as GA 90W up to GA 315W are water-cooled.

The compressors are enclosed in a sound-insulated enclosure. The front panel comprises an electronic control module including the start and stop buttons.

An emergency stop button is also provided. An electric cubicle comprising the motor starters is located behind this panel.

1.1.1 Air Flow

Reference Fig. 4a and 4b

GA 90 up to GA 160 (Fig. 4a)

GA 90W up to GA 160W (Fig. 4a)

Air drawn through air filter (AF) and unloading valve (UV) into compressor element (E) is compressed. Compressed air and oil flow into air receiver (AR) (which contains oil separator element (OS)) via check valve (CV). The valve prevents blow-back of the compressed air when the compressor is stopped.

GA 200 up to GA 315 (Fig. 4b)

GA 200W up to GA 315W (Fig. 4b)

Air drawn through air filter (AF) and unloading valves (UV1 and UV2) into compressor elements (E1 and E2) is compressed. Compressed air and oil flow into the air receiver (AR) (which contains the oil separator element (OS)) via check valves (CV1 and CV2). The valves prevent blow-back of the compressed air when the compressor is stopped.

On all compressors

The air is discharged through outlet valve (AV) via the minimum pressure valve (Vp), air cooler (Ca) and moisture trap (MTa).

The minimum pressure valve (Vp) prevents the receiver pressure from dropping below a minimum pressure. The minimum pressure valve has a built-in check valve.

1.1.2 Oil System

Reference Fig. 4a and 4b

In air receiver/oil separator (AR/OS), most of the oil is removed from the air/oil mixture centrifugally. The balance is removed by the oil separator element (OS). The lower part of the air receiver (AR) serves as an oil tank.

The oil system is provided with a bypass valve (BV) 1). When the oil temperature is below 104°F, the bypass valve (BV) shuts off the oil supply from the oil cooler (Co).

Air pressure forces the oil from the air receiver (AR) through

the oil filters (OF) and the oil stop valve (Vs) 1) to the compressor element(s) (E) and its lubrication points. Oil cooler (Co) is by-passed.

Bypass valve (BV) starts opening the oil supply from cooler (Co) when the oil temperature has increased to approximately 104°F. At approx. 131°F, all the oil flows through the oil cooler.

Oil stop valve (Vs) 1) prevents the compressor element(s) from flooding with oil when the compressor is stopped. The valve is opened by element outlet pressure when the compressor is started.

- 1) GA 200 to 315 and GA 200W to GA 315W have two bypass valves (BV) and oil stop valves (Vs1 and Vs2).

1.1.3 Cooling and Condensate Systems

Reference Fig. 3, Fig. 4a and 4b

The cooling system includes air cooler (Ca) and oil cooler(s) (Co).

On air cooled compressors, the cooling air for the air cooler and oil cooler is generated by fans (FN2) and (FN3) 1).

On water-cooled compressors, the water flows through inlet pipe (6-Fig. 4a), the tubestacks of the air cooler and oil cooler 2), and the outlet pipe (5-Fig. 4a). The water cooled enclosed units are equipped with a fan (VF) to vent the enclosure. The cooling water must be free from solid impurities. The content of calcium compounds must be as low as possible to avoid the formation of scale. Contact your local Atlas Copco representative if there are questions about water purity.

A drain valve should be fitted by the customer in the lower part of the cooling water inlet and outlet pipes.

- 1) GA 90 and GA 110 have one fan, GA 160-315 have two fans.
- 2) GA 90W and GA 110W have one oil cooler, GA 160W - GA 315W have two oil coolers.

CAUTION: When the compressor is stopped and freezing temperatures are expected, the cooling system should be drained completely.

All compressors have a moisture trap (MTa) provided with a valve for automatic condensate draining during operation (Daa-Fig. 3) and a manually operated valve (Dma-Fig. 3) for draining after stopping the compressor.

1.2 Unloading/Loading System

Reference Fig. 4a and 4b

The system is operated by an electronic control module. The system controls the air delivery in relation to the air consumption and maintains the system pressure within the pre-selected upper and lower limits of the working pressure (Unloading and loading pressures).

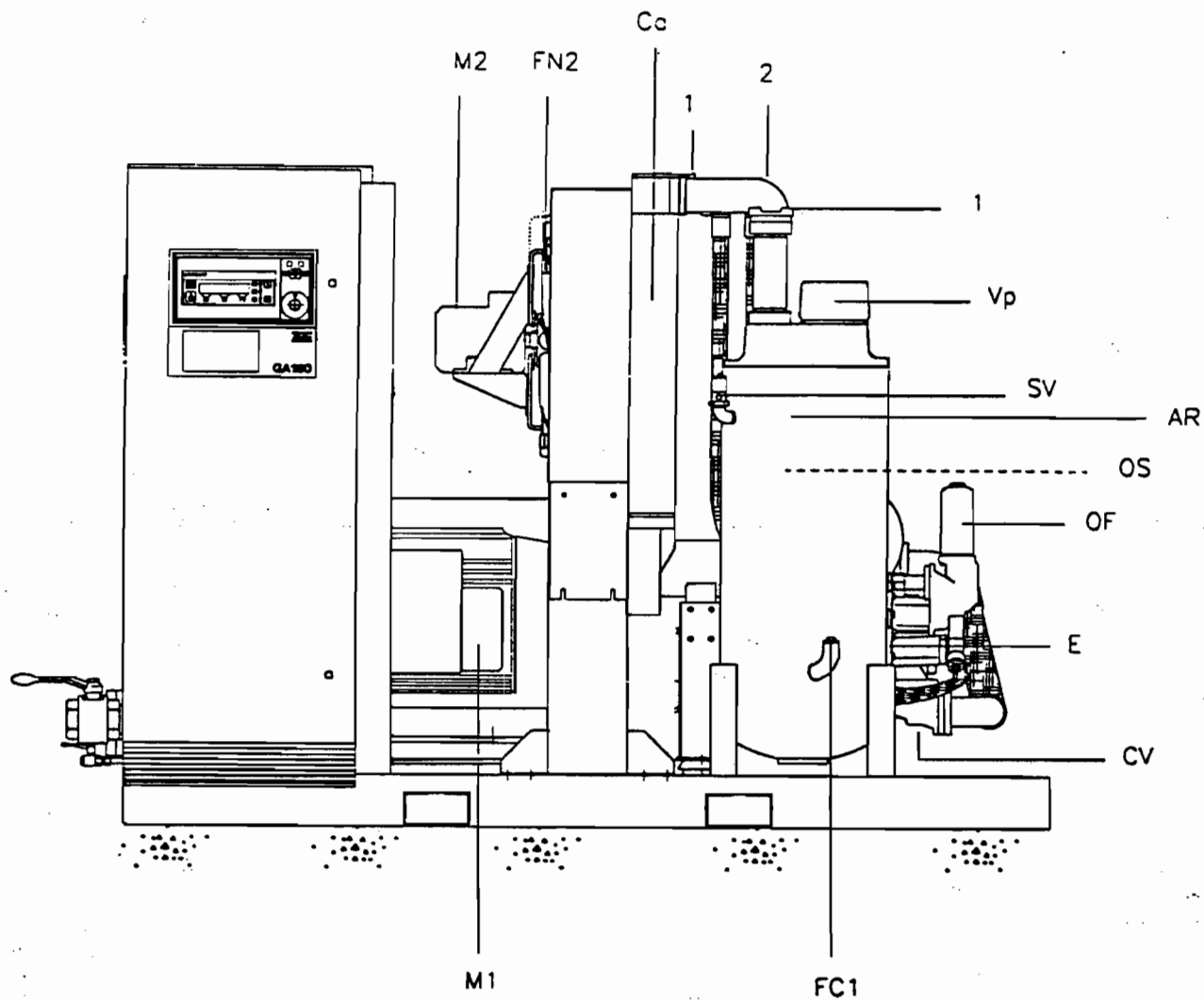


Fig. 1 Front view of GA 160 (shown without enclosure)

AR	Air receiver	FN2	Fan	SV	Safety valve
Ca	Air cooler	M1	Drive motor	Vp	Minimum pressure valve
CV	Check valve	M2	Fan motor	1	Bolts
E	Compressor Element	OF	Oil Filters	2	Air cooler inlet pipe
FC1	Oil filler plug	OS	Oil separator element		

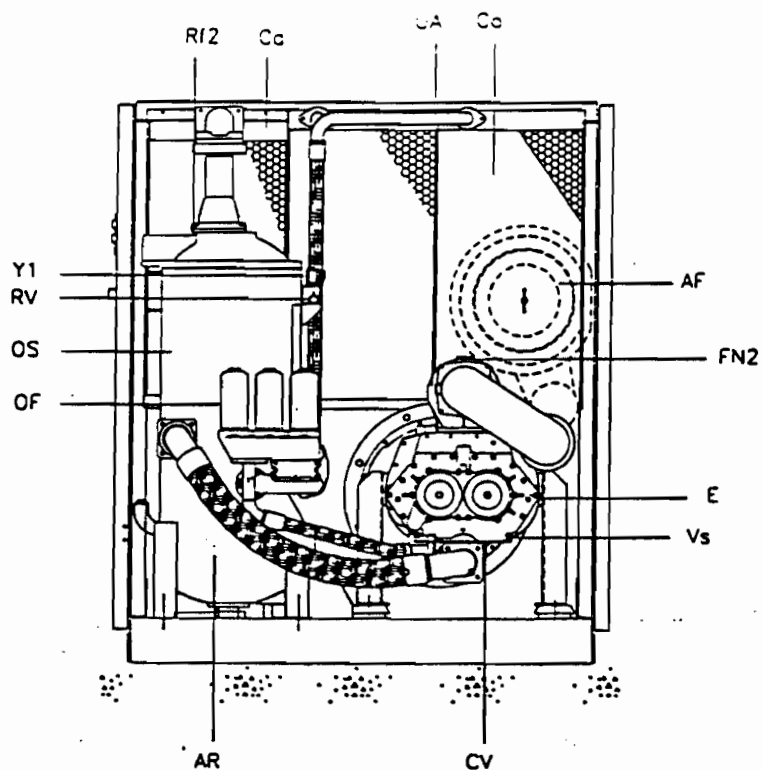


Fig. 2 End view of GA 160 (shown without enclosure)

AF Air filter
AR Air receiver
Ca Air cooler
Co Oil cooler
CV Check valve

E Compressor element
FN2 Fan
OF Oil filters
OS Oil separator element
UA Unloader

RI2 Restrictor
RV Regulating valve
Vs Oil Stop Valve
Y1 Loading solenoid valve

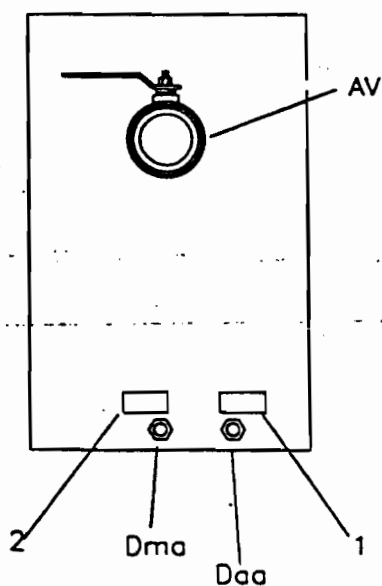


Fig. 3 Air Outlet and Condensate drain outlets of GA 160

AV Air outlet valve
Daa Automatic condensate drain
Dma Manual condensate drain

1 Pictographs, automatic condensate drain
2 Pictographs, manual condensate drain

1.2.1 Unloading

Reference Fig. 4a

If the air consumption is less than the air output of the compressor, the system pressure increases. When the system pressure reaches the unloading pressure, solenoid valve (Y1) is deenergized. The plunger of the valve returns by spring force.

1. Control pressure is fed via hose (4) and selection valve (Ss) through solenoid valve (Y1) to valves (V and VV) and, on GA 200-315 units, also valve (VV1).
2. The plungers of vent valves (V) and (VV) and, on GA 200-315 units, also valve (VV1) move against spring force.
3. Control pressure present in chamber(s) (1) is vented to atmosphere through valve (V) and, on the GA 200-315 units, also valve (VV1). This causes unloading valve (UV) or valves (UV1 and UV2) to close.
4. Valve (VV) and, on GA 200-315 units, also valve (VV1) allow the small amount of air, which remains drawn in to blow off from air receiver (AR) via hose (3) to unloader (UA) or via hoses (3 and 9) to unloaders (UA1 and UA2).

Air output is stopped (0%), the compressor runs unloaded.

1.2.2. Loading

Reference Fig. 4b

When the system pressure decreases to unloading pressure, solenoid valve (Y1) is energized. The plunger of solenoid valve (Y1) moves against spring force.

1. The plungers of the vent valve (VV), control valve (V) and, on GA 200-315 units, also valve (VV1) return to their original positions by spring force as the control pressure is vented via solenoid valve (Y1).
2. Control pressure is fed via hose (3) or hose (4), selector valve (Ss) and valve (V) to chamber(s) (1) to open unloading valve (UV) or valves (UV1 and UV2).
3. Valve (VV) and, on GA 200-315 units, also valve (VV1) closes the air blow-off opening.

Air output is resumed (100%), the compressor runs loaded.

1.3 Electrical System

The system includes:

1. Drive motor (M1-Fig. 1)
2. For GA 90 and GA 110 one fan motor, for GA 160 up to GA 315 two fan motors (M2/M3)
3. Electronic control module (Fig. 5a)
4. Compressor start, stop and emergency stop buttons (8, 9 and S2-Fig. 5a)

5. Control mode switch (S5-Fig. 5a)
6. Starter cabinet, which includes the starting equipment of the motors
7. Temperature and pressure sensors

1.3.1 Electronic control module

Reference Fig. 5a

The control module consists of an electronic regulator and a control panel.

1.3.2 Electronic regulator (E1)

Reference Fig. 6a and 6b

The regulator includes following functions:

Automatic control of the compressor

The regulator maintains the system pressure between programmable limits by automatically loading and unloading the compressor. A number of programmable settings, e.g. the unloading and loading pressures, the minimum stop time and the maximum number of motor starts are taken into account.

The regulator stops the compressor whenever possible to reduce the power consumption and restarts it automatically when the system pressure decreases. In case the expected unloading period is too short, the compressor is kept running to prevent too-short of a standstill period.

Warning

A number of time-based automatic start/stop commands may be programmed. 1) Take into account that a start command will be executed (if programmed and activated), even after manually stopping the compressor.

- 1) This function is called the Timer function. See "user manual for Elektronikon® regulator - 4 x 40 display", section "Timer submenu".

Protecting the compressor

If the compressor element outlet temperature exceeds the programmed shut-down level, the compressor will be stopped. This will be indicated on display (4-Fig. 5a). The compressor will also be stopped in case of overload of the drive motor (M1) or fan motor(s) (M2/M3). 2)

If the compressor element outlet temperature exceeds a programmed value below the shut-down level, this will also be indicated to warn the operator before the shut-down level is reached.

- 2) Air-cooled compressors only.

Monitoring components subject to service

The regulator continuously monitors the oil, oil filters, oil separator, compressor motor grease and air filter. Each input is compared to programmed maximum time intervals or pressure drops. If these limits are exceeded, a message will appear on display (4-Fig. 5a) to warn the operator to replace the indicated components.

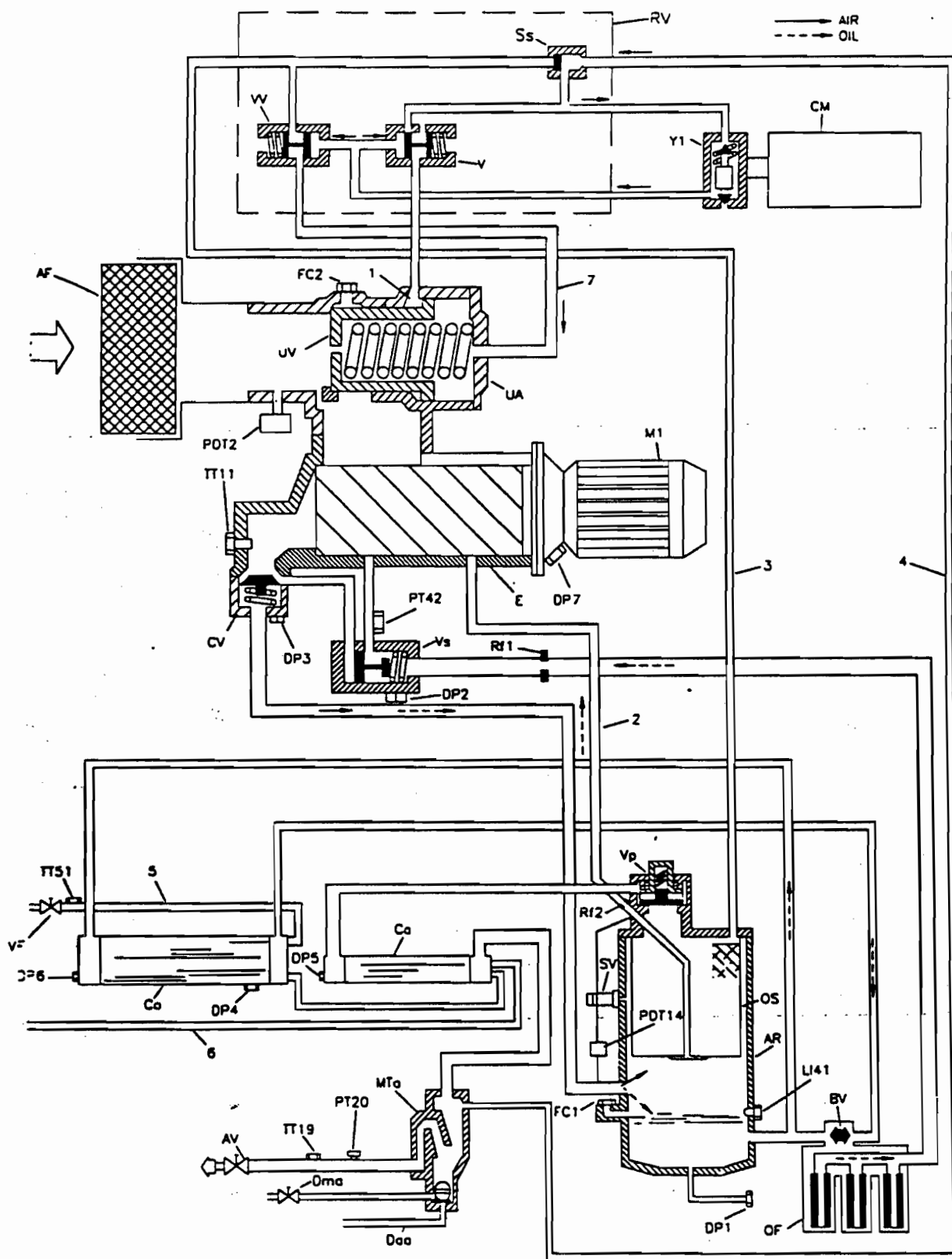


Fig. 4a Flow Diagram GA90W-160W (unloaded)

AF	Air filter(s)
AR	Air receiver
AV	Air outlet valve
BV	Oil cooler by-pass valve(s)
Ca	Air cooler
CM	Control module
Co	Oil cooler(s)
CV	Check valve
Daa	Automatic condensate drain outlet
Dma	Manual condensate drain valve
DP1	Oil drain plug, air receiver
DP2	Oil drain plug, oil stop valve
DP3	Oil drain plug, check valve
DP4	Oil drain plug, oil cooler 1)
DP5	Water drain plug, air cooler
DP6	Water drain plug, oil cooler 1)
DP7	Oil drain plug, gear box
E	Compressor element
FC1	Oil filler plug
FC2	Oil filler plug(s) (only to be used at initial start-up)
LI41	Oil level gauge
MTa	Moisture trap
M1	Drive motor
OF	Oil filter(s)
OS	Oil separator element
PDT2	Pressure sensor, air filter pressure drop
PDT14	Pressure sensor, oil separator pressure drop

PT20	Pressure sensor, delivery air
PT42	Pressure sensor, oil injection
Rf1,2	Restrictors
RV	Regulating valve
Ss	Pressure selector valve
SV	Safety valve
TT11	Temperature sensor, compressor element outlet
TT19	Temperature sensor, delivery air
TT51	Temperature sensor, cooling air
UA	Unloader
UV	Unloading valve
V	Control valve for unloading valve
Vf	Cooling water regulating valve 2)
Vp	Minimum pressure valve
Vs	Oil stop valve
VV	Vent valve
Y1	Loading solenoid valve
1	Chamber, control air
2	Hose, oil scavenging
3	Hose, control air or blow-off air
4	Hose, control air
5	Cooling water outlet pipe
6	Cooling water inlet pipe
7	Hose, blow-off air

- 1) Two plugs on GA160W up to GA 315W
- 2) Customer's installation

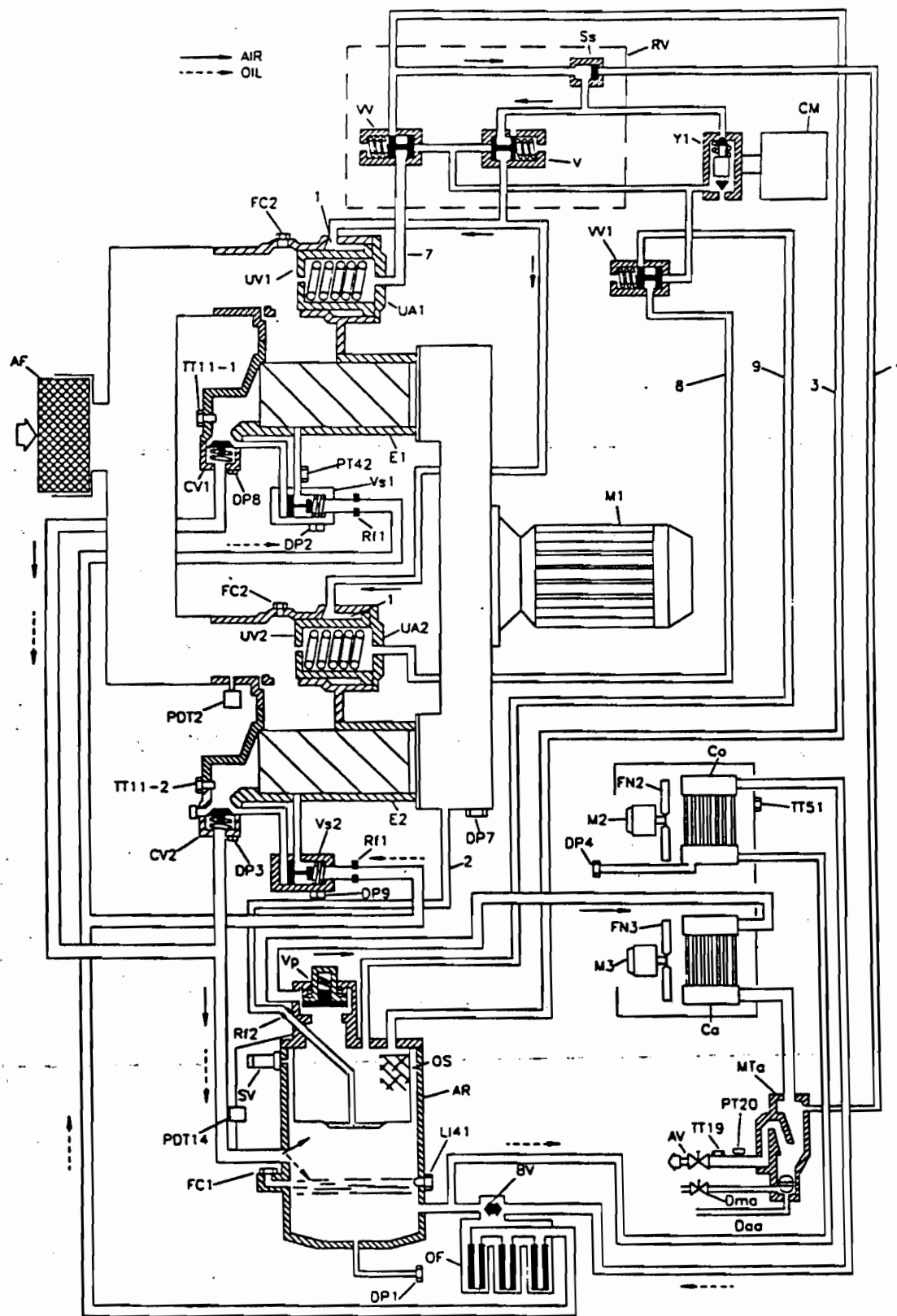


Fig. 4b Flow Diagram GA 200-315 (loaded)

AF Air filter(s)
 AR Air receiver
 AV Air outlet valve
 BV Oil cooler by-pass valve(s)
 Ca Air cooler
 CM Control module
 Co Oil cooler(s)
 CV1 Check valve 3)
 CV2 Check valve 3)
 Daa Automatic condensate drain outlet
 Dma Manual condensate drain valve
 DP1 Oil drain plug, air receiver
 DP2 Oil drain plug, oil stop valve
 DP3 Oil drain plug, check valve
 DP4 Oil drain plug, oil cooler
 DP7 Oil drain plug, gear box
 DP8 Oil drain plug, check valve 3)
 DP9 Oil drain plug, oil stop valve 3)
 E Compressor element
 E1 Compressor element 3)
 E2 Compressor element 3)
 FC1 Oil filler plug
 FC2 Oil filler plug(s) (only to be used at initial start-up)
 FN2/3 Fans
 LI41 Oil level gauge
 MTa Moisture trap
 M1 Drive motor
 M2/3 Fan motor(s)
 OF Oil filter(s)
 OS Oil separator element
 PDT2 Pressure sensor, air filter pressure drop
 PDT14 Pressure sensor, oil separator pressure drop

PT20 Pressure sensor, delivery air
 PT42 Pressure sensor, oil injection
 Rf1,,2 Restrictors
 RV Regulating valve
 Ss Pressure selector valve
 SV Safety valve
 TT11.1 Temperature sensor, outlet of compressor element 1 3)
 TT11.2 Temperature sensor, outlet of compressor element 2 3)
 TT19 Temperature sensor, delivery air
 TT51 Temperature sensor, cooling air
 UA1 Unloader 3)
 UA2 Unloader 3)
 UV1 Unloading valve 3)
 UV2 Unloading valve 3)
 V Control valve for unloading valve
 Vp Minimum pressure valve
 Vs1 Oil stop valve 3)
 Vs2 Oil stop valve 3)
 VV Vent valve
 VV1 Vent valve 3)
 Y1 Loading solenoid valve
 1 Chamber, control air
 2 Hose, oil scavenging
 3 Hose, control air or blow-off air
 4 Hose, control air
 7 Hose, blow-off air
 8 Hose, blow-off air 3)
 9 Hose, blow-off air 3)
 3) GA 200-315 only

Automatic restart after voltage failure

For compressors leaving the factory, this function is made inactive. If desired, the function can be activated. Consult your local Atlas Copco representative.

Warning

If activated and provided the module was in the automatic operation mode and provided the compressor control mode (see section 3.4.3) was not changed during the power failure, the compressor will automatically restart if the supply voltage to the module is restored within a programmed time period (this time period is called the power recovery time).

Permissive start

After a start command (either automatic start by the electronic regulator or manual start), the permissive start function is operating: if the programmed start conditions are not fulfilled within a programmed time interval, the compressor will not start (indicated as Start failure).

Start commands during stop time and unloading time

The control module also includes following functions:

Minimum unloading time

After pressing stop button (9-Fig. 5a), the compressor will run unloaded for 30 seconds. The compressor stops after this period. A start command during this time is ignored.

Minimum stop time

After stopping, the module prevents the motor from restarting within a programmable time. A start command during this time will be memorized and executed after running out of this interval.

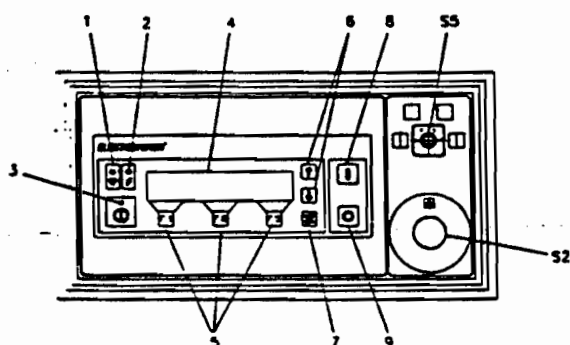


Fig. 5a Control Panel

1.3.3 Control Panel

Reference Fig. 5a

Indicators, keys, and buttons

Ref.	Designation	Function
1	Automatic operation LED	Indicates that the regulator is automatically controlling the compressor: the compressor is loaded, unloaded, stopped and restarted depending on the air consumption and the limitations programmed in the regulator.
2	Voltage on LED	Indicates that the voltage is switched on.
3	General alarm LED	Is lighted if a shut-down warning condition exists. See "User manual for Elektronikon® regulator - 4 x 40 display" Status data submenu. Blinks if a shut-down condition exists, if the sensor of the compressor element is out of order or after an emergency stop.
4	Display	Indicates messages concerning the compressor operating condition, a service need or a fault. See "User manual for Elektronikon® regulator - 4 x 40 display" sections "Status data submenu" and "Service submenu".
5	Function keys	Keys to control and program the compressor. See below.
6	Scroll keys	Keys to scroll through the display.
7	Tabulator key	Key to go to the next field of the display.
8	Start button	Push button to start the compressor. LED (1) lights up indicating that the regulator is operative (in automatic operation). The LED goes out after unloading the compressor manually.
9	Stop button	Push button to stop the compressor. LED (1) goes out. The compressor will stop after running in unloaded condition for 30 seconds.

Ref.	Designation	Function
S2	Emergency stop button	Push button to stop the compressor immediately in case of emergency. After remedying the trouble, unlock the button by turning counter clockwise.
S5	Control mode switch [†]	Key switch to select the compressor control modes. See section 3.1.1.

Selecting a menu

To facilitate controlling the compressor, menu-driven programs are implemented in the electronic module. Use the function keys (5) to select the menus in order to program and monitor the compressor. The "User manual for Elektronikon® regulator - 4 x 40 display" deals elaborately with all regulator functions.

Function keys

The functions of the keys vary depending on the displayed menu. The actual function is indicated just above the relevant key. The most common functions are listed below:

Designation	Function
Add	To add compressor start/stop commands (day/hour)
Cancel	To cancel a programming setting when programming parameters
Delete	To delete compressor start/stop commands
Limits	To show limits for a programmable setting
List	To list programmed start/stop commands (day/hour)
Load	To load the compressor manually
Main Screen	To return from a menu to the main display (Fig. 5b)
Menu	Starting from the main display (Fig. 5b), to initiate the main menu (Fig. 5c) which gives access to submenus Starting from a submenu, to return to the main menu (Fig. 5c)
Modify	To modify programmable settings
Show More	To have a quick look at the compressor status
Program	To program modified settings
Reset	To reset a timer or message
Return	To return to a previously shown option or menu
Select	To select a submenu or to read more details of a selection shown on display
Unload	To unload the compressor manually

Compressor outlet 100psi

Automatically loaded
Menu Show More Unload

F1 F2 F3

Fig. 5b Example of the main display

Status data



Main Screen Select

F1 F2 F3

Fig. 5c Example of main menu

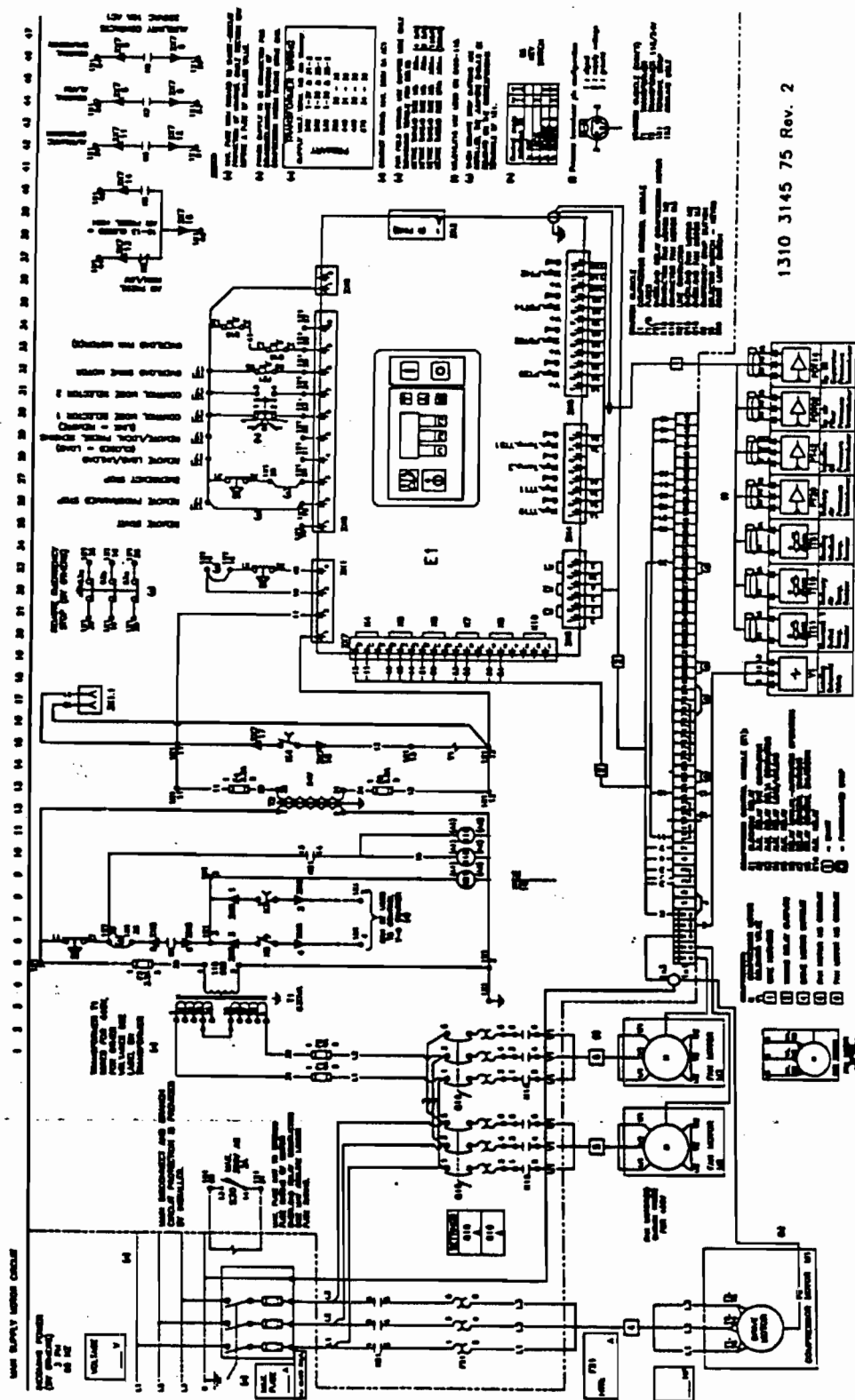


Fig. 6a Service diagram GA 90-160 Air cooled DOL

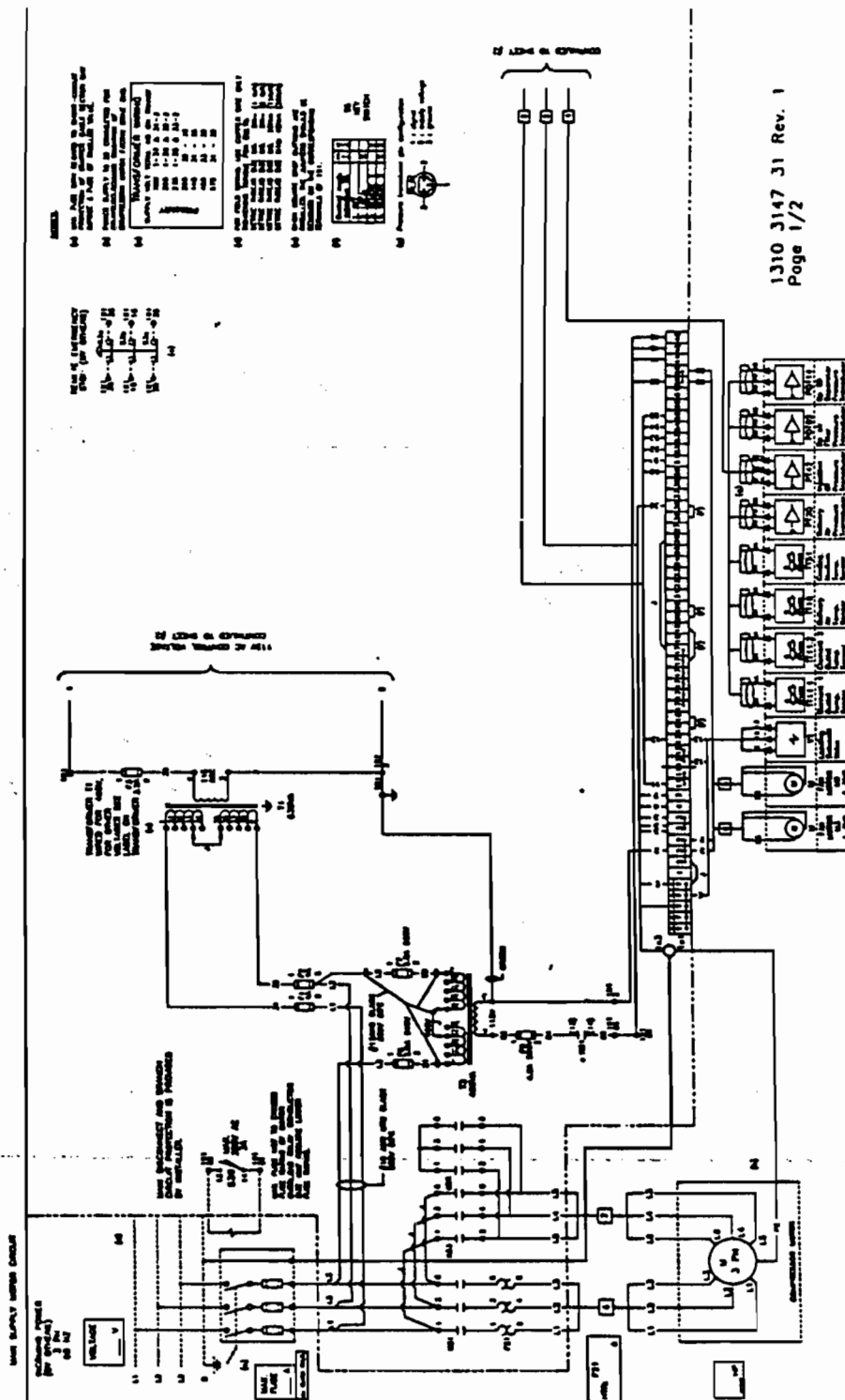


Fig. 6b Service diagram GA 200-315 Water cooled YD Page 1

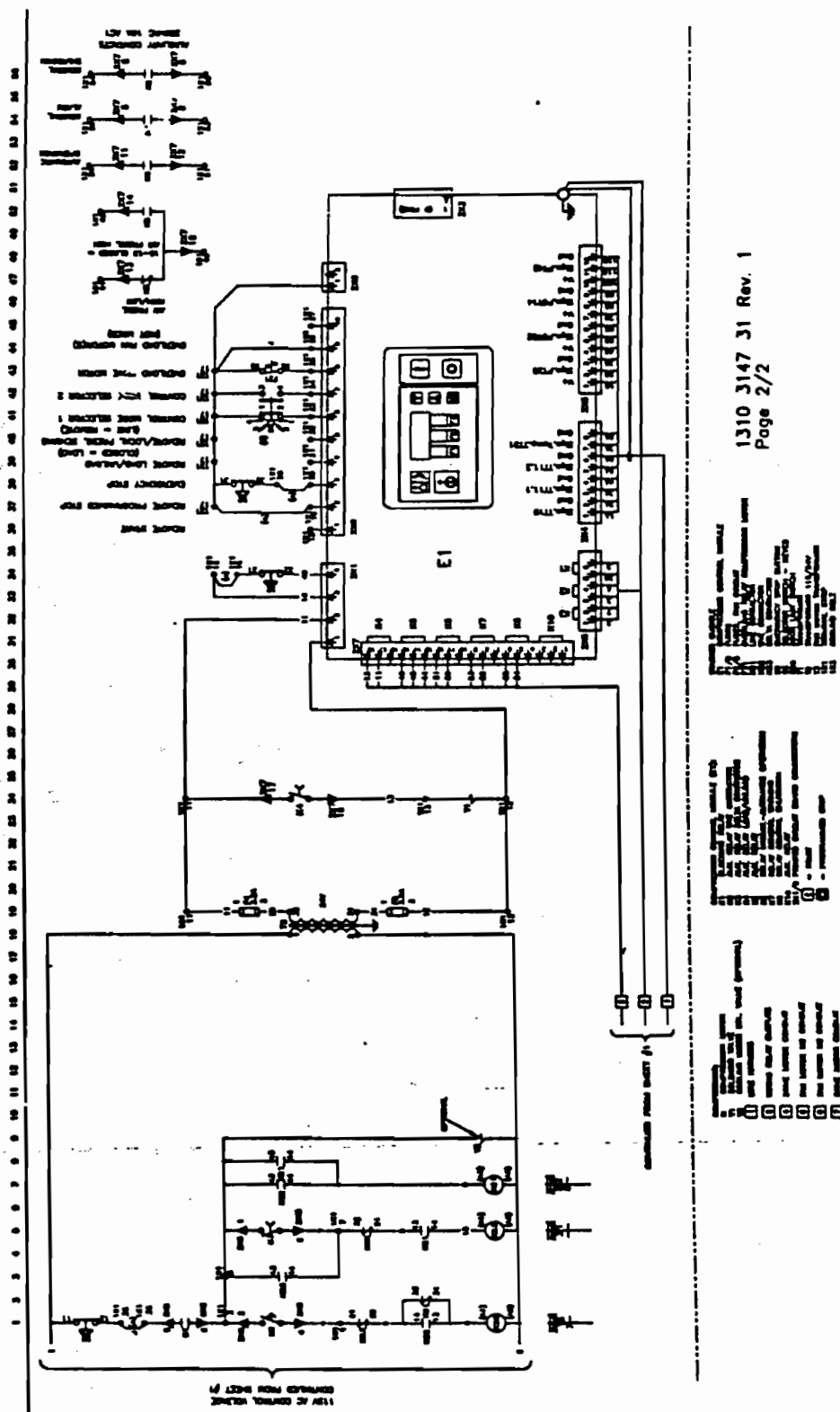


Fig. 6b Service diagram GA 200-315 Water cooled YD Page 2

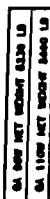
2.1 Dimension drawings



DIMENSIONS ARE IN INCHES

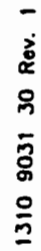
1310 9012 29 Rev. 1

Fig. 7a General Arrangement GA 90-110 Air cooled

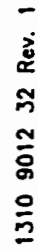


TECHNICAL STAFF

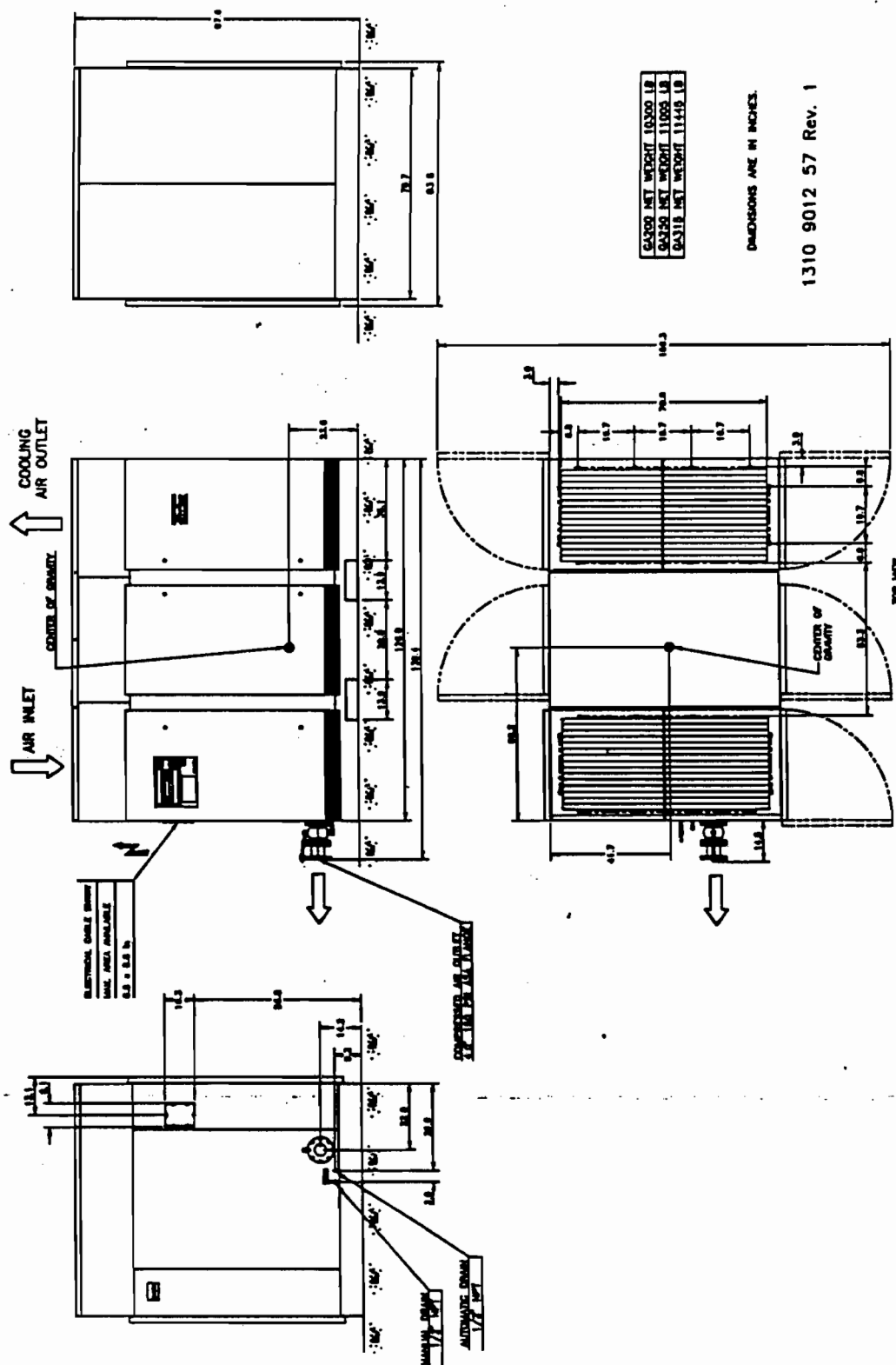
1310 9012 31 Rev. 1



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GA200 NET WEIGHT	10200 LB
GA250 NET WEIGHT	11000 LB
GA315 NET WEIGHT	11400 LB

DIMENSIONS ARE IN INCHES.

1310 9012 57 Rev. 1

Fig. 7e General Arrangement GA 200-315 Air cooled



DIMENSIONS ARE IN INCHES.

1310 9012 58 Rev. 1

Fig. 71 General Arrangement GA 200-315 Water cooled

2.2 Installation proposal (Typical)

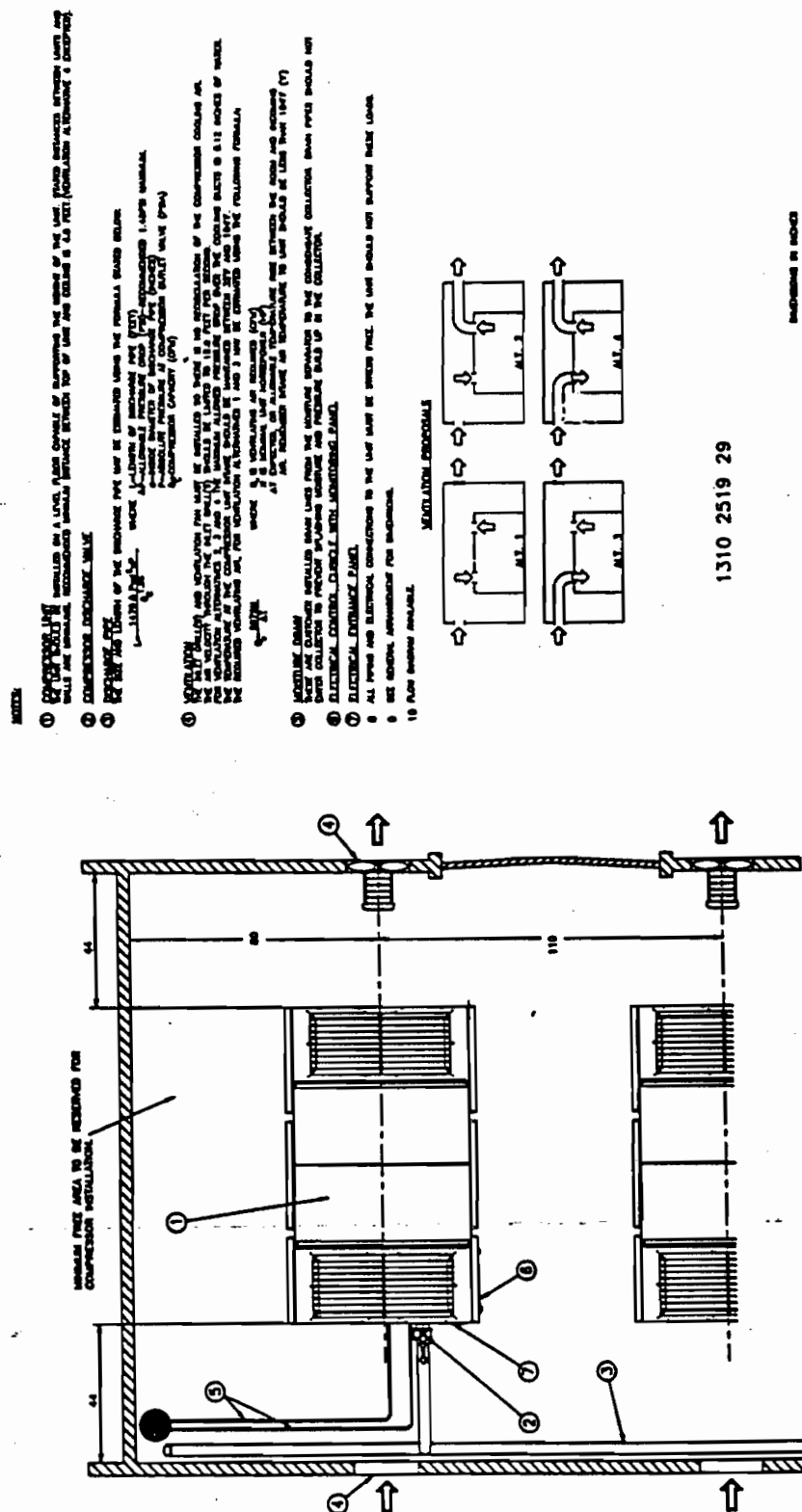


Fig. 8a Typical Installation GA 90-110 Air cooled

- NOTES:
1. CONDENSING LINE SHALL BE A LINE PLAIN CORREL OF RAMPING THE WORK OF THE UNIT. PIPES BETWEEN INTERIOR LIGHTS AND UNIT AND OUTSIDE. INTERIOR LIGHTS SHALL BE INSTALLED BETWEEN TOP OF UNIT AND CORNER OF THE TEST. (CONNECTION ALLOWANCE + EXCEPTED)
 2. CONDENSING LINE SHALL BE INSTALLED BETWEEN TOP OF UNIT AND CORNER OF THE TEST. (CONNECTION ALLOWANCE + EXCEPTED)
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 9. CONDENSING LINE SHALL BE INSTALLED BETWEEN TOP OF UNIT AND CORNER OF THE TEST. (CONNECTION ALLOWANCE + EXCEPTED)
 10. CONDENSING LINE SHALL BE INSTALLED BETWEEN TOP OF UNIT AND CORNER OF THE TEST. (CONNECTION ALLOWANCE + EXCEPTED)
 11. CONDENSING LINE SHALL BE INSTALLED BETWEEN TOP OF UNIT AND CORNER OF THE TEST. (CONNECTION ALLOWANCE + EXCEPTED)

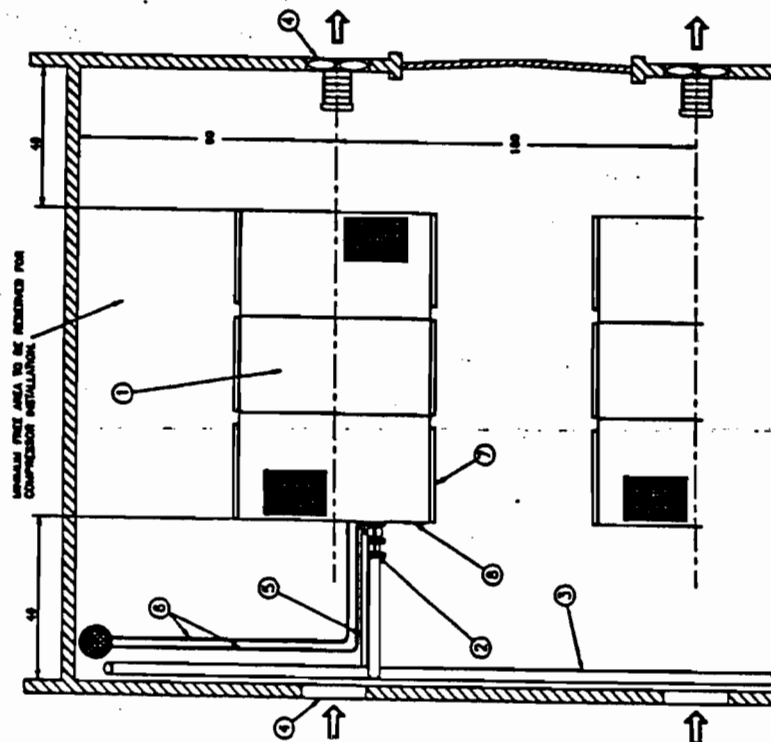
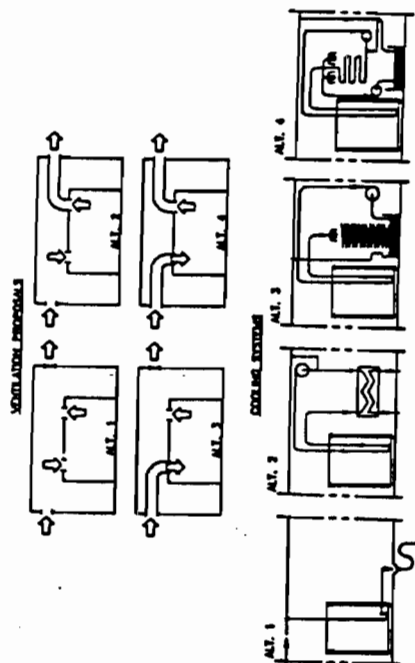


Fig. 8b Typical installation GA 200-315 water cooled



1310 2523 91 Rev. 0

REVISIONS IN WORK

2.3 Pictographs

Reference Fig. 9a and 9b

Following pictographs are used on the control panel (Fig. 9a):

- 1 Automatic operation
- 2 Voltage on
- 3 Start
- 4 Stop
- 5 Compressor locked (in off position)
- 6 Local control
- 7 Remote control (by external switches)
- 8 Remote control (by computer)
- 9 Emergency stop
- 10 Key to scroll through display
- 11 Key to go to next field on display
- 12 Alarm

Flow diagram

The air system is colored in blue, the oil system in yellow.

- 13 Check valve
- 14 Oil separator
- 15 Coolers
- 16 Condensate trap
- 17 Outlet
- 18 Oil filter
- 19 Air filter
- 20 Valve
- 21 Bypass valve
- 22 Compressor element(s)

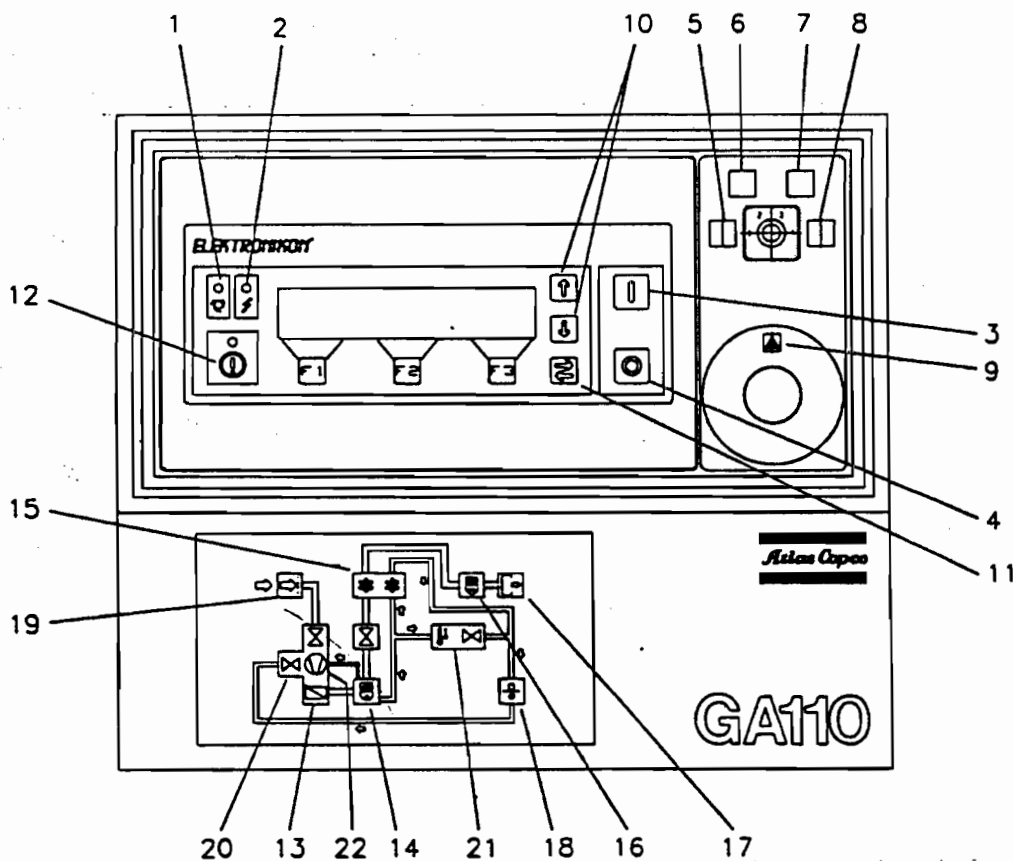


Fig. 9a Pictographs on control panel

Fig. 9b shows examples of pictographs which may be attached to the compressor:

- 57 Water outlet
- 58 Water inlet
- 59 Manual condensate drain
- 60 Automatic condensate drain
- 61 Before connecting compressor electrically, consult Instruction book for motor rotation direction
- 62 Torques for steel (Fe) or brass (CuZn) bolts

- 63 Consult Instruction book before greasing
- 64 Switch off voltage before removing protecting cover inside electric cubicle
- 65 Switch off voltage and depressurize compressor before maintenance or repair
- 66 Oil gasket, screw on filter and then tighten by hand
- 67 Consult Instruction book before maintenance or repair

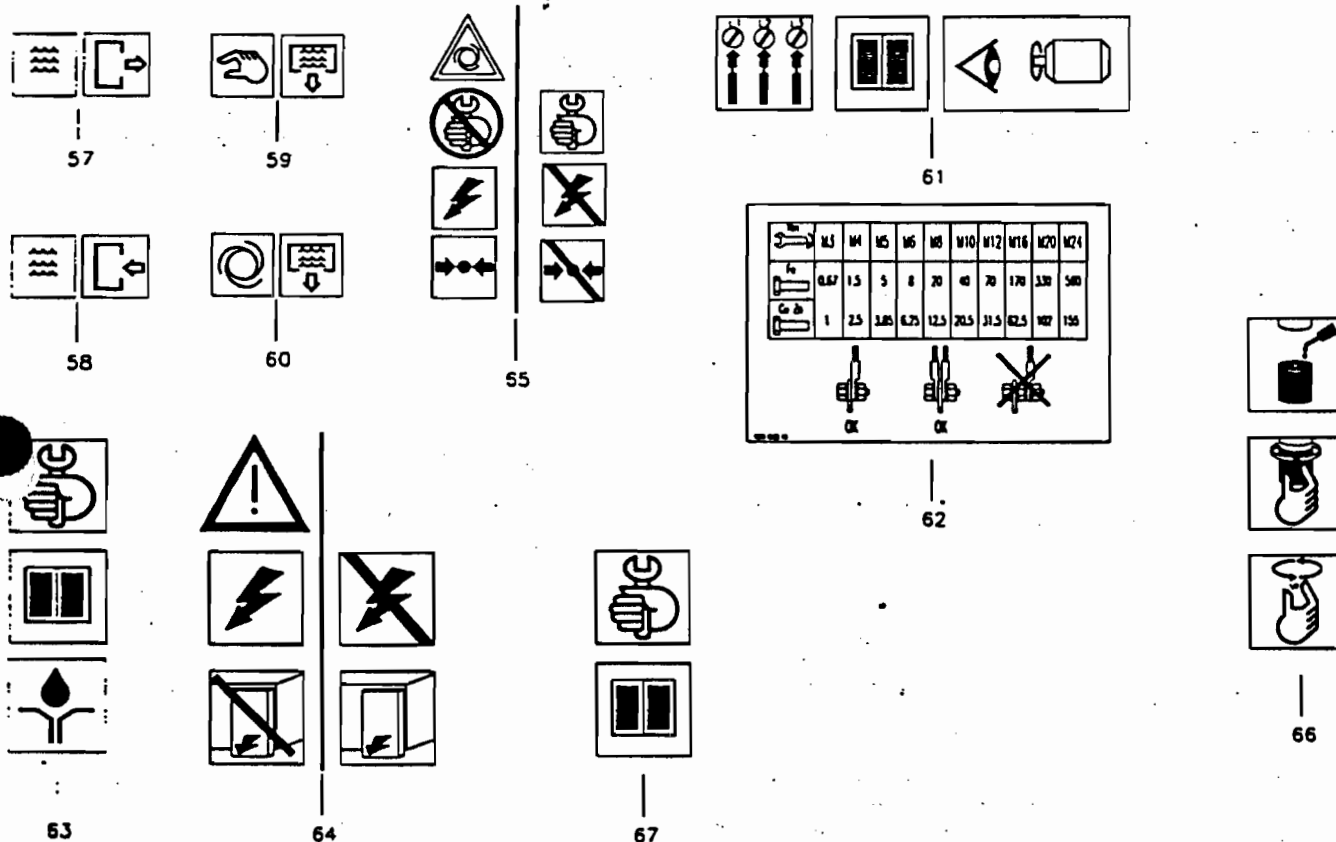


Fig. 9b Pictographs (typical examples)

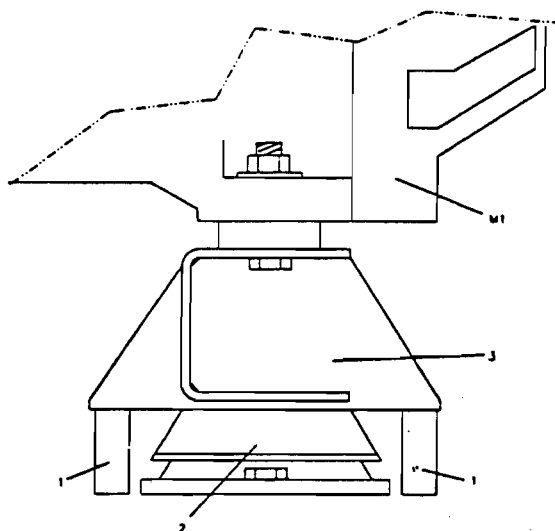


Fig. 10 Compressor motor support

M1	Drive motor
1	Bushing, to be removed
2	Vibration damper
3	Motor support

3 Operating instructions

3.1 Initial start-up

Safety

The operator must apply all relevant safety precautions, including those mentioned in this book.

Outdoor/altitude operation

If the compressor is installed outdoors or if the air inlet temperature can be below 32°F, precautions must be taken. In this case, and also if operating above 9800ft., consult your local Atlas Copco representative.

Moving/lifting

The compressor can be moved by a lift truck using the slots in the frame. Make sure that the forks protrude from the other side of the frame. The compressor can also be lifted after inserting beams in the slots. Make sure that the beams cannot slide and that they protrude from the frame equally. The chains must be held parallel to the enclosure by chain spreaders in order not to damage the compressor. The lifting equipment must be placed in such a way that the compressor will be lifted perpendicularly. Lift smoothly and avoid twisting.

Start-up

1. The compressor element supports and motor support are secured to the frame, immobilizing the vibration dampers during transport. Remove the stud and nuts (1-Fig. 14a and 14b) of both compressor element supports as well as the bushing (1-Fig. 10) of the motor support.
2. Check that the electrical connections correspond to the local codes. Check the connections for correct tightness. An isolating switch must be installed near the compressor.
3. Check transformer (T1-Fig. 6a and 6b) for correct connection, the settings of the drive motor overload relay (F21-Fig. 6a and 6b). See section 6.3.
4. Check oil level. Consult section 3.4. Remove filler plugs (FC2-Fig. 4a and 4b) from each element. Pour 1 quart of oil into each compressor element. Reinstall the plugs. Do not mix oils.
5. Fit the air outlet valve (AV-Fig. 3). Close the valve. Connect the air system to the valve.
6. Connect the manual condensate drain valve (Dma-Fig. 3). Close the valve. Connect the valve to the drain collector.
7. Connect the automatic condensate drain outlet (Daa-Fig. 3) to the drain collector.
8. On water cooled compressors, drain valves should be fitted by the customer in the water inlet and outlet pipes. Also, provide and open the water inlet and regulating valves. Consult section 4.6 for cooling water requirements.
9. Labels are delivered with the compressor, warning the operator that:
 - The compressor automatically restarts after voltage failure (see section 1.3.2)
 - the compressor is automatically controlled and may be restarted, even after manually stopping (see section 1.3.2)

Stick these labels in an obvious place near the control panel. Read these warnings (as well as the warnings mentioned in section 1.3.2) and take them into account.
10. Switch on the voltage. Start the compressor and stop it immediately. Check the rotation of the drive motor, and on air cooled units, also of the fan motor(s) 1) When facing the drive end shaft of the motors, the correct rotation is counter-clockwise for both the compressor motor and fan motor(s) 1). First, check the drive motor (M1). If the rotation direction is wrong, switch off the voltage and reverse two incoming electric lines. Then, check fan motor (M2). If necessary, switch off the voltage and reverse two incoming connections at the terminals of circuit breaker (Q15). If provided, also check fan motor (M3). If necessary, switch off the voltage and reverse two incoming connections at the terminals of circuit breaker (Q16).
11. Check the programmed settings. 2)
12. Open air outlet valve (AV-Fig. 3). On water cooled compressors, open the cooling water inlet valve and regulating valve.

13. Start and run the compressor for a few minutes. Check that the compressor operates normally.

- 1) GA 90 and GA 110 have one fan motor and circuit breaker.
GA 160 up to 315 have two fan motors and circuit breakers.
- 2) Consult the "User manual for Elektronikon® Regulator 4x40 display", section "Modify settings" 0 submenus.

3.2 Before starting

Reference Fig. 5a

Safety

The operator must apply all relevant safety precautions, including those mentioned in this book.

1. Switch on the voltage. Voltage on LED (2) lights up. The message **compressor off** appears on the display (4).
2. Close condensate drain valve (Dma-Fig. 3).
3. Open air outlet valve (AV-Fig.3).
4. Check the oil level (LI41-Fig. 4a and 4b). The pointer should register in the green range or in the orange range.

On water cooled compressors also:

5. Check that the cooling water drain valves (customer's installation) in the inlet and outlet pipes are closed.
6. Open the cooling water inlet valve (customer's installation).

7. Open the water flow regulating valve (customer's installation). This step can be overlooked if, after previous operation, the setting of this valve has not been disturbed.

3.3 Starting

Reference Fig. 5a

1. Press start button (8). The compressor starts running in unloaded condition. Automatic operation LED (1) lights up. For wye-delta starting, ten seconds 1) after pressing button (8), the drive motor switches over from wye to delta. At the same time 1), the compressor starts running loaded. The message on the display (4) changes from **Auto unloaded** to **Auto loaded**. For direct-on-line starting, drive motor starts immediately after pressing button (8).

On watercooled compressors also:

2. Regulate the cooling water flow during loaded running to obtain the most suitable air temperature at the outlet of the compressor element, i.e., between 4°F above the relevant temperature in Fig. 11 and approx. 9°F above that value. Refer to the example below Fig. 11.

For optimum operation, the cooling water outlet temperature must never exceed the value specified in section 6.4.1. Consult your local Atlas Copco representative if condensate should be formed during frequent unloading periods.

1) Programmable

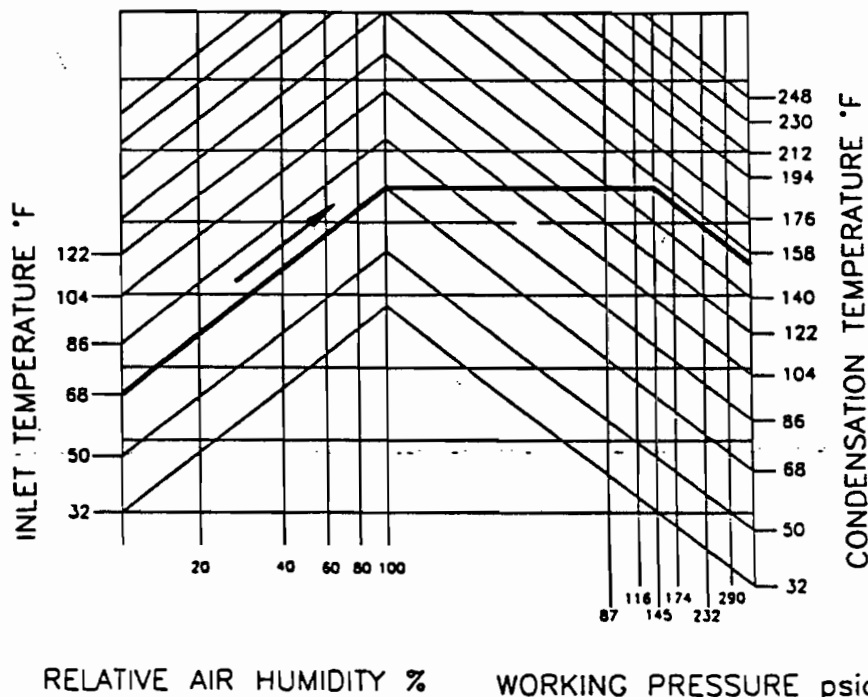


Fig. 11 Minimum allowable air temperature at outlet of compressor elements for watercooled units

Example:

If operating at a pressure of 145psi in an ambient temperature of 68°F and a relative air humidity of 100%, the minimum temperature to prevent condensate from forming is 154°F. Regulate the cooling water flow during loaded operation to obtain a temperature between 158°F and approx. 163°F at the outlet of the compressor element.

3.4 During Operation

Reference Fig. 5a

1. Check the oil level during loaded operation: the pointer of the level indicator (LI41-Fig. 4a and 4b) must register in the green range; if it is in the low range, press button (stop button) (9), wait until the compressor has stopped and switch off the voltage.
2. Depressurize the oil system by unscrewing the oil filler plug (FC1-Fig. 1) one turn, replace plug wait a few minutes and add oil until the level reaches the filler plug. Replace and tighten the plug.
3. If automatic operation LED (1) is lighted, the regulator is automatically controlling the compressor, i.e., loading, unloading, stopping of the motors and restarting.

Important

1. If the compressor is stopped, it may start automatically. See also section 1.3.
2. To avoid unauthorized switching over to another control mode, take out key (S5) after selecting the required mode. See also section 3.4.3.

3.4.1 Checking the display

Reference Fig. 5a and 5b

1. Regularly check the display for readings and messages. Normally, the main display is shown, indicating the compressor outlet pressure, the status of the compressor and the functions of the keys below the display.
2. Always check the display (4) and remedy the trouble if alarm LED (3) is lighted or blinks. Consult the "User manual for Elektronikon® regulator - 4x40 display", section "Status data submenu".
3. The display (4) will show a service message if one of the monitored components is to serviced: replace the component and reset the relevant timer. Consult the "User manual for Elektronikon® regulator - 4x40 display" section "Service submenu".

Warning

Before carrying out any maintenance, repair or adjustment, stop the compressor, press emergency stop button (S2), switch off the voltage and depressurize the compressor.

Notes

- Whenever a warning, service request, sensor error or motor overload message is displayed, the free spaces on the display between the function keys (5) are filled with blinking indicators (***).
 - When more than one message needs to be displayed (e.g. both warning and service), the message will be displayed one after the other for 3 seconds.
4. Regularly press the key Show More (5) 2) to call up information about the actual compressor condition:
 - the status of controlling the compressor (automatic or manual, local or remote)
 - the status of the compressor start/stop timer (on or off) 1)

- the maximum allowable unloading pressure
- the compressor outlet pressure
- the pressure drop across the air filter
- the pressure difference across the oil separator
- the oil injection pressure at compressor element 1 3)
- the compressor outlet temperature
- the outlet temperature at compressor element 1 3)
- the cooling air inlet temperature (on GA) or cooling water outlet temperature (on GA W)
- the status of the overload protection of both the drive motor and fan motor (normal or not)
- the total running and loading hours

- 1) The compressor is automatically started and stopped if these start/stop commands are programmed and active: consult section 1.3.2.
- 2) If the function Show More is not indicated on the bottom line of display (4), press key Menu (5) until function Main Screen appears above key (F1), then press the key Main Screen.
- 3) GA 90/160 have one compressor element, GA 200/315 two elements, "element 1" represents the element at the outer side.

3.4.2 External Compressor status indication

The electronic regulator is provided with auxiliary contacts (K6, K7 and K8) at the back of the electronic module for external indication of:

- automatic operation (K6)
- warning condition (K7)
- shut-down condition (K8)

Maximum load for these contacts: 10A/250VAC. Stop the compressor and switch off voltage before connecting external equipment.

3.4.3 Compressor Control Modes

Key switch (S5-Fig. 5a) allows the selection of four modes:

Key position	Compressor Control Mode
1	Compressor off
2	Local control mode (remote control mode is made inactive). The compressor can only be controlled by the buttons on the control panel. The compressor can be started and stopped by the Timer function (see section 1.3.2), if programmed and if activated.
3	Remote control mode 1 (local control is made inactive). The compressor can only be started and stopped by external switches. Emergency stop button (S2) remains active. Compressor start/stop commands via function Timer (see section 1.3.2) are still possible, if programmed and active.

Key position	Compressor Control Mode
4	Remote control mode 2. The compressor can be controlled by computer. Consult your local Atlas Copco representative.

Important

To avoid unauthorized switching over to another control mode, take out the key after selecting the required mode.

3.5 Manual Control

Reference Fig. 5a 1)

Normally, the compressor runs in automatic operation, i.e. the electronic regulator loads, unloads, stops and restarts the compressor automatically. LED (1) is then lighted.

If required, the compressor can be unloaded manually. In this case, the compressor is switched out of automatic operation, i.e. the compressor remains running unloaded unless it is loaded again manually.

Manually unloading

Press the key Unload (5). LED (1) goes out. The message **Manually Unloaded** appears on the display.

Manually loading

Press the key Load (5). LED (1) lights up. The command Load does not force the compressor in loaded condition, but it will switch the compressor to automatic operation again, i.e. the compressor will be loaded if the system pressure drops below the programmed level.

Manually starting

In automatic operation, the regulator limits the number of motor starts. Observe an interval of 20 minutes between each manual start.

1) If the Load or Unload function is not indicated on the bottom line of display (4), press key Menu (5) until the function **Main Screen** appears above key (F1), then press the key **Main Screen**.

3.6 Stopping

Reference Fig. 5a

1. Press stop button (9). LED (1) goes out. The message **Programmed stop** appears. The compressor runs unloaded for 30 seconds and then stops.
2. To stop the compressor in case of emergency, press button (S2). Alarm LED (3) blinks. After remedying the fault, unlock the button by turning it counterclockwise and press the key **Reset**, the message **all protection functions are ok** will appear after which the compressor can be restarted. Press the keys **Menu** and **Main Screen** to return to the main display (Fig. 5b)
3. Close air outlet valve (AV-Fig.3) and switch off the voltage.
4. Open condensate drain valve (Dma-Fig.3).
On watercooled compressors only:
5. Close the cooling water inlet valve.
6. If freezing temperature are expected, drain the cooling system.

3.7 Taking out of operation

When the compressor is to be taken out of operation, proceed as follows:

1. Stop the compressor and close the air outlet valve.
2. Switch off the voltage and disconnect the compressor from the power supply.
3. Depressurize the compressor by opening plug (FC1-Fig. 1) one turn and valve (Dma-Fig. 3).
4. Shut off and depressurize the part of the air system which is connected to the outlet valve. Disconnect the compressor air outlet pipe from the air system.
5. Isolate and disconnect the compressor water system from the cooling water system.
6. Drain the oil, water and condensate circuits.
7. Disconnect the compressor condensate piping from the condensate drain system.

4 Maintenance

Before carrying out any maintenance or repair on the compressor, press stop button (9-Fig. 5a), wait until the compressor has stopped (approx. 30 seconds) and then press emergency stop button (S2), and switch off the voltage. Depressurize the air system. Apply all relevant safety precautions, including those mentioned in this book.

4.1 Preventive maintenance schedule for the compressor

Read the respective section before taking maintenance measures. When servicing, replace all disengaged gaskets, O-Rings, washers. The "longer interval" checks must also include the "shorter interval" checks. The local Atlas Copco Sales Company may overrule the maintenance schedule, especially the service intervals, depending on the environmental and working conditions of the compressor.

Period 1)	Running hours 1)	See section	See note	Action
Daily				Before starting
				Check oil level (LI41)
				Empty dust trap of air filter (AF), if necessary
		3.4		During Operation
	8			Check readings on display
	8			Check that condensate is discharged (Daa) during loading
	8			Check oil level (LI41)
				After stopping
				Drain condensate (Dm)
3-Months		5.3		Check safety valve (SV)
			4	Check for possible leaks
	500	5.2		Check coolers (Ca and Co); clean if necessary
	500		1,2	Remove air filter elements (AF) inspect and replace if necessary.
Yearly		5.3		Have safety valve (SV) tested
				Have operation of sensors, electrical interlocking and components tested by an electrician
			1,2	Inspect and replace air filter elements (AF), if necessary
				Check restrictor (Rf2) and also restrictor upstream of oil stop valve (Vs) for cleanness
	2000			Remove, dismantle and clean float valve of moisture trap (MTa)
			5	Have all hoses inspected
	2000	3.4	2	Replace oil filters (OF)
2 Years	4000	3.4	6	Change oil (GA-4K or GA-FG)
	8000	3.4	6	Change oil (GA-8K)
	8000		3	Have oil separator element replaced

- 1) Whichever interval comes first. The local Sales Company may overrule the maintenance schedule, especially the service intervals, depending on the environmental and working conditions of the compressor.

Remarks

For overhauling valves or carrying out preventive maintenance, service kits are available. Consult the Parts List for the contents of the kits.

- Inspect more frequently when operating in a dusty atmosphere.
- Use Atlas Copco filters.
- The separator element must be replaced bi-yearly or each 8000 running hours or when the pressure difference over the element exceeds 12 psi. Check the pressure drop when the compressor is running loaded and preferably with a stable working pressure.
- Any leak should be attended to immediately.
- Damaged hoses must be replaced immediately.
- More frequently for discharge temperature exceeding 200°F.

4.2 Motors

4.2.1 Compressor motor (M1)

Reference Fig. 1

The greasing interval and the correct type and quantity of grease for lubricating the bearings are stressed. Stop the compressor before greasing. The bearings should be regreased per the motor manufacturer's instruction.

4.2.2 Fan motor(s) (Air cooled only)

GA 160 up to GA 315 have two fan motors (M2 and M3-Fig. 14). GA 90 and GA 110 have one fan motor (M2). The bearings of the motors must be replaced after 25,000 operating hours.

4.3 Oil and oil filter change interval

Consult section 4.1 for the change intervals and section 4.4 for the oil specification.

The oil change interval depends on the working temperature. See sections 4.4.1 - 4.4.3 for examples.

As a rule, a 15°F increase in continuous operating temperatures will half the lubricant life.

4.4 Oil specifications

Through precise formulation, Atlas Copco has developed three GA lubricants for their line of rotary screw compressors. Each GA lubricant has the necessary anti-oxidant, anti-wear and demulsibility properties that yield consistent viscosity over an extended service life.

For detailed changing or lubricant conversion procedures, refer to GA lubricant literature Atlas Copco part number 1310 9050 78.

Atlas Copco lubricant product specifications

TYPICAL PROPERTIES	TEST METHOD	GA-4K
Viscosity (Cst)		
@ 0 °F	ASTMD445	2100
@ 100 °F	ASTMD445	38.0
@ 210 °F	ASTMD445	6.0
Viscosity index	ASTMD2270	109
Pour point (°F)	ASTMD97	-34
Flash point (°F)	ASTMD92	415
Four ball wear test	ASTMD2266	0.48
Demulsibility	ASTMD1401	40/39/1
Total acid number	ASTMD974	0.80
Specific gravity	ASTMD1298	0.862

TYPICAL PROPERTIES	TEST METHOD	GA-8K
Viscosity (Cst)		
@ 0 °F	ASTMD445	1496
@ 100 °F	ASTMD445	47.3
@ 210 °F	ASTMD445	7.8
Viscosity index	ASTMD2270	140
Pour point (°F)	ASTMD97	-55
Flash point (°F)	ASTMD92	475
Four ball wear test	ASTMD2266	0.43
Demulsibility	ASTMD1401	40/38/2
Total acid number	ASTMD974	0.22
Specific gravity	ASTMD1298	0.8745

TYPICAL PROPERTIES	TEST METHOD	GA-FG
Viscosity (Cst)		
@ 0 °F	ASTMD445	2995
@ 100 °F	ASTMD445	62.9
@ 210 °F	ASTMD445	9.1
Viscosity index	ASTMD2270	133
Pour point (°F)	ASTMD97	-50
Flash point (°F)	ASTMD92	465
Four ball wear test	ASTMD2266	0.64
Demulsibility	ASTMD1401	40/39/1
Total acid number	ASTMD974	0.17
Specific gravity	ASTMD1298	0.8332

4.4.1 GA-4K

A super-refined double hydrogenated and de-waxed compressor lubricant. Under normal operating conditions, 190-200°F discharge temperature, lubricant life of 4000 hours can be expected.

4.4.2 GA-FG

For applications in the food industry, GA-FG is authorized by the USDA for use in federally inspected plants, GA-FG complies with FDA 21 CFR 178.3570 for lubricants with incidental contact. Under normal operating conditions, 190-200°F discharge temperature, lubricant life of 4000 hours can be expected.

4.4.3 GA-8K

A specially blended PAO (polyalphaolefin) based lubricant. Under normal operating conditions, 190-200°F discharge temperature, lubricant life of 8,000 hours can be expected.

4.5 Oil change

1. Run the compressor until warm. Stop the compressor and switch off the voltage. Wait a few minutes and depressurize the compressor by unscrewing plug (FC1-Fig.1) only one turn to permit any pressure in the system to escape.
2. Drain the oil by removing the drain plugs. Plugs are provided on the air receiver (DP1-Fig. 4a and 4b), oil stop valve (DP2-Fig. 15) (on GA 200 up to 315 one plug for each valve), check valve (DP3-Fig. 15a) (on GA 200

up to 315 one plug for each valve), oil cooler (DP4-Fig.4a and 4b) (two plugs on GA 160 up to GA 315) and gearbox (DP7-Fig. 15a). Tighten the plugs after draining.

3. Remove filler plug (FC1-Fig. 1). Fill the air receiver with oil until the level reaches the filler neck. Reinstall and tighten plug (FC1).
4. Run the compressor loaded for a few minutes to allow the oil cooler by-pass valve(s) to open. Stop the compressor and wait a few minutes. Depressurize the system (Consult step 1.). Remove filler plug (FC1-Fig. 1). Fill the air receiver with oil until the level reaches the filler neck. Tighten plug (FC1).
5. Reset the oil service warning using the key **Reset** in submenu **Service. 1)**

4.6 Oil filter change

1. Stop the compressor, switch off the voltage and depressurize it. See step 1 of section 4.4.
2. Remove the oil filters.
3. Clean the filter seats on the manifold. Oil the gasket of the new elements. Screw the elements into place until the gaskets contact their seats, then tighten by hand one half turn only.
4. Tighten filler plug (FC1).
5. Reset the oil filter service warning using the key **Reset** in submenu **Service. 1)**

4.7 Cooling water requirements

Following requirements are given as a general rule to prevent cooling water problems. If in any doubt, consult your local Atlas Copco representative.

Recommended maxima	Recirculating system	Pass-through system
Chloride (Cl)	<600 mg/l	<150 mg/l
Sulphate (SO ₄)	<400 mg/l	<250 mg/l
Total solids	<3000 mg/l	<750 mg/l
Suspended solids (as SiO ₂)	<10 mg/l	<10 mg/l
Free chlorine (Cl ₂)	<4 mg/l	<2 mg/l
Ammonia (NH ₄ ⁺)	<0.5 mg/l	<0.5 mg/l
Copper	<0.5 mg/l	<0.5 mg/l
Iron	<0.2 mg/l	<0.2 mg/l
Manganese	<0.1 mg/l	<0.1 mg/l
Oxygen	<3 mg/l	<3 mg/l
Carbonate hardness (as CaCO ₃)	50-1000 mg/l	50-500 mg/l
Organics (KMnO ₄ Consumption)	< 25 mg/l	< 10 mg/l
No algae		
No oil		
Remarks		

Chloride and sulphate are interactive. In pass-through systems the square sum of these values must not exceed 85,000. Recirculating systems with proper controls and treatment may permit a square sum up to 520,000. Note that the sulphate value must include any sulphite present.

4.8 Storage after installation

Run the compressor twice a week until warm. Load and unload the compressor a few times to operate the components of the unloading/loading system.

If the compressor is going to be stored without running from time to time, protective measures must be taken. Consult your local Atlas Copco representative.

4.9 Service kits

Service kits are available offering the benefits of genuine Atlas Copco parts at an affordable price. The ordering numbers are mentioned in the parts list for GA 90-315.

5 Adjustments and servicing procedures

5.1 Air filters

Reference Fig. 12

1. Stop the compressor and switch off the voltage. Remove the filter element. Discard damaged elements.
2. Fit the new filter element. Take care to fit the filter element correctly as shown in Fig. 12. (center gasket as shown)
3. Reset the air filter service warning using the key **Reset** in submenu **Service 1)**.

5.2 Coolers

Keep the coolers clean to maintain the cooling efficiency.

On Air-cooled compressors

Unscrew bolts (3-Fig. 13) and rotate the fans away from the cooler block. Blow air from the compressor element compartment through the coolers towards the drive motor compartment. Remove any dirt. If it should be necessary to wash the coolers with a cleansing agent, consult your local Atlas Copco representative. Reposition and secure the fans. Make sure that the fans rotate freely.

On Water-cooled compressors

Consult your local Atlas Copco representative for cleaning.

5.3 Safety valve

Reference Fig. 1

Operating

Operate the safety valve by unscrewing the cap one or two turns and retightening it or by pulling the valve lifting lever.

Testing

The valve can be tested on a separate compressed air line. If the valve does not open at the pressure specified in specified in section 6.2, consult your local Atlas Copco representative. No adjustments are allowed. Never run the compressor without safety valves.

- 1) See "User manual for Elektronikon® regulator - 4 X 40 display"

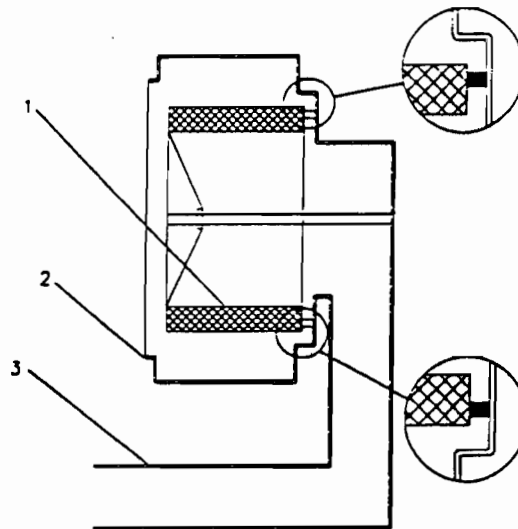


Fig. 12 Correct position of air filter

- 1 Filter
- 2 Filter chamber
- 3 Air inlet pipe

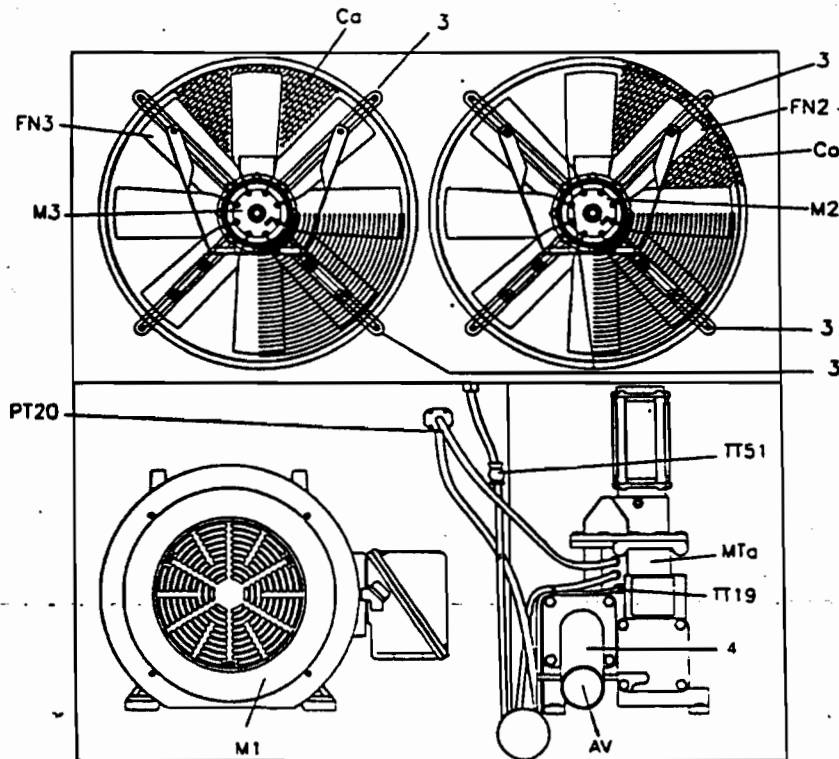


Fig. 13 View of drive motor and cooling components of GA

- AV Air outlet valve
- Ca Air cooler
- Co Oil cooler
- FN2/3 Fans
- M1 Compressor motor
- M2/3 Fan motor
- MTa Moisture trap

- PT20 Pressure sensor, air outlet
- TT19 Temperature sensor, air outlet
- TT51 Temperature sensor, cooling air
- 3 Bolt
- 4 Air outlet pipe

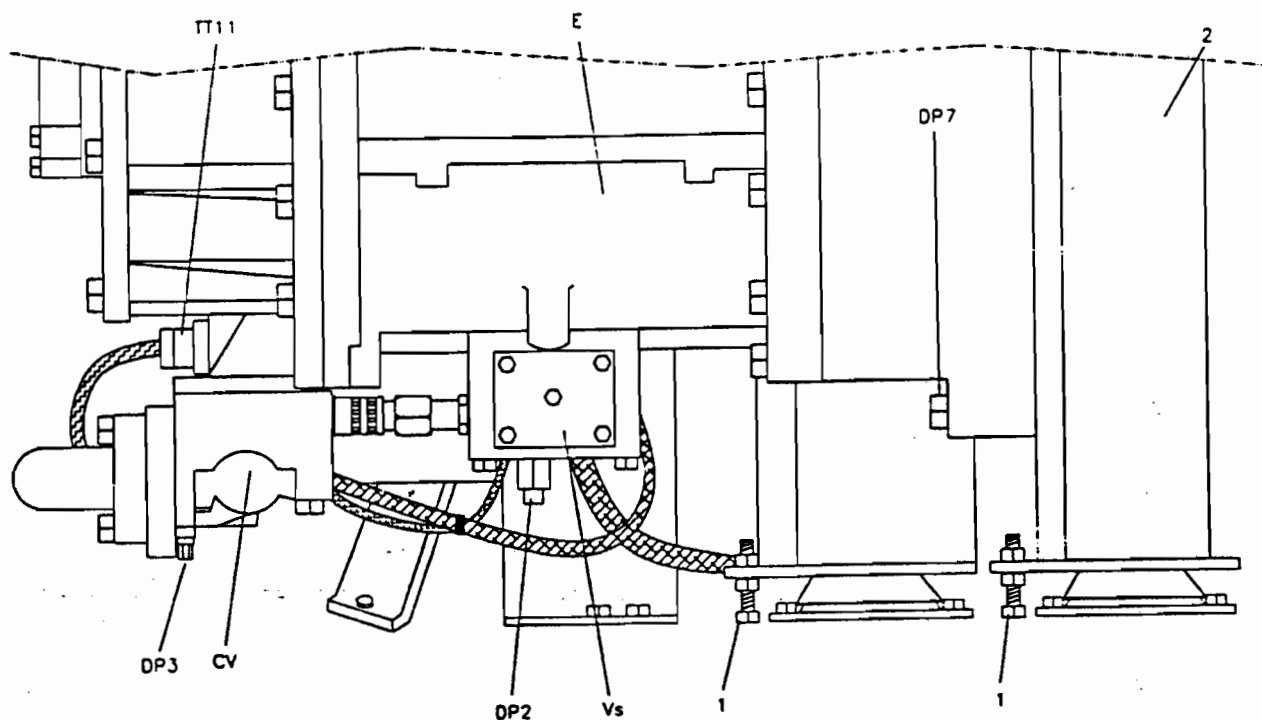


Fig. 14a View of compressor element GA 90 up to GA 160

CV Check valve
 DP2 Oil drain plug, oil stop valve
 DP3 Oil drain plug, check valve
 DP7 Oil drain plug, gear box

E compressor element
 TT11 Temperature sensor, compressor element outlet
 Vs Oil stop valve
 1 Shipping stud and nuts, to be removed
 2 Compressor element support

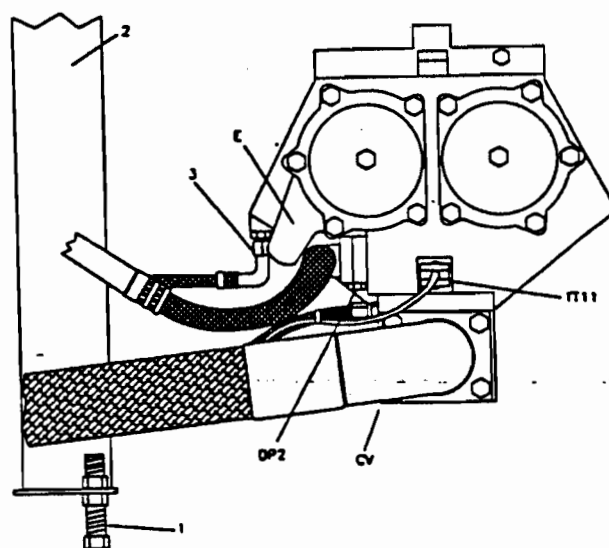


Fig. 14b View of compressor element GA 90 up to GA 160

CV Check valve
 DP2 Oil drain plug, oil stop valve
 E Compressor element
 TT11 Temperature sensor, compressor element outlet

1 Shipping stud and nuts, to be removed
 2 Compressor element support
 3 Oil scavenging hoses

6 Principal data

6.1 Readings on display

Reference Fig. 5b

Normally the main display (Fig. 5b) is shown, indicating the actual air outlet pressure (which modulates between the programmed values) and the actual compressor status (e.g. Automatically Loaded)

The key Show More allows the operator to call up other information about the condition of the compressor. See section 3.4.1.

Reference	Reading
Maximum unloading pressure ..	See section 6.4
Compressor outlet pressure	Depends on programmed unloading and loading pressures
Pressure drop over air filter	Below .725 psi or 20 in. H ₂ O
Pressure difference over oil separator	Below 12.0 psi
Oil injection pressure at compressor element	Depends on programmed unloading and loading pressures
Compressor outlet temperature .	See section 6.4
Compressor element outlet temperature	Between 158°F and 212°F
On air cooled compressors	
Cooling air inlet temperature ...	Below 104°F
On water cooled compressors	
Cooling water temperature	Below 122°F

6.2 Setting of safety valve

Compressor Type	Safety valve Set pressure
GA 100 psi	175 psig
GA 125 psi	175 psig
GA 150 psi	175 psig
GA 200 psi	225 psig

6.3 Setting of overload relay, circuit breakers and fuses

Drive motor overload relay (F21) and fuses

Compressor type	Supply voltage (V)	Range setting of F21 DOL (A)	Range setting of F21 YD (A)	Max. fuse ratings (A) UL Class RK1
GA90	200	341-374A	188-205A	600
GA90	230	274-298A	171-187A	500
GA90	460	142-155A	85-92A	250
GA90	575	118-129A	74-78A	200
GA110	230	341-374A	225-244A	600
GA110	460	171-187A	102-110A	300
GA110	575	142-155A	85-92A	250
GA160	460	225-244A	130-141A	400
GA160	575	188-205A	108-117A	300
GA200	460	311-340A	171-187A	500
GA200	575	236-259A	142-155A	400
GA250	460	341-374A	206-224A	500
GA250	575	284-310A	156-170A	450
GA315	460	412-448A	227-249A	600
GA315	575	341-374A	189-206A	500

Fan motor circuit breakers (Q15 and Q16, air cooled only)

60Hz Compressors

Compressor type	Supply voltage (V)	Max. setting of circuit breaker (A)
GA90/160	200	14.5
GA90/160	230	11.1
GA90/160	460	6.2
GA90/160	575	4.5
GA200/315	460	10.4
GA200/315	575	8.0

6.4 Compressor specifications

6.4.1 Reference conditions/limitations

Reference conditions

Air inlet pressure (absolute)	psia	14.5
Air inlet temperature	°F	68
Relative humidity	%	0
Working pressure	psig	See nominal pressures in sections 6.4.2/6.4.7

On water cooled compressors:

Cooling water inlet temperature . . .	°F	68

Limitations

Maximum inlet temperature	°F	104
Minimum inlet temperature	°F	32
Maximum cooling water inlet temperature (open systems)	°F	104
Maximum cooling water inlet temperature (recirculating systems)	°F	104
Maximum cooling water outlet temperature (open systems)	°F	122
Maximum cooling water outlet temperature (recirculating systems)	°F	140
Maximum cooling water inlet pressure	psi	72.4

6.4.2 Specific data of GA90 1)

Compressor type	100 psig	125 psig	150 psig	200 psig
Frequency	Hz	60	60	60
Maximum (unloading) pressure . . .	psi	107	132	157
Nominal working pressure	psi	100	125	150
Minimum working pressure	psi	58	58	58
Recommended cooling water flow 2)	gal/min	32	32	32
Temperature at outlet valve, approx. 1)	°F	81	81	81
Motor, GE	type	5K	5K	5K
Motor shaft speed	r/min	1785	1785	1785
Prime mover input power 1)	HP	125	125	125
Fan motor (GA90 air cooled), Leroy Somer LS		100L-4	100L-4	100L-4
Oil capacity, approx.	gal	20	20	20

1) At reference conditions

2) At temperature rise of 18°F

6.4.3 Specific data of GA110 1)

Compressor type	100 psig	125 psig	150 psig	200 psig
Frequency Hz	60	60	60	60
Maximum (unloading) pressure . . . psi	107	132	157	200
Nominal working pressure psi	100	125	150	193
Minimum working pressure psi	58	58	58	58
Recommended cooling water flow 2) gal/min	38	38	38	38
Temperature at outlet valve, approx. 1) °F	82	82	82	82
Motor, GE type	5K	5K	5K	5K
Motor shaft speed r/min	1790	1790	1790	1790
Prime mover input power 1) HP	150	150	150	150
Fan motor (GA110 air cooled), Leroy Somer LS 100L-4	100L-4	100L-4	100L-4	100L-4
Oil capacity, approx. gal	20	20	20	20

6.4.4 Specific data of GA160 1)

Compressor type	100 psig	125 psig	150 psig	200 psig
Frequency Hz	60	60	60	60
Maximum (unloading) pressure . . . psi	107	132	157	200
Nominal working pressure psi	100	125	150	193
Minimum working pressure psi	58	58	58	58
Recommended cooling water flow 2) gal/min	54	54	54	54
Temperature at outlet valve, approx. 1) °F	86	86	86	86
Motor, GE type	5K	5K	5K	5K
Motor shaft speed r/min	1790	1790	1790	1790
Prime mover input power 1) HP	200	200	200	200
Fan motor (GA 160 air cooled), Leroy Somer LS 100L-4	100L-4	100L-4	100L-4	100L-4
Oil capacity, approx. gal	21	21	21	21

1) At reference conditions

2) At temperature rise of 18°F

6.4.5 Specific data of GA200 1)

Compressor type	100 psig	125 psig	150 psig
Frequency Hz	60	60	60
Maximum (unloading) pressure . . . psi	107	132	157
Nominal working pressure psi	100	125	150
Minimum working pressure psi	58	58	58
Recommended cooling water flow 2) gal/min	62	62	62
Temperature at outlet valve, approx. 1) °F	86	86	86
Motor, GE type	5K	5K	5K
Motor shaft speed r/min	1790	1790	1790
Prime mover input power 1) HP	250	250	250
Fan motor (GA200 air cooled), Leroy Somer LS 112M-4	112M-4	112M-4	112M-4
Oil capacity, approx. gal	33	33	33

6.4.6 Specific data of GA250 1)

Compressor type	100 psig	125 psig	150 psig	200 psig
Frequency Hz	60	60	60	60
Maximum (unloading) pressure . . . psi	107	132	157	200
Nominal working pressure psi	100	125	150	193
Minimum working pressure psi	58	58	58	58
Recommended cooling water flow 2) gal/min	76	76	76	76
Temperature at outlet valve, approx. 1) °F	86	86	86	86
Motor, GE type	5K	5K	5K	5K
Motor shaft speed r/min	1790	1790	1790	1790
Prime mover input power 1) HP	300	300	300	300
Fan motor (GA250 air cooled), Leroy Somer LS 112M-4	112M-4	112M-4	112M-4	112M-4
Oil capacity, approx. gal	33	33	33	33

1) At reference conditions

2) At temperature rise of 18°F

6.4.7 Specific data of GA315 1)

Compressor type		100 psig	125 psig	150 psig	200 psig
Frequency	Hz	60	60	60	60
Maximum (unloading) pressure ...	psi	107	132	157	200
Nominal working pressure	psi	100	125	150	193
Minimum working pressure	psi	58	58	58	58
Recommended cooling water flow 2)	gal/min	84	84	84	84
Temperature at outlet valve, approx. 1)	°F	86	86	86	86
Motor, GE	type	5K	5K	5K	5K
Motor shaft speed	r/min	1790	1790	1790	1790
Prime mover input power 1)	HP	350	350	350	350
Fan motor (GA315 air cooled), Leroy Somer LS		112M-4	112M-4	112M-4	112M-4
Oil capacity, approx.	gal	33	33	33	33

1) At reference conditions

2) At temperature rise of 18°F

6.5 Conversion list of SI units into British/US units

1 bar = 14.504 psi

1 g = 0.035 oz

1 kg = 2.205 lb

1 kW = 1.341 hp (UK and US)

1 l = 0.264 US gal

1 l = 0.220 imp gal (UK)

1 l = 0.035 cu.ft

1 l/s = 2.117 cfm

1 mm = 0.039 in

1 mbar = 0.401 in water column

1 N = 0.225 lbf

1 Nm = 0.738 lbf.ft

$x^{\circ}\text{C} = (32 + 1.8x)^{\circ}\text{F}$

A temperature difference of 1°C = a temperature difference of 1.8°F

7 Problem solving

Before starting repairs, press stop button (9-Fig. 5a), wait until the compressor has stopped (approx. 30 seconds and press emergency stop button (S2). Switch off the voltage and depressurize the compressor. Furthermore, apply all relevant safety precautions, including those mentioned in this book.

Mechanical faults and suggested remedies

1. **A service message appears on the display**
Replace the indicated component or grease the drive motor as the case may be. Consult the "User manual for Elektronikon® regulator - 4 x 40 display" to remedy the trouble and to reset the message (section "Service submenu").
2. **A shut-down warning message appears on the display**
LED (3-Fig.5a) will light up indicating that the temperature at the outlet of the compressor element is too high. See step 6. The message disappears as soon as the cause of the trouble is remedied.
3. **Unit is shut-down**
LED (3-Fig. 5a) will blink indicating either that the outlet temperature is too high (see step 6) or that the motor overload relay has tripped. Consult the "User manuals for Elektronikon® regulator - 4 x 40 display" to remedy the trouble and to reset the message (Section "Status data submenu")
4. **Condensate is not discharged from moisture trap during loading**
 - a. Discharge pipe clogged
 - a. Check and correct as necessary
 - b. Float valve malfunctioning
 - b. Remove float valve assembly, clean and check
5. **Compressor air delivery or pressure below normal**
 - a. Air consumption exceeds air delivery of compressor
 - a. Check equipment connected
 - b. Choked air inlet filter elements (AF)
 - b. Clean or replace filter elements
 - c. Leak in control air hoses
 - c. Repair
 - d. Air leakages
 - d. Check and correct as necessary
6. **Element outlet or delivery air temperature above normal**
 - a. On aircooled compressors, insufficient cooling air or cooling air temperature too high.
 - a. Check for cooling air restriction. Improve ventilation of compressor room. Avoid recirculation of cooling air.
 - b. On water cooled compressors, cooling water temperature too high or flow too low
 - b. Decrease temperature, if possible, or increase water flow
 - c. Oil level too low
 - c. Check and correct as necessary
 - d. Oil cooler (Co) clogged
 - d. Consult your local Atlas Copco representative
 - e. Air cooler (Ca) clogged
 - e. Consult your local Atlas Copco representative
 - f. On water cooled compressors, restriction in cooling water system due to dirt or formation of scale
 - f. Consult your local Atlas Copco representative

SAFETY PRECAUTIONS FOR STATIONARY COMPRESSORS & EQUIPMENT (continued)

Read and understand these precautions before installing your unit
and observe them during operation and maintenance.

aftercooler or air system is free to expand under heat and that it is not in contact with or close to flammable material.

8. No external force may be exerted on the air outlet valve; the connected pipe must be free of stress and strain.

9. If remote control is installed, the unit must bear an obvious sign reading:

DANGER: This machine is remotely controlled and may start without warning.

As a further safeguard, persons switching on remotely controlled units shall take adequate precautions to ensure that there is no one checking or working on the machine. To this end, a suitably worded notice must be affixed to the starting equipment.

10. In multiple compressor systems, manual valves must be installed to isolate each compressor. Non-return valves (check valves) must not be relied upon for isolating pressure systems.

11. Never remove or tamper with the safety devices, guards or insulations fitted on the unit. Every pressure vessel or auxiliary installed outside the unit to contain air above atmospheric pressure shall be protected by a pressure-relieving device or devices as required.

12. External pipework or other parts with a temperature in excess of 175°F (80°C) and which may be accidentally touched by personnel in normal operation must be guarded or insulated. Other high-temperature pipework should be clearly marked.

13. If the ground is not level or can be subject to variable inclination, consult Atlas Copco.

14. The electrical connections must be in accordance with the local codes. The units must be properly grounded and protected against short circuits by fuses.

Operation

1. Air hoses shall be of correct size and suitable for the working pressure and flow. Never use frayed, damaged or deteriorated hoses. Use only the correct type and size of hose fittings and connections. When blowing through a hose or air line, ensure that the open end is held securely. A free end will whip and may cause injury. Make sure that a hose is fully depressurized before disconnecting it.

2. Never operate the unit when there is a possibility of taking in flammable or toxic fumes.

3. Never operate the unit at pressures below or in excess of its limit ratings as prescribed on the Principal Data Sheet.

4. All canopy doors (if provided) must be closed during operation.

5. Personnel in environments or rooms where the sound pressure level reaches or exceeds 90 dB(A) must wear ear protectors.

6. Periodically check that:

- a. All guards are in place, in good condition and securely fastened.
- b. All hoses and/or pipes inside the unit are in good condition, secure and not rubbing.
- c. There are no leaks.
- d. All fasteners are tight.
- e. All electrical leads are secure and in good condition.
- f. Safety valves and other pressure-relief devices are not obstructed by dirt or paint.
- g. Air outlet valve and air system, i.e. pipes, couplings, manifolds, valves, hoses, etc. are in good repair, free of wear or abuse.

Maintenance

Maintenance and repair work shall only be carried out under supervision of someone qualified for the job.

1. Use only the correct tools for maintenance and repair work.

2. Use only genuine Atlas Copco spare parts.

3. All maintenance work must only be undertaken when the unit is stopped and the main power supply is switched off. Take proper lockout precautions to ensure that the unit cannot be started inadvertently.

4. Before removing any pressurized component, isolate the unit from all sources of pressure and relieve the entire system of pressure.

5. Never use flammable solvents or carbon tetrachloride for cleaning parts. Take safety precautions against toxic vapors of cleaning liquids.

6. Maintain a clean environment during maintenance and repair. Keep dirt away by covering the parts and exposed openings with a clean cloth, paper or tape.

7. Never weld or perform any operation involving heat near the oil system. Oil tanks must be completely purged, e.g. by steam-cleaning, before carrying out such operations.

8. Make sure that no tools, loose parts or rags are left in or on the unit.

9. Before cleaning the unit for use after maintenance or overhaul, check that operating pressures, temperatures and time settings are correct and that the control and shutdown devices function correctly.

10. Protect the motor, air filter, electrical and regulating components, etc. to prevent moisture from entering them, e.g. when steam-cleaning.

11. Do not remove any of, or tamper with, the sound-damping material.

12. Never use caustic solvents which can damage materials of the air system, e.g. polycarbonate bowls.

13. Always consult local, state and federal regulations when handling refrigerant.

Parts Book for

Stationary Compressors

GA90,-GA110,-GA160

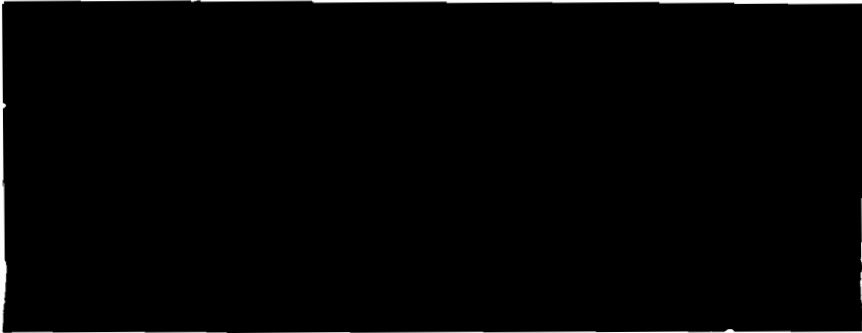
GA90W,-GA110W,-GA160W

P/N 1310 9051 04

500 IP 7/96

Atlas Copco

Atlas Copco Compressors Inc.
161 Lower Westfield Road
Holyoke, MA 01041-0431



SAFETY PRECAUTIONS FOR STATIONARY COMPRESSORS & EQUIPMENT

Read and understand these precautions before installing your unit
and observe them during operation and maintenance.

This instruction book describes how to handle and operate the subject machine(s) to ensure safe operation, optimum working economy and long service life.

Read this book before putting the machine into operation to ensure correct handling, operating and proper maintenance from the beginning. Keep this book available for the operator(s). Make sure that the unit is operated and that the maintenance actions are carried out according to the instructions. Record all operating data, maintenance work, etc. in an operator's logbook available from Atlas Copco. Follow all applicable safety precautions.

Repair operations should be performed by qualified personnel, available at authorized Atlas Copco distributors and Regional Service Centers.

In all correspondence, always reference the unit type and the complete serial number, shown on the unit's data plate. The serial number is composed of three letters followed by six digits.

For specific data not mentioned in the text, consult sections "Preventive Maintenance Schedule" and "Principal Data".

Atlas Copco reserves the right to make changes without prior notice.

If any statement in this book, especially with regard to safety, does not comply with local regulations, the stricter of the two shall apply.

These precautions are general in nature, and cover several machine types and equipment; hence some statements may not apply to the unit(s) described in this book.

All responsibility for any damage or injury resulting from neglecting these precautions, or by non-observance of ordinary caution and due care required in handling, operating, maintenance or repair, even if not expressly mentioned in this book, will be disclaimed by Atlas Copco.

For breathing air applications, special filtering equipment and purifiers are required, with monitors, to assure that the breathing air quality is in compliance with local, state and federal standards such as, but not limited to OSHA29 CFR1910.134.

Should the purchaser and/or user of this compressor fail to include filtering and purifying equipment and proceeds to use the compressor for breathing air service, the purchaser/user assumes all liabilities from resulting

consequences with no responsibility to be assumed by Atlas Copco.

In addition to general safety rules which should be observed with air compressors and associated equipment, the following safety directions and precautions are of special importance.

When operating this unit, the operator is expected to employ safe working practices and to observe all related local work safety requirements and ordinances.

The owner is responsible for maintaining the unit in a safe operating condition. Parts and accessories must be replaced if unsuitable for safe operation.

Installation, operation, maintenance and repair should only be performed by authorized, trained, competent personnel.

Installation

Apart from general engineering practice in conformity with the local safety regulations, the following directives are specially stressed:

1. A compressor must be lifted only with adequate equipment in conformity with local safety rules.

Loose or pivoting parts must be securely fastened before lifting. Do not, under any circumstances, enter the risk zone under a lifted load. Lifting acceleration and retardation must be kept within safe limits.

2. Any blanking flanges, plugs, caps and desiccant bags must be removed before connecting up the pipes. Distribution pipes and connections must be correctly sized and suitable for the working pressure and flow.

3. Place the unit in a cool and clean environment. If necessary, install a suction duct. Never obstruct the air inlet.

4. The intake air shall be free from flammable fumes or vapors, e.g. paint solvents, that can lead to internal fire or explosion.

5. Install air-cooled units in such a way that an adequate flow of cooling air is available and that the exhausted air does not recirculate to the inlet.

6. Arrange the air intake so that loose items, such as clothing, cannot be sucked in.

7. Ensure that the discharge pipe from the compressor to the

(continued on back cover)

OWNERSHIP DATA

Unit model: _____

Owner's machine no.: _____

Electric motor type: _____

Unit serial no.: _____

Delivery date: _____

Motor serial no.: _____

Service plan: _____

First start-up date: _____

Selected Lubricants

Compressor: _____

Capacity: _____

Bearing grease type, electric motor: _____

Printed Matter Nos.

Atlas Copco instruction book: _____

Atlas Copco logbook: _____

Atlas Copco parts list: _____

Motor parts list: _____

Local Atlas Copco Representative

Name: _____

Address: _____

Telephone: _____

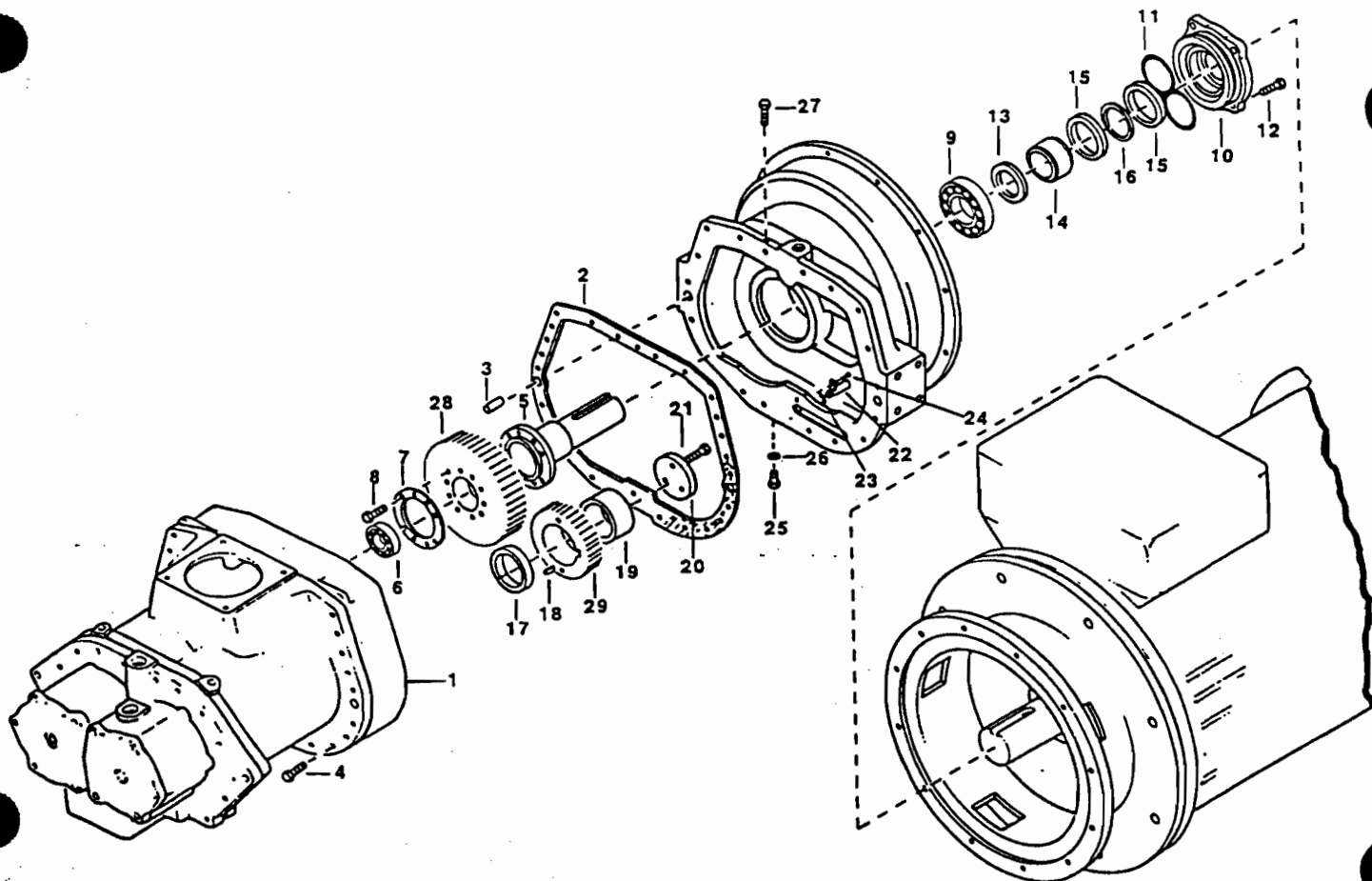
Contact persons: Service: _____

Telefax: _____

Parts: _____

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Drive Arrangement

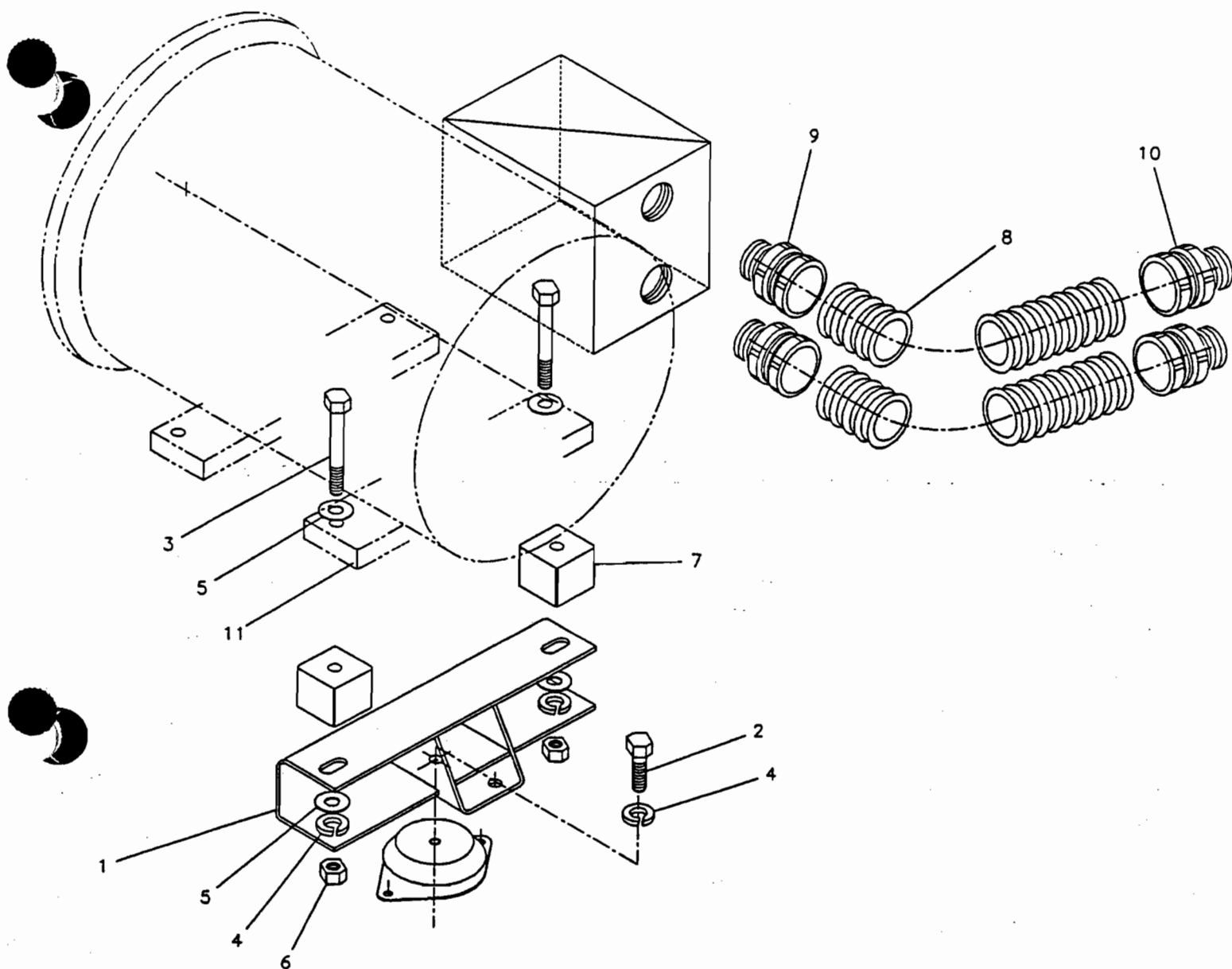
Ref	Note	Part No	Description	Qty
1		2989 0122 00	Service Stage	1
		2989 0019 00	GA160	
		2989 0019 00	GA90, GA110	
2	2)	1202 7003 00	Gasket	1
3		0101 1626 00	Pin	2
4		0147 1380 03	Bolt	18
5		2252 2546 00	Drive Shaft	1
6	2)	0508 2158 01	Bearing	1
7		2252 5476 00	Locking Plate	1
8	2)	0211 1409 00	Cap Screw	8
9	2)	0506 0100 08	Bearing	1
10		2252 5479 00	Retainer	1
11	2)	0663 7154 00	O-Ring	1
12		0147 1366 03	Bolt	4
13		2252 5477 00	Washer	1
14	2)	2252 5478 00	Bushing	1
15	2)	1619 5177 00	Seal Ring	2
16		2254 7604 00	Ring	1
17		2254 8832 00	Bushing	1
18	2)	0337 6074 00	Key	1
19		2254 8830 00	Bushing	1
20		2252 5470 00	Washer	1
21		0211 1409 00	Cap Screw	3
22		2252 5480 00	Oil Nozzle	1
23	2)	0663 3117 00	O-Ring	1
24		0147 1244 03	Bolt	1
25		0686 4204 00	Plug	1

Ref	Note	Part No	Description	Qty
26	1)	0661 1033 00	Gasket	1
27	(1)	1619 6032 00	Nipple	1
28		2252 7474 00	Gearwheel	1
		2254 1000 00	GA90-100psi	
		2252 7748 00	GA90-125psi	
		2254 1002 00	GA90-150psi	
		2255 0124 00	GA110-100psi	
		2253 8256 00	GA110-125psi	
		1619 5398 00	GA110-150psi	
		2252 7476 00	GA160-100psi	
		2254 0998 00	GA160-125psi	
29		2252 7473 00	GA160-150psi	
		2254 1001 00	Gearwheel	1
		2252 7747 00	GA90-100psi	
		2254 1003 00	GA90-125psi	
		2255 0125 00	GA90-150psi	
		2253 8257 00	GA110-100psi	
		1616 5399 00	GA110-125psi	
		2252 7475 00	GA110-150psi	
		2254 0999 00	GA160-100psi	
			GA160-125psi	
			GA160-150psi	

Note: 1) Kit 2906 0092 00

2) Kit 2906 0102 00

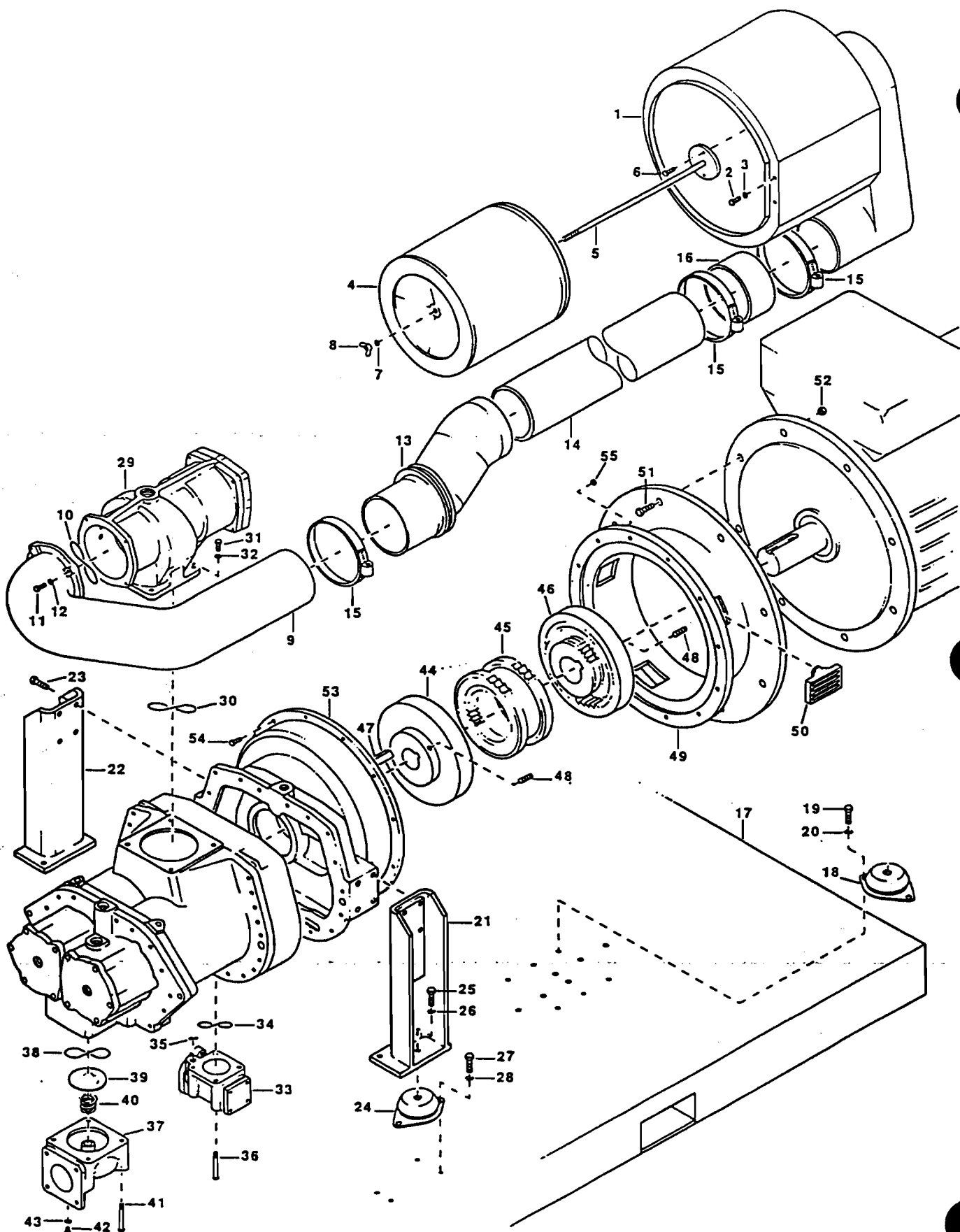
(1) SPM vibration monitoring



Motor Support and Conduit

Ref	Note	Part No	Description	Qty
1		1310 2518 73	Motor Support	1
2		0147 1476 03	Screw, M16x35 Hex	1
3		0147 1487 03	Screw, M16x90 Hex	2
			GA90 ODP	
		0147 1483 03	Screw, M16x70 Hex	2
			GA90 TEFC	
		0147 1483 03	Screw, M16x70 Hex	2
			GA110/160	
4		0333 2243 00	Washer - Spring	3
5		0301 2179 00	Washer - Flat	4
6		0266 2114 00	Nut M16	2
7		1310 2861 06	Spacer	2
8		1310 2520 34	Conduit, GA90/110	1
9		1310 2521 44	Conduit, GA160	2
9		1310 2515 67	Connector, GA90/110	1
		1310 2515 68	Connector, GA160	2

Ref	Note	Part No	Description	Qty
10		1310 2515 68	Connector, GA90/110	1
		1310 2515 68	Connector, GA160	2
11		1310 3160 60	Motor 460V, 125HP	1
			GA90 ODP	
		1310 3160 64	Motor 460V, 125HP	1
			GA90 TEFC	
		1310 3160 61	Motor 460V, 150 HP	1
			GA110 ODP	
		1310 3160 65	Motor 460V, 150HP	1
			GA110 TEFC	
		1310 3160 62	Motor 460V, 200HP	1
			GA160 ODP	
		1310 3160 66	Motor 460V, 200HP	1
			GA160 TEFC	

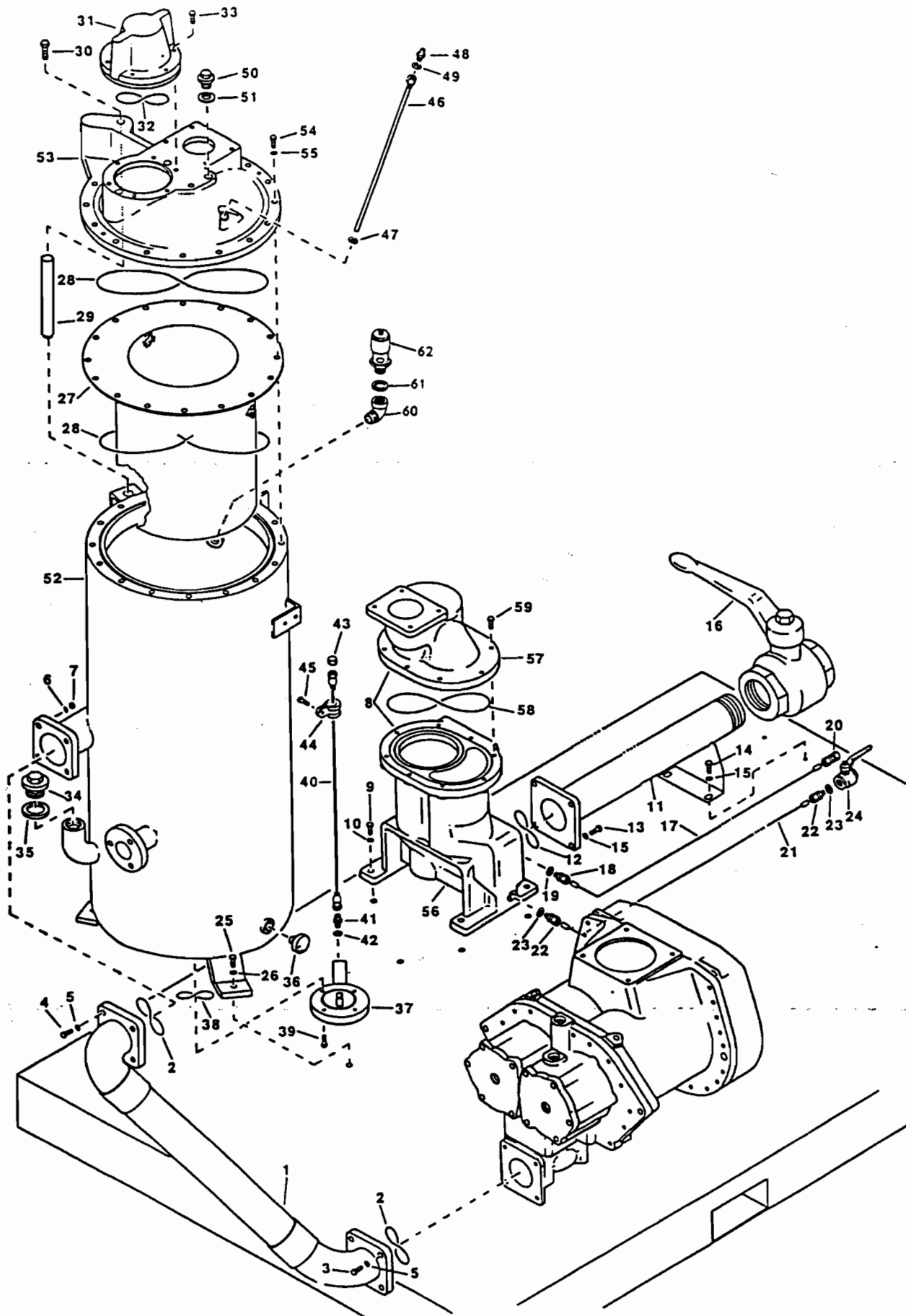


Air Inlet, Compressor Mounting

Ref	Note	Part No	Description	Qty
1	(7)	1614 6584 00	Housing	1
2		0147 1320 03	Bolt	2
3		0301 2335 00	Washer	2
4	1)	1030 0979 00	Air Filter	1
5		1614 6585 00	Stud	1
6		1619 5337 01	Bolt	2
7		0301 2358 00	Washer	1
8		0296 1112 02	Wing Nut	1
9		1614 6441 00	Pipe	1
10		0663 2100 64	O-Ring	1
11		0147 1328 03	Bolt	4
12		0301 2335 00	Washer	4
13		1614 6428 00	Pipe	1
14			Pipe	1
	(3)	1614 6514 01		
	(1)(2)	1614 6514 02		
15		0347 6121 00	Hose Clip	3
16		1614 6442 00	Hose	1
17			Frame	1
	(3)	1614 6466 00		
	(1)(2)	1614 6683 00		
18		1619 5318 01	Antivibration Pad	1
19		0147 1400 03	Bolt	2
20		0333 3237 00	Lock Washer	2
21		1614 6420 00	Support	1
22		1614 6421 00	Support	1
23		0147 1401 03	Bolt	8
24		1020 5072 00	Antivibration Pad	2
25		0147 1475 03	Bolt	2
26		0333 3244 00	Lock Washer	2
27		0147 1400 03	Bolt	4
28		0333 3237 00	Lock Washer	4
29		***	Unloading Valve	1
30	4)	0663 2100 64	O-Ring	1
31		0147 1364 03	Bolt	4
32		0301 2344 00	Washer	4
33		***	Oil Stop Valve	1
34	3)4)	0663 7142 00	O-Ring	1
35	3)4)	0663 3120 00	O-Ring	1
36		0147 1379 03	Bolt	4
37		1614 6425 00	Housing	1

Ref	Note	Part No	Description	Qty
38	2)4)	0663 3153 00	O-Ring	1
39	2)	2254 5324 00	Check Valve	1
40	2)	2254 8075 00	Spring	1
41		0147 1417 03	Bolt	4
42		0686 3716 01	Plug	1
43	1)	0661 1020 00	Gasket	1
44		1310 2519 78	Coupling Half Compressor	1
45		1310 2518 23	Coupling Element	1
46			Coupling Half Motor	1
	(1)(2)(3)	1310 2518 21		
	(5)(6)	1310 2518 21		
	(1)(4)(6)	1310 2518 22		
47		0337 5305 00	Key	1
48		0196 1360 00	Set Screw	2
49			Coupling Housing	1
	(1)(2)(6)	1614 6794 00		
	(3)(6)	1614 6793 00		
50		1614 6611 00	Grating	3
51		0147 1555 03	Bolt	8
52		0266 2116 00	Nut	8
53			Gear Casing	1
	(3)	1614 6807 00		
	(1)(2)	1614 6443 00		
54		0147 1366 03	Bolt	12
55		0266 2111 00	Nut	12

Note: 1) Kit 2906 0092 00
 2) Kit 2906 0093 00
 3) Kit 2906 0094 00
 4) Kit 2906 0102 00
 (1) GA90
 (2) GA110
 (3) GA160
 (4) Motor Shaft Dia. 2.125"
 (5) Motor Shaft Dia. 2.375"
 (6) 60 Hz
 (7) To be lined with foam plastic
 1079 0003 32 (2000x1500x30)
 *** in Part No. column indicates
 part is shown on separate page

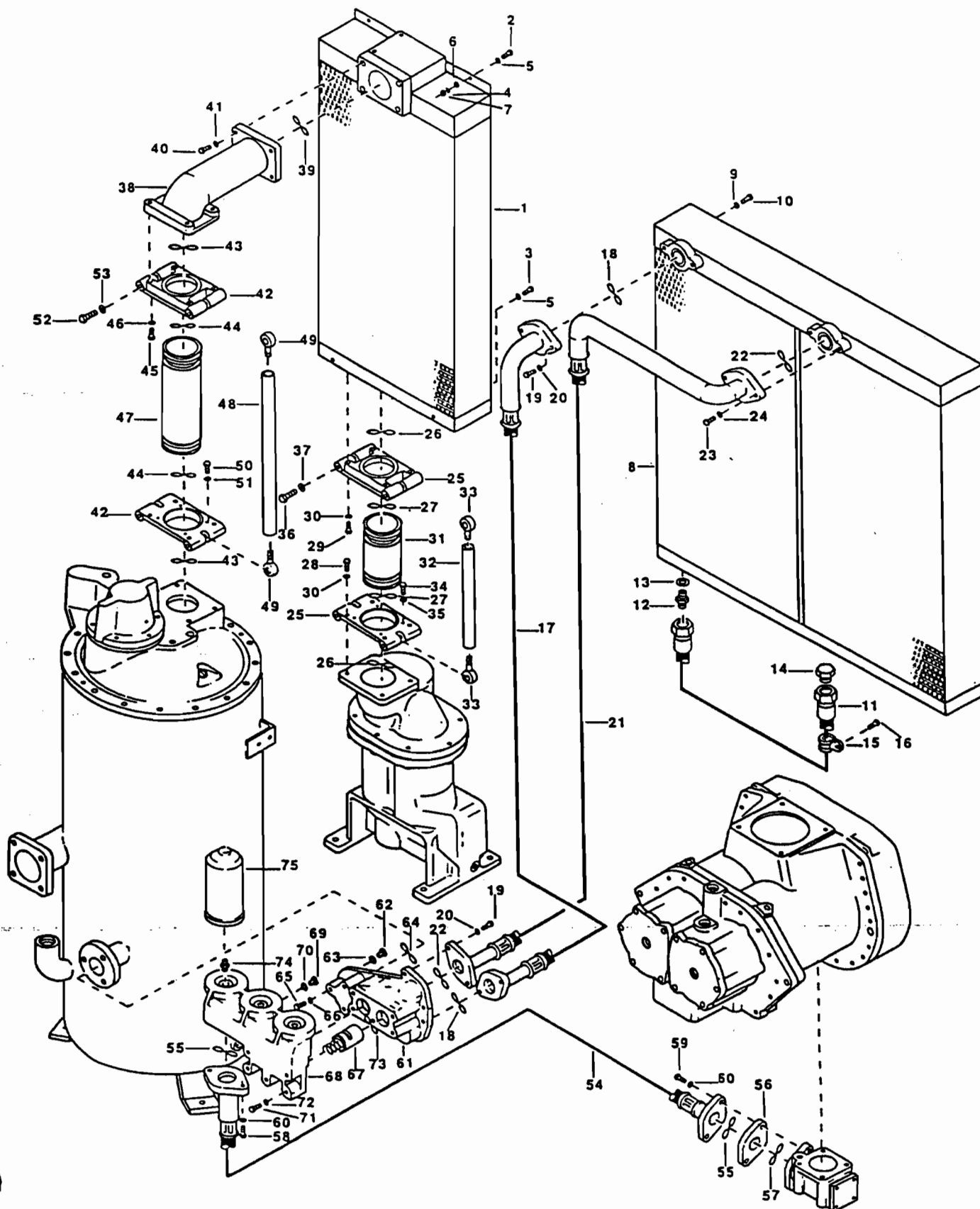


Air Receiver and Drain Connections

Ref	Note	Part No	Description	Qty
1			Hose Assembly	1
	(1)	1614 6445 00		
	(2)	1614 6625 00		
2	2	0663 7145 00	O-Ring	2
3		0147 1403 03	Bolt	4
4		0147 1407 03	Bolt	4
5		0301 2358 00	Washer	8
6		0333 3237 00	Lock Washer	4
7		0266 2112 00	Nut	4
8		***	Water Separator	1
9		0147 1402 03	Bolt	4
10		0301 2358 00	Washer	4
11			Pipe	1
	(1)	1614 6471 00		
	(2)	1614 6687 00		
12		0663 7153 00	O-Ring	1
13		0147 1404 03	Bolt	4
14		0147 1400 03	Bolt	2
15		0301 2358 00	Washer	6
16			Ball Valve	1
	(1)	0852 0010 08		
	(2)	1619 6153 10		
17	(3)	0075 5551 39	Pipe	A/R
18		0582 0016 00	Pipe Coupling	1
19		0661 1033 00	Gasket	1
20		0582 1016 00	Pipe Coupling	1
21	(3)	0075 5551 39	Pipe	A/R
22		0582 0016 00	Pipe Coupling	2
23		0661 1033 00	Gasket	2
24		1619 6153 04	Ball Valve	1
25		0147 1401 03	Bolt	3
26		0301 2358 00	Washer	3
27	4)	1614 6423 00	Separator	1
28	4)	0663 2103 25	O-Ring	2
29		1614 6432 00	Pivot Pin	1
30		0147 1479 03	Bolt	1
31		***	Minimum Pressure Valve	1
32	3)	0663 3555 00	O-Ring	1
33		0147 1366 03	Bolt	6
34		2250 2528 00	Plug	1
35	1)	0661 1056 00	Gasket	1

Ref	Note	Part No	Description	Qty
36		1089 0529 02	Level Sensor	1
37		1614 7213 00	Cover	1
38		0663 7142 00	O-Ring	1
39		0147 1361 03	Bolt	4
40		1614 6518 02	Hose Assembly	1
41	1)	1615 2796 00	Nipple	1
42		0653 1165 00	Gasket	2
43		1615 3026 00	Plug	1
44		0346 1002 10	Clamp	1
45		1619 5337 01	Bolt	1
46		1614 6519 01	Scavenge Line	1
47	1)	0653 1100 00	Gasket	1
48		1614 6561 00	Nozzle	1
49		0653 1046 00	Gasket	1
50		0686 3716 01	Plug	1
51		0653 1062 00	Gasket	1
52		1614 6444 02	Air Receiver	1
53		1614 6476 00	Housing	1
54		0147 1480 03	Bolt	16
55		0301 2378 00	Washer	16
	*	1614 6485 80	Water Separator	1
56	(4)	1614 6485 00	Housing	1
57	(4)	1614 6483 00	Cover	1
58	(4)	0663 7868 00	O-Ring	1
59	(4)	0147 1365 03	Bolt	8
60		0560 1308 03	Elbow	1
61		0653 1227 00	Gasket	1
62		1310 2517 11	Safety Valve	1

Note: 1) Kit 2906 0092 00
 2) Kit 2906 0093 00
 3) Kit 2906 0095 00
 4) Kit 2906 0098 00
 (1) GA160
 (2) GA90, GA110
 (3) A/R in Qty column indicates "as required"
 * at Ref column indicates part not shown assembled
 (4) part of 1614 6485 80
 *** in Part No column indicates
 part is shown on separate page

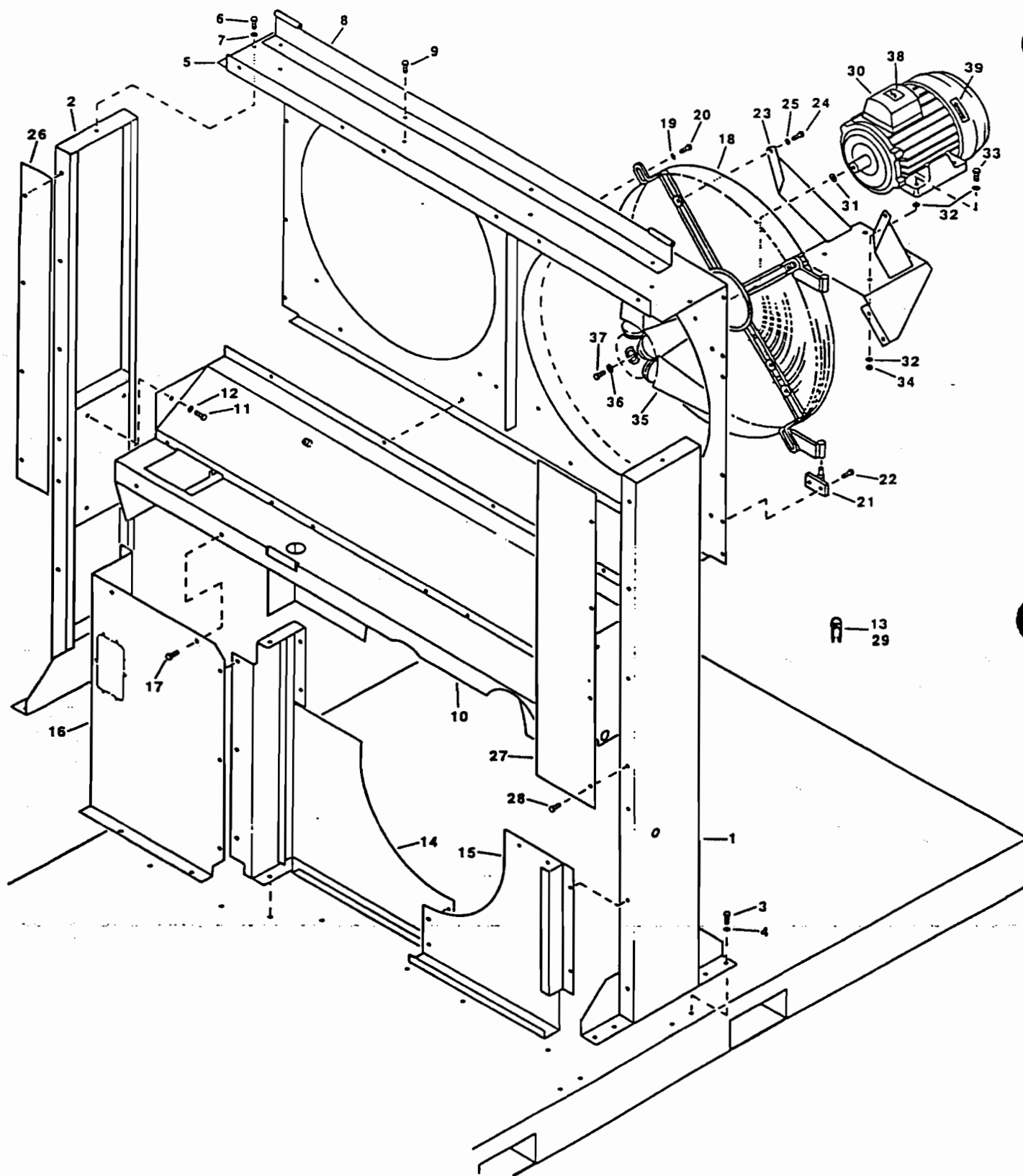


Air and Oil Connections, Air-Cooled

Ref	Note	Part No	Description	Qty
1			Aftercooler	1
	(1)	1614 6437 00		
	(2)	1614 6673 00		
2		0147 1325 03	Bolt	2
3		0147 1323 03	Bolt	2
4	4)	0333 3227 00	Lock Washer	2
5		0303 1274 01	Washer	4
6		0301 2335 00	Washer	2
7		0266 2110 00	Nut	2
8			Oil Cooler	1
	(1)	1614 6436 00		
	(2)	1614 6674 00		
9		0147 1323 03	Bolt	8
10		0303 1274 01	Washer	8
11		1614 6518 01	Hose Assembly	1
12		2250 6676 00	Nipple	1
13		0653 1124 00	Gasket	1
14		1615 3026 00	Plug	1
15		0346 1002 10	Clamp	1
16		1619 5337 01	Bolt	1
17		1614 6446 00	Hose Assembly	1
18	4)	0663 9868 00	O-Ring	2
19		0147 1402 03	Bolt	4
20		0301 2358 00	Washer	4
21		1614 6447 00	Hose Assembly	4
22		0663 9868 00	O-Ring	2
23		0147 1402 03	Bolt	4
24		0301 2358 00	Washer	4
25		1614 6424 00	Flange	2
26	4)	0663 7143 00	O-Ring	2
27		0663 3145 00	O-Ring	2
28		0147 1368 03	Bolt	4
29		0147 1367 03	Bolt	4
30		0301 2344 00	Washer	8
31		1614 6494 01	Pipe	1
32		1614 6492 01	Tie Rod	2
33		1614 6450 00	Eye Bolt	4
34		0147 1322 03	Bolt	8
35		0303 1274 01	Washer	8
36		0147 1376 03	Bolt	4
37		0301 2344 00	Washer	4
38		1614 6429 00	Pipe	1
39	4)	0663 7143 00	O-Ring	1
40		0147 1402 03	Bolt	4

Ref	Note	Part No	Description	Qty
41		0301 2358 00	Washer	4
42		1614 6424 00	Flange	2
43	3)	0663 7143 00	O-Ring	2
44		0663 3145 00	O-Ring	2
45		0147 1369 03	Bolt	8
46		0301 2344 00	Washer	8
47		1614 6494 02	Pipe	1
48		1614 6492 02	Tie Rod	2
49		1614 6450 00	Eye Bolt	4
50		0147 1322 03	Bolt	8
51		0303 1274 01	Washer	8
52		0147 1376 03	Bolt	4
53		0301 2344 00	Washer	4
54			Hose Assembly	1
	(1)	1614 6448 00		
	(2)	1614 6626 00		
55		0663 9868 00	O-Ring	2
56		1614 6497 01	Flange	1
57	2)	0663 9868 00	O-Ring	1
58		0147 1402 03	Bolt	2
59		0147 1404 03	Bolt	2
60		0301 2358 00	Washer	4
61		1614 6439 00	Valve Housing	1
62		0686 3716 01	Plug	1
63		0653 1062 00	Gasket	1
64		0663 9868 00	O-Ring	1
65		0147 1411 03	Bolt	3
66		0301 2358 00	Washer	3
67		1619 7560 00	Thermostatic Valve	1
68		1614 6440 00	Filter Housing	1
69		0686 3716 01	Plug	2
70		0653 1062 00	Gasket	2
71		0147 1371 03	Bolt	5
72		0301 2344 00	Washer	5
73		0663 9868 00	O-Ring	2
74		1619 3770 00	Nipple	3
75	1)	1613 6105 00	Oil Filter	3

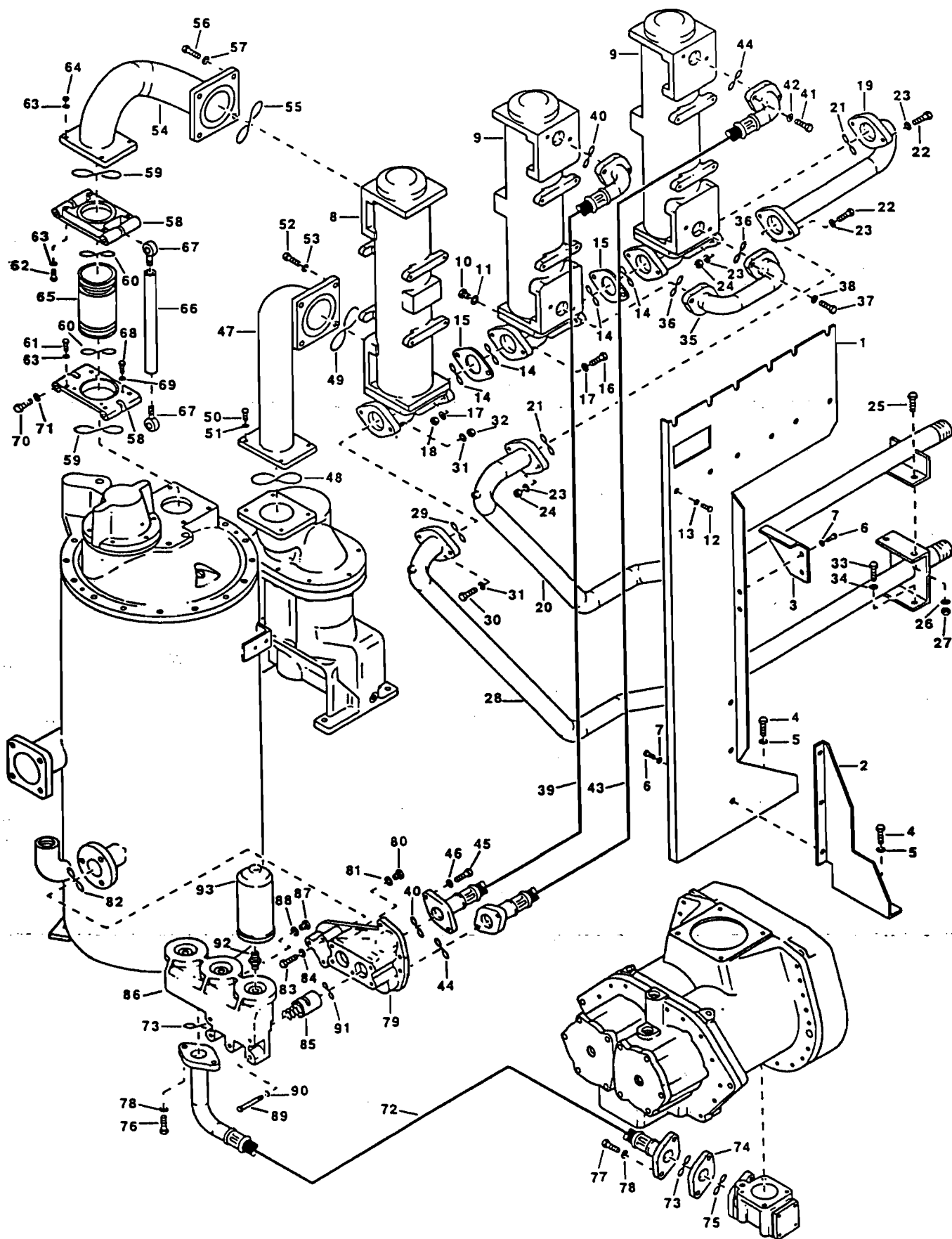
Note: 1) Kit 2906 0092 00
2) Kit 2906 0094 00
3) Kit 2906 0098 00
4) Kit 2906 0099 00
(1) GA160
(2) GA90, GA110



Fan and Cooling Duct Plates, Air-Cooled

Ref	Note	Part No	Description	Qty	Ref	Note	Part No	Description	Qty
1		1614 6430 00	Support	1	26	(2)	1614 6700 00	Plate	1
2		1614 6431 00	Support	1	27	(2)	1614 6701 00	Plate	1
3		0147 1401 03	Bolt	8	28	(2)	1619 2766 00	Bolt	8
4		0301 2358 00	Washer	8	29	(2)	1619 2795 00	Seal	A/R
5			Fan Cowl	1	30			Fan Motor	
	(1)	1614 6435 00				(1)(4)	1080 2776 09	220-230V/60Hz, 440-460V/60Hz	2
	(2)	1614 6675 00				(2)(4)	1090 2776 09	220-230V/60Hz, 440-460V/60Hz	1
6		0147 1362 03	Bolt	14		(1)(4)	1080 2776 10	575V/60Hz	2
7		0301 2344 00	Washer	14		(2)(4)	1080 2776 10	575V/60Hz	1
8			Support	1				Washer	
	(1)	1614 6451 00			31	(1)	1614 6453 00		2
	(2)	1614 6678 00				(2)	1614 6453 00		1
9		1619 2766 00	Bolt	4	32			Washer	
10			Support	1		(1)	0301 2344 00		16
	(1)	1614 6438 00				(2)	0301 2344 00		8
	(2)	1614 6676 00			33			Bolt	
11		0147 1362 03	Bolt	8		(1)	0147 1364 03		8
12		0301 2344 00	Washer	8		(2)	0147 1364 03		4
13		1619 2795 00	Seal	A/R	34			Nut	
14			Baffle	1		(1)	0266 2111 00		8
	(1)(3)	1614 6512 00				(2)	0266 2111 00		4
	(2)(3)	1614 6677 00			35			Fan	
15	(3)	1614 6434 00	Baffle	1		(1)	1614 6509 00	60Hz	2
16		1614 6513 00	Baffle	1		(2)	1614 6509 00	60Hz	1
17		1619 2766 00	Bolt	20	36			Washer	
18			Fan Guard			(1)	1614 6456 00		2
	(1)	164 6510 00		2		(2)	1614 6456 00		1
	(2)	1614 6510 00		1	37			Bolt	
19			Lock Washer			(1)	0147 1362 03		2
	(1)	0333 3232 00		8		(2)	0147 1362 03		1
	(2)	0333 3232 00		4	38			Warning Mark	
20			Bolt			(1)	1088 1001 01		2
	(1)	0147 1363 03		8		(2)	1088 1001 01		1
	(2)	0147 1363 03		4	39			Rotation Arrow	
21			Hinge			(1)	1503 0786 00		2
	(1)	1614 6582 00		4		(2)	1503 0786 00		1
	(2)	1614 6582 00		2					
22			Bolt						
	(1)	1619 5337 01		8					
	(2)	1619 5337 01		4					
23			Support						
	(1)	1614 6511 00		2					
	(2)	1614 6511 00		1					
24			Bolt						
	(1)	0147 1398 03		12					
	(2)	0147 1398 03		6					
25			Washer						
	(1)	0301 2358 00		12					
	(2)	0301 2358 00		6					

Note: (1) GA160
(2) GA90, GA110
(3) To be lined with foam plastic
1079 0003 29 (2000x1500x50)
(4) Use on CSA
A/R in Qty column indicates "as required"



Air, Oil and Water Connections, Water-Cooled

Ref	Note	Part No	Description	Qty
1			Support	1
	(1)	1614 6639 00		
	(2)	1614 6704 00		
2		1614 6630 00	Support	1
3		1614 6631 00	Bracket	1
4		0147 1400 03	Bolt	4
5		0301 2358 00	Washer	4
6		0147 1362 03	Bolt	5
7		0301 2344 00	Washer	5
8		***	Aftercooler	1
9			Oil Cooler	
	(1)	***		2
	(2)	***		1
10			Plug	
	(1)	0686 3716 03		6
	(2)	0686 3716 03		4
11			Gasket	
	1)2) (1)	0653 1062 00		6
	1)2) (2)	0653 1062 00		4
12			Bolt	
	(1)	0147 1362 03		12
	(2)	0147 1362 03		8
13			Washer	
	(1)	0301 2344 00		12
	(2)	0301 2344 00		8
14			O-Ring	
	(1)	0663 7138 00		4
	(2)	0663 7138 00		2
15			Plate	
	(1)	1614 6632 00		2
	(2)	1614 6632 00		1
16			Bolt	
	(1)	0147 1405 03		4
	(2)	0147 1405 03		2
17			Washer	
	(1)	0301 2358 00		8
	(2)	0301 2358 00		4
18			Nut	
	(1)	0266 2112 00		4
	(2)	0266 2112 00		2
19			Pipe	
	(1)	1614 6638 00		1
	(2)	1614 6707 00		
20			Pipe	
	(1)	1614 6637 00		1
	(2)	1614 6706 00		
21		0663 7138 00	O-Ring	2
22		0147 1405 03	Bolt	4
23		0301 2358 00	Washer	8
24		0266 2112 00	Nut	4
25		0147 1400 03	Bolt	2
26		0301 2358 00	Washer	2
27		0266 2112 00	Nut	2
28			Pipe	
	(1)	1614 6636 00		1
	(2)	1614 6705 00		
29		0663 7138 00	O-Ring	1
30		0147 1405 03	Bolt	2
31		0301 2358 00	Washer	4
32		0266 2112 00	Nut	2
33		0147 1400 03	Bolt	2
34		0301 2358 00	Washer	2
35	(1)	1614 6634 00	Pipe	1
36	3) (1)	0663 9868 00	O-Ring	2
37	(1)	0147 1402 03	Bolt	4
38	(1)	0301 2358 00	Washer	4
39			Hose Assembly	1
	(1)	1614 6640 00		
	(2)	1614 6702 00		

Ref	Note	Part No	Description	Qty
40		0663 9868 00	O-Ring	2
41		0147 1402 03	Bolt	4
42		0301 2358 00	Washer	4
43			Hose Assembly	1
	(1)	1614 6641 00		
	(2)	1614 6703 00		
44		0663 9868 00	O-Ring	2
45		0147 1402 03	Bolt	4
46		0301 2358 00	Washer	4
47		1614 6633 00	Pipe	1
48		0663 7143 00	O-Ring	1
49	2)	0663 6147 00	O-Ring	1
50		0147 1365 03	Bolt	4
51		0301 2344 00	Washer	4
52		0147 1402 03	Bolt	4
53		0301 2358 00	Washer	4
54		1614 6642 00	Pipe	1
55	2)	0663 6147 00	O-Ring	1
56		0147 1402 03	Bolt	4
57		0301 2358 00	Washer	4
58		1614 6424 00	Flange	2
59	2)	0663 7143 00	O-Ring	2
60		0663 3145 00	O-Ring	2
61		0147 1369 03	Bolt	4
62		0147 1371 03	Bolt	4
63		0301 2344 00	Washer	12
64		0266 2111 00	Nut	4
65		1614 6494 01	Pipe	1
66		1614 6492 01	Tie Rod	2
67		1614 6450 00	Eye Bolt	4
68		0147 1322 03	Bolt	8
69		0303 1274 01	Washer	8
70		0147 1376 03	Bolt	4
71		0301 2344 00	Washer	4
72			Hose Assembly	1
	(1)	1614 6448 00		
	(2)	1614 6626 00		
73		0663 9868 00	O-Ring	2
74		1614 6497 01	Flange	1
75		0663 9868 00	O-Ring	1
76		0147 1402 03	Bolt	2
77		0147 1404 03	Bolt	2
78		0301 2358 00	Washer	4
79		1614 6439 00	Valve Housing	1
80		0686 3716 01	Plug	1
81		0653 1062 00	Gasket	1
82		0663 9868 00	O-Ring	1
83		0147 1411 03	Bolt	3
84		0301 2358 00	Washer	3
85		1619 7560 00	Thermostatic Valve	1
86		1614 6440 00	Filter Housing	1
87		0686 3716 01	Plug	2
88		0653 1062 00	Gasket	2
89		0147 1371 03	Bolt	5
90		0301 2344 00	Washer	5
91		0663 9868 00	O-Ring	2
92		1619 3770 00	Nipple	3
93		1613 6105 00	Oil Filter	3

Note: 1) Kit 2906 0092 00

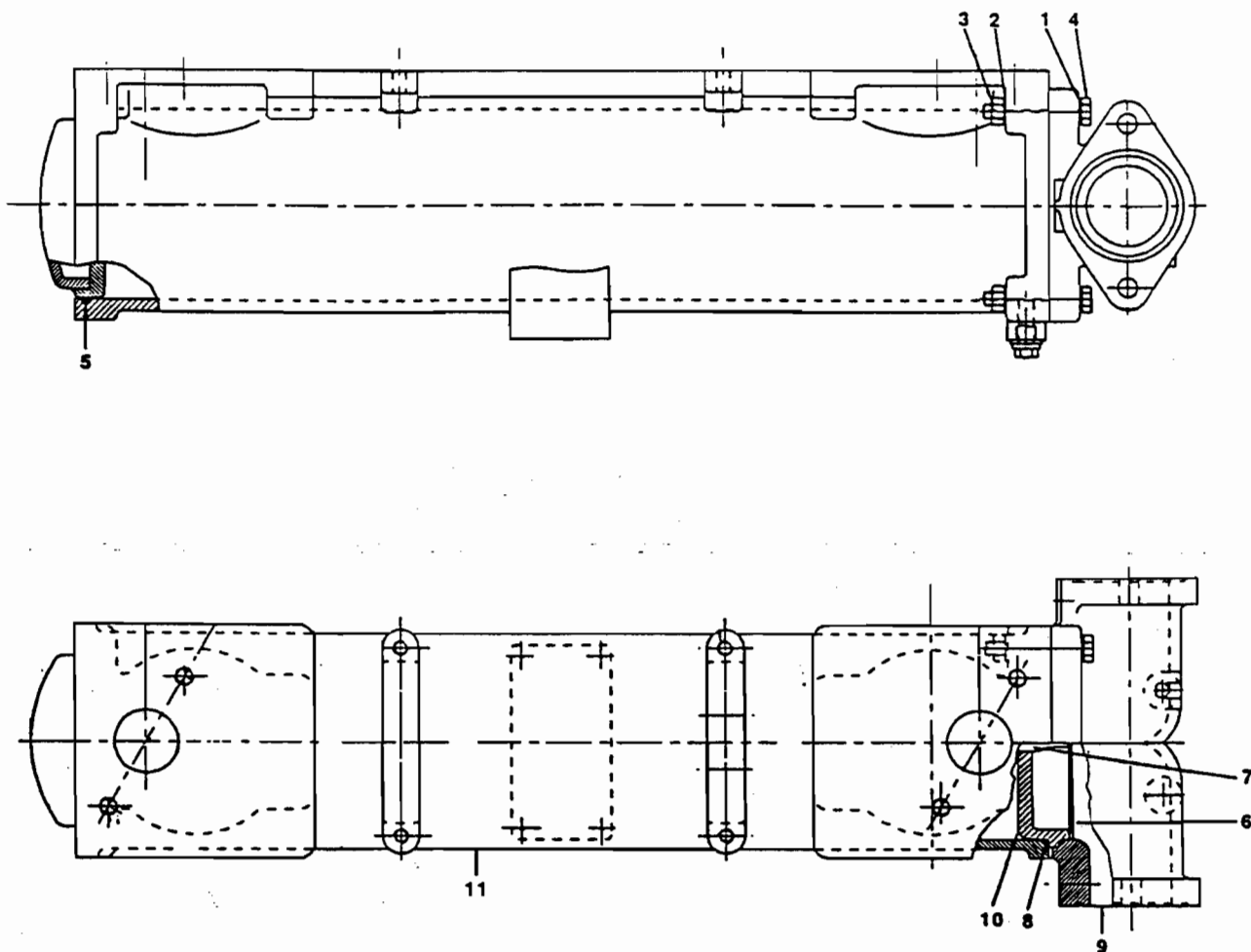
2) Kit 2906 0100 00

3) Kit 2906 0101 00

(1) GA160

(2) GA90, GA110

*** in Part No column indicates part is shown on separate page



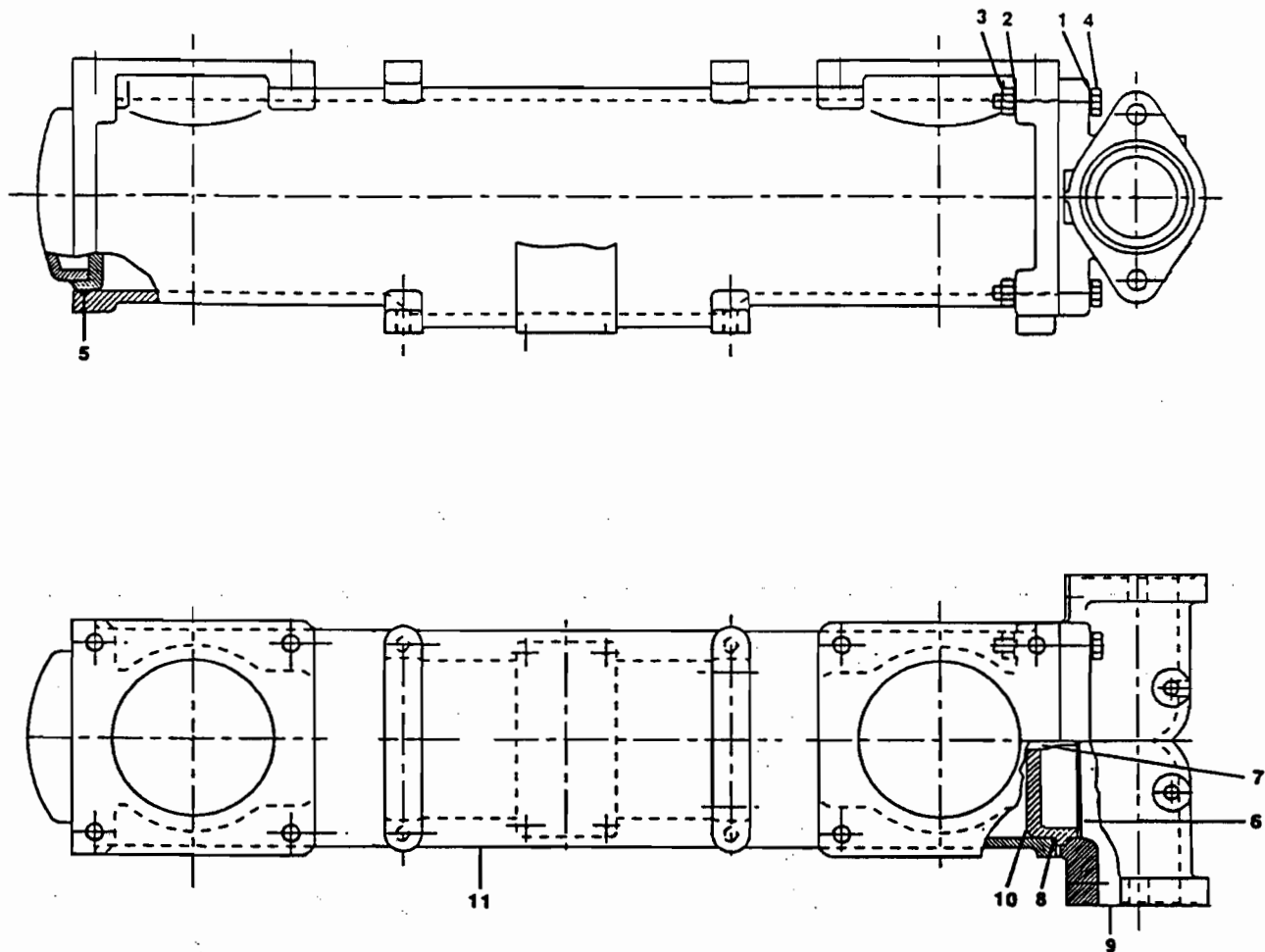
Oil Cooler, Water-Cooled

Ref	Note	Part No	Description	Qty
			Oil Cooler	
	(1)	1614 6628 08		2
	(2)	1614 6629 08		1
1		0301 2358 00	Washer	4
2	1)	0333 2136 00	Spring Washer	4
3		0266 2112 00	Nut	4
4		0147 1408 03	Bolt	4
5	1)	1614 6667 00	O-Ring	1
6	1)	1614 6259 00	Gasket	1
7	1)	1614 6258 00	Seal Strip	1
8	1)	1614 6256 00	O-Ring	2
9		1614 6666 00	Cover	1
10			Core	1
	(1)	1614 6669 00		
	(2)	1614 6671 00		
11			Housing	1
	(1)	1614 6668 00		
	(2)	1614 6670 00		

Note: 1) Kit 2906 0101 00

(1) GA160

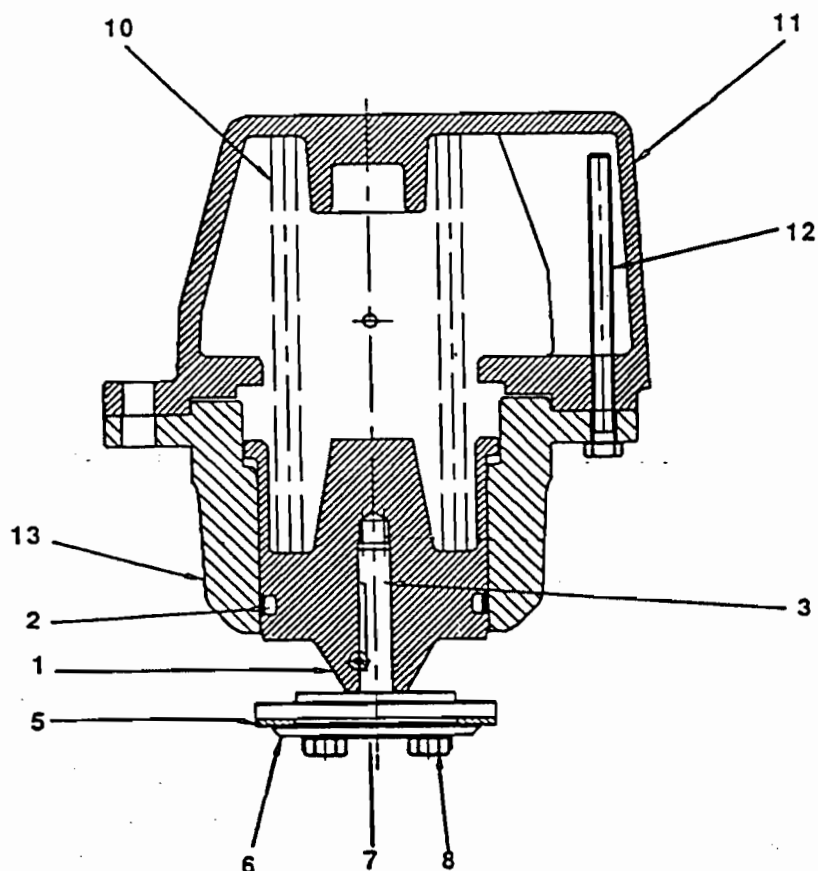
(2) GA90, GA110



Aftercooler, Water-Cooled

Ref	Note	Part No	Description	Qty
			Aftercooler	1
1		1614 6627 08		
		0301 2358 00	Washer	4
2	1)	0333 2136 00	Spring Washer	4
3		0266 2112 00	Nut	4
4		0147 1408 03	Bolt	4
5	1)	1614 6667 00	O-Ring	1
6	1)	1614 6259 00	Gasket	1
7	1)	1614 6258 00	Seal Strip	1
8	1)	1614 6256 00	O-Ring	2
9		1614 6666 00	Cover	1
10		1614 6665 00	Core	1
11		1614 6664 00	Housing	1

Note: 1) Kit 2906 0100 00

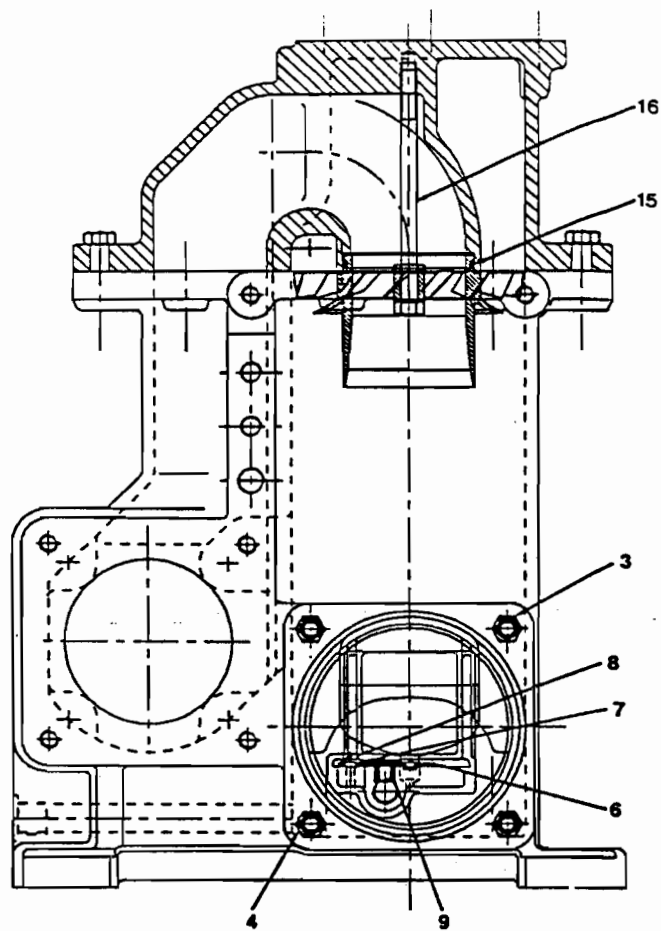
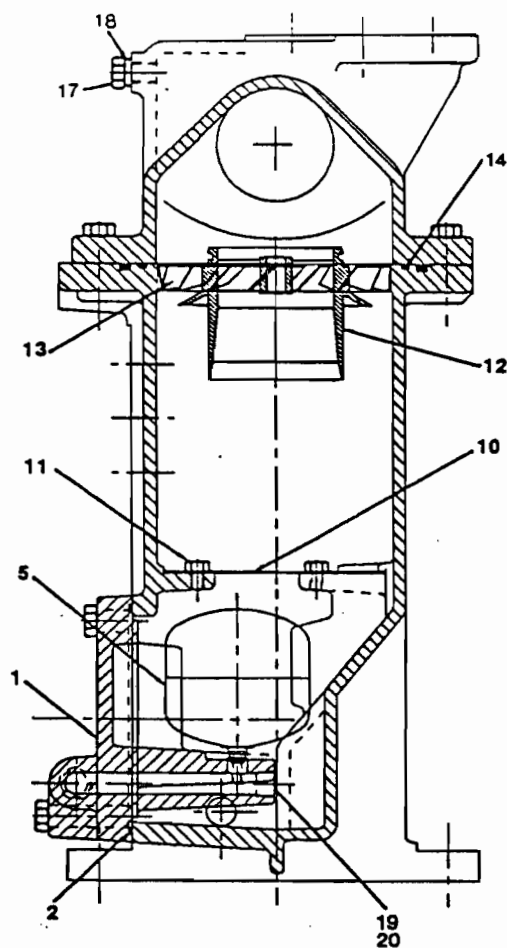


Minimum Pressure Valve

Ref	Note	Part No	Description	Qty
	(1)	1614 6476 80	Minimum Pressure Valve	1
1		1614 6479 00	Piston	1
2	1)	0665 0700 89	Ring	1
3	1)	1614 7294 00	Check Valve	1
5	1)	1614 6957 00	Washer	1
6		2254 9214 00	Washer	1
7	1)	2254 9215 00	Lock Plate	1
8		0147 1322 03	Bolt	3
10		2253 1860 00	Spring	1
11		1614 6478 00	Cover	1
12		0147 1958 97	Bolt	2
13		1614 6477 00	Sleeve	1

Note: 1) Kit 2906 0095 00

(1) Complete valve assembly

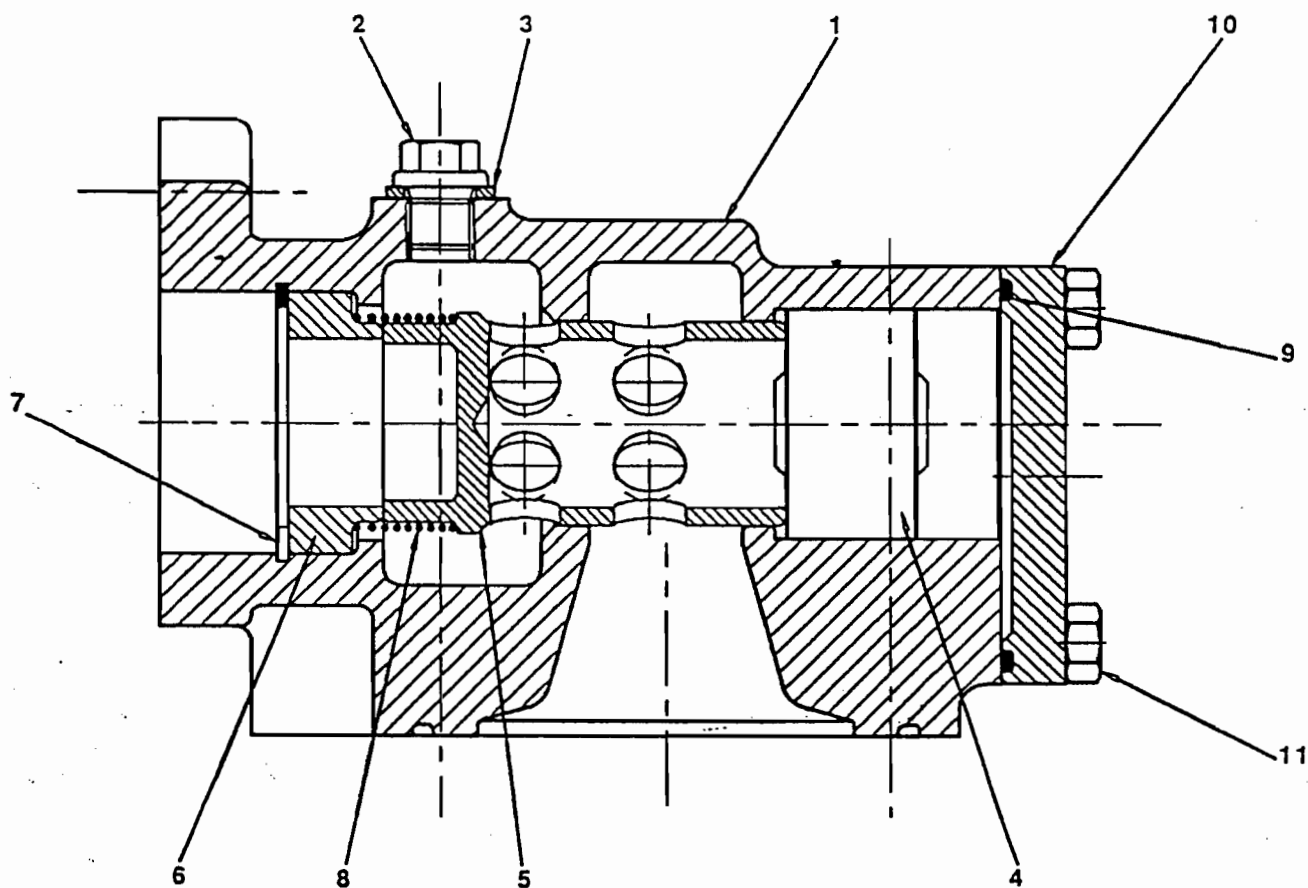


Water Separator

Ref	Note	Part No	Description	Qty
	(1)	1614 6481 80	Water Separator	1
1		1614 6484 00	Valve Base	1
2	1)	0663 7153 00	O-Ring	1
3		0147 1404 03	Bolt	3
4		0117 1410 03	Bolt	1
5		1202 3825 00	Float	1
6	1)	1202 3739 00	Membrane	1
7		1202 3740 00	Clamp	1
8		0160 1244 01	Screw	1
9	1)	1202 3873 00	Insert	1
10		1614 6486 00	Shield	1
11		0147 1320 03	Bolt	3
12		1614 6481 00	Impinger	1
13		1614 6482 00	Swirler	1
14		0663 2104 35	O-Ring	1
15		0663 9870 00	O-Ring	1
16		0147 1383 03	Bolt	1
17		0686 3716 01	Plug	1
18		0653 1062 00	Gasket	1
19		0686 4203 00	Plug	1
20		0653 1100 00	Gasket	1

Note: 1) Kit 2906 0096 00

(1) Complete assembly consisting of reference 1 through 20. See also item 1614 6485 80, page 9.



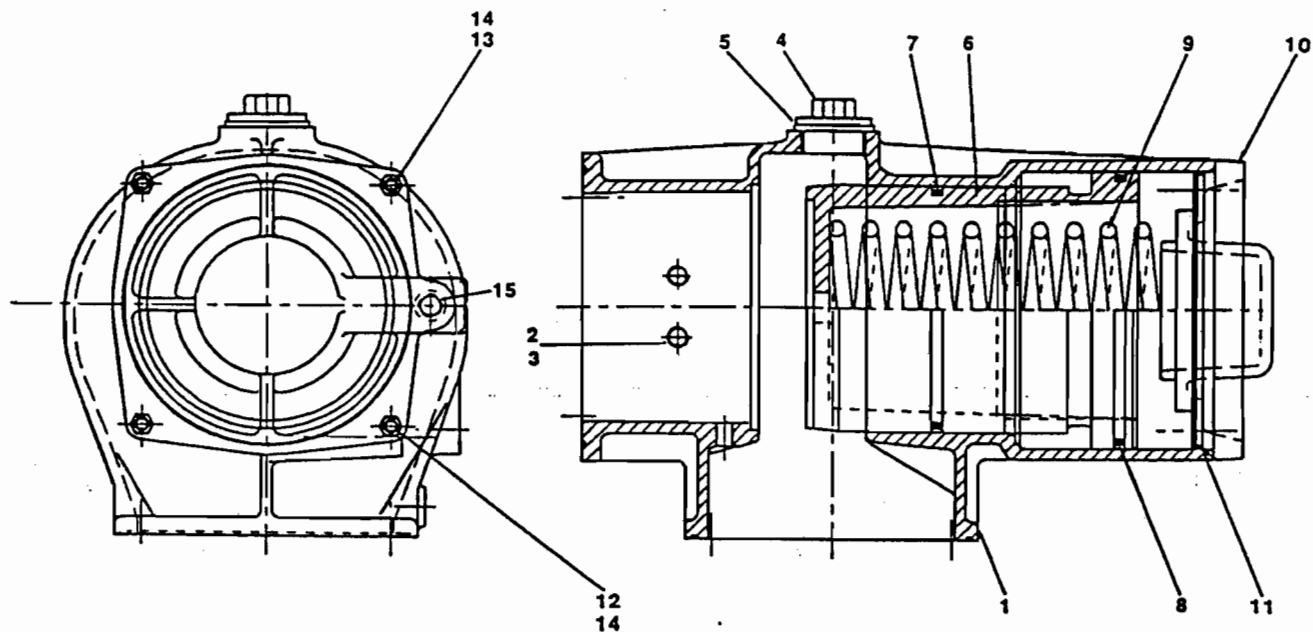
Oil Stop Valve

Ref	Note	Part No	Description	Qty
	(1)	1614 6474 80	Oil Stop Valve	1
1		1614 6474 00	Housing	1
2		0686 3716 01	Plug	1
3	1)	0661 1020 00	Gasket	1
4		2255 2813 00	Piston	1
5		2255 2751 00	Valve	1
6		2252 6269 00	Spring Guide	1
7		0335 2145 00	Circlip	1
8	2)	2254 9868 00	Spring	1
9	2)	0663 7138 00	O-Ring	1
10		1614 6475 00	Cover	1
11		0147 1325 03	Bolt	4

Note: 1) Kit 2906 0092 00

2) Kit 2906 0094 00

(1) Complete valve assembly

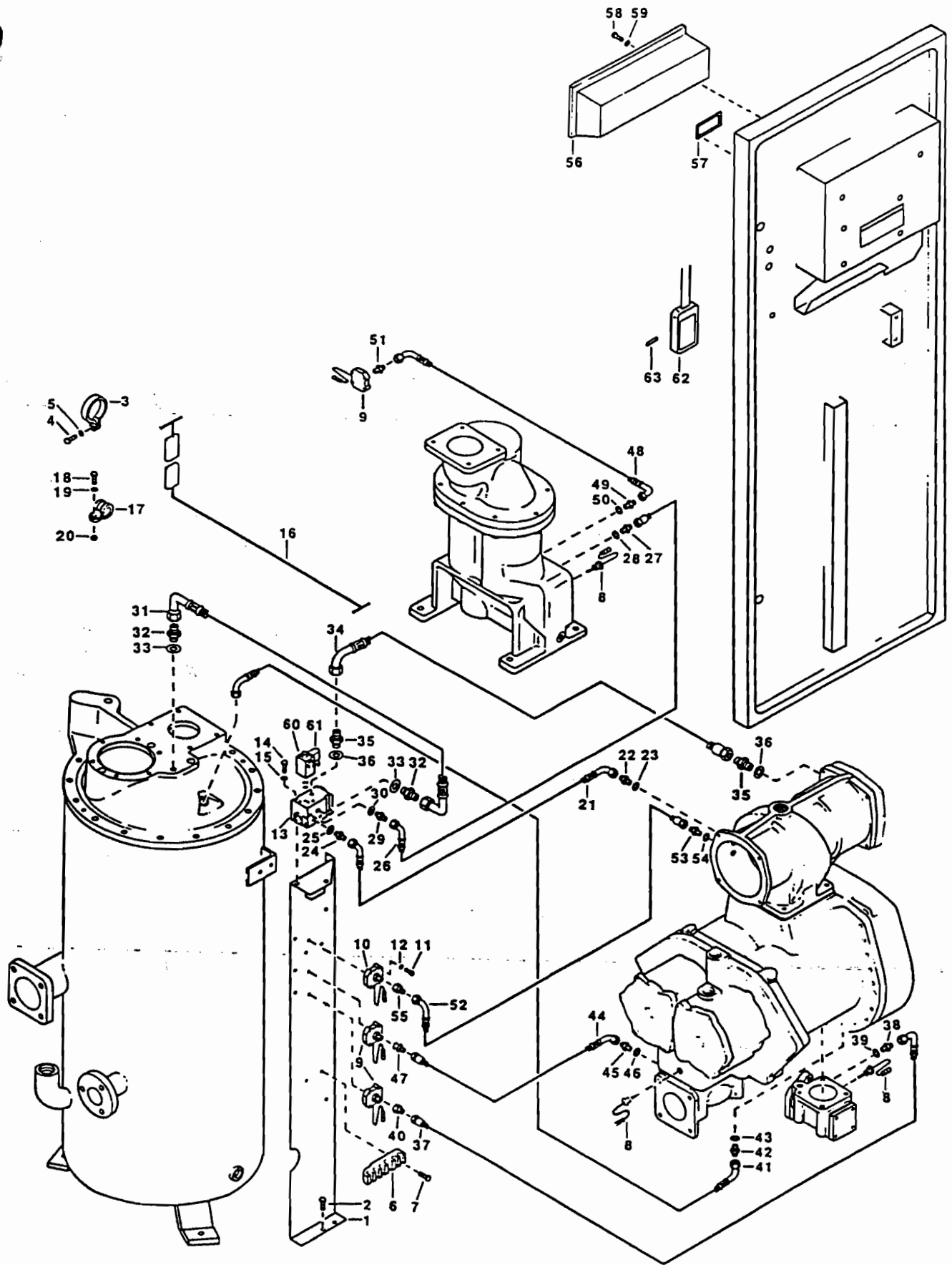


Unloading Valve

Ref	Note	Part No	Description	Qty
	(1)	1614 6487 80	Unloading Valve	1
1		1614 6489 00	Housing	1
2		0686 3716 03	Plug	1
3		0653 1062 00	Gasket	1
4		2250 2528 00	Plug	1
5		0661 1056 00	Gasket	1
6		1614 6487 00	Valve	1
7	1)	1619 6142 00	Seal Ring	1
8	1)	1619 6143 00	Seal Ring	1
9		2253 7362 00	Spring	1
10		1614 6488 00	Cover	1
11	1)	0663 2100 64	O-Ring	1
12		0147 1328 03	Bolt	2
13		0147 1958 98	Bolt	2
14		0301 2335 00	Washer	4
15	1)	0663 2122 00	O-Ring	1

Note: 1) Kit 2906 0097 00

(1) Complete valve assembly



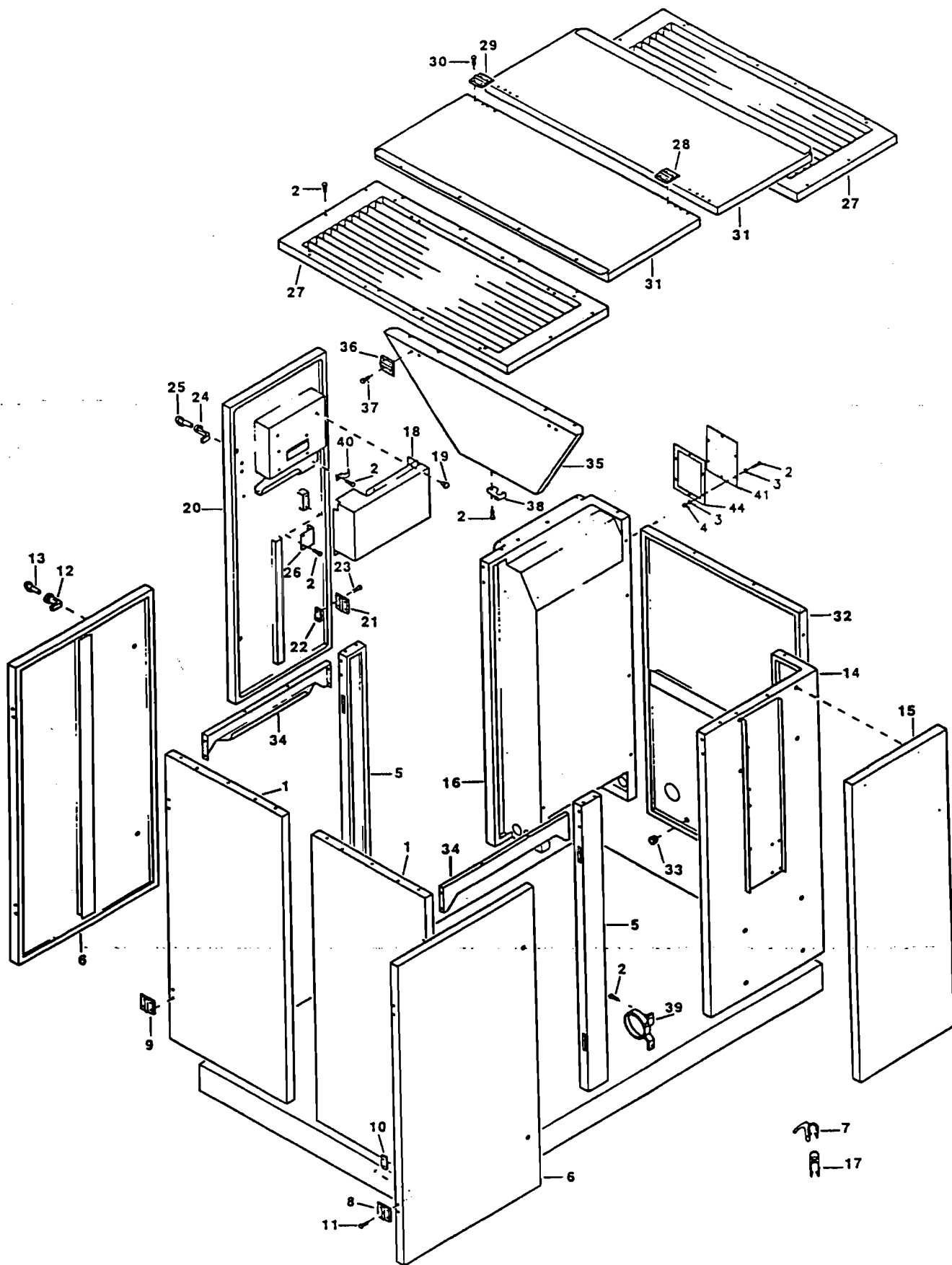
Regulating Connections

Ref	Note	Part No	Description	Qty
1		1614 6517 00	Support	1
2		1619 2766 00	Bolt	4
3		0346 2116 00	Pipe Clamp	3
4		0147 1247 03	Bolt	3
5		0301 2321 00	Washer	3
6		1613 2683 00	Hose Support	2
7		0160 6081 00	Screw	4
8		1089 0517 12	Temperature Sensor	4
9		1089 0515 04	Pressure Transducer	3
10		1089 0515 07	Pressure Transducer	1
11		0160 6043 00	Bolt	8
12		0301 2315 00	Washer	8
13		1614 6449 00	Regulating Valve	1
14		0147 1258 03	Bolt	2
15		0301 2321 00	Washer	2
16		1614 6583 00	Wire Harness	1
17		1613 0803 02	Clamp	2
18		0147 1247 03	Bolt	2
19		0301 2321 00	Washer	2
20		0266 2108 00	Nut	2
21		0574 8841 48	Hose Assembly	1
22		1619 5205 00	Nipple	1
23		0653 1062 00	Gasket	1
24		1079 5840 01	Nipple	1
25		0653 1046 00	Gasket	1
26		0574 8231 51	Hose Assembly	1
27		1619 5205 00	Nipple	1
28		0653 1062 00	Gasket	1
29		1079 5840 01	Nipple	1
30	1)	0653 1046 00	Gasket	1
31		0575 0405 18	Hose Assembly	1
32		1079 5840 21	Nipple	2
33		0653 1124 00	Gasket	2
34		0574 8235 33	Hose Assembly	1
35		1079 5840 21	Nipple	2

Ref	Note	Part No	Description	Qty
36		0653 1124 00	Gasket	2
37		0574 8861 36	Hose Assembly	1
38		1619 5205 00	Nipple	1
39		0653 1062 00	Gasket	1
40		1079 5840 13	Nipple	1
41		0575 0791 47	Hose Assembly	1
42		1619 5205 00	Nipple	1
43		0653 1062 00	Gasket	1
44		0575 0401 39	Hose Assembly	1
45		1619 5205 00	Nipple	1
46		0653 1062 00	Gasket	1
47		1079 5840 13	Nipple	1
48		0574 8841 15	Hose Assembly	1
49		1619 5205 00	Nipple	1
50		0653 1062 00	Gasket	1
51		1079 5840 13	Nipple	1
52		0574 8231 15	Hose Assembly	1
53		1619 5205 00	Nipple	1
54		0653 1062 00	Gasket	1
55		1079 5840 13	Nipple	1
56		1900 0598 02	Regulator	1
57		1202 5402 00	Gasket	1
58		0147 1322 03	Bolt	4
59		0301 2335 00	Washer	4
60			Solenoid Valve	1
		1089 0505 07	24V/60Hz	
x	(1)	0663 2104 83	O-Ring	2
61		1088 0150 04	Connection Head	1
62		1089 9212 02	Programmer	1
63		1614 6066 00	Label	1

Note: 1) Kit 2906 0092 00

(1) Solenoid Valve 1089 0505 07
includes O-Ring 0653 2104 83



Bodywork, Air-Cooled

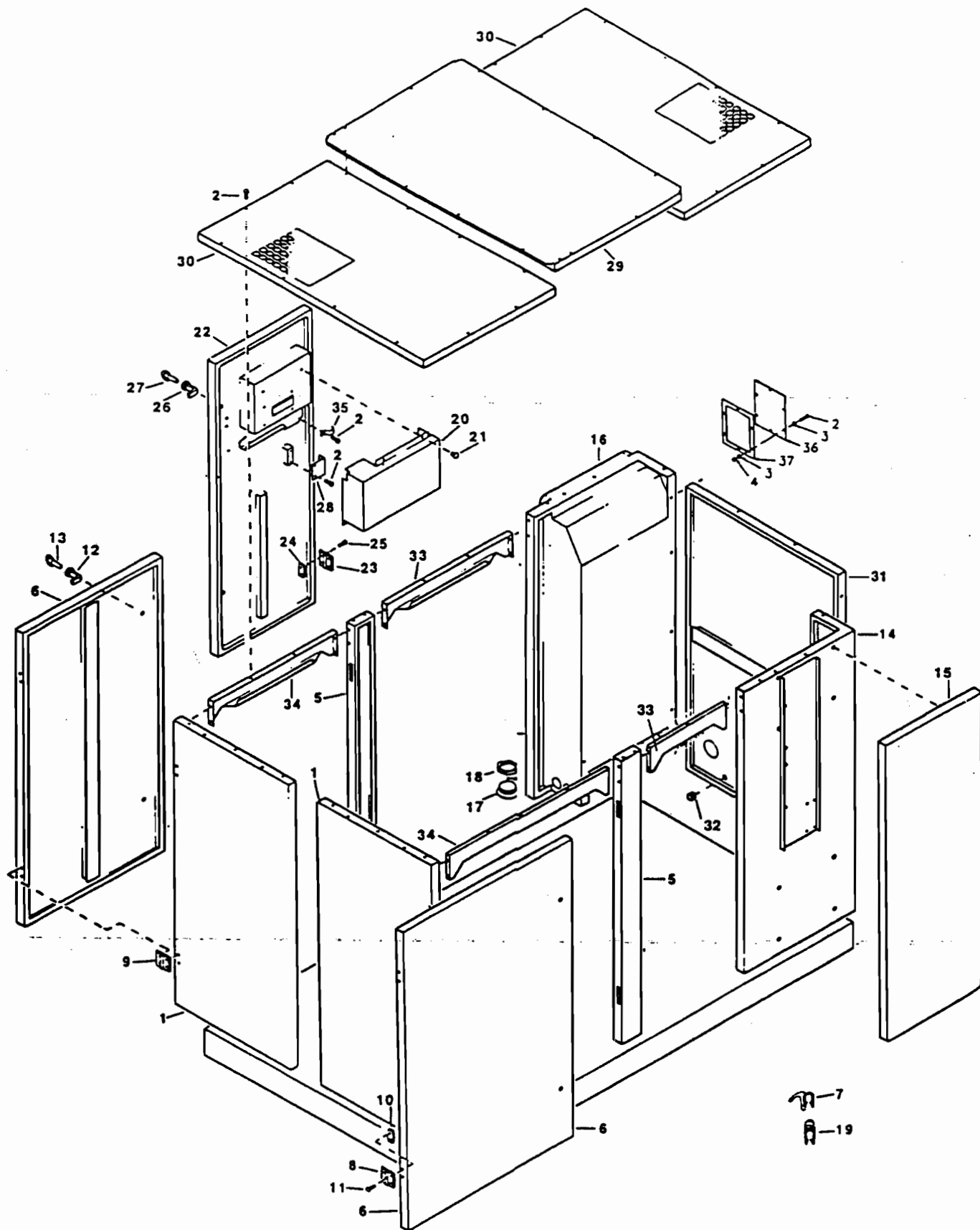
Ref	Note	Part No	Description	Qty
1	(1)	1614 6459 00	Side Panel	2
		GA160		
		1614 6680 00	GA90-110	
2			Bolt	A/R
		0147 1173 03	M4x16	
		0147 1250 03	M6x30	
		0147 1322 03	M8x16	
		1619 2766 00	M8x20	
		0147 1325 03	M8x25	
		1619 2766 02	M8x70	
3			Washer	A/R
		0301 2315 00	4.3x9x0.8	
		0301 2321 00	6.4x12.5x1.6	
		0301 2335 00	8.4x16x16	
4			Nut	A/R
		0266 2106 00	M4	
		0266 2108 00	M6	
		0266 2110 00	M8	
5	(1)	1614 6455 00	Beam	2
6	(1)		Door	4
		1614 6422 00	GA160	
		1614 6686 00	GA90-110	
7		1619 2665 00	Seal	A/R
8		1615 2243 00	Hinge	4
9		1615 2243 01	Hinge	4
10		1615 2242 00	Bracket	16
11		0162 4322 00	Screw	32
12		2255 2059 00	Lock	8
13		1089 9068 01	Key	1
14	(1)	1614 7129 00	Corner Panel	1
15		1614 6462 00	Panel	1
16		1614 6472 00	Cubicle	1
17		1619 2795 00	Seal	A/R
18		1614 6594 00	Box	1
19		1614 6596 00	Nut	4
20		1614 6473 00	Door	1
21		1615 2243 00	Hinge	2

Ref	Note	Part No	Description	Qty
22		1615 2242 00	Bracket	4
23		0162 4322 00	Screw	8
24		1619 7704 00	Lock	2
25		1089 9154 02	Key	1
26		1614 6550 00	Plate	1
27			Roof	2
		1614 6463 00	GA160	
		1614 6682 00	GA90-110	
28		1615 2243 00	Hinge	2
29		1615 2243 01	Hinge	2
30		0162 4322 00	Screw	8
31	(1)(2)		Roof	2
		1614 6460 00	GA160	
		1614 6681 00	GA90-110	
32	(1)		Side Panel	1
		1614 6458 00	GA160	
		1614 6684 00	GA90-110	
33		1088 0801 26	Grommet	2
34	(1)		Panel	2
		1614 6457 00	GA160	
		1614 6685 00	GA90-110	
35	(1)		Baffle	2
		1614 6464 00	GA160	
		1614 6694 00	GA90-110	
36		1615 2243 01	Hinge	4
37		0162 4322 00	Screw	8
38		1614 6465 00	Hook	2
39		1614 6452 00	Hose Clip	1
40		0346 2100 03	Clamp	1
41		1614 7146 00	Flange	1
44		1614 7145 00	Gasket	1

Note: (1) To be lined with foam plastic
1079 0003 29 (2000x1500x50)

(2) To be lined with foam plastic
1079 0003 32 (2000x1500x30)

A/R in Qty column indicates "as required"

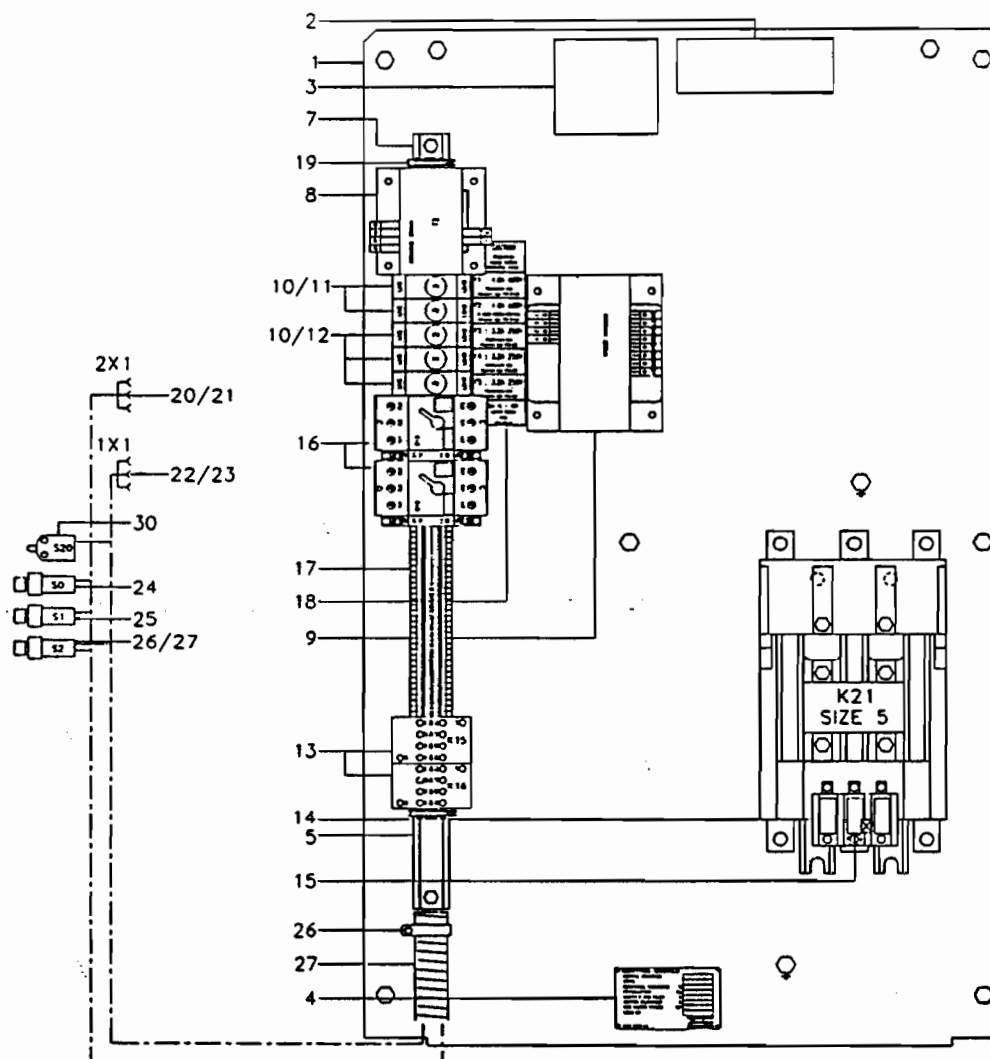


Bodywork, Water-Cooled

Ref	Note	Part No	Description	Qty
1	(1)		Side Panel	2
		1614 6459 00	GA160	
		1614 6680 00	GA90-110	
2			Bolt	A/R
		0147 1173 03	M4x16	
		0147 1250 03	M6x30	
		0147 1322 03	M8x16	
		0147 1325 03	M8x25	
		1619 2766 00	M8x20	
		1619 2766 02	M8x70	
3			Washer	A/R
		0301 2315 00	4.3x9x0.8	
		0301 2321 00	6.4x12.5x1.6	
		0301 2335 00	8.4x16x1.6	
4			Nut	A/R
		0266 2106 00	M4	
		0266 2108 00	M6	
		0266 2110 00	M8	
5	(1)	1614 6455 00	Beam	2
6	(1)		Door	4
		1614 6422 00	GA160	
		1614 6686 00	GA90-110	
7		1619 2665 00	Seal	A/R
8		1615 2243 00	Hinge	4
9		1615 2243 01	Hinge	4
10		1615 2242 00	Bracket	16
11		0162 4322 00	Screw	32
12		2255 2059 00	Lock	8
13		1089 9068 01	Key	1
14	(1)	1614 7129 00	Corner Panel	1
15		1614 6462 00	Panel	1
16		1614 6472 00	Cubicle	1
17		1088 0524 06	Plug	2
18		0697 9806 00	Nut	2
19		1619 2795 00	Seal	A/R

Ref	Note	Part No	Description	Qty
20		1614 6594 00	Box	1
21		1614 6596 00	Nut	4
22		1614 6473 00	Door	1
23		1615 2243 00	Hinge	2
24		1615 2242 00	Bracket	4
25		0162 4322 00	Screw	8
26		1619 7704 00	Lock	2
27		1089 9154 02	Key	1
28		1614 6550 00	Plate	1
29	(1)		Roof	1
		1614 6644 00	GA160	
		1614 6709 00	GA90-110	
30	(1)(2)		Roof	2
		1614 6645 00	GA160	
		1614 6708 00	GA90-110	
31	(1)		Side Panel	1
		1614 6635 00	GA160	
		1614 6710 00	GA90-110	
32		1088 0801 26	Grommet	2
33	(1)		Panel	2
		1614 6643 00	GA160	
		1614 6712 00	GA90-110	
34	(1)		Panel	2
		1614 6457 00	GA160	
		1614 6685 00	GA90-110	
35		0346 2100 03	Clamp	1
36		1614 7146 00	Flange	1
37		1614 7145 00	Gasket	1

Note: (1) To be lined with foam plastic
1079 0003 27 (2000x1500x50)
(2) To be lined with foam plastic
1079 0003 33 (2000x1500x50)
AR in Qty column indicates "as required"



Cubicle with Direct On-Line Starter, 60 Hz UL, Air-Cooled

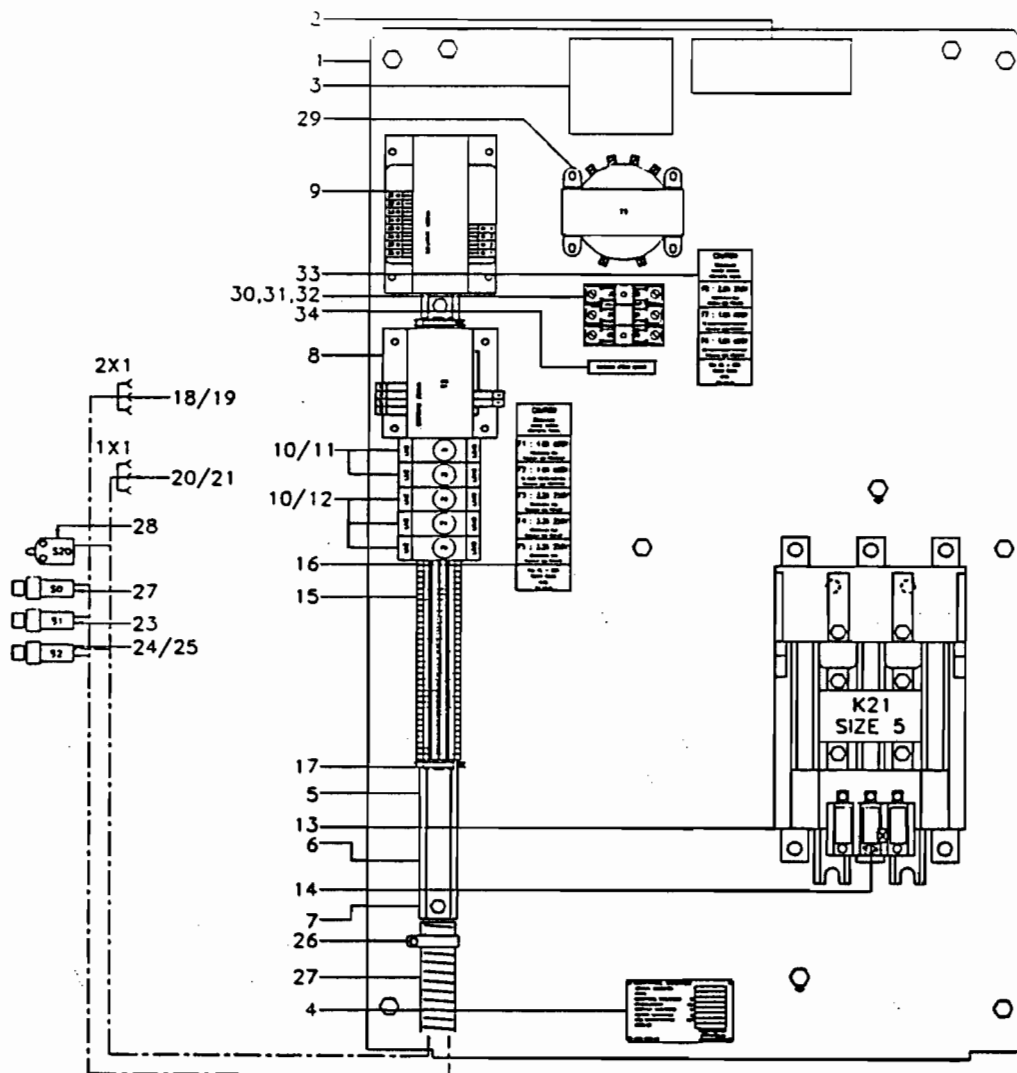
Ref	Note	Part No	Description	Qty	Ref	Note	Part No	Description	Qty
1		1614 6491 00	Mounting Panel	1	17		1089 0506 09	Terminal	31
2		1614 3559 00	Label	1	18		1614 6970 00	Label	1
3		1615 4435 00	Label	1	19		1089 0506 30	End Bracket	2
4		1613 3064 00	Data Plate	1	20		1088 0016 06	Plug	1
5		0090 1400 02	Rail	A/R	21		1088 0016 51	Socket	11
6		1088 0851 13	Raceway	A/R	22		1088 0016 09	Plug	1
7		0324 1132 00	Spacer	2	23		1088 0016 51	Socket	10
8		1089 9136 27	Transformer	1	24		1089 0362 05	Push Button	1
9		1079 9136 25	Transformer	1	25		1089 0362 15	Push Button	1
10		1089 9049 04	Fuse Holder	5	26		1089 0362 16	Push Button	1
11		1089 9168 26	Fuse Link	2	27		1089 9125 05	Label	1
12		1089 9168 02	Fuse Link	3	28		1613 0801 06	Clamp	2
13			Contactor		29		0070 7250 08	Tube	A/R
	(1)(2)	1089 9319 35		1	30		1089 0304 04	Limit Switch	1
	(3)	1089 9145 38		2	31		1310 3109 08	Label	1
14		1310 2003 72	Starter	1					
15			O/L Heater						
	(1)	1310 2003 83		3					
	(2)	1310 2003 85		3					
	(3)	1310 2003 88		3					
16			Circuit Breaker						
	(1)(2)	1089 9180 05		1					
	(3)	1089 9180 05		2					

Note: (1) GA90

(2) GA110

(3) GA160

A/R in Qty column indicates "as required"



Cubicle with Direct On-Line Starter, 60 Hz UL, Water-Cooled

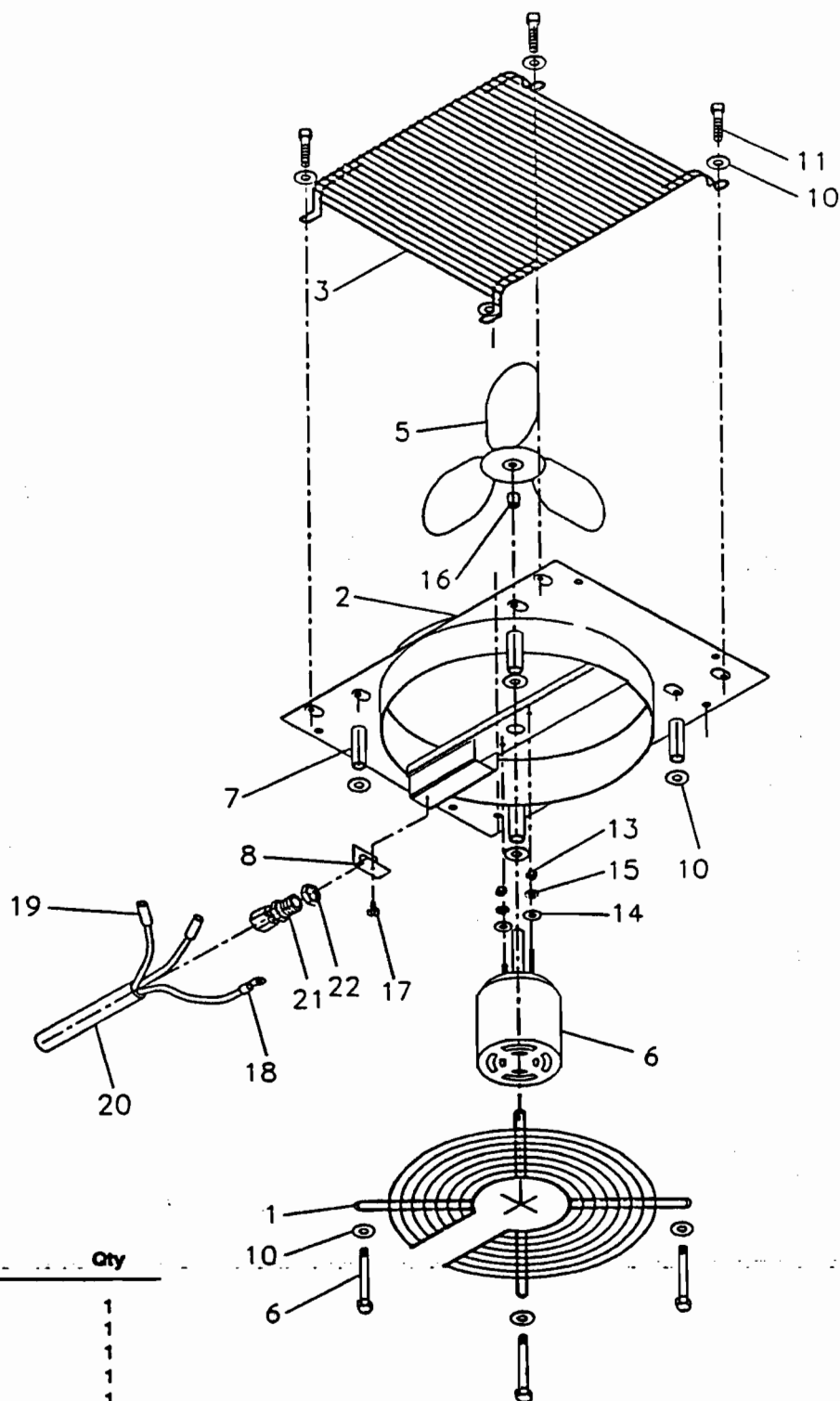
Ref	Note	Part No	Description	Qty	Ref	Note	Part No	Description	Qty
1		1614 6491 00	Mounting Panel	1	19		1088 0016 51	Socket	10
2		1614 3559 00	Label	1	20		1088 0016 09	Plug	1
3		1615 4435 00	Label	1	21		1088 0016 51	Socket	10
4		1613 3064 00	Data Plate	1	22		1089 0362 05	Push Button	1
5		0090 1400 02	Rail	A/R	23		1089 0362 15	Push Button	1
6		1088 0851 13	Raceway	A/R	24		1089 0362 16	Push Button	1
7		0324 1132 00	Spacer	2	25		1089 9125 05	Label	1
8		1089 9136 27	Transformer	1	26		1613 0801 06	Clamp	2
9		1099 9136 25	Transformer	1	27		0070 7250 08	Tube	A/R
10		1089 9049 04	Fuse Holder	5	28		1089 0304 04	Limit Switch	1
11		1089 9168 26	Fuse Link	2	29		1310 3082 01	Transformer	1
12		1089 9168 02	Fuse Link	3	30		1089 902H 05	Fuse Holder	1
13		1310 2003 72	Starter	1	31		1089 905H 05	Fuse 2A	1
14			Q/L Heater		32		1310 0365 28	Fuse 1A	2
	(1)	1310 2003 83		3	33		1310 2520 68	Label	1
	(2)	1310 2003 85		3	34		1310 3109 08	Label	1
	(3)	1310 2003 88		3					
15		1089 0506 09	Terminal	31					
16		1614 6970 00	Label	1					
17		1089 0506 30	End Bracket	2					
18		1088 0016 06	Plug	1					

Note: (1) GA90

(2) GA110

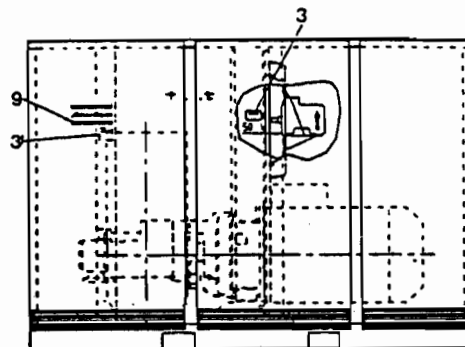
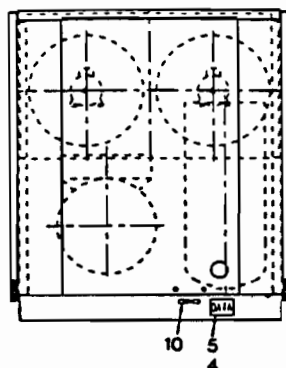
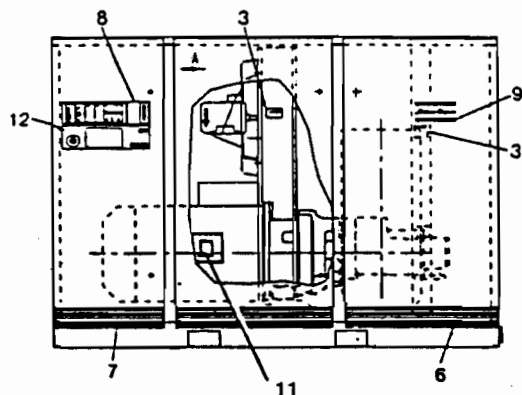
(3) GA160

AR in Qty column indicates "as required"

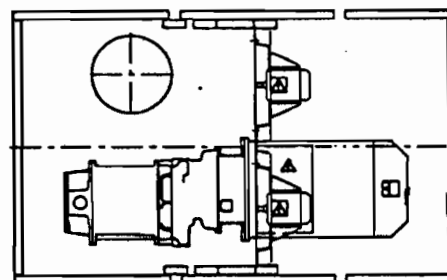


Motor Fan Assembly, 60 Hz, Water-Cooled

Ref	Note	Part No	Description	Qty
1		1310 2520 61	Inner Guard	1
2		1310 2520 59	Fan Shroud	1
3		1310 2520 62	Outer Guard	1
5		1310 3080 00	Cooling Fan	1
6		1310 2520 58	Fan Motor	1
7		1310 2520 85	Fan Guard Spacer	4
8		1310 2520 60	Conduit Cover	1
9		0144 3256 03	Screw	4
10		0300 0275 01	Washer	12
11		0144 3246 03	Screw	4
13		0263 413H 00	Nut	2
14		0301 2315 00	Washer	2
15		0333 3214 00	Lockwasher	2
16		1310 3079 00	Bushing	1
17		0226 3343 10	Screw	1
18		0694 500H 02	Wire	1
19		9710 5456 00	Wire	2
20		1310 2509 12	Cable Conductor	20 ft.
21		1310 2509 13	Conduit Connector	1
22		1310 3017 02	Nut	1

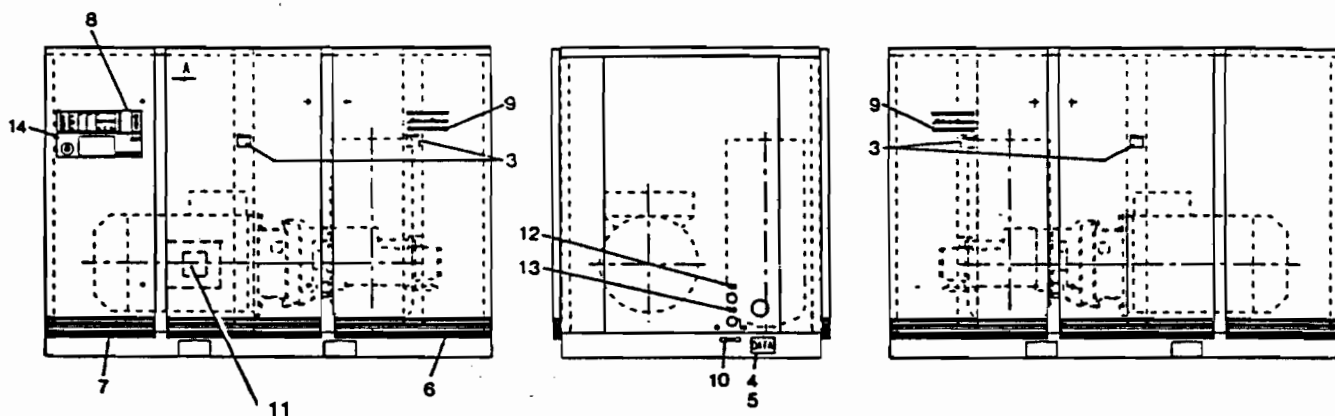


VIEW A INSIDE THE UNIT

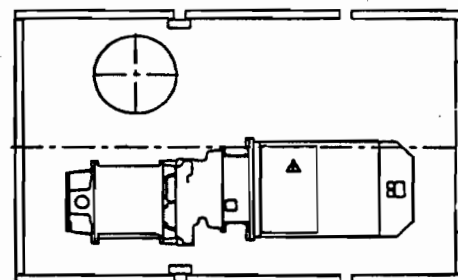


Position of Labels, Air-Cooled

Ref	Note	Part No	Description	Qty
1		1091 1204 00	Patent Plate	1
2		0129 3103 00	Blind Rivet	4
3		1079 9901 09	Label	4
4		0129 310400	Blind Rivet	4
5		1310 2519 16	Data Plate	1
6			Decal	4
		1614 5342 14	GA160	
		1614 5342 16	GA90-100	
7		1614 5342 15	Decal	2
8		1614 6490 00	Decal	1
9		0690 1132 01	Decal	2
10		1079 9915 99	Label	1
11		1310 3109 74	Label	1
12			Flow Label	1
		1614 6844 01	GA90	
		1614 6844 02	GA110	
		1614 6844 04	GA160	



VIEW A INSIDE THE UNIT



Position of Labels, Water-Cooled

Ref	Note	Part No	Description	Qty
1		1091 1204 00	Patent Plate	1
2		0129 3103 00	Blind Rivet	4
3		1079 990109	Label	4
4		0129 3104 00	Blind Rivet	4
5		1310 2519 16	Data Plate	1
6			Decal	4
		1614 5342 14	GA160	
		1614 5342 16	GA90-110	
7		1614 5342 15	Decal	2
8		1614 6490 00	Decal	1
9		0690 1132 01	Decal	2
10		1079 9915 99	Label	1
11		1310 3109 74	Label	1
12		1079 9913 69	Label	1
13		1079 9913 79	Label	1
14			Flow Label	1
		1614 6844 07	GA90	
		1614 6844 08	GA110	
		1614 6844 10	GA160	

Service and Maintenance Kits

Ref	Note	Part No	Description	Qty
		2906 0092 00	Air/Oil Filter Kit	
		1030 0979 00	Air Filter Element	1
		1613 6105 00	Oil Filter Element	3
		0661 1033 00	Gasket Gear Casing	1
			Drain Plug	
		0661 1020 00	Gasket Oil Stop Valve/	1
			Check Valve Drain Plug	
		0661 1056 00	Gasket Oil Filler Plug	1
		0653 1046 00	Gasket Compressor	2
			Casing Oil Nozzle	
		0653 1100 00	Gasket Oil Nozzle	1
		0653 1062 00	Gasket Drain Plugs	6
			(Water-Cooled Units)	
		2906 0093 00	Check Valve Kit	
		0663 3153 00	O-Ring	1
		2254 5324 00	Check Valve	1
		2254 8075 00	Spring	1
		0663 7145 00	O-Ring	1
			Air Discharge Flex.	
		2906 0094 00	Oil Stop Valve Kit	
		0663 7142 00	O-Ring	1
		0663 3120 00	O-Ring	1
		0663 9868 00	O-Ring	2
		2254 9868 00	Spring	1
		0663 7138 00	O-Ring	1
		2906 0095 00	Min. Pressure Valve Kit	
		0665 0700 89	Seal Ring	1
		1614 6480 00	Check Valve	1
		2254 8074 00	Spring	1
		1614 6957 00	Washer	1
		2254 9215 00	Lockplate	1
		0663 3555 00	O-Ring	1
		2906 0096 00	Water Separator Kit	
		0663 7153 00	O-Ring	1
		1202 3739 00	Membrane	1
		1202 3873 00	Insert	1
		2906 0097 00	Throttle Valve Kit	
		0663 2100 64	O-Ring	3
		1619 6142 00	Seal Ring	1
		1619 6143 00	Seal Ring	1
		0663 2122 00	O-Ring	1
		2906 0098 00	Oil Separator Kit	
		1614 6423 00	Oil Separator Element	1
		0663 2103 25	O-Ring	2
		0663 7143 00	O-Ring	2
		2906 0099 00	Cooler Kit, Air-Cooled	
		0663 7143 00	O-Ring Air Cooler	4
		0333 3227 00	Lockwasher Air Cooler	2
		0663 9868 00	O-Ring Oil Cooler	2
		2906 0100 00	Aftercooler Kit, Water-Cooled	
		0663 6147 00	O-Ring	2
		0663 7143 00	O-Ring	2
		0333 2136 00	Spring Washer	4
		1614 6667 00	O-Ring	1
		1614 6259 00	Gasket	1
		1614 6258 00	Seal Strip	1
		1614 6256 00	O-Ring	2
		0653 1062 00	Gasket	2

Ref	Note	Part No	Description	Qty
		2906 0101 00	Oil Cooler Kit, Water-Cooled	
		0663 9868 00	O-Ring	2
		0333 2136 00	Spring Washer	4
		1614 6667 00	O-Ring	1
		1614 6259 00	Gasket	1
		1614 6258 00	Seal Strip	1
		1614 6256 00	O-Ring	2
		0653 1062 00	Gasket	2
			Note: For GA160 use 2 oil cooler kits (2906 0101 00)	
		2906 0102 00	Element Installation Kit	
		0508 2158 01	Bearing Drive Shaft	1
		0506 0100 08	Bearing Drive Shaft	1
		0337 6074 00	Key Driven Gear	1
		0211 1409 00	Cap Screw Driven Gear	3
		2252 5478 00	Seal Ring Bushing	1
		1619 5177 00	Seal Ring	2
		0663 7154 00	O-Ring	1
		0663 3117 00	O-Ring Nozzle	1
		2254 7357 09	Drive Coupling Element	1
		1202 7003 00	Gasket Bearing Housing	1
		0663 2100 64	O-Ring Inlet Valve	2
		0663 7142 00	O-Ring Oil Stop Valve	1
		0663 3120 00	O-Ring Oil Stop Valve	1
		0663 3153 00	O-Ring Check Valve	1
		2906 0103 00	4,000 Hr. Yearly Service Kit	
		2906 0092 00	Air/Oil Filter Kit	1
		2906 0093 00	Check Valve Kit	1
		2906 0094 00	Oil Stop Valve Kit	1
		2906 0095 00	Min. Pressure Valve Kit	1
		2906 0096 00	Water Separator Kit	1
		2906 0104 00	8,000 Hr. 2-Year Service Kit	
		2906 0092 00	Air/Oil Filter Kit	1
		2906 0093 00	Check Valve Kit	1
		2906 0094 00	Oil Stop Valve Kit	1
		2906 0095 00	Min. Pressure Valve	1
		2906 0096 00	Water Separator Kit	1
		2906 0097 00	Throttle Valve Kit	1
		2906 0098 00	Oil Separator Kit	1
		2906 0091 00	Vent Valve Kit	1
		1619 7560 00	Thermostatic Valve	1
		0663 9868 00	O-Ring	1
		2906 0105 00	Overhaul Kit Air-Cooled	
		2906 0104 00	8,000 Hr. 2-Year	1
			Maintenance Kit	
		2906 0102 00	Element Installation Kit	1
		2906 0099 00	Cooler Kit	1
		1619 5318 01	Rubber Buffer	1
		1020 5072 00	Rubber Buffer	2
		2906 0106 00	Overhaul Kit Water-Cooled	
		2906 0104 00	8,000 Hr. 2-Year	1
			Maintenance Kit	
		2906 0102 00	Element Installation Kit	1
		2906 0100 00	Aftercooler Kit	1
		2906 0101 00	Oil Cooler Kit	2
		1619 5318 01	Rubber Buffer	1
		1020 5072 00	Rubber Buffer	2
			Note: The kit does contain 2 oil cooler kits (2906 0101 00) for GA160	

SAFETY PRECAUTIONS FOR STATIONARY COMPRESSORS & EQUIPMENT (continued)

Read and understand these precautions before installing your unit
and observe them during operation and maintenance.

aftercooler or air system is free to expand under heat and that it is not in contact with or close to flammable material.

8. No external force may be exerted on the air outlet valve; the connected pipe must be free of stress and strain.

9. If remote control is installed, the unit must bear an obvious sign reading:

DANGER: This machine is remotely controlled and may start without warning.

As a further safeguard, persons switching on remotely controlled units shall take adequate precautions to ensure that there is no one checking or working on the machine. To this end, a suitably worded notice must be affixed to the starting equipment.

10. In multiple compressor systems, manual valves must be installed to isolate each compressor. Non-return valves (check valves) must not be relied upon for isolating pressure systems.

11. Never remove or tamper with the safety devices, guards or insulations fitted on the unit. Every pressure vessel or auxiliary installed outside the unit to contain air above atmospheric pressure shall be protected by a pressure-relieving device or devices as required.

12. External pipework or other parts with a temperature in excess of 175°F (80°C) and which may be accidentally touched by personnel in normal operation must be guarded or insulated. Other high-temperature pipework should be clearly marked.

13. If the ground is not level or can be subject to variable inclination, consult Atlas Copco.

14. The electrical connections must be in accordance with the local codes. The units must be properly grounded and protected against short circuits by fuses.

Operation

1. Air hoses shall be of correct size and suitable for the working pressure and flow. Never use frayed, damaged or deteriorated hoses. Use only the correct type and size of hose fittings and connections. When blowing through a hose or air line, ensure that the open end is held securely. A free end will whip and may cause injury. Make sure that a hose is fully depressurized before disconnecting it.

2. Never operate the unit when there is a possibility of taking in flammable or toxic fumes.

3. Never operate the unit at pressures below or in excess of its limit ratings as prescribed on the Principal Data Sheet.

4. All canopy doors (if provided) must be closed during operation.

5. Personnel in environments or rooms where the sound pressure level reaches or exceeds 90 dB(A) must wear ear protectors.

6. Periodically check that:

- a. All guards are in place, in good condition and securely fastened.
- b. All hoses and/or pipes inside the unit are in good condition, secure and not rubbing.
- c. There are no leaks.
- d. All fasteners are tight.
- e. All electrical leads are secure and in good condition.
- f. Safety valves and other pressure-relief devices are not obstructed by dirt or paint.
- g. Air outlet valve and air system, i.e. pipes, couplings, manifolds, valves, hoses, etc. are in good repair, free of wear or abuse.

Maintenance

Maintenance and repair work shall only be carried out under supervision of someone qualified for the job.

1. Use only the correct tools for maintenance and repair work.

2. Use only genuine Atlas Copco spare parts.

3. All maintenance work must only be undertaken when the unit is stopped and the main power supply is switched off. Take proper lockout precautions to ensure that the unit cannot be started inadvertently.

4. Before removing any pressurized component, isolate the unit from all sources of pressure and relieve the entire system of pressure.

5. Never use flammable solvents or carbon tetrachloride for cleaning parts. Take safety precautions against toxic vapors of cleaning liquids.

6. Maintain a clean environment during maintenance and repair. Keep dirt away by covering the parts and exposed openings with a clean cloth, paper or tape.

7. Never weld or perform any operation involving heat near the oil system. Oil tanks must be completely purged, e.g. by steam-cleaning, before carrying out such operations.

8. Make sure that no tools, loose parts or rags are left in or on the unit.

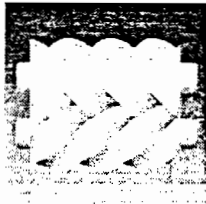
9. Before cleaning the unit for use after maintenance or overhaul, check that operating pressures, temperatures and time settings are correct and that the control and shutdown devices function correctly.

10. Protect the motor, air filter, electrical and regulating components, etc. to prevent moisture from entering them, e.g. when steam-cleaning.

11. Do not remove any of, or tamper with, the sound-damping material.

12. Never use caustic solvents which can damage materials of the air system, e.g. polycarbonate bowls.

13. Always consult local, state and federal regulations when handling refrigerant.

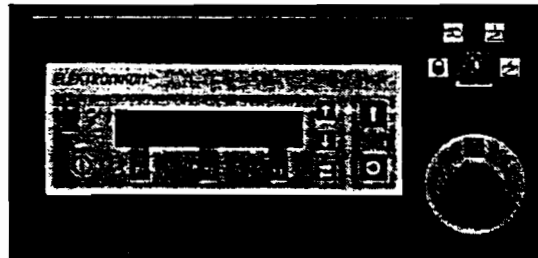


User manual for Elektronikon® regulator for

GA90/315 GR110/200
ZE45/185 ZA160/500
ZT/ZR18/90 ZR110/275
ZT110/275

Important

1. This Manual applies exclusively to the above-mentioned compressors equipped with an electronic regulator as shown below.
2. This Manual must be used together with the relevant Instruction book for the compressor.
3. All screens shown are typical examples and may differ depending on the type of compressor.



F2536

Registration code
Collection: APC ZE/ZA45-500
Tab: 38
Sequence: 990

Collection: APC G ≥ 90
Tab: 38
Sequence: 975

Collection: APC Z ≤ 90
Tab: 38
Sequence: 988

Collection: ZR/ZT110-275
Tab: 38
Sequence: 993

Replaces
No. 2920 1291 01

No. 2920 1291 02

1996-04

Atlas Copco

Oil-free Air Division - B-2610 Wilrijk - Belgium



• 2 9 2 0 1 2 9 1 0 2 •



OWNERSHIP DATA

Unit type:
Motor type:
Delivery date:
Service Plan:

Selected lubricants

Compressor:
Bearing grease type, electric motor:

Printed Matter Nos.

Atlas Copco instruction book:
Atlas Copco parts list:
Atlas Copco logbook:

Local Atlas Copco Representative

Name:
Address:
Telephone:
Telex:

Owner's machine No.:
Unit serial No.:
Motor serial No.:
First start-up date:

Capacity:

Motor instruction book:
Motor parts list:

Contact persons: Service:
Parts:

SAFETY PRECAUTIONS FOR STATIONARY COMPRESSORS

To be read attentively and acted accordingly before installing, operating or repairing the unit

These recommendations apply to machinery processing or consuming air or inert gas. Processing of any other gas requires additional safety precautions typical to the application which are not included herein.

In addition to normal safety rules which should be observed with stationary air compressors and equipment, the following safety directions and precautions are of special importance.

When operating this unit, the operator must employ safe working practices and observe all related local work safety requirements and ordinances.

The owner is responsible for maintaining the unit in a safe operating condition. Parts and accessories shall be replaced if unsuitable for safe operation.

Installation, operation, maintenance and repair shall only be performed by authorized, trained, competent personnel.

Normal ratings (pressures, temperatures, time settings, etc.) shall be durably marked.

Any modification on the compressor shall only be performed in agreement with Atlas Copco and under supervision of authorized, competent personnel.

If any statement in this book, especially with regard to safety, does not comply with local legislation, the stricter of the two shall apply.

These precautions are general and cover several machine types and equipment; hence some statements may not apply to the unit(s) described

in this book.

Installation

Apart from general engineering practice in conformity with the local safety regulations, the following directives are specially stressed:

1. A compressor shall be lifted only with adequate equipment in conformity with local safety rules.

Loose or pivoting parts shall be securely fastened before lifting. It is strictly forbidden to dwell or stay in the risk zone under a lifted load. Lifting acceleration and retardation shall be kept within safe limits.

2. Any blanking flanges, plugs, caps and desiccant bags shall be removed before connecting up the pipes. Distribution pipes and connections shall be of correct size and suitable for the working pressure.

3. Place the unit where the ambient air is as cool and clean as possible. If necessary, install a suction duct. Never obstruct the air inlet. Care shall be taken to minimize the entry of moisture with the inlet air.

4. The aspirated air shall be free from flammable fumes or vapours, e.g. paint solvents, that can lead to internal fire or explosion.

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1 GENERAL DESCRIPTION

The electronic regulator automatically controls the compressor, i.e.:

- loading and unloading the compressor 1)
- stopping the compressor whenever possible
- restarting the compressor when required

In order to control the compressor and to read and modify programmable parameters, the regulator has a control panel provided with:

- LEDs indicating the status of the compressor
- a display indicating the operating conditions, a service need or a fault
- keys to control and program the compressor, and to have access to the data collected by the regulator
- buttons to manually start and stop the compressor
- a key switch to select the required compressor control mode
- an emergency stop button

In general, the regulator has following functions:

- controlling the compressor
- protecting the compressor
- monitoring components subject to service
- automatic restart after voltage failure (made inactive)
- permissive start

1.1 Controlling the compressor

The regulator maintains the net pressure between programmable limits by automatically loading and unloading the compressor depending on the air consumption. 1)

The regulator takes into account a number of programmable settings, such as:

- the unloading pressure
- the loading pressure
- the minimum stop time
- the maximum number of motor starts

The regulator stops the compressor whenever possible (when the expected unloading period exceeds a programmed value) to reduce the power consumption and restarts it automatically when the net pressure decreases. In case the expected unloading period is below a programmed value, the regulator keeps the compressor running to prevent too-short standstill periods.

When the compressor has stopped automatically and the net pressure decreases, the regulator will start the compressor before the net pressure has dropped to the loading pressure to prevent the net pressure from falling under the programmed minimum level.

When stopping the compressor manually, the regulator will unload the compressor for a programmed time and then stop the compressor. 2)

1.2 Protecting the compressor

1.2.1 Shut-down and motor overload

Several temperature and pressure sensors are provided on the compressor. If one of these measurements exceeds the programmed shut-down level, the compressor will be stopped. This will be indicated on the control display.

The compressor will also be stopped in case of overload of the drive motor or a fan motor (if provided).

1.2.2 Shut-down warning

If the regulator detects a temperature or pressure just below the programmed shut-down level, this will be indicated on the control panel to warn the operator before the shut-down level is reached. The message disappears as soon as the warning condition disappears.

1.3 Monitoring components subject to service

The regulator continuously monitors critical components (motor grease, oil, oil filter, oil separator 3) and air filters). Each input is compared to programmed limits. Exceeding these limits causes a message on the control display to warn the operator to replace the indicated component or to regrease the bearings of the drive motor.

1.4 Automatic restart after voltage failure

The regulator has a built-in function to automatically restart the compressor if the voltage is restored after voltage failure. For compressors leaving the factory, this function is made inactive. If desired, the function can be activated. Consult Atlas Copco.

If activated, and provided the module was in the automatic operation mode and the compressor control mode (see section 3.5) was not changed during the power failure, the compressor will automatically restart if the supply voltage to the module is restored within a programmed time period (this time period is called the **power recovery time**).

- 1) For ZE45/185 and ZA160/500 without full load/no load regulator, the settings for unloading and loading the compressor are not programmable; consequently, these parameters are not taken into account.
- 2) GA90/315 and GR110/200 have an unloading time of 30 seconds, for Z compressors this period is 3 seconds.
If a compressor with 30 seconds unloading time was running at the moment of manually stopping in automatic unloading condition for 10 seconds, it will remain running unloaded for $30 - 10 = 20$ seconds before stopping.
- 3) Not for Z compressors.

1.5 Permissive start

After a start command (either automatic start by the Elektronikon regulator or manual start), the start conditions are checked; if the programmed start conditions are not fulfilled within a programmed time interval, the compressor will not start (indicated as **Start failure**).

1.6 Start commands during programmed stop time and minimum stop time

The control module also includes following functions:

- **Programmed stop time**
After pressing stop button 0 (9-Fig. 1), the compressor will run unloaded for a programmed time period. The compressor then stops. A start command during this period is ignored.
- **Minimum stop time**
After stopping, the module prevents the motor from restarting within a programmed time period. A start command during this time will be memorized and executed after running out of this period.

2 CONTROL PANEL (Fig. 1)

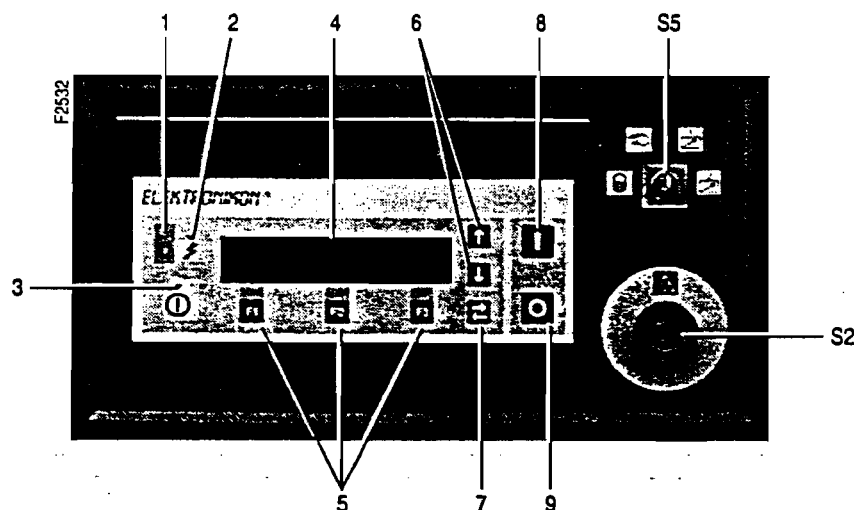


Fig. 1. Control panel

Ref.	Designation	Function	Ref.	Designation	Function
1	Automatic operation LED	Indicates that the regulator is automatically controlling the compressor: the compressor is loaded, unloaded, stopped and restarted depending on the air consumption and the limitations programmed in the regulator.			LED (1) lights up indicating that the regulator is operative (in automatic operation). The LED goes out after unloading the compressor manually.
2	Voltage on LED	Indicates that the voltage is switched on.	9	Stop button	Push button to stop the compressor. LED (1) goes out. The compressor will stop after running in unloaded condition for a few seconds. See also sections 1.1 and 1.6.
3	General alarm LED	Is alight if a shut-down warning condition exists. See section 7. Blinks if a shut-down condition exists, if an important sensor is out of order or after an emergency stop. See section 7.	S2	Emergency stop button	Maintained-action push button to stop the compressor immediately in case of emergency. After remedying the trouble, unlock the button by turning it to the left.
			S5	Operation mode switch	Key switch to select the compressor control mode. See section 3.5.
4	Display	Indicates messages concerning the compressor operating condition, a service need or a fault. See section 3.1.	Note: For ZE45/185 and ZA160/500 without full load/no load regulator, the settings for unloading and loading the compressor are not programmable; consequently these parameters are not taken into account.		
5	Function keys	Keys to control and program the compressor. See section 3.4.			
6	Scroll keys	Keys to scroll through the display. See section 3.2.			
7	Tabulator key	Key to go to the next field of the display. See section 3.3.			
8	Start button	Push button to start the compressor.			

Compressor Outlet		7.0 bar
Automatically Loaded		
Menu	Show More	Unload
F1	F2	F3

Fig. 2. Typical example of a display

3 DISPLAY - KEYS

3.1 Display (4-Fig. 1)

The display has four lines of 40 characters. A typical display is shown in Fig. 2. It indicates:

- On the first three lines:
 - the name of the sensor(s) of which the actual reading is displayed
 - the unit and actual reading of the sensor(s)
 - messages regarding the compressor operating condition (e.g. <<Automatically Loaded>>), a service need (e.g. for the oil filter and air filter) or a fault (e.g. shut-down)
- On the fourth line, just above the three function keys (F1/F2/F3), the actual functions of these keys.

3.2 Scroll keys (6-Fig. 1)

These keys, labelled with vertical arrows, allow to scroll through the display.

As long as a downwards pointing arrow is shown at the utmost right position of the display, key (6) with the same symbol can be used to see the next item.

As long as an upwards pointing arrow is shown at the utmost right position of the display, key (6) with the same symbol can be used to see the previous item.

3.3 Tabulator key (7-Fig. 1)

This key, labelled with two horizontal arrows, allows the operator to go to the next field of the display, e.g. during modifying of programmable parameters.

3.4 Function keys (5-Fig. 1)

The keys are used:

- to manually load/unload the compressor 1)
- to call up or program settings
- to reset an active motor overload, shut-down or service message, or an emergency stop
- to have access to all data collected by the regulator

The function keys allow to make the required selection from a menu of possibilities. The functions of the keys vary depending on the displayed menu. The actual function is indicated on the bottom line of the display just above the relevant key. Only the active and relevant functions at a moment are shown.

The most common functions are listed below:

Designation	Function
Add	To add compressor start/stop commands (day/hour)
Cancel	To cancel a programmed setting when programming parameters
Delete	To delete compressor start/stop commands
Limits	To show limits for a programmable setting
List	To list programmed start/stop commands (day/hour)
Load	To load the compressor manually 1)
MainScreen	To return from a menu to the main display (Fig. 3)
Menu	Starting from the main display (Fig. 3), to initiate the main menu (Fig. 4) which gives access to submenus Starting from a submenu, to return to the main menu (Fig. 4)
Modify	To modify programmable settings
Show More	To have a quick look at the compressor status
Program	To program modified settings
Reset	To reset a timer or message
Return	To return to a previously shown option or menu
Select	To select a submenu or to read more details of a selection shown on the display
Unload	To unload the compressor manually 1)

3.5 Key switch (S5-Fig. 1)

The switch allows the operator to select four compressor control modes.

Key position	Compressor control mode
1	Compressor off. The regulator will not react on any start/stop or manual load/unload command.
2	Local control mode. The regulator will only react on commands entered by means of the buttons on the control panel of the compressor.
3	Remote control mode 1. The regulator will only react on start/stop and manual load/unload commands generated by external switches. Emergency stop button (S2) on the control panel of the compressor remains active. Compressor start/stop commands via function Timers (see section 13) are still possible, if programmed and activated. It also remains possible to call up data and to program the regulator. Consult Atlas Copco before connecting external equipment to the regulator. Maintained-action buttons must not be used for the remote start and stop functions.
4	Remote control mode 2. The regulator will only react on start/stop and manual load/unload commands generated by computer. Consult Atlas Copco.

1) Not for ZE45/185 and ZA160/500 without full load/no load regulator.

Important

- To avoid unauthorized switching over to another compressor control mode, take out the key after selecting the mode.
- The regulator will only react on a new control mode if the new position of the key switch is maintained for 3 seconds.

4 MENU-DRIVEN CONTROL PROGRAMS

In order to facilitate programming and controlling, menu-driven control programs have been implemented in the regulator.

4.1 Function of control programs (Figs. 5)

Program	See section	Function
MAIN DISPLAY	5	Shows in short the operation status of the compressor. Is the gateway to all functions.
MAIN MENU	6	Is the gateway to most other functions via submenus.
Submenu Status data	7	Calling up the status of the compressor protection functions (shut-down, shut-down warning and motor overload). Resetting of a shut-down and motor overload.
Submenu Measured data	8	Calling up the actual measured data and the status of the motor overload protection.
Submenu Hours	9	Calling up the running hours, loading hours, regulator hours and number of motor starts.
Submenu Service	10	Calling up and resetting the service messages for the oil, oil filter, oil separator (if provided), air filter and drive motor grease.
Submenu Test	11	Display test.
Submenu Modify settings	12	Modifying the settings for regulation (e.g. loading and unloading pressures) 1), for protection (e.g. temperature shut-down level) and for service (e.g. for the oil).
Submenu Timers	13	Programming time-based compressor start/stop commands.

Program	See section	Function
Submenu Configuration	14	Programming the time, date, display language, units, motor start mode and date format.
Submenu Saved data	15	Calling up the saved data: last shut-down, longest load data, longest unload data. 1)
SHOW MORE	16	Quick look at the actual status of the compressor.
LOAD/UNLOAD	17	To manually load/unload the compressor. 1)

4.2 Selecting a menu (Fig. 5a)

4.2.1 Main display

When the voltage is switched on, the MAIN DISPLAY (Fig. 3) is shown automatically, showing in short the operation status of the compressor. See section 5. The other menus are selected by pressing one of the function keys (5-Fig. 1).

4.2.2 Calling up other menus

MAIN MENU

Pushing the key <<Menu>> initiates the MAIN MENU (Fig. 4), giving access to most other functions via submenus; the submenus can be selected by pressing the key <<Select>>; see section 6.

SHOW MORE

Pushing the key <<Show More>> gives the operator a quick look at the actual status of the compressor; see section 16.

UNLOAD or LOAD 1)

The keys <<Unload>> and <<Load>> are used to manually unload and load the compressor respectively. See section 17.

4.2.3 Returning to the main menu or main display

MAIN MENU

Whenever displayed on the bottom line of the screen, press the key <<Menu>> to return from a submenu to the MAIN MENU (Fig. 4).

MAIN DISPLAY

Whenever displayed, press the key <<MainScreen>> to return from a menu to the MAIN DISPLAY (Fig. 3).

1) Not for ZE45/185 and ZA160/500 without full load/no load regulator.

5 MAIN DISPLAY: compressor status in short/gateway to all other functions

5.1 Function

The main display (Fig. 3) shows in short the compressor operation status and is the gateway to all functions implemented in the regulator.

5.2 Procedure (Fig. 1)

The main display is shown automatically when the power is switched on.

If the function keys or arrow keys (5, 6 and 7) are not used for 4 minutes, the regulator will automatically return to the main display.

Exception is made, when the screen is left untouched when modifying data in the regulator. In this case, the screen will remain unchanged, since the regulator does not take a decision whether to accept or refuse the new data.

Compressor Outlet		7.0 bar
Intercooler		2.3 bar
Automatically Loaded		
Menu	Show More	Unload
F1	F2	F3

Fig. 3. Example of the main display

On line 1, the compressor outlet pressure is displayed in bar (the units for pressure and temperature can be selected, see section 14).

On line 2, the compressor interstage pressure is displayed in bar.

On line 3, the compressor operation status is displayed (e.g. <<Automatically Loaded>>, <<Manually Unloaded>>). This line is also used to display following messages:

- motor overload, shut-down or shut-down warning (see section 7)
- service required (see section 10)
- sensor error (check wiring or replace sensor if necessary)

Note

When more than one message needs to be displayed (e.g. both warning and service), the messages will be displayed one after the other for 3 seconds.

6 MAIN MENU: gateway to other functions

6.1 Function

The main menu (Fig. 4) gives the operator access to most other functions via submenus.

6.2 Procedure

The main menu is activated by pressing:

- the key <<Menu>> on the main display (Fig. 3)
- the key <<Menu>> on whatever submenu display

Status Data			↓
MainScreen	Select		
F1	F2	F3	

Fig. 4. Example of a main menu

The display indicates the name of the submenu which can be selected (only one name is shown, use scroll keys (6-Fig. 1) to see the other names).

In this example, the display shows:

- that the <<Status data>> submenu can be selected
- that other submenus are available using the scroll key ↓
- that the key <<MainScreen>> can be used to return to the main display
- that the key <<Select>> can be used to select the submenu <<Status data>> to get more detailed information

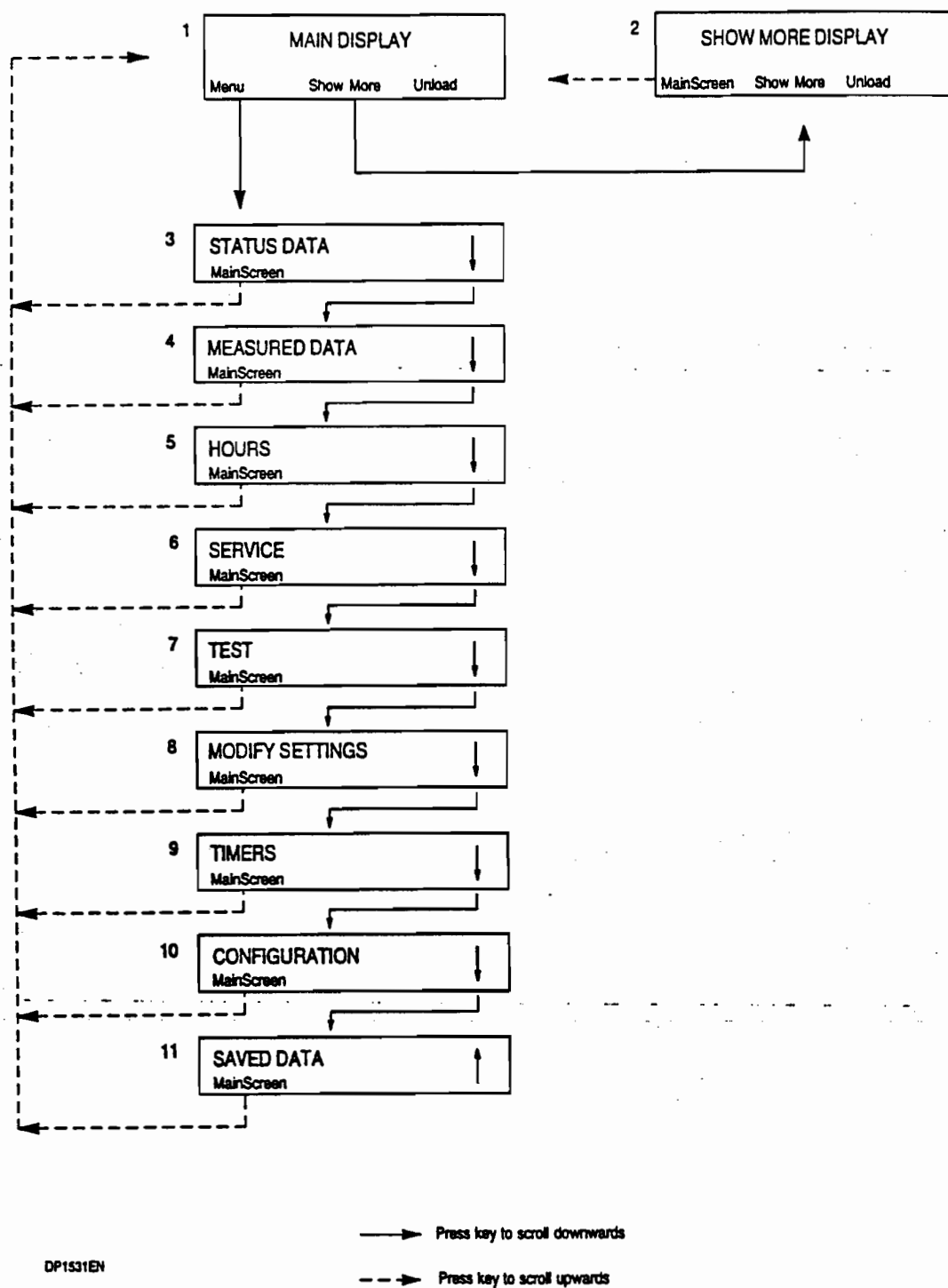


Fig. 5a. General menu flow



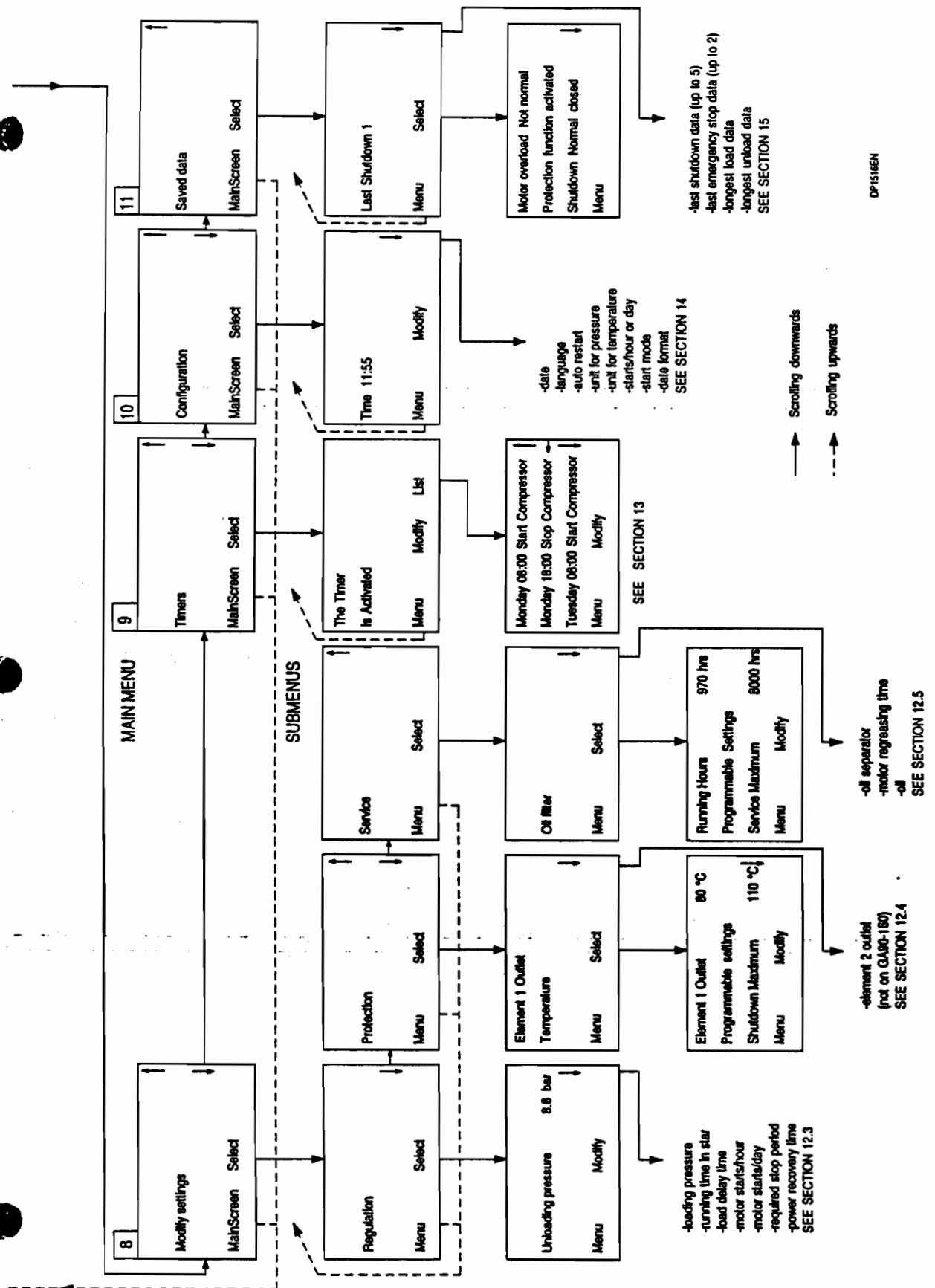
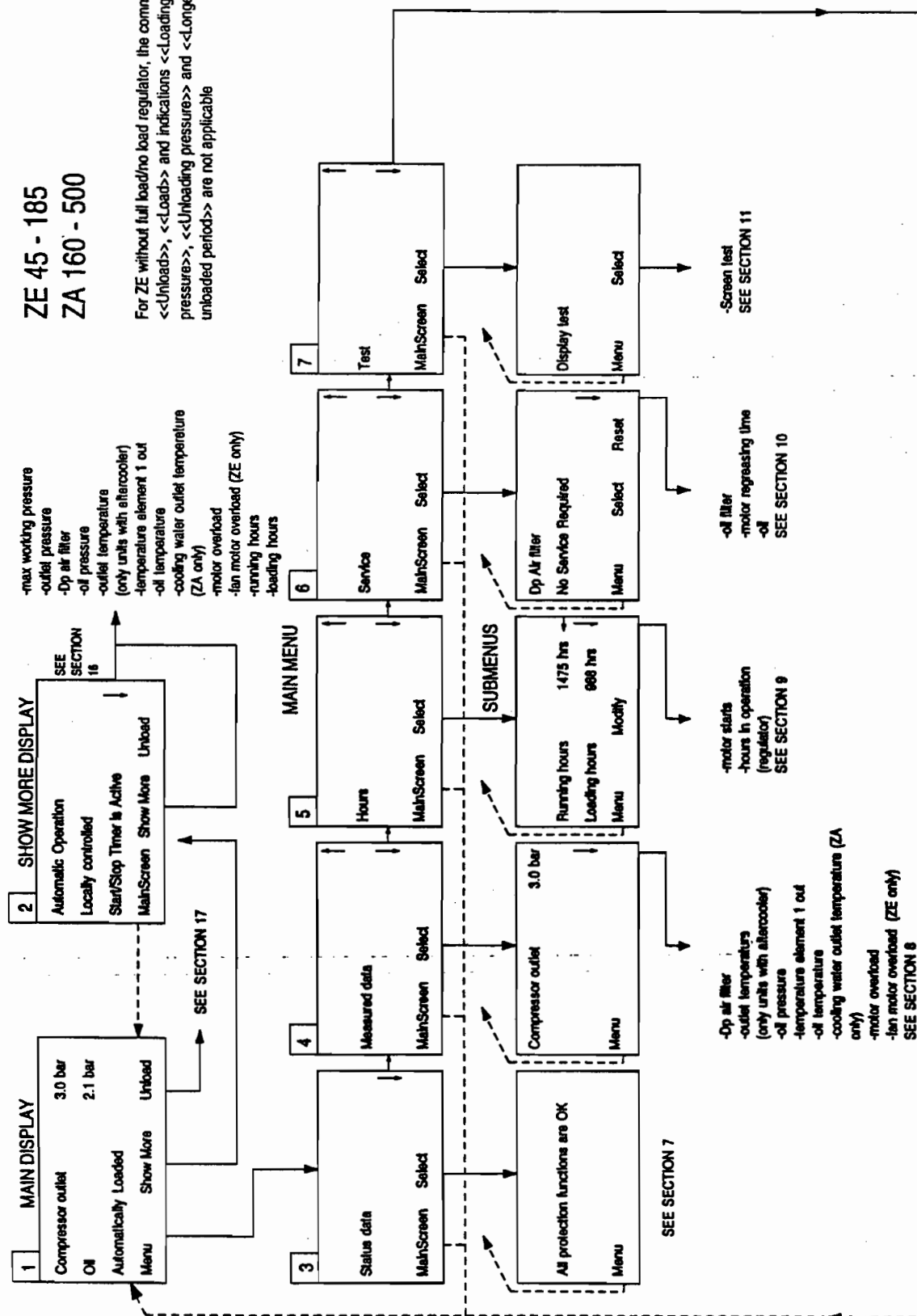


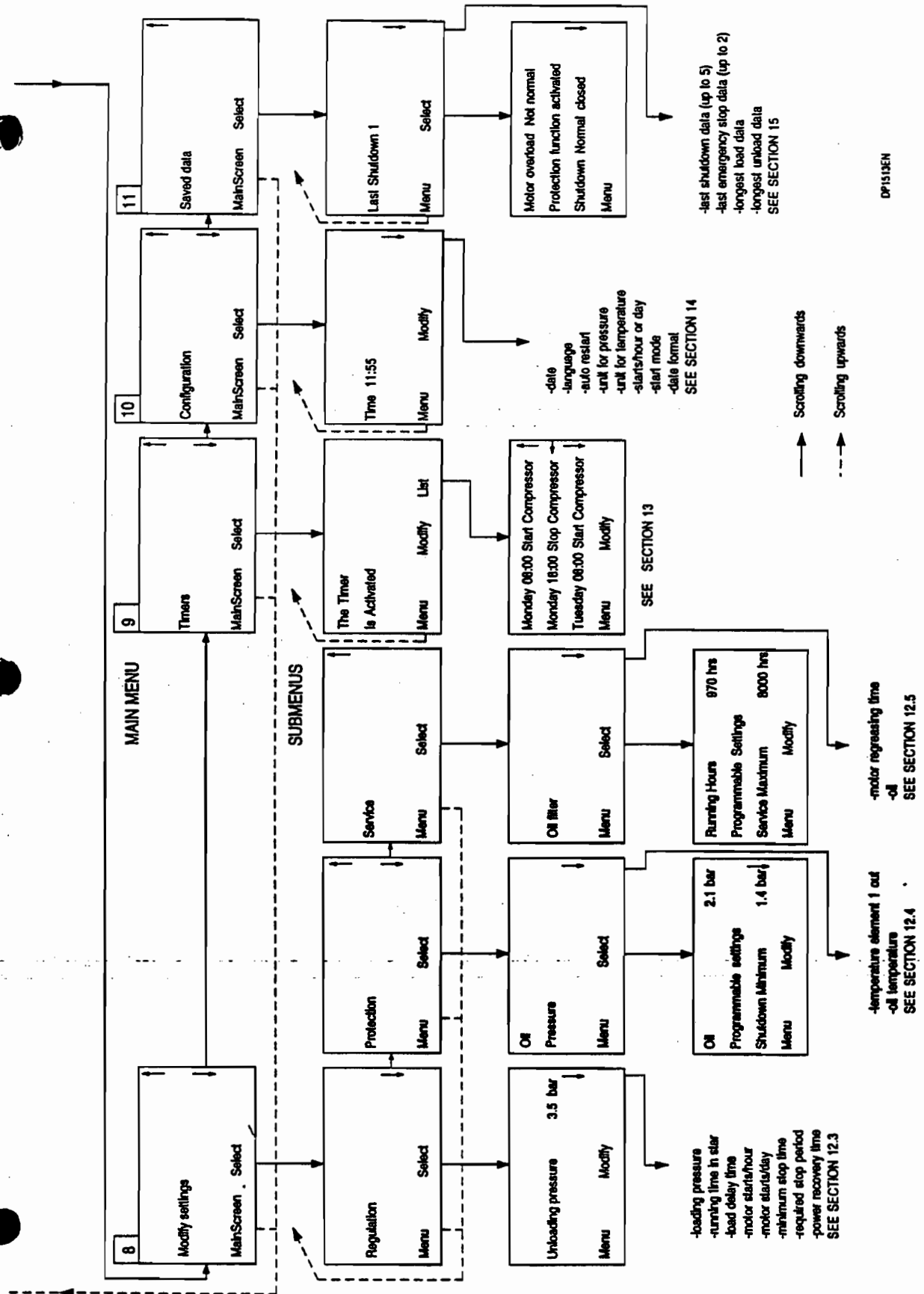
Fig. 5b. Menu flow for regulator of GA90/315 and GR110/200 (the screens shown are typical examples)

ZE 45 - 185 ZA 160 - 500

For ZE without full load/no load regulator, the commands <<Unload>>, <<Load>> and indications <<Loading pressure>>, <<Unloading pressure>> and <<Longest unloaded period>> are not applicable



DP1514EN



DP151DEN

Fig. 5c. Menu flow for regulator of ZA160/500 and ZE45/185 with full load/no load regulator (the screens shown are typical examples)

ZT/ZR18-90 ZR110-275 ZT110-275

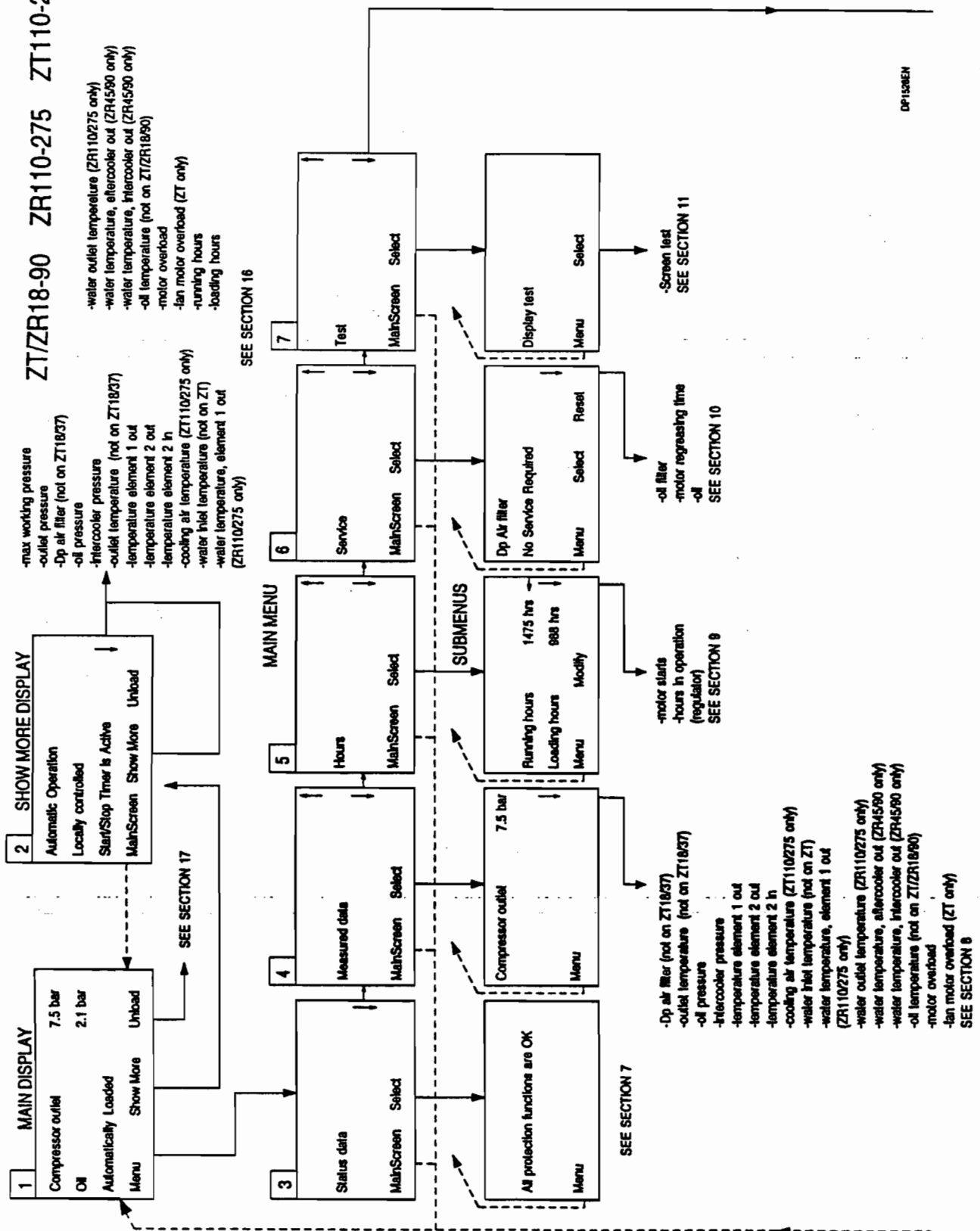




Fig. 5d. Menu flow for regulator of ZTR1890, ZR110275 and ZT110275 (the screens shown are typical examples)

7 Submenu STATUS DATA: calling up compressor status/resetting of shut-down

7.1 Function

The status data submenu gives information regarding the status of the compressor protection functions (shut-down, shut-down warning and motor overload) and allows resetting of a shut-down and motor overload.

7.2 Procedure (Fig. 1)

1. Activate the main menu by pressing key <<Menu>> (5).
2. The first option shown on the second line of the display is <<Status data>>.
3. Press key <<Select>> (5).

7.2.1 No shut-down warning message or shut-down message exists

In this case, LED (3-Fig. 1) is out and the message on the display indicates that all conditions are normal (Fig. 6):

All protection functions are OK

Menu

F1	F2	F3

Fig. 6. Example of a status data screen

7.2.2 A shut-down message exists

LED (3-Fig. 1) blinks and the shut-down screen (Fig. 7) automatically appears on the display if the compressor is shut down.

In case of a shut-down due to too high a temperature at the outlet of compressor element 1 1), a screen similar to that in Fig. 7 will appear:

Element 1 Outlet	112°C
Protection function activated	
Shutdown	Maximum
Menu	*** Reset
F1	F2 F3

Fig. 7. Example of a status data screen

The top line of the display, the actual temperature (112°C) and the indicators (***) are blinking.

It remains possible to scroll through other menus and then return to the status data menu. In this case, the first option of a submenu will be shown, i.e. <<shut-downs>>. This option can be selected by pressing key <<Select>> (5-Fig. 1) to return to the screen of (Fig. 7).

See section 7.3 to reset the shut-down message.

7.2.3 A shut-down warning message exists

1. LED (3-Fig. 1) is alight and the main display screen will change into a screen similar to the one in Fig. 8 if a shut-down warning exists.

Compressor Outlet	7.0 bar
Shutdown Warning	
Menu	*** Show More *** Unload
F1	F2 F3

Fig. 8. Example of a shut-down warning screen

2. The indicators (***) are blinking and the warning message appears alternately with the messages indicating whether the compressor runs unloaded or loaded.
3. Press the key <<Menu>>: the main menu appears (Fig. 4) with blinking indicators (***)
4. Press the key <<Select>>, use scroll key (6-Fig. 1) until the option <<Warnings>> is shown and select this option. A screen similar to the one in Fig. 9 appears, indicating that the temperature at the outlet of compressor element 1 is too high (<<106°C>>). 1) Consult the instruction book to remedy the trouble.

Element 1 Outlet	106°C
Protection function activated	
Shutd Warn	Maximum
Menu	*** 100°C
F1	F2 F3

Fig. 9. Example of a shut-down warning screen

- 1) For ZE/ZA and GA90/160, element 1 stands for the compressor element. GA200/315 have two compressor elements; element 1 stands for the compressor element at the outer side of the bodywork, element 2 for the other one.
For GR/ZR/ZT, element 1 and 2 stand for the low-pressure compressor element and the high-pressure compressor element respectively.

5. If necessary, stop the compressor by means of button O (9-Fig. 1) and wait until the compressor has stopped.
6. Switch off the voltage and inspect the compressor.
7. The warning message will disappear automatically as soon as the warning condition disappears.

Resetting

1. Switch off the voltage and remedy the trouble.
2. Switch on the voltage and press the key <<Reset>>; see also step 4 of section 7.3.
3. Restart the compressor by means of button I (8-Fig. 1).

7.3 Shut-down reset

1. Suppose that the shut-down screen as shown in Fig. 7 exists.
2. The display indicates that:
 - the compressor is shut down due to too high a temperature at the outlet of compressor element 1 1)
 - the activated function is a shut-down function
 - the maximum level is <<110°C>>
 - the actual temperature is <<112°C>>
 The fourth line of the screen shows the available function keys, i.e.:
 - <<Menu>> to return to the submenu allowing to choose between <<shut-downs>>, <<warnings>> and <<permissive start>>
 - <<Reset>>
3. Switch off the voltage and remedy the trouble. Consult the relevant Instruction book. After remedying and when the shut-down condition has disappeared, switch on the voltage and start the compressor.
4. If the function automatic restart after voltage failure is activated (see section 1.4) and the duration of repair is shorter than the programmed power recovery time, reset the display after remedying the fault: press the key <<Reset>>, the message <<All protection functions are OK>> will appear whereafter the compressor can be restarted. Press the keys <<Menu>> and <<MainScreen>> to return to the main display (Fig. 3).

7.4 Reset of motor overload

If the drive motor overload relay or a fan motor circuit breaker 2) trips, the compressor will be shut down and LED (3-Fig. 1) will blink. Following screen (Fig. 10) appears:

Motor overload		Not normal
Protection function activated		
Shutdown		Normal closed
Menu	---	--- Reset
F1	F2	F3

Fig. 10. Example of a motor overload display

The example indicates that:

- the compressor is shut down due to motor overload
- the contacts of the motor overload relay are normally closed
- the condition is <<Not normal>> (i.e. the contacts are actually open)

The top line of the display and the indicators (***) are blinking.

- 1) For ZE/ZA and GA90/160, element 1 stands for the compressor element. GA200/315 have two compressor elements; element 1 stands for the compressor element at the outer side of the bodywork, element 2 for the other one.
For GR/ZR/ZT, element 1 and 2 stand for the low-pressure compressor element and the high-pressure compressor element respectively.
- 2) If provided.

8 Submenu MEASURED DATA: calling up measured data

8.1 Function

To call up following actually measured data 1):

For GA/GR:

- compressor outlet pressure
- pressure drop (Dp) over air filters
- pressure drop (Dp) over oil separator
- intercooler pressure (not on GA)
- oil injection pressure at compressor element 1
- compressor outlet temperature
- outlet temperature at compressor element 1
- outlet temperature at compressor element 2 (not on GA90/160)
- cooling medium temperature
- status of motor overload
- status of fan motor overload

For ZE/ZA/ZR/ZT:

- compressor outlet pressure
- pressure drop over air filters (not on ZT18/37)
- oil pressure
- intercooler pressure (not on ZE/ZA)
- compressor outlet temperature (not on ZT18/37, not on ZE/ZA without aftercooler)
- outlet temperature of compressor element 1
- outlet temperature of compressor element 2 (not on ZE/ZA)
- inlet temperature of compressor element 2 (not on ZE/ZA)
- cooling air temperature (ZT110/275 only)
- cooling water temperatures (not on ZE/ZT)
- oil temperature (not on ZT/ZR18/90)
- status of motor overload protection
- status of fan motor overload protection (ZE/ZT only)
- number of running hours
- number of loading hours

8.2 Procedure (Fig. 1)

1. Activate the main menu by pressing key <<Menu>> (5).
2. Scroll through the available options using scroll keys (6) until option <<Measured data>> is shown.
3. Press key <<Select>> (5). A screen similar to the one in Fig. 11 appears.

Compressor Outlet		6.6 bar
Menu		↓
F1	F2	F3

Fig. 11. Example of a measured data display

The display indicates that the outlet pressure is 6.6 bar and that key ↓ can be used to call up the other measured data.

4. If one of the sensors is linked to a protection function (shut-down or motor overload), it will be indicated as follows (Fig. 12):

Element 1 Outlet		95°C
Related protection settings		
Shutdown	Maximum	110°C
Menu	Warning	
F1	F2	F3

Fig. 12. Example of a measured data display

The display indicates that the temperature at the outlet of compressor element 1 is 95°C, that the sensor has a shut-down function and that the shut-down value is programmed at 110°C.

5. The key <<Warning>> in Fig. 12 indicates to use this key to look at the programmed shut-down warning value.

9 Submenu HOURS: calling up hours

9.1 Function

To call up the running hours and loading hours of the compressor, the hours the regulator has been in operation as well as the number of motor starts.

9.2 Procedure (Fig. 1)

1. Activate the main menu by pressing key <<Menu>> (5).
2. Scroll through the available options using scroll keys (6) until the option <<Hours>> is shown.
3. Press key <<Select>> (5).

The display will show the number of running hours and the number of loading hours (Fig. 13). By using scroll keys (6), other items can be called up: the number of motor starts and the number of hours the regulator has been in operation.

Running hours		2455 hrs	←
Loading hours		1980 hrs	↓
Menu	Modify		
F1	F2	F3	

Fig. 13. Example of hours display

The bottom line of the screen shows the available function keys, i.e. <<Menu>> to return to the submenu and <<Modify>> to modify the value of the indicated timer; if this should be required, consult Atlas Copco.

- 1) For ZE/ZA and GA90/160, element 1 stands for the compressor element. GA200/315 have two compressor elements; element 1 stands for the compressor element at the outer side of the bodywork, element 2 for the other one.
For GR/ZR/ZT, element 1 and 2 stand for the low-pressure compressor element and the high-pressure compressor element respectively.

10 Submenu SERVICE: calling up and resetting service messages

10.1 Function

To call up and reset service messages for following monitored components: oil, oil filter, oil separator (not on Z), air filters and grease for the drive motor bearings.

10.2 Calling up service messages (Fig. 1)

1. Activate the main menu by pressing Key <<Menu>> (5).
2. Scroll through the available options using scroll keys (6) until the option <<Service>> is shown.
3. Press key <<Select>> (5). The first option (i.e. Dp Air filter) is shown; use scroll keys (6) to select the desired option. If selecting option Dp Air filter, a screen similar to the one in Fig. 14 will appear.

Dp Air Filter
No Service required

Menu	Select	Reset
F1	F2	F3

Fig. 14. Example of a service display

The display will show the name of the monitored component <<Dp Air filter>> 1) and the message whether service is needed or not (Fig. 14). A vertical arrow appears indicating to scroll through the display to check the condition of the other components subject to service.

If a monitored component needs to be serviced, it will be indicated on the main display (Fig. 3). By calling up the relevant item as described above, a screen similar to the one in Fig. 15 will appear.

Oil filter
Service required

Menu	Select	Reset
F1	F2	F3

Fig. 15. Example of a service display

The bottom line of the screen shows the available function keys, i.e.

- <<Menu>> to return to the main menu
- <<Select>> to read more details; see section 10.3
- <<Reset>> to reset the service item; see section 10.4

10.3 Calling up the actual measured value and service level

1. Call up the related service item. See section 10.2.
2. Press the key <<Select>> to get the actual measured value (for the example above, the running hours since last service). The related level at which the component needs to be serviced is also shown; see Fig. 16.

The example shows that the service life of the filter has expired; as a consequence, the filter must be replaced and the service message reset as described in section 10.4.

Oil filter	2002 hrs
Related Service settings	
Service Maximum	2000 hrs
Menu	*** Return
	*** Reset
F1	F2
	F3

Fig. 16. Example of a service screen

The bottom line of this display again shows the available function keys, i.e.:

- <<Menu>>, to return to the previous screen
- <<Return>>, to return to the message whether service is required or not
- <<Reset>>, to reset the service item; see section 10.4

10.4 Service reset

To reset the service timer:

1. If the air filters are indicated: stop the compressor, wait until the compressor has stopped and replace the filters.
2. If the oil, oil separator 2) or oil filter is indicated: stop the compressor, wait until the compressor has stopped, on GA and GR compressors unscrew the oil filler plug one turn to depressurize the system, and change the oil or replace the component as the case may be.
3. If the drive motor regreasing time is indicated: stop the compressor, wait until the compressor has stopped and regrease the drive motor bearings. Consult the relevant Instruction book.
4. Call up the service menu for the relevant component as described above.
5. Press the key <<Reset>>: the timer is reset to 0.

Note

- Each service item must be reset individually.
- Apply all related safety precautions, including those mentioned in the relevant Instruction book.

1) Dp stands for 'pressure drop over'.
2) GA/GR only.

11 Submenu TEST: display test

11.1 Function

To carry out a display test, i.e. to check whether the display and LEDs are still intact.

11.2 Procedure (Fig. 1)

1. Activate the main menu by pressing key <<Menu>> (5).
2. Scroll through the options using scroll keys (6) until the option <<Test>> is shown.
3. Press key <<Select>> (5).

The display shows the option <<Display test>>. Press key <<Select>> (5).

During testing, the regulator will generate a series of patterns on the display which enable the operator to check that each pixel still functions normally; at the same time the LEDs are lit.

4. Press key <<Menu>> (5) to return to the submenu.

12 Submenu MODIFY SETTINGS: Modifying settings for regulation, protection and service

12.1 Function

To modify a number of programmable parameters, including:

1 Regulation settings:

- unloading pressure 3)
- loading pressure 3)
- motor running time in star
- load delay time
- number of motor starts/hour (low-voltage motor)
- number of motor starts/day (high-voltage motor)
- minimum stop time (i.e. the time period during which the compressor, if stopped automatically, remains stopped whatever happens with the air net pressure) 4)
- required stop period (the compressor will not be stopped automatically by the regulator unless a standstill period equal to the sum of the minimum stop time and required stop period is expected)
- power recovery time (is the period within which the voltage must be restored to have an automatic restart, appears only if automatic restarting after voltage failure is activated) 1)

2 Protection settings 2):

For GA90/315 and GR110/200

- shut-down level for the outlet temperature at compressor element 1

- shut-down level for the outlet temperature at compressor element 2 (not on GA90/160)
- the shut-down warning levels for the above-mentioned parameters
- the delay at signal time (is the period during which the signal must exist before the compressor is shut down)

For ZE/ZA

- shut-down level for the outlet temperature at compressor element 1
- shut-down level for the oil temperature
- shut-down level for the oil pressure
- the shut-down warning levels for the above-mentioned parameters
- delay at starting (is the period within which the oil pressure must be built up)

For ZR/ZT

- shut-down level for the outlet temperature at compressor element 1
- shut-down level for the outlet temperature at compressor element 2
- shut-down level for the inlet temperature at compressor element 2
- shut-down level for the oil pressure
- shut-down level for the oil temperature (not on ZT/ZR18/90)
- shut-down warning levels for the above-mentioned parameters
- delay at starting (is the period during which the oil pressure must be built up)

3 Service settings:

Service level for the:

- oil separator (not on Z)
- oil filter
- drive motor regreasing time
- oil

- 1) If required, the automatic restart function after voltage failure can be activated by Atlas Copco. If so, provide a label near to the control panel warning the operator that the compressor automatically restarts if the voltage is restored. See also the relevant instruction book.
- 2) For ZE/ZA and GA90/160, element 1 stands for the compressor element. GA200/315 have two compressor elements; element 1 stands for the compressor element at the outer side of the bodywork, element 2 for the other one.
For GR/ZR/ZT, element 1 and 2 stand for the low-pressure compressor element and the high-pressure compressor element respectively.
- 3) Not for ZE45/185 and ZA160/500 without full load/no load system. For these compressors, the first two values (i.e. <<5.0 bar>> and <<0.0 bar>>) are not to be taken into account.
- 4) For GA and GR: if provided.

12.2 Procedure (Fig. 1)

1. Activate the main menu by pressing key <<Menu>> (5).
2. Scroll through the available options using scroll keys (6) until the option <<Modify Settings>> is shown.
3. Press key <<Select>> (5).

A submenu is started, allowing the operator to select between following options:

- regulation
- protections
- service

4. Scroll through the options using scroll keys (6) until the desired option is shown on the display.
5. Press the key <<Select>>.

12.3 Modifying compressor regulation settings

1. Call up the modify settings submenu and select the option <<regulation>>. See section 12.2.
2. The first option (i.e. unloading pressure) is shown (1). See section 12.1 for the list of all programmable parameters. Use scroll keys (6) to select the parameter to be modified.
3. For each parameter, the modifying procedure is similar to the example below.

12.3.1 Example: Modifying the setting for the loading pressure (1)

1. Consult section 12.3 for selecting the option <<loading pressure>>.
2. After selecting, a display similar to that shown in Fig. 17 will appear:

Loading Pressure		6.4 bar	↑
			↓
Menu	Modify		
F1	F2	F3	

Fig. 17. Example of a modifying screen (regulation settings)

3. After pressing the key <<Modify>> the value of the parameter starts blinking and the functions of the keys (5-Fig. 1) change into:

F1 <<Program>>
F2 <<Limits>>
F3 <<Cancel>>

4. Modify the value by means of scroll keys (6-Fig. 1).
5. Press the key <<Program>> to program the new value or the key <<Cancel>> to cancel the modification operation (the original value will be retained).

Notes

The regulator will not accept new values beyond the limitations. See sections 18 up to 22.

It is possible to check the limitations which are valid for the parameter to be modified by selecting <<Limits>>.

12.4 Modifying protection settings

1. Call up the modify settings submenu and select the option <<protections>>. See section 12.2.
2. The first protection setting is shown. See section 12.1 for the list of all programmable settings. Use scroll keys (6) to select the setting to be modified.
3. For each setting, the modifying procedure is similar to the example below.

12.4.1 Example: Modifying the shut-down setting for the outlet temperature at compressor element 1

1. Consult section 12.4 for selecting the option <<element 1 outlet>>.
2. After selecting, a display similar to that shown in Fig. 18 will appear:

Element 1 Outlet		88°C	
Programmable settings			
Shutdown Maximum		110°C	↓
Menu	Modify		
F1	F2	F3	

Fig. 18. Example of a modifying screen (protection settings)

The example in Fig. 18 indicates:

- the name of the sensor (Compressor <<Element 1 outlet>>) and actual measured value (<<88 °C>>)
 - the type of parameter (<<Shutdown>>), the level type (<<Maximum>> level) and the actual programmed value (<<110 °C>>)
3. To modify the shut-down level, press the key <<Modify>> and then use scroll keys (6-Fig. 1).
 4. Use the key <<Program>> to program the new value or the key <<Cancel>> to cancel the modification operation (the original value will be retained).

- 1) For ZE45/185 and ZA160/500 without full load/no load regulator, the loading and unloading pressures are not programmable. For these compressors, the first two values when scrolling through the options (i.e. <<5.0 bar>> and <<0.0 bar>>) are not to be taken into account.

Notes

The regulator will not accept new values beyond the limitations. See sections 18 up to 22.

It is possible to check the limitations which are valid for the parameter to be modified by selecting <<Limits>>.

- The vertical arrow ↓ on the screen (Fig. 18) indicates to use scroll key ↓ (6-Fig. 1) to show the relevant <<Shut-down warning>> value (e.g. <<100 °C>>); see Fig. 19.

Element 1 Outlet	88°C	
Programmable settings		
Shutd. Warn. Maximum	100°C	↓
Menu	Modify	
F1	F2	F3

Fig. 19. Example of a modifying screen (protection settings)

- To modify the shut-down warning level, press the key <<Modify>> and then use scroll keys (6-Fig. 1).
- Use the key <<Program>> to program the new value or the key <<Cancel>> to cancel the modification operation (the original value will be retained).
- The vertical arrow << ↓ >> on the screen (Fig. 19) indicates to use scroll key ↓ (6-Fig. 1) to show the programmed delay for the shut-down; see Fig. 20.

Element 1 Outlet		↑
Programmable settings		
Delay at signal	5 sec	
Menu	Modify	
F1	F2	F3

Fig. 20. Example of a modifying screen (protection settings)

- If it should be necessary to modify the nominal setting, consult Atlas Copco.
- Use the key <<Program>> to program the new value or the key <<Cancel>> to cancel the modification operation (the original value will be retained).

12.5 Modifying service settings

- Call up the modify settings submenu and select the option <<service settings>>. See section 12.2.
- The first option of a list of programmable service settings is shown. See section 12.1 for the list of all programmable parameters. Use scroll keys (6-Fig. 1) to select the parameter to be modified.
- For each setting, the modifying procedure is similar to the example below.

12.5.1 Example: Modifying the setting for the oil service life

- Consult section 12.5 for selecting the option <<oil>>.
- After selecting, a display similar to that shown in Fig. 21 will appear.

Running Hours	944 hrs	
Programmable settings		
Service Maximum	4000 hrs	↓
Menu	Modify	
F1	F2	F3

Fig. 21. Example of a modifying screen (service settings)

- To modify the setting of the oil service life, press the key <<Modify>> and then use scroll keys (6-Fig. 1).
- Use the key <<Program>> to program the new value or the key <<Cancel>> to cancel the modification operation (the original value will be retained).

Notes

The regulator will not accept new values beyond the limitations. See sections 18 up to 22.

It is possible to check the limitations which are valid for the parameter to be modified by selecting <<Limits>>.

13 Submenu TIMERS: programming compressor start/stop commands

13.1 Function

To program time-based start/stop commands for the compressor.

13.2 Procedure (Fig. 1)

1. Activate the main menu by pressing key <<Menu>> (5).
2. Scroll through the available options using scroll keys (6) until the option <<Timers>> is shown.
3. Press key <<Select>> (5).
4. Initially, the list with start/stop commands is empty, hence the timer function is switched off. Following screen appears:

The timer is
Not activated

Menu	Modify	List
F1	F2	F3

Fig. 22. Example of a Timer screen

13.2.1 To program start/stop commands

1. Press the key <<List>>. The display will show a message that the list is empty (<<This list is empty>>). The bottom line will now include the key <<Modify>>.
2. Press the keys <<Modify>> and then <<Add>>. The command <<Monday 00:00 Stop Compressor>> will be shown.
3. Using scroll keys (6-Fig. 1), modify this command as required, as described in section 13.2.4. Add and delete commands as required, as described in sections 13.2.5 and 13.2.6.
4. Activate the timer as described in section 13.2.2.

13.2.2 To activate/deactivate the timer

1. The timer can only be activated if at least one start/stop command is programmed.
2. Select the menu <<Timers>>. Press the key <<Modify>>, the message <<The Timer is not activated>> will blink.
3. Use scroll keys (6-Fig. 1) to change the message into <<The Timer is activated>>.
4. Press the key <<Program>> to program the Timer active function or key <<Cancel>> to cancel the modifying operation. If activated, the regulator will execute the programmed commands.
5. The timer can be deactivated again. In this case, the programmed start/stop commands will not be executed (but remain in the memory of the regulator).

13.2.3 To display the list of commands

1. Press the key <<List>> on the timer screen. A typical display is shown in Fig. 23.

Monday	06:00	Start Compressor	↑
Monday	17:00	Stop Compressor	←
Tuesday	07:00	Start Compressor	↓
Menu	Modify		
F1	F2	F3	

Fig. 23. Example of start/stop command screen

The vertical arrows at the right-hand side indicate to use the vertical scroll keys to select the next and previous start/stop commands. The horizontal arrow indicates the command which is accessible at that moment.

2. Use the key <<Menu>> to return to the submenu or the key <<Modify>> to modify the start/stop commands.
3. After pressing the key <<Modify>>, three selections are shown on the bottom line of the display (Fig. 24):

Monday	06:00	Start Compressor	↑
Monday	17:00	Stop Compressor	←
Tuesday	07:00	Start Compressor	↓
Modify	Add	Delete	
F1	F2	F3	

Fig. 24. Example of start/stop command screen

4. Use:
 - <<Modify>> to modify the command indicated by the horizontal arrow
 - <<Add>> to add a new command at the location of the horizontal arrow
 - <<Delete>> to delete start/stop commands

13.2.4 To modify a command

1. Suppose the command <<Monday 17:00 Stop Compressor>> is to be modified, i.e. stopping at 18 o'clock instead of 17 o'clock.
2. Press the key <<List>> and scroll through the compressor start/stop commands until the command to be modified is indicated by the horizontal arrow on the screen. Press the key <<Modify>>. Press the key <<Modify>> again. The day indication will blink. If desired, the day can be modified using scroll keys (6-Fig. 1).
3. Press tabulator key (7) to go to the next field to be modified (the hour indication). Modify using keys (6); in the example above, use the keys to change "17" into "18".
4. Proceed in the same way to modify, if desired, the minutes indication and the start/stop indication.
5. Press the key <<Program>> to program the new command or the key <<Cancel>> to quit without reprogramming.
6. The regulator will ask if it is desired to change more commands.

Important:

1. It is necessary to program the start/stop commands in successive order timewise. Program the commands from Monday till Sunday, e.g.:

Monday 07.30 start
 Monday 18.00 stop
 Tuesday 08.00 start
 Tuesday 17.00 stop
 etc.

2. The regulator does not accept a new compressor start/stop command unless it is situated between the next and previous start/stop command timewise. If not, the new command is not accepted and the command line remains blinking. In this case, either modify the command or use the key <<Cancel>> to quit the modification operation.
3. Make sure that the timer function is activated (<<Timer active>>). If not, the programmed start/stop commands will not be executed.

13.2.5 To add a command

1. Press the key <<List>> and scroll through the commands until the command after which a new command is to be added appears, followed by a horizontal arrow.
2. Press the keys <<Modify>> and <<Add>>. 1) The command which was indicated by the horizontal arrow will be copied and the day indication of the copied command will blink.
3. The way of modifying this command is similar to the description in section 13.2.4.
4. The regulator will ask if it is desired to change more commands.

13.2.6 To delete a command

1. Press the key <<List>> and scroll through the commands until the command to be deleted appears, followed by a horizontal arrow.
2. Press the keys <<Modify>> and <<Delete>>. 1) The bottom line of the screen shows following selections:
 <<All>> to delete all commands
 <<This>> to delete the command indicated by the horizontal arrow
 <<Cancel>> if the delete selection must not be carried out
3. When selecting <<All>>, the regulator will ask <<Are you sure to delete all commands?>> By pressing the key <<Yes>> all commands are deleted.
4. The regulator will ask if it is desired to change more commands.

14 Submenu CONFIGURATION: reprogramming time / date / display configuration

14.1 Function

To reprogram a number of parameters. These parameters are:

- time
- date
- language on display (two languages are provided)
- auto restart after voltage failure 2)
- unit for pressure (bar, psi or kg/cm²)
- unit for temperature (°C or °F)
- starts/hour or starts/day (the latter is used for high-voltage motors)
- motor start mode (star-delta Y-D or direct-on-line DOL)
- format of date (day/month/year - DD MM YY or month/day/year - MM DD YY or year/month/day - YY MM DD)

14.2 Procedure (Fig. 1)

1. Activate the main menu by pressing key <<Menu>> (5).
2. Scroll through the available options using scroll keys (6) until the option <<Configuration>> is shown.
3. Press key <<Select>> (5).
4. The first option shown is <<Time>>. If another option is desired, scroll through the display (using scroll keys 6) and select (using key <<Select>>).
5. In case of option <<Time>>, the second line on the screen indicates the actual setting, e.g. 14:30.
6. If it is desired to modify the time, press key <<Modify>> (5). If not, press key <<Menu>> to return to the submenu.
7. After pressing the key <<Modify>>, the first field (i.e. 14) will blink. Modify the hours using scroll keys (6). Then press tabulator key (7) to go to the next field (i.e. 30). The setting of this field can now be modified with the scroll keys.
8. The bottom line of the display will show two options:
 - <<Program>> to program the new setting
 - <<Cancel>> to cancel the new setting
9. Proceed in the same way for the other parameters to be modified. Use scroll keys (6) to modify the parameter.

Note

For most settings only one reprogrammable field is used; in this case tabulator key (7) to jump from one field to the other one is not needed.

- 1) If the key <<Yes>> was pressed at the question <<Do you want to change another command>>, the display will include the options <<Add>> and <<Delete>>. In this case, one of these keys can be pressed without using the key <<Modify>> first.
- 2) To be activated by Atlas Copco only.

15 Submenu SAVED DATA: calling up compressor data saved by regulator

15.1 Function

To call up the compressor data saved by the electronic regulator. These data are:

- the data of the five last shut-downs (indicated <<Last shutdown 1, 2, 3, 4, 5>>): cause of the shut-down, time, date and other data reflecting the condition of that moment
- the data of the two last emergency stops (indicated <<Last emergency stop 1, 2>>): time, date and other data reflecting the condition of that moment
- the longest load data (time, date, duration and other data reflecting the condition of that moment)
- the longest unload data (time, date, duration and other data reflecting the condition of that moment) 1)

15.2 Procedure (Fig. 1)

1. Activate the main menu by pressing key <<Menu>> (5).
2. Scroll through the available options using scroll keys (6) until the option <<Saved data>> is shown.
3. Press key <<Select>> (5).
4. The first option is shown (i.e. <<Last shutdown 1>>). Scroll through the available options using scroll keys (6) until the desired option is shown.
5. Press key <<Select>> (5).
6. If desired, repeat steps 4 and 5 to look at the other options.

15.2.1 Example of the last shut-down data

1. Select option <<Last shut-down 1>>. Following screen may appear:

Motor Overload	Not Normal	
Protection function activated		
Shutdown	Normal closed	↓
Menu		
F1	F2	F3

Fig. 25. Example of a saved data screen

The display (Fig. 25) indicates:

- the last shut-down was a <<Motor Overload>>
 - the contacts of the overload relay are normally closed
 - the position of the contacts was <<Not Normal>>, i.e. open due to overcurrent
 - on the bottom line the key <<Menu>> to return to the submenu
2. By using scroll key <<>> (6) a number of data are shown reflecting the condition of the compressor at the moment of shut-down.
 3. Press the key <<Menu>> to return to the submenu.

16 SHOW MORE FUNCTION: quick look at compressor status

16.1 Function

To have a quick look at the most important compressor data: 1)

For GA/GR:

- maximum working pressure
- compressor outlet pressure
- pressure drop over air filters
- pressure drop over oil separator
- oil pressure at inlet of compressor element 1
- intercooler pressure (not on GA)
- compressor outlet temperature
- outlet temperature of compressor element 1
- outlet temperature of compressor element 2 (not on GA90/160)
- cooling medium temperature
- status of motor overload protection
- status of fan motor overload protection
- number of running hours
- number of loading hours

For ZE/ZA/ZR/ZT:

- maximum working pressure
- compressor outlet pressure
- pressure drop over air filters (not on ZT18/37)
- oil pressure
- intercooler pressure (not on ZE/ZA)
- compressor outlet temperature (not on ZT18/37, not on ZE/ZA without aftercooler)
- outlet temperature of compressor element 1
- outlet temperature of compressor element 2 (not on ZE/ZA)
- inlet temperature of compressor element 2 (not on ZE/ZA)
- cooling air temperature (ZT110/275 only)
- cooling water temperatures (not on ZE/ZT)
- oil temperature (not on ZT/ZR18/90)
- status of motor overload protection
- status of fan motor overload protection (ZE/ZT only)
- number of running hours
- number of loading hours

- 1) Not for ZE45/185 and ZA160/500 without full load/no load system
- 2) For ZE/ZA and GA90/160, element 1 stands for the compressor element. GA200/315 have two compressor elements; element 1 stands for the compressor element at the outer side of the bodywork, element 2 for the other one.
For GR/ZR/ZT, element 1 and 2 stand for the low-pressure compressor element and the high-pressure compressor element respectively.

16.2 Procedure (Fig. 1)

1. If necessary, activate the main display. See section 4.2.
2. Press key <<Show More>> (5). A screen similar to Fig. 26 appears:

Automatic operation			
Locally controlled			
Start/Stop Timer is active			
MainScreen	Show More	Unload	↓
F1	F2	F3	

Fig. 26. Example of a more display

Line 1 indicates the operation status of the regulator, i.e. automatic or manual.

<<Automatic operation>> means that the regulator automatically adapts the operation of the compressor, i.e. loading, unloading, stopping and automatic restarting according to the programmed parameters. See also section 1.1.

<<Manual operation>> means that the automatic pressure control function of the regulator is interrupted after manual intervention through the function keys on the keyboard (see section 17).

Line 2 indicates whether the regulator operates in local control or remote control mode.

<<Local control>> means that the start/stop and load/unload buttons on the keyboard are activated.

<<Remote control>> means that these functions are controlled remotely. Consult Atlas Copco.

Line 3 indicates whether the timer which generates time-based start and stop commands is activated or not. See section 13.

3. Use scroll keys (6) to call up the other data (see above).

compressor remains running unloaded unless it is loaded again manually.

Important

This function does not apply for ZE without full load/no load regulator.

17.2 Manually unloading (Fig. 1)

1. If necessary, activate the main display. See section 4.2.
2. Press key <<Unload>> (5). LED (1) goes out. The message <<Manually Unloaded>> appears on the display.

17.3 Manually loading (Fig. 1)

1. If necessary, activate the main display. See section 4.2.
2. Press key <<Load>> (5). LED (1) lights up. Note that the command <<Load>> does not force the compressor in loaded condition, but it will switch the compressor to automatic operation again, i.e. the compressor will be loaded if required by the air net pressure.

17 MANUALLY LOADING/UNLOADING

17.1 Function

To load and unload the compressor manually.

Normally, the compressor is running in automatic operation, i.e. the electronic regulator loads, unloads, stops and restarts the compressor automatically. LED (1-Fig. 1) is then alight.

If required, the compressor can be unloaded manually. In this case, the compressor is switched out of automatic operation, i.e. the

18 PROGRAMMABLE SETTINGS FOR GA90/315

18.1 Regulation settings

		Minimum setting	Factory setting	Maximum setting
Motor running time in star	sec	10	10	20
Load delay time (star-delta)	sec	0	0	20
Load delay time (not star-delta)	sec	10	10	20
Number of motor starts (low-voltage motor)	starts/hr	0	3	3
Required stop period 1)	sec	0	0	60
Power recovery time 11)	sec	1	3	255

Unloading pressure 3)

7.5 bar compressor	bar(e)	4.5	7.0	7.5
10 bar compressor	bar(e)	4.5	9.5	10.0
13 bar compressor	bar(e)	4.5	12.5	13.0
100 psi compressor	bar(e)	4.5	6.9	7.4
125 psi compressor	bar(e)	4.5	8.6	9.1
150 psi compressor	bar(e)	4.5	10.3	10.8
175 psi compressor	bar(e)	4.5	13.3	13.8

Loading pressure 3)

7.5 bar compressor	bar(e)	4.5	6.4	7.4
10 bar compressor	bar(e)	4.5	8.9	9.9
13 bar compressor	bar(e)	4.5	11.9	12.9
100 psi compressor	bar(e)	4.5	6.3	7.3
125 psi compressor	bar(e)	4.5	8.0	9.0
150 psi compressor	bar(e)	4.5	9.7	10.7
175 psi compressor	bar(e)	4.5	12.7	13.7

18.2 Protection settings

		Minimum setting	Factory setting	Maximum setting
Compressor element 1 outlet temperature 12)	°C	4)	100	109
(shut-down warning level)				
Compressor element 1 outlet temperature 12)	°C	80	110	110
(shut-down level)				
Compressor element 2 outlet temperature 12)	°C	4)	100	109
(shut-down warning level)				
Compressor element 2 outlet temperature 12)	°C	80	110	110
(shut-down level)				
Delay at shut-down signal 10)	sec	5	5	5

18.3 Service settings

		Minimum setting	Factory setting	Maximum setting
Drive motor regreasing time (running hours)	hr	0	4000	8)
Oil filter lifetime (running hours)	hr	0	2000	5)
Oil lifetime (running hours)	hr	0	7)	7)
Oil separator lifetime (running hours)	hr	0	8000	6)

18.4 Fixed settings

Minimum stop time 1)	sec	20
Permissive start level for oil injection pressure at compressor element 1 9)	bar(e)	2.5 (GA90/160)
	bar(e)	2 (GA200/315)
Service warning level for oil separator	bar	0.8
Service warning level for air filters 22)	bar	0.05

19 PROGRAMMABLE SETTINGS FOR GR110/200

19.1 Regulation settings

		Minimum setting	Factory setting	Maximum setting
Motor running time in star	sec	10	10	20
Load delay time (star-delta)	sec	0	0	20
Load delay time (not star-delta)	sec	10	10	20
Number of motor starts (low-voltage motor)	starts/hr	0	3	3
Required stop period 1)	sec	0	0	60
Power recovery time 11)	sec	1	3	255
Unloading pressure 13)	bar(e)	9.5	19	20
Loading pressure 13)	bar(e)	9.5	18	19.9

19.2 Protection settings

		Minimum setting	Factory setting	Maximum setting
Compressor element 1 outlet temperature 15) (shut-down warning level)	°C	14)	110	119
Compressor element 1 outlet temperature 15) (shut-down level)	°C	80	120	120
Compressor element 2 outlet temperature 15) (shut-down warning level)	°C	14)	110	119
Compressor element 2 outlet temperature 15) (shut-down level)	°C	80	120	120
Delay at shut-down signal 10)	sec	5	5	5

19.3 Service settings

		Minimum setting	Factory setting	Maximum setting
Drive motor regreasing time (running hours)	hr	0	4000	8)
Oil filter lifetime (running hours)	hr	0	2000	5)
Oil lifetime (running hours)	hr	0	2000	19)
Oil separator lifetime (running hours)	hr	0	8000	6)

19.4 Fixed settings

Minimum stop time 1)	sec	20
Permissive start level for oil injection pressure at compressor element 1 9)	bar(e)	2.5
Service warning level for oil separator	bar	0.8
Service warning level for air filters 22)	bar	0.05

20 PROGRAMMABLE SETTINGS FOR ZE45/185 AND ZA160/500

20.1 Regulation settings

		Minimum setting	Factory setting	Maximum setting
Motor running time in star	sec	10	20	30
Load delay time (star-delta)	sec	5	5	30
Load delay time (not star-delta)	sec	20	20	30
Number of motor starts (low-voltage motor)	starts/hr	0	3	5
Number of motor starts (high-voltage motor)	starts/day	0	3	16)
Required stop period 1)	sec	5	5	60
Power recovery time 1)	sec	1	3	255
Minimum stop time 1)	sec	20	20	99
For ZE/ZA with full load/no load regulator also:				
Unloading pressure for ZE/ZA without aftercooler 2)				
2 bar compressors	bar(e)	1	1.5	2
3.5 bar compressors	bar(e)	1	3	3.5
Unloading pressure for ZE/ZA with aftercooler 2)				
2 bar compressors (ZE)	bar(e)	1	1.5	1.85
2 bar compressors (ZA)	bar(e)	1	1.5	1.9
3.5 bar compressors	bar(e)	1	3	3.4
Loading pressure for ZE/ZA without aftercooler 2)				
2 bar compressors	bar(e)	1	1.2	1.9
3.5 bar compressors	bar(e)	1	2.5	3.4
Loading pressure for ZE/ZA with aftercooler 2)				
2 bar compressors (ZE)	bar(e)	1	1.2	1.75
2 bar compressors (ZA)	bar(e)	1	1.2	1.8
3.5 bar compressors	bar(e)	1	2.5	3.3

20.2 Protection settings

		Minimum setting	Factory setting	Maximum setting
Compressor element 1 outlet temperature 17)	°C	100	230(ZE)	239(ZE)
(shut-down warning level)			225(ZA)	234(ZA)
Compressor element 1 outlet temperature 17)	°C	100	240(ZE)	240(ZE)
(shut-down level)			235(ZA)	235(ZA)
Oil temperature (shut-down warning level)	°C	40	67	79
Oil temperature (shut-down level)	°C	40	70	80
Oil pressure (shut-down warning level)	bar(e)	1.0	1.5	2.0
Oil pressure (shut-down level)	bar(e)	1.0	1.4	1.9
Delay at starting 21)	sec	15	20	25

20.3 Service settings

		Minimum setting	Factory setting	Maximum setting
Drive motor regreasing time	hr	0	8)	8)
Oil filter lifetime (running hours)	hr	0	8000	18)
Oil lifetime (running hours)	hr	0	16000	20)

20.4 Fixed settings

Service warning level for air filters 22) bar 0.044

21 PROGRAMMABLE SETTINGS FOR ZT/ZR18/90

21.1 Regulation settings

		Minimum setting	Factory setting	Maximum setting
Motor running time in star	sec	10	10	30
Load delay time (star-delta)	sec	0	0	30
Load delay time (not star-delta)	sec	20	20	30
Number of motor starts	starts/hr	0	10	10
Required stop period 1)	sec	5	5	60
Power recovery time 11)	sec	1	3	255
Minimum stop time 1)	sec	20	20	99
Unloading pressure 23)				
7 bar compressors	bar(e)	4.5	7.0	7.0
7.5 bar compressors	bar(e)	4.5	7.5	7.5
8 bar compressors	bar(e)	4.5	8.0	8.0
8.5 bar compressors	bar(e)	4.5	8.5	8.5
8.6 bar compressors	bar(e)	4.5	8.6	8.6
10 bar compressors	bar(e)	4.5	10	10
Loading pressure 23)				
7 bar compressors	bar(e)	4.5	6.5	6.9
7.5 bar compressors	bar(e)	4.5	7.0	7.4
8 bar compressors	bar(e)	4.5	7.5	7.9
8.5 bar compressors	bar(e)	4.5	8.0	8.4
8.6 bar compressors	bar(e)	4.5	8.1	8.5
10 bar compressors	bar(e)	4.5	9.5	9.9

21.2 Protection settings

	Minimum setting	Factory setting	Maximum setting
Compressor element 2 inlet temperature 15) °C (shut-down warning level)	40	67	79
Compressor element 2 inlet temperature 15) °C (shut-down level)	40	70	80
For ZT/ZR18/37 15)17)			
Compressor element 1 outlet temperature °C (shut-down warning level)	100	215	224
Compressor element 1 outlet temperature °C (shut-down level)	100	225	225
Compressor element 2 outlet temperature °C (shut-down warning level)	100	215	224
Compressor element 2 outlet temperature °C (shut-down level)	100	225	225
Oil pressure (shut-down warning level) bar(e)	1.0	1.15	2.0
Oil pressure (shut-down level) bar(e)	1.0	1.05	1.9
Delay at starting 21) sec	5	10	15
For ZT/ZR45/55 15)17)			
Compressor element 1 outlet temperature °C (shut-down warning level)	100	215	224
Compressor element 1 outlet temperature °C (shut-down level)	100	225	225
Compressor element 2 outlet temperature °C (shut-down warning level)	100	215	224
Compressor element 2 outlet temperature °C (shut-down level)	100	225	225
Oil pressure (shut-down warning level) bar(e)	1.0	1.1	2.0
Oil pressure (shut-down level) bar(e)	1.0	1.0	1.9
Delay at starting 21) sec	5	10	15
For ZT/ZR75/90 15)17)			
Compressor element 1 outlet temperature °C (shut-down warning level)	100	210	219
Compressor element 1 outlet temperature °C (shut-down level)	100	220	220
Compressor element 2 outlet temperature °C (shut-down warning level)	100	210	219
Compressor element 2 outlet temperature °C (shut-down level)	100	220	220
Oil pressure (shut-down warning level) bar(e)	1.0	1.5	2.0
Oil pressure (shut-down level) bar(e)	1.0	1.4	1.9
Delay at starting 21) sec	5	10	15

21.3 Service settings

		Minimum setting	Factory setting	Maximum setting
Drive motor regreasing time	hr	0	8)	8)
Oil filter lifetime (running hours)	hr	0	8000	18)
Oil lifetime (running hours)	hr	0	8000	24)

21.4 Fixed settings

Service warning level for air filters 22) bar 0.050

22 PROGRAMMABLE SETTINGS FOR ZR110/275 AND ZT110/275**22.1 Regulation settings**

		Minimum setting	Factory setting	Maximum setting
Motor running time in star	sec	10	15	30
Load delay time (star-delta)	sec	10	10	30
Load delay time (not star-delta)	sec	20	20	30
Number of motor starts (low-voltage motor)	starts/hr	0	3	5
Number of motor starts (high-voltage motor)	starts/day	0	3	16)
Required stop period 1)	sec	5	5	60
Power recovery time 11)	sec	1	3	255
Minimum stop time 1)	sec	20	20	99
Unloading pressure 23)				
7.5 bar compressors	bar(e)	2.0	7.0	7.5
10 bar compressors	bar(e)	2.0	9.0	10
125 psi compressors	bar(e)	2.0	7.0	8.6
150 psi compressors	bar(e)	2.0	9.0	10.4
Loading pressure 23)				
7.5 bar compressors	bar(e)	2.0	6.0	7.4
10 bar compressors	bar(e)	2.0	8.0	9.9
125 psi compressors	bar(e)	2.0	6.0	8.5
150 psi compressors	bar(e)	2.0	8.0	10.3

22.2 Protection settings

	Minimum setting	Factory setting	Maximum setting
For 7.5/8.6 bar compressors 15)17)			
Compressor element 1 outlet temperature °C (shut-down warning level)	100	210	219
Compressor element 1 outlet temperature °C (shut-down level)	100	220	220
Compressor element 2 outlet temperature °C (shut-down warning level)	100	210	219
Compressor element 2 outlet temperature °C (shut-down level)	100	220	220
For 10/10.4 bar compressors 15)17)			
Compressor element 1 outlet temperature °C (shut-down warning level)	100	225	234
Compressor element 1 outlet temperature °C (shut-down level)	100	235	235
Compressor element 2 outlet temperature °C (shut-down warning level)	100	225	234
Compressor element 2 outlet temperature °C (shut-down level)	100	235	235
For all ZR			
Compressor element 2 inlet temperature °C (shut-down warning level)	40	65	79
Compressor element 2 inlet temperature °C (shut-down level)	40	70	80
Oil temperature (shut-down warning level) °C	40	65	79
Oil temperature (shut-down level) °C	40	70	80
Oil pressure (shut-down warning level) bar(e)	1.0	1.3	2.0
Oil pressure (shut-down level) bar(e)	1.0	1.2	1.9
Delay at starting 21) sec	15	15	20

22.3 Service settings

	Minimum setting	Factory setting	Maximum setting
Drive motor regreasing time hr	0	8)	8)
Oil filter lifetime (running hours) hr	0	8000	18)
Oil lifetime (running hours) hr	0	16000	20)

22.4 Fixed settings

Service warning level for air filters 22) bar 0.044

- 1) Once the compressor is automatically stopped, it will remain stopped for the minimum stop time (approx. 20 seconds), whatever happens with the air net pressure.
In automatic operation, the compressor will not be stopped by the regulator until a standstill period of at least the sum of the minimum stop time and required stop period is expected. However, if the decrease in air net pressure should require a new start of the compressor, the regulator will start the compressor after the minimum stop time.
- 2) The regulator does not accept illogical settings, e.g. if the unloading pressure is programmed at 3.0 bar(e), the maximum limit for the loading pressure changes into 2.9 bar(e). The recommended minimum pressure difference between loading and unloading is 0.5 bar for 3.5 bar compressors and 0.3 bar for 2 bar compressors.
- 3) The regulator does not accept illogical settings, e.g. if the unloading pressure is programmed at 7.0 bar(e), the maximum limit for the loading pressure changes into 6.9 bar(e). The recommended minimum pressure difference between loading and unloading is 0.6 bar.
- 4) The regulator does not accept illogical settings, e.g. if the warning level is programmed at 95 °C, the minimum limit for the shut-down level changes into 96 °C. The recommended difference between the warning level and shut-down level is 10 °C.
- 5) Use Atlas Copco oil filters. The recommended change interval is after 2000 running hours or yearly.
- 6) The recommended change interval is two-yearly or after 8000 running hours.
- 7) Recommended oil: Atlas Copco Roto-injectfluid. The change interval for this oil is after 2000 running hours or yearly for 13 bar and 175 psi compressors and after 4000 running hours or yearly for lower-pressure compressors. If using mineral oil as described in the Instruction book, the change interval is after 500 running hours or yearly for 13 bar and 175 psi compressors and after 1000 running hours or yearly for lower-pressure compressors.
- 8) Consult the relevant Instruction book.
- 9) The compressor will not start if this level is exceeded at the moment of starting. If the level remains too high for 30 seconds, the message Start failure will appear on the display.
- 10) This is the period during which the signal must exist before the compressor is shut down. If it should be required to program this setting at another value, consult Atlas Copco.
- 11) Is the period within which the voltage must be restored to have an automatic restart. Is accessible if the automatic restart is activated. To activate the automatic restart function, consult Atlas Copco.
- 12) GA90/160 have one compressor element. GA200/315 have two compressor elements; element 1 stands for the compressor element at the outer side of the bodywork; element 2 for the other one.
- 13) The regulator does not accept illogical settings, e.g. if the unloading pressure is programmed at 19.0 bar(e), the maximum limit for the loading pressure changes into 18.9 bar(e). The recommended minimum pressure difference between loading and unloading is 1 bar.
- 14) The regulator does not accept illogical settings, e.g. if the warning level is programmed at 105 °C, the minimum limit for the shut-down level changes into 106 °C. The recommended difference between the warning level and shut-down level is 10 °C.
- 15) Element 1 and 2 stand for the low-pressure compressor element and the high-pressure compressor element respectively.
- 16) Consult the motor manufacturer.
- 17) The regulator does not accept illogical settings, e.g. if the warning level is programmed at 210 °C, the minimum limit for the shut-down level changes into 211 °C. The recommended difference between the warning level and shut-down level is 10 °C.
- 18) Use Atlas Copco oil filters. The recommended change interval is after 8000 running hours or yearly.
- 19) Use oil as specified in the relevant Instruction book. The change interval for this oil is after 2000 running hours or yearly.
- 20) Use oil as specified in the relevant Instruction book. The change interval for this oil is after 16000 running hours or 2-yearly.
- 21) Is the time interval within which the oil pressure must be built up
- 22) Replace the filters when the warning level is reached or yearly.
- 23) The regulator does not accept illogical settings, e.g. if the unloading pressure is programmed at 7.5 bar(e), the maximum limit for the loading pressure changes into 7.4 bar(e). The recommended minimum pressure difference between loading and unloading is 1 bar for ZR/ZT110/Z75 and 0.5 bar for ZT/ZR18/90.
- 24) Use oil as specified in the relevant Instruction book. The change interval for this oil is after 8000 running hours or yearly.

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Notes:

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no text or other markings on the paper.

SAFETY PRECAUTIONS FOR STATIONARY COMPRESSORS (continued)

5. Air-cooled units shall be installed in such a way that an adequate flow of cooling air is available and that the exhausted air does not recirculate to the inlet.
6. Arrange the air intake so that loose clothing of people cannot be sucked in.
7. Ensure that the discharge pipe from the compressor to the aftercooler or air net is free to expand under heat and that it is not in contact with or close to flammable material.
8. No external force may be exerted on the air outlet valve; the connected pipe must be free of strain.
9. If remote control is installed, the unit shall bear an obvious sign reading:
DANGER: This machine is remotely controlled and may start without warning.

As a further safeguard, persons switching on remotely controlled units shall take adequate precautions to ensure that there is no one checking or working on the machine. To this end, a suitably worded notice shall be affixed to the start equipment.
10. On units with automatic start-stop system, a sign stating "This machine may start without warning" shall be attached near the instrument panel.
11. In multiple compressor systems manual valves shall be installed to isolate each compressor. Non-return valves (check valves) shall not be relied upon for isolating pressure systems.
12. Never remove or tamper with the safety devices, guards or insulations fitted on the unit. Every pressure vessel or auxiliary installed outside the unit to contain air above atmospheric pressure shall be protected by a pressure-relieving device or devices as required.
13. Pipework or other parts with a temperature in excess of 80°C (175°F) and which may be accidentally touched by personnel in normal operation shall be guarded or insulated. Other high-temperature pipework shall be clearly marked.
14. If the ground is not level or can be subject to variable inclination, consult Atlas Copco.
15. The electrical connections shall correspond to the local codes. The units shall be grounded and protected against short circuits by fuses.

Operation

1. Air hoses shall be of correct size and suitable for the working pressure. Never use frayed, damaged or deteriorated hoses. Use only the correct type and size of hose end fittings and connections. When blowing through a hose or air line, ensure that the open end is held securely. A free end will whip and may cause injury. Make sure that a hose is fully depressurized before disconnecting it.

Never play with compressed air. Do not apply it to your skin or direct an air stream at people. Never use it to clean dirt from your clothes. When using it to clean down equipment, do so with extreme caution and use eye protection.
2. The compressor is not considered as capable of producing air of breathing quality. For breathing air quality, the compressed air must be adequately purified according to local legislation and standards.
3. Never operate the unit when there is a possibility of taking in flammable or toxic fumes.
4. Never operate the unit at pressures below or in excess of its limit ratings as indicated on the Principal Data sheet.
5. Keep all bodywork doors shut during operation. The doors may be opened for short periods only, e.g. to carry out checks. Wear ear protectors when opening a door.
6. People staying in environments or rooms where the sound pressure level reaches or exceeds 90 dB(A) shall wear ear protectors.
7. Periodically check that:
 - a. All guards are in place and securely fastened
 - b. All hoses and/or pipes inside the unit are in good condition, secure and not rubbing
 - c. There are no leaks
 - d. All fasteners are tight
 - e. All electrical leads are secure and in good order
 - f. Safety valves and other pressure-relief devices are not obstructed by dirt or paint
 - g. Air outlet valve and air net, i.e. pipes, couplings, manifolds, valves, hoses, etc. are in good repair, free of wear or abuse
8. If warm cooling air from compressors is used in air heating systems, e.g. to

warm up a workroom, take precautions against air pollution and possible contamination of the breathing air.

9. Do not remove any of, or tamper with, the sound-damping material.

Maintenance

Maintenance and repair work shall only be carried out under supervision of someone qualified for the job.

1. Use only the correct tools for maintenance and repair work.
2. Use only genuine spare parts.
3. All maintenance work, other than routine attention, shall only be undertaken when the unit is stopped and the main power supply is switched off. Take positive precaution to ensure that the unit cannot be started inadvertently.

In addition, a warning sign bearing a legend such as "work in progress; do not start" shall be attached to the starting equipment.
4. Before removing any pressurized component, effectively isolate the unit from all sources of pressure and relieve the entire system of pressure.
5. Never use flammable solvents or carbon tetrachloride for cleaning parts. Take safety precautions against toxic vapours of cleaning liquids.
6. Scrupulously observe cleanliness during maintenance and repair. Keep dirt away by covering the parts and exposed openings with a clean cloth, paper or tape.
7. Never weld or perform any operation involving heat near the oil system. Oil tanks must be completely purged, e.g. by steam-cleaning, before carrying out such operations.

Never weld on, or in any way modify, pressure vessels.

Whenever there is an indication or any suspicion that an internal part of a machine is overheated, the machine shall be stopped but no inspection covers shall be opened before sufficient cooling time has elapsed; this to avoid the risk of spontaneous ignition of the oil vapour when air is admitted.

Never use a light source with open flame for inspecting the interior of a machine, pressure vessel, etc.

8. Make sure that no tools, loose parts or rags are left in or on the unit.
9. Before clearing the unit for use after maintenance or overhaul, check that operating pressures, temperatures and time settings are correct and that the control and shut-down devices function correctly.
10. Every time the separator element is renewed, examine the discharge pipe and the inside of the oil separator vessel for carbon deposits; if excessive, the deposits should be removed.
11. Protect the motor, air filter, electrical and regulating components, etc. to prevent moisture from entering them, e.g. when steam-cleaning.
12. Make sure that all sound-damping material, e.g. on the bodywork and in the air inlet and outlet systems of the compressor, is in good condition. If damaged, replace it by genuine Atlas Copco material to prevent the sound pressure level from increasing.
13. Never use caustic solvents which can damage materials of the air net, e.g. polycarbonate bows.
14. The following safety precautions are stressed when handling refrigerant R22, R12, etc.:
 - a. Never inhale refrigerant vapours. Check that the working area is adequately ventilated; if required, use breathing protection.
 - b. Always wear special gloves. In case of refrigerant contact with the skin, rinse the skin with water. If liquid refrigerant contacts the skin through clothing, never tear off or remove the latter; flush abundantly with fresh water over the clothing until all refrigerant is flushed away; then seek medical first aid.
 - c. Always wear safety glasses.

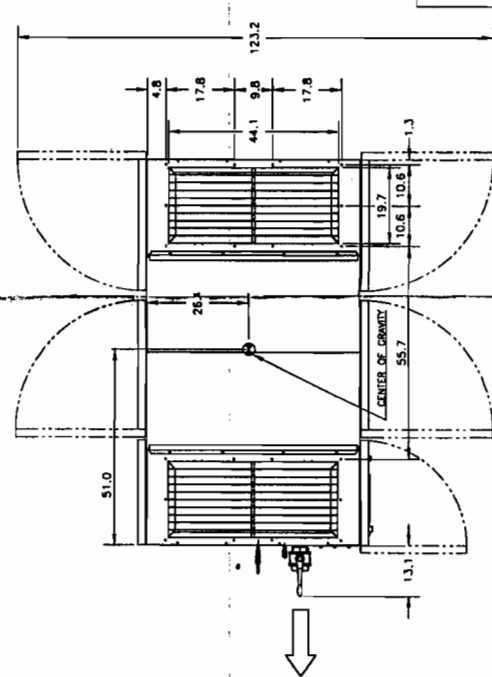
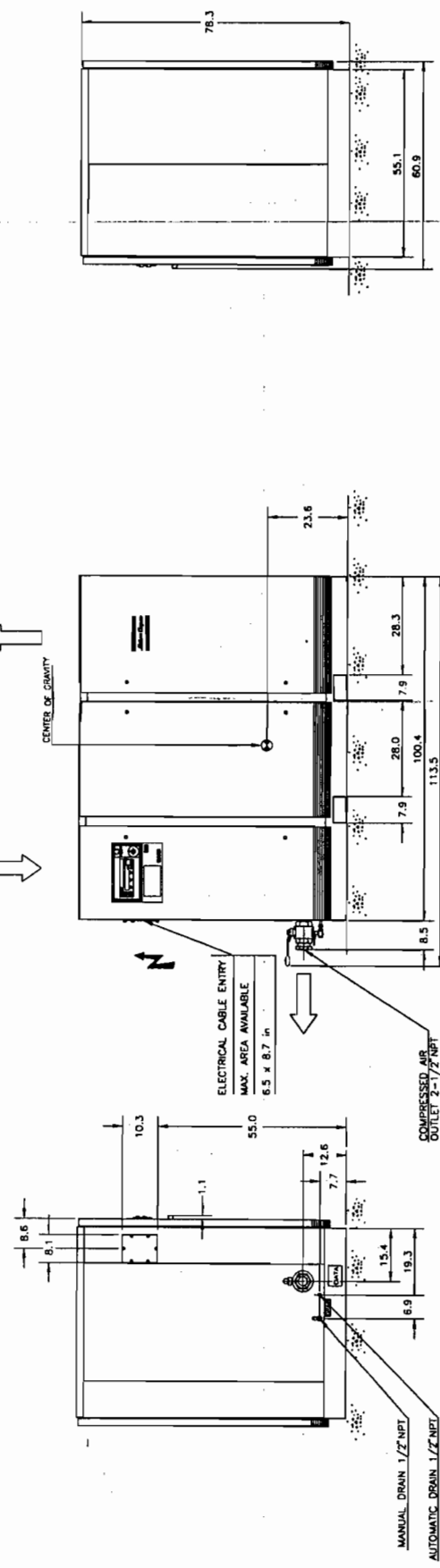
Note: With stationary machine units driven by an internal combustion engine, allowance has to be made for extra safety precautions, e.g. spark arrestors, fuelling care, etc. Consult Atlas Copco.

All responsibility for any damage or injury resulting from neglecting these precautions, or by non-observance of ordinary caution and due care required in handling, operating, maintenance or repair, even if not expressly mentioned in this book, will be disclaimed by Atlas Copco.

AIR INLET



COOLING AIR OUTLET



GA 90 NET WEIGHT 5405 LB
GA 110 NET WEIGHT 5865 LB

DIMENSIONS ARE IN INCHES

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ATLAS COPCO COMPRESSORS INC.
11101 HOLYOKE, MASSACHUSETTS 01906
TEL: 508/461-1110 FAX: 508/461-1111

GENERAL ARRANGEMENT
GA90/110
MK III

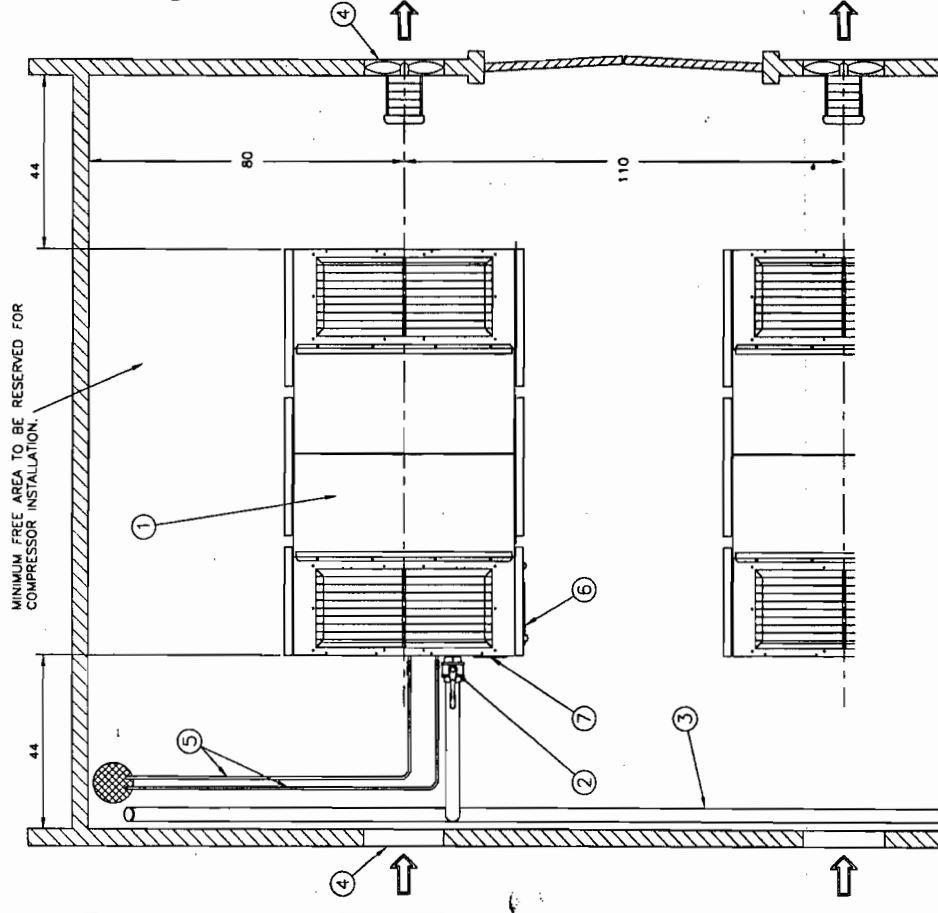
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CHECKED: 1310 3003 90
DESIGNATION: SHEET 1/1
REV: 02

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DATE: 97/06/06
BY: Lee Anna Harvey

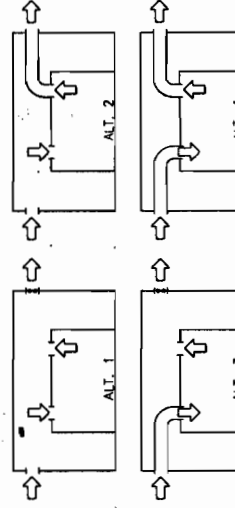
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NOTES:

- ① COMPRESSOR UNIT
THE UNIT SHOULD BE INSTALLED ON A LEVEL FLOOR CAPABLE OF SUPPORTING THE WEIGHT OF THE UNIT. STATED DISTANCES BETWEEN UNITS AND WALLS ARE MINIMUMS. RECOMMENDED MINIMUM DISTANCE BETWEEN TOP OF UNIT AND CEILING IS 4.0 FEET.(VENTILATION ALTERNATIVE 4 EXCEPTED).
- ② COMPRESSOR DISCHARGE VALVE
- ③ DISCHARGE PIPE
THE SIZE AND LENGTH OF THE DISCHARGE PIPE MAY BE ESTIMATED USING THE FORMULA STATED BELOW:
$$L = \frac{1470 \Delta P d^{5/2} P}{Q_c^{1.85}}$$
 WHERE
L=LENGTH OF DISCHARGE PIPE (FEET)
ΔP=ALLOWABLE PRESSURE DROP (PSI)-RECOMMENDED 1.45PSI MAXIMUM.
d=INSIDE DIAMETER OF DISCHARGE PIPE (INCHES)
P=ABSOLUTE PRESSURE AT COMPRESSOR OUTLET VALVE (PSIA)
Q_c=COMPRESSOR CAPACITY (CFM)
- ④ VENTILATION
THE INLET GRILL(S) AND VENTILATION FAN MUST BE INSTALLED SO THERE IS NO RECIRCULATION OF THE COMPRESSOR COOLING AIR. THE AIR VELOCITY THROUGH THE INLET GRILL(S) SHOULD BE LIMITED TO 15.0 FEET PER SECOND.
FOR VENTILATION ALTERNATIVES 2, 3 AND 4 THE MAXIMUM ALLOWED PRESSURE DROP OVER THE COOLING DUCTS IS 0.12 INCHES OF WATER. THE TEMPERATURE AT THE COMPRESSOR UNIT INTAKE SHOULD BE MAINTAINED BETWEEN 32°F AND 104°F.
THE REQUIRED VENTILATING AIR, FOR VENTILATION ALTERNATIVES 1 AND 3 MAY BE ESTIMATED USING THE FOLLOWING FORMULA:
$$Q_v = \frac{2875N}{\Delta T}$$
 WHERE Q_v IS VENTILATING AIR REQUIRED (CFM)
N IS NOMINAL UNIT HORSEPOWER (HP)
ΔT EXPECTED, OR ALLOWABLE TEMPERATURE RISE BETWEEN THE ROOM AND INCOMING AIR. REMEMBER INTAKE AIR TEMPERATURE TO UNIT SHOULD BE LESS THAN 104°F (F)
- ⑤ MOISTURE DRAIN
THESE ARE CUSTOMER INSTALLED DRAIN LINES FROM THE MOISTURE SEPARATOR TO THE CONDENSATE COLLECTOR. DRAIN PIPES SHOULD NOT ENTER COLLECTOR TO PREVENT SPLASHING MOISTURE AND PRESSURE BUILD UP IN THE COLLECTOR.
- ⑥ ELECTRICAL CONTROL CABINET WITH MONITORING PANEL
- ⑦ ELECTRICAL ENTRANCE PANEL
- 8 ALL PIPING AND ELECTRICAL CONNECTIONS TO THE UNIT MUST BE STRESS FREE. THE UNIT SHOULD NOT SUPPORT THESE LOADS.
- 9 SEE GENERAL ARRANGEMENT FOR DIMENSIONS.
- 10 FLOW DIAGRAM AVAILABLE.



VENTILATION PROPOSALS



DIMENSIONS IN INCHES

INFORMATION ONLY

☐ CERTIFIED

☐ APPROVAL REQUIRED (CUSTOMER STAMP REQUIRED)

DATE: _____

NAME: _____

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ATLAS COPCO COMPRESSORS, INC.

DR. BY: U.T. TOLERANCES PER A/C STANDARD 1350K DSK 239

SCALE: 1"=18" (APPROX.)

TITLE: PROPOSAL-INSTALLATION GAG0-110

MA: "L" THIRD ANGLE PROJECTION

COMPARE: _____ DATE: 92/02/13 DESIGNATION: 1310 2519 29 SHEET 1/1

NOTE: _____

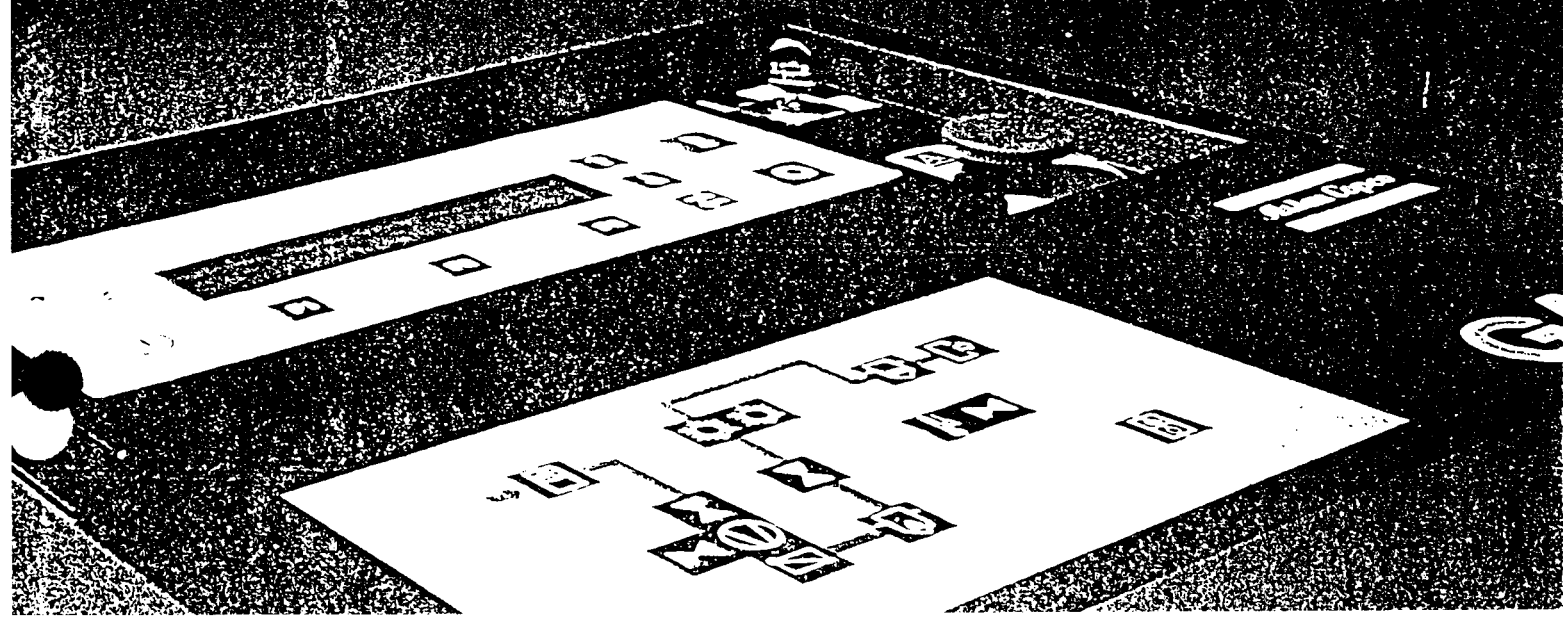
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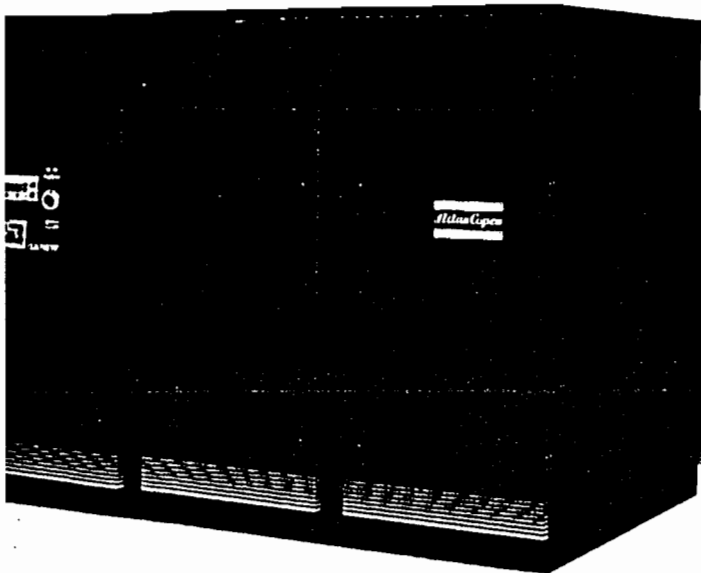
Rotary screw air compressors GA90-315 and GR110-200 Series

Atlas Copco



The GA90-315 Series

Efficient, Reliable, Ease of Maintenance



The Superior Choice

The GA90-315 Series incorporates the latest advancements in air compressor and microprocessor technology. Atlas Copco's innovative designs and engineering yield the ultimate in compressor package efficiency, reliability and ease of maintenance.

In fact, these machines have proven to be one of the most efficient air compressors in the world.

After we developed the basic machine for superior mechanical efficiencies, we then complemented it with superior controls, the Elektronikon Mark III microprocessor.

Add reliability, simple maintenance and a company with excellent aftersales support, and there is no other choice but Atlas Copco's GA90-315 Series.

The GR110-200 Series

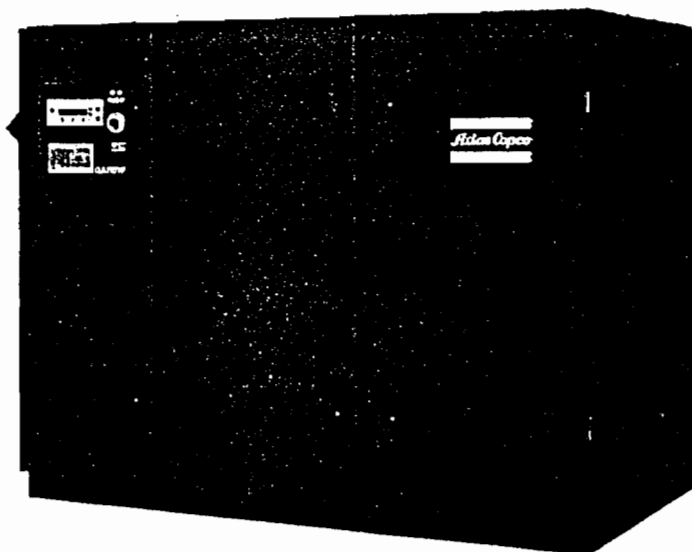
High Pressure Performance

High Pressure Applications

If the application requires all of the GA90-315 advantages, plus an operating pressure up to 290 psig... The GR110-200 Series will be the superior choice.

The GR110-200 Series are two-stage machines. They are offered as air or water cooled and include the basic design parameters of the GA90-315.

Of course, the Elektronikon control system is part of the standard scope of supply.

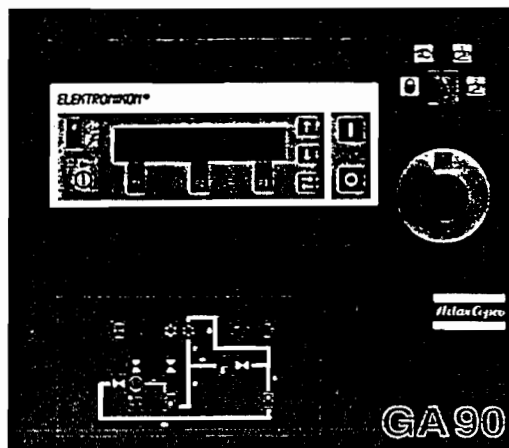


Controls with Superior Electronic Intelligence

The Elektronikon® System

The Elektronikon System sets the standard in compressor controls. Researched and developed by Atlas Copco, the Elektronikon simultaneously monitors, regulates and protects the GA compressor.

Electronic sensors in the GA compressor continuously feed data on temperatures and pressures to the central microprocessor. The Elektronikon not only monitors the status of the compressor, but also interprets the data and operates the compressor within pre-programmed parameters for optimum efficiency and reliability. The displayed information also simplifies maintenance and trouble-shoot procedures. The key switch selector offers four control modes: On/Off (with a security lock-out feature), local panel control, and two remote capabilities via relay/switch or computer communication.



Efficient and Economical

Using the most efficient method of compressor regulation, load/no-load control, the Elektronikon regulates compressor operation within a programmed pressure range.

The "controlled stop" function will minimize unloaded operation by shutting down the compressor when an extended period of unloaded operation is anticipated. When air demand increases, the compressor restarts automatically. This provides reduced energy consumption for the most economical operation.

Reliable and Versatile

The Elektronikon, fully programmed at the factory, continuously monitors and displays the operating status of the compressor. To meet varying field application requirements, it can be easily adjusted at the compressor control panel.

Compressor operation will not be interrupted due to a sensor malfunction. The Elektronikon will detect an inconsistent reading, display a "sensor error" condition, and switch to a backup sensor. The Elektronikon itself is inherently trouble-free because of its integrated circuitry.

ELEKTRONIKON®

Compressor control • Start/stop • Load/unload • Emergency stop • Reset/test	Compressor status indications • Voltage on • Automatic operation • Compressor loaded • Compressor unloaded • Compressor maximum allowed unloaded pressure • Key switch for local/remote compressor control
Service requirement indications • Air filter • Oil filter • Oil lifetime • Air/oil separator • Regreasing of motor • Sensor error	Temperature, numerical readouts • Delivery air • Element 1 outlet (GA90-315) • Element 2 inlet (GR110-200) • Element 2 outlet (GR/GA200-315) • Cooling medium
Compressor safety - warning indications • High element 1 outlet temperature • High element 2 outlet temperature	Hours meters • Total running hours • Total loaded hours
Compressor safety - shutdown indications • High element 1 outlet temperature • High element 2 outlet temperature • Drive motor overload • Fan motor overload • Emergency stop	Pressure, numerical readouts • Delivery air • Air filter pressure differential • Oil inlet element 1 • Air/oil separator differential

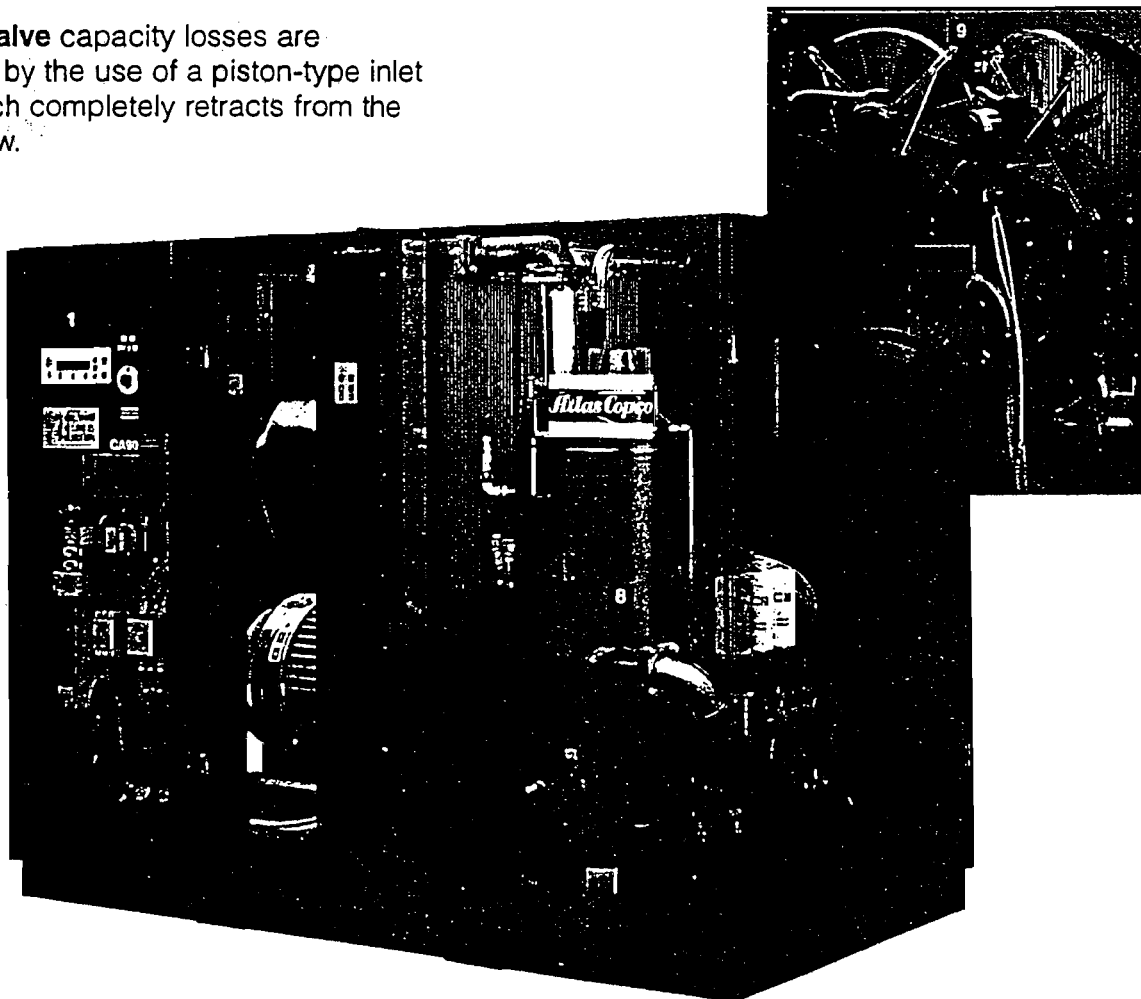
Atlas Copco's Advantage...

Proven Technology and Superior Engineering

The GA90-315 and GR110-200 compressors have been designed to perform and built to last. Atlas Copco utilizes only those components which have been analyzed, designed and manufactured to assure the superior quality of each product.

- 1 The Elektronikon control system** maximizes operating efficiency, provides reliable and versatile operation, and makes it easy to identify when maintenance is required.
- 2 Improved compressor capacity** is achieved by locating the inlet air filter at the cool end of the package. This high efficiency filter prevents foreign particles from entering the compressor. Clean air and oil mean long reliable bearing life.
- 3 Air inlet valve capacity losses** are eliminated by the use of a piston-type inlet valve, which completely retracts from the air inlet flow.

- 4 Permanent alignment** is assured by the flanged motor drive assembly.
- 5 Reduced bearing loads** are achieved with a flexible coupling between the motor and compressor shafts.
- 6 Bearing life** is extended by the helical drive gears which offset axial loads.
- 7 Smooth, reliable operation** results from strategically located flexible vibration isolators.
- 8 The air/oil separator**, with its extended surface area, reduces power consumption.



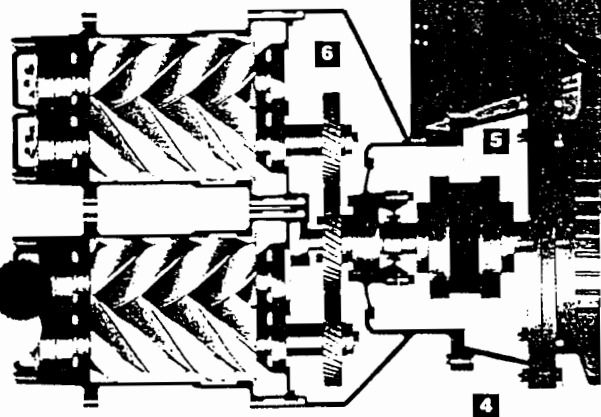
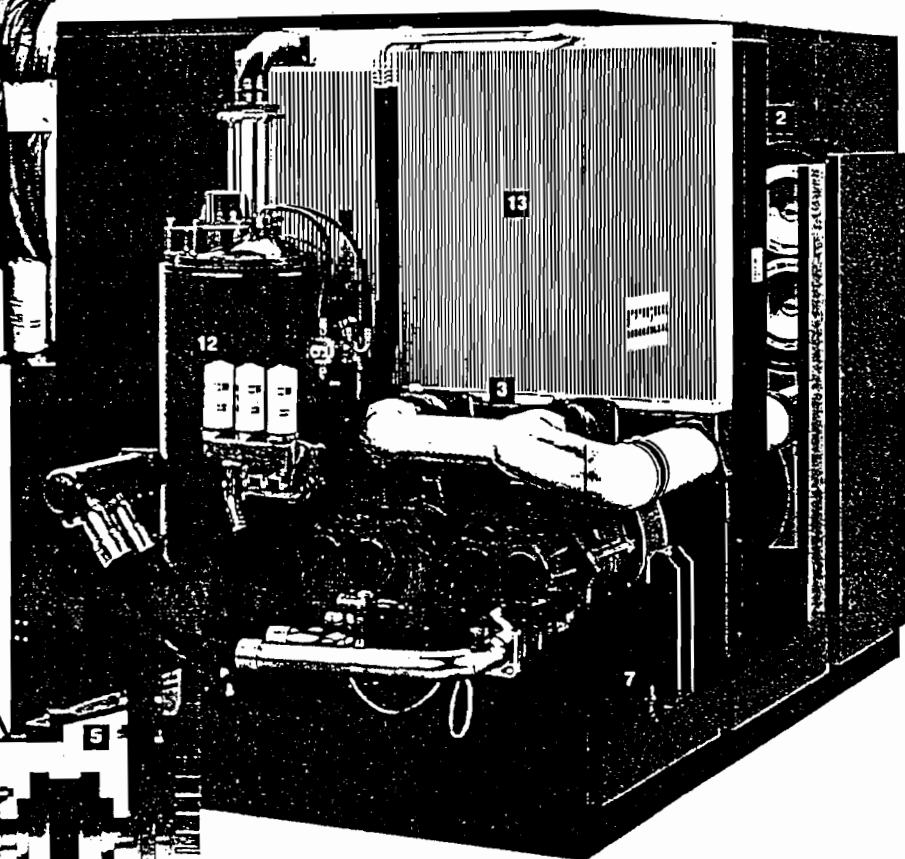
9 **Aircooled units** include axial cooling fans driven by a separate TEFC motor. The fan, fan guard and motor assemblies are hinged for easy cooler cleaning.

10 **The cover of the air/oil separator** is hinged so that a separator element can be easily changed.

11 **Easy and leak-free assembly** is provided by O-ring seals.

12 **The easily accessible oil filters** are positioned to allow simple, clean replacement. The oil drains from the cartridge, back into the system, prior to removal.

13 **The side-by-side oil cooler and aftercooler arrangement** achieves optimal heat transfer and makes cleaning simple.



Innovative Designs that Yield Efficiency and Reliability

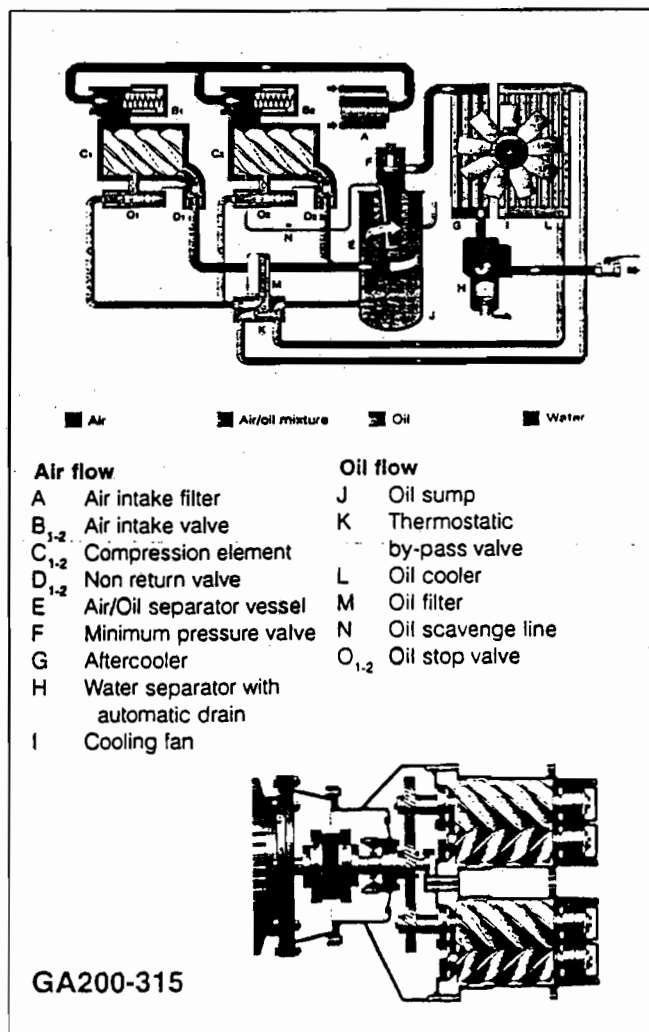
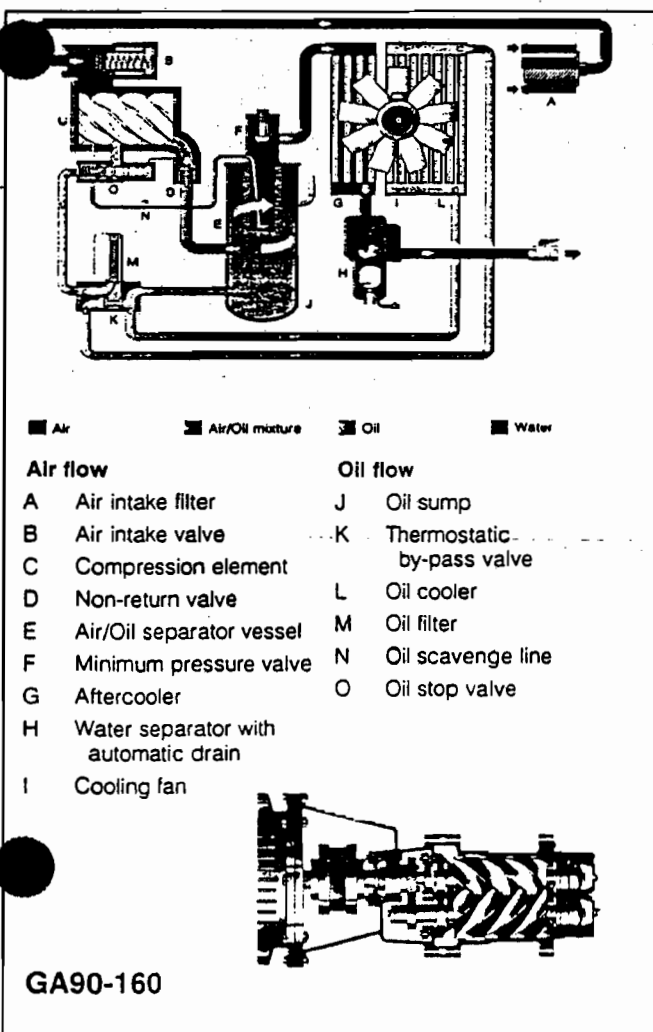
The Atlas Copco compressor element and drive system design have demonstrated exceptional reliability and long service life. Patented asymmetric rotors provide efficient compression over a wide range of capacities and pressures. Each rotor is supported by a set of bearings specifically designed for this application.

The helical gear drive optimizes operating speeds and compensates for 30% of thrust loads, resulting in longer compressor element life. Bearings on both sides of the drive gear eliminate the cantilever forces inherent in overhung designs. Furthermore, the motor is flanged to the gearcase to ensure permanent alignment of the drive system. A flexible drive

coupling dampens starting torque and isolates the motor from common compressor vibration and thrust loads.

Two proven single-stage compressor elements (as are used on the GA160 Series) are mounted on a single gear casing resulting in the GA200-315 Series. A twin compression element design that yields:

- Efficiencies which are far superior to those designs using one large element.
- Efficiencies which are better than some two-stage designs, and in a much more cost efficient package.
- Extended life due to reduced loads on the bearings, rotors and gears.

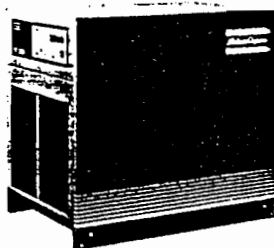


A Complete System Engineered to Meet All Applications

Compressed air quality requirements and system control demands are as diverse as the range of plant applications. An efficient and reliable air compressor is only the first component in a complete system. Atlas Copco has developed a wide range of complementary equipment that makes it easy to obtain the desired air quality, while efficiently managing compressor operation. Utilizing Atlas Copco designed and manufactured products, in a complete compressed air system, assures maximum product quality control and performance.

Eliminate Damaging Moisture

FD refrigerated dryers remove the moisture that is harmful to equipment and products. With dry compressed air, machinery lasts longer and requires less maintenance. Designed to match the GA compressor in both performance and appearance, FD refrigerated dryers make it possible to obtain pressure dewpoints down to 35°F. Innovative component selection results in low energy consumption, low pressure drop, and a compact configuration that requires a minimum of floor space.



Contamination Removal

Atlas Copco's compressed air filters eliminate air system contamination. Particulates, oil aerosols and even vapor can be effectively removed, protecting equipment and products. The DD and PD filters feature borosilicate fibers, while the QD filters are made with an activated carbon

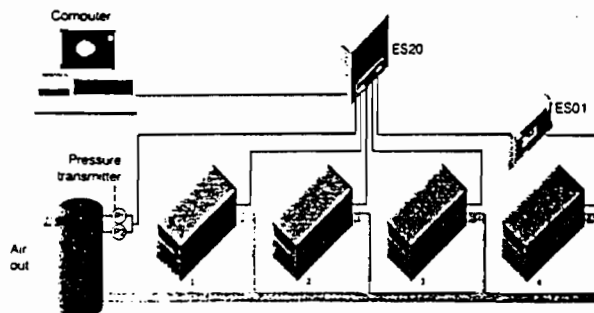
element. Each filter is designed to provide the desired air quality with minimum pressure loss.

Multiple Compressor Installations

Atlas Copco has developed flexible control capabilities which manage and monitor multiple compressor installations for optimum system performance.

A variety of sequencers and central governors are available which integrate easily with Atlas Copco compressors. The simple ES100 will sequence up to 7 compressors. More advanced system management is available with the ES20 and ES30. These powerful central governors will manage up to 6 or 12 compressors, displaying individual compressor status as well as system data. Though developed for use with Elektronikon-controlled compressors, they are fully compatible with electro-pneumatic compressor controls.

Remote monitoring of up to 12 compressors is simple with the ES40. This software package provides compressor operation. When used with Elektronikon-controlled compressors, a wide variety of current and historical information can be easily obtained and displayed to assist in system management. When used alone with an ES20 or ES30, it will also provide easy access to overall system data.



1, 2 & 3: Elektronikon compressors / 4: Electro-pneumatic compressor

About Atlas Copco

The World Leader in Compressed Air

Atlas Copco has been manufacturing air compressors for the industrial and construction markets for more than 80 years. This experience, plus on-going innovations in research and development, has made Atlas Copco the largest manufacturer of compressed air systems in the world. The GA90-315 and GR110-200 Series

compressors are a direct result of that leadership in compressed air technology.

Atlas Copco's network of nearly 100 U.S. stocking distributors provide local availability of both parts and factory trained service technicians.

Local support efforts are backed by Atlas Copco's parts warehouse and direct service team.

Technical Specifications

Model	Motor HP	Working Pressure PSIG	Capacity ACFM ⁽¹⁾	Sound Level ⁽²⁾ dB(A)		Net Weight Lbs.		Dimensions Inches		
				Aircooled	Watercooled	Aircooled	Watercooled	L	W	H
GA90	125	100	640							
		125	565	76	74	5405	5230	100	61	78
		150	495							
GA110	150	200	373							
		100	750							
		125	677	77	75	5865	5690	100	61	78
GA160	200	150	591							
		200	458							
		100	1020							
GA200	250	125	905	78	75	6770	6505	110	70	78
		150	800							
		200	657							
GA250	300	100	1300							
		125	1155	77	75	10300	10035	126	85	98
		150	1055							
GA315	350	100	1555							
		125	1375	78	76	11005	10740	126	85	98
		150	1215							
GR110	150	200	983							
		100	1695							
		125	1545	79	77	11445	11180	126	85	98
GR200	250	150	1355							
		200	1067							
		100	2400							
GR110	150	290	475	78	75	6925	6595	110	70	78
GR200	250	290	800	80	77	7850	7410	110	70	78

(1) Unit performance measured according to CAGI-Pneurop PN2CPTC2.

(2) Maximum noise level measured at a distance of 3 feet according to CAGI-Pneurop PN8NTC2 test code.

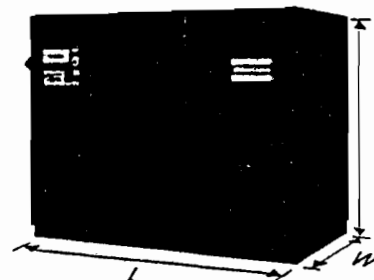
Danger: Compressed air should never be supplied as breathing air unless air is properly purified for breathing. Atlas Copco assumes no responsibility or liability related to the purchaser's/user's breathing air system.

Member:



Atlas Copco

Atlas Copco Compressors Inc.
161 Lower Westfield Road
Holyoke, MA 01040
Tel. 413-536-0600 Fax. 413-536-0091



This information contained herein is general in nature and is not intended for specific construction, installation or application purposes.

Building 820 POL Site

Equipment Data



**OHM Remediation
Services Corp.**
A Subsidiary of OHM Corporation

Component Group: Equipment Compound

Equipment Data

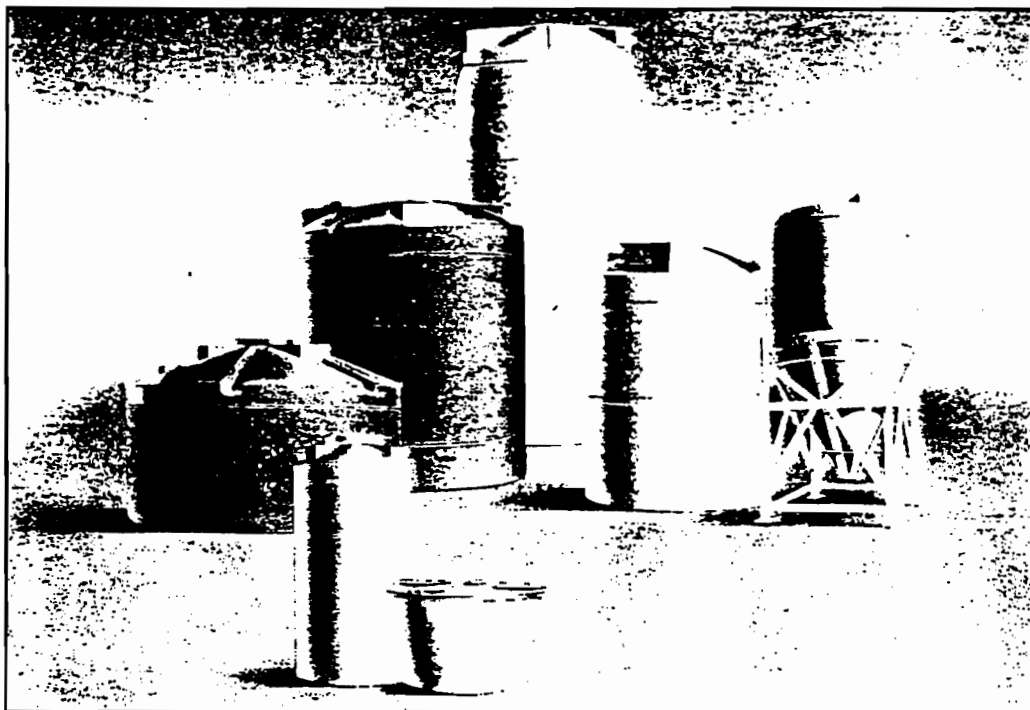
Component Name Poly Tank
Manufacturer Poly Processing
Model Number 2000 Vert. I, 1.35 Nat LINEAR
Serial Number V-97-04014
Description Poly Tank complete with tie down hardware
see cut sheets

OEM Vendor Data

Original Vendor Hugo Jans and Associates
Spare Part Vendor Poly Processing
Service/Maintenance Vendor Site

Notes

INSTALLATION MANUAL



■ ■ ■ ■ ■

INSTALLATION USE AND MAINTENANCE GUIDELINES

PROTECT YOUR WARRANTY - READ THESE INSTRUCTIONS

Poly Processing Company's polyethylene tanks are the most efficient, economical and durable vessels for storing corrosives and other fluids. Observing the few precautions described in this manual may prevent major problems later.

■ ■ ■ ■ ■

**POLY
PROCESSING**
Company

A DIVISION OF ABELL CORPORATION ▲

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PROTECT YOUR WARRANTY – READ CAREFULLY

I. SAFETY CONSIDERATIONS

Safety should be the primary consideration and is the shared responsibility of all people involved in an operation. This manual does not profess to address all of the safety problems associated with the use of polyethylene tanks. It is the responsibility of the user of this manual to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to the use of tank(s).

MATERIAL SAFETY DATA SHEETS - The products which are stored in tanks may require health and safety considerations. Obtain and read MSDS sheets for any chemical stored in the tank. Take the necessary precautions of the MSDS.

CONFINED SPACES - The interior of a tank is considered to be a confined space and must be entered by permit only. Adequate preparations should be made as necessary such as lock out of all electrical circuit of internal equipment, all lines to the tank blinded off, adequate ventilation provided, adequate and safe lighting provided, tank decontaminated, safety watches and emergency procedures established, all safety equipment procured and personnel trained in its use before entry into the tank.

LADDERS - Ladders are designed for access of one person to the manway. Ladders are not designed for multiple persons or heavy equipment.

HYDROTESTING - After a tank has been installed with its fittings and accessories in place, hydrotest with standing water for at least two hours before putting into service.

DOMEL LOADING - Exercise extreme caution when walking or standing on the dome of a polyethylene tank. Polyethylene is a very flexible material and does not afford sure footing. There is no weight or load rating for the dome.

SPIII PROTECTION - Hazardous chemicals may require secondary containment to protect against spills getting into the environment. For additional information on secondary containment, please contact your local Poly Processing Company distributor.

GENERAL SAFETY OF AREA AND PLANT - Before the tank is ordered, preparations should be made to ensure safe, adequate space is available for the tank and accessories. Head room must be considered as well as provision to transport the tank to the desired location. If the tank is to be indoors, a plan must be in place to transport the tank to the desired location assuring that access through doorways and around obstructions is adequate. Special consideration should be made so that there are no electrical hazards present. Good housekeeping in the area is always a prime consideration for safety.

AND OTHER REGULATIONS - There may be Federal, State, Local, or internal regulations that apply as well.

II. RECEIVING YOUR TANK

Upon receipt of your tank, INSPECT IMMEDIATELY for obvious defects. Parts and accessories are often secured and/or shipped inside the tank. Open the packages, inspect and account for all parts against the packing slip. Any discrepancies should be noted on both the driver's delivery copy and your packing list. We urge you to IMMEDIATELY NOTIFY your Authorized Distributor of any problems.

III. IF THERE IS A PROBLEM

DAMAGED MERCHANDISE OR OTHER PROBLEMS - Failure to report damaged/lost merchandise within the time limitations may mean you relinquish your rights to claim. Despite our best efforts, merchandise is sometimes damaged/lost in transit. Always inspect your merchandise on the day you receive it. Obvious damage should be noted on the freight bill or shipping invoice and the driver should initial the notation. Hidden damage must be reported to the carrier within THREE (3) WORKING DAYS. Any damaged/lost items can be reported to your Authorized Distributor or the factory and we will work to replace your damaged or missing merchandise as quickly as possible.

Poly Processing Company
Customer Service Department
Phone (318) 343-7565
FAX (318) 343-8795

RETURN MERCHANDISE AUTHORIZATION POLICY - While Poly Processing Company does not authorize the return of used containers to its facilities, we will work with the customer to determine what should be done with the used container. You must have a RMA (Return Merchandise Authorization) Number to be used with the return of merchandise to Poly Processing Company. This insures that we correctly identify the merchandise being returned and you receive the proper credit and service in the handling of your claim. To receive an RMA Number please contact the Customer Service Department as noted above. Have your packing slip available to provide the necessary information to complete the RMA. Please use this RMA Number in any correspondence, shipping papers or paper work involved with the return of the merchandise. Please maintain this RMA Number until the claim is resolved. All material should be shipped freight PREPAID unless prior arrangements have been made. Shipments made on a freight collect basis are subject to refusal. A RESTOCKING FEE will be assessed on new and unused equipment being returned after fifteen (15) days. All items are subject to inspection to assess credit value.

IV. OFF-LOADING

While rotationally-molded tanks are extremely durable, damage can occur to the tanks and fittings if they are improperly handled. Avoid all sharp blows or sharp edges. Do not allow the tanks to be rolled over the fittings. Whenever possible, use a crane or other suitable lifting equipment to remove the tanks from the trailers. Make sure the off-loading area is clear of rocks, sharp stones, or other objects which could damage the tank. Prior to installation, protect the tank from rolling, toppling or being struck while in the off-load area.

V. UNINSTALLED PARTS

Parts must sometimes be shipped uninstalled to prevent damage in transit. These parts can usually be found bagged or boxed **INSIDE** the tank. **THESE ARE BEST REMOVED BEFORE SETTING THE TANK IN PLACE.** Please check before reporting missing parts.

VI. FOUNDATIONS AND SUPPORTS

Although a concrete pad provides the best foundation for vertical flat bottom tanks, a smooth level base of sand, pea gravel, or fine soil confined so that it will not wash is sufficient for any flat bottom tank less than 8,000 gallons capacity. Tanks 8,000 gallons and above require reinforced concrete base or other factory-approved base. IMFO tanks require the same base requirements as vertical flat bottom tanks with provision made for the IMFO outlet. Spherical, horizontal, and cone-bottom tanks all require specifically designed support. To avoid inadequate or improperly designed supports, any support structure not of Poly Processing Company's design must be approved in writing or **ALL WARRANTIES ARE VOID.** Consult the Technical Services Department at (318) 343-7565 for approval or recommendation on any foundations or tank supports.

VII. LOCATION CONSTRAINTS

Poly Processing Company's polyethylene tanks are tough, durable, and suitable for both indoor and outdoor service. However, there are location constraints which should be considered prior to placement of a tank into service. Some of these considerations are: secondary containment requirements; placement in flood plains; placement in areas where seismic or wind forces may be experienced (lateral, seismic, anti-flotation, and wind restraint systems may be required for these areas); continuous ambient and process temperatures above 100°F; adjacent equipment; and work in surrounding areas such as welding. These are only some of the location constraints to be considered. This manual does not profess to include all location constraints that may occur.

It is the responsibility of the end user to ensure that all location constraints applicable are taken into consideration. The installer should check any Federal, State, Local, or internal regulations that may apply to the tank installation. A thorough evaluation of location constraints should be done prior to installation. Contact the factory with questions concerning specific location constraints.

VIII. INSTRUCTIONS FOR INSTALLATION OF FITTINGS

GENERAL RULES

1. It is very important when locating your tank fittings to be extremely careful to consider the fitting contact inside the tank. The fitting must not rest against any portion of the tank that will not allow a complete seal of the fittings. These surfaces are the curved knuckle radii, molded ribs, etc. If a hole is drilled incorrectly the entire tank may be a total loss.
2. The use of a proper size hole saw is recommended for cutting fitting holes. A sabre saw can be used if hole saws are not available. The hole must be precisely cut, however.
3. Refer to the instructions for the particular style of fitting in the following pages.
4. In the case of thick wall tanks (+1/2") some sanding on the inside of the tank may have to be done to get a good sealing surface. This must be done very carefully and to the bare minimum necessary. If the holes were drilled at the factory the sanding should have been done there. Check to ensure even wall thickness around the holes to within 1/32".
5. Tools you will need for installing tank fittings:
 - 1/2" drill motor or a sabre saw for very large holes
 - Hole saw sized to the O.D. of the fitting portion to be put through the wall
 - Drills to the size of the bolts used +1/16"
 - Pocket knife
 - Adjustable wrench
 - A strap or chain wrench for some large fittings
 - Marker to lay out holes
6. Poly Processing Company strongly recommends the use of expansion joints for all plumbing connections. **RIGID PIPING MUST NOT BE USED.** The use of rigid piping or the failure to provide for the expansion of the tank will void all warranties.
7. Spool pieces and flange adapters will be shipped loose. Installation on site will be required. Exercise caution when installing to avoid cross-threading. **DO NOT FORCE FITTINGS.**

■ BULKHEAD FITTINGS

- Remove the large fitting nut from the fitting body. Note that the gasket is located immediately below this nut. The gasket and remainder of the fitting should be set aside for later use.
- Using the nut as a template, locate the desired position of the fitting. Trace the nut inside and out. Draw a line through the center of the traced outline from each of the points of the nut (See illustration). This will locate the center of the fitting.
 - Before drilling, the hole saw should match the O. D. portion of the fitting that must go through the hole in the tank. Drill the tank with a hole saw. Remove any flashing with your pocket knife and brush away any shavings around the hole.
 - Working from the inside of the tank, slide the fitting body through the hole in the tank. The gasket should be between the back of the shoulder of the fitting and the inside wall of the tank.
 - Install the large fitting nut on the outside of the tank. Tighten the nut securely, hand tight plus one half turn to three quarter turn. Care should be taken to prevent the fitting body from turning during this process. The gasket may creep from between the fitting and the tank wall.
 - Inspect the gasket to make sure it has not crept from the shoulder of the fitting. If so, loosen the nut on the outside of the tank. The gasket will jump back into place. Retighten the nut carefully.
 - Piping such as a flange adapter should be threaded into the fitting now. Teflon sealant tape or other thread sealant should be applied to all pipe threads.
 - HYDROTEST THE TANK WITH STANDING WATER FOR AT LEAST TWO HOURS BEFORE PUTTING INTO SERVICE.**

NOTE: Some bulkhead fittings have left hand threads for the large fitting nut.

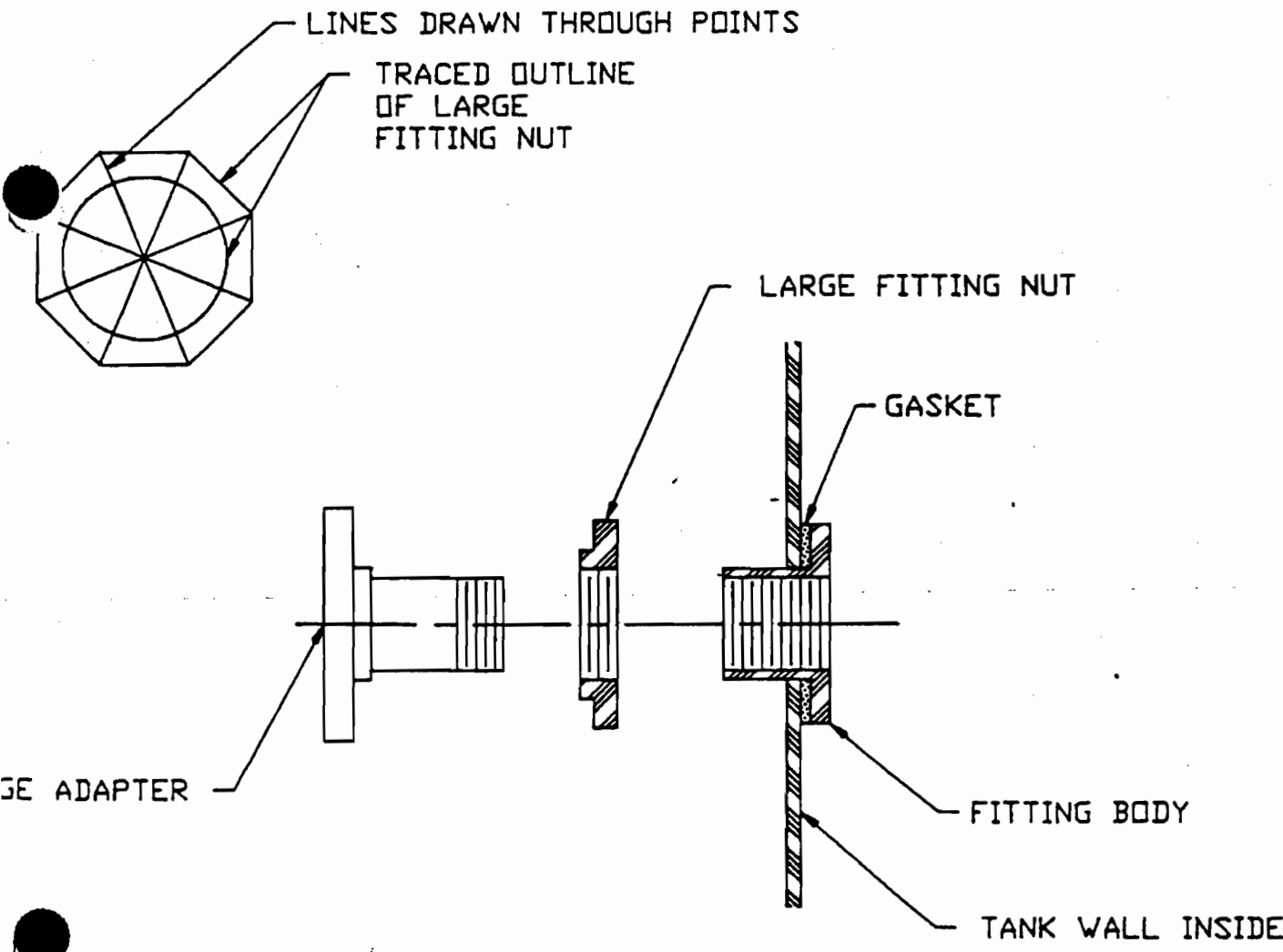


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■ TWO-FLANGE FITTINGS

1. Disassemble the fittings as shipped. If the holes are not drilled, place the flange against the tank in the desired location and use as a template for drilling the holes. Use either a hole saw the same size as the fitting's size or up to a 1/2" size larger.
2. With their gaskets on them place the studs through their holes with the plastic head on the inside of the tank, threads on the outside.
3. Place the full face flange gasket over the bolts on the outside surface of the tank.
4. Place the flange over the gasket and stud threads with the snout of the flange facing out.
5. Put the washers and nuts on the stud. Be sure to lubricate the threads of the bolts.
6. Tighten nuts in same manner as putting a head on an engine block, i.e.: tighten a little on each nut bringing the flange up to the gasket evenly. Tighten until the gasket is fully compressed (Approximately 15/20 ft. lbs. on a torque wrench).
7. Inspect fitting. Gasket should be compressed and the outer flange drawn down evenly.
8. Piping such as a flange adapter should be threaded into the fitting now. Teflon sealant tape or other thread sealant should be applied to all pipe threads.
9. **HYDROTEST THE TANK WITH STANDING WATER FOR AT LEAST TWO HOURS BEFORE PUTTING INTO SERVICE.**

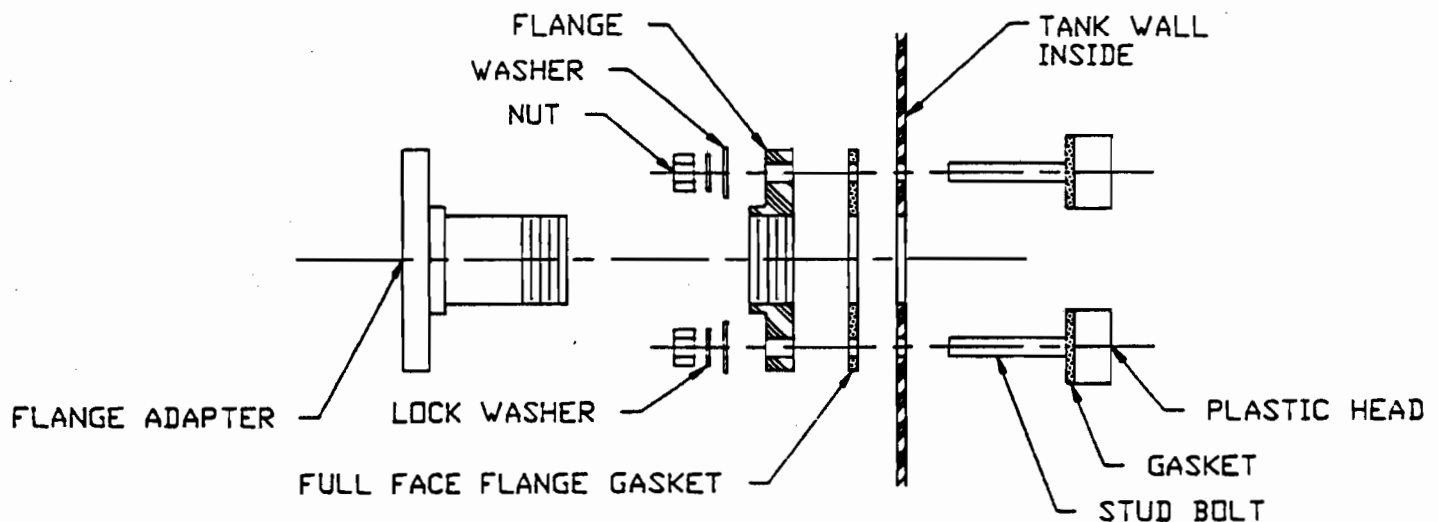


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■ STAINLESS STEEL FITTINGS

1. Disassemble the stainless steel fitting by removing the nuts from the stud bolts. Remove the 1/8" thick stainless steel outer plate. Set the remainder of the fitting along with the nuts and washers aside.
2. Using the outer plate as a template, mark the hole patterns on the outside of the tank.
3. Find the center of the large "tank fitting" hole by drawing an "X" through the center of the bolt holes (See illustration).
4. With the drill motor and hole saw, drill out the pipe fitting hole. Please note that the hole to be drilled in the tank may be much smaller than the hole in the outer plate that was used as a template. The hole saw should match the O.D. of the portion of the fitting that must go through the hole in the tank.
5. Next drill out the stud bolt holes using the 9/16" drill bit for fittings with 1/2" diameter studs or a 3/8" drill bit for fittings with 5/16" diameter studs.
6. Trim any flashing from the holes with a pocket knife and brush away any shavings around the hole.
7. You are now ready to insert the tank fitting. With the gasket on the studs against the back plate of the fitting, install the fitting from the inside of the tank. Slide the outer plate onto the stud bolts that are protruding from the tank wall.
8. Replace the washers and nuts on the stud bolts. Tighten the nuts. Tighten a little on each nut bringing the outer plate down to the wall of the tank evenly. Tighten until the gasket on the inside of the tank is fully compressed. **1/2" nuts should be torqued to 30 ft. lbs., 5/16" nuts to 12 ft. lbs. Be sure to lubricate the threads of the bolts.**
9. Inspect the fitting. The gasket should be compressed. The outer stainless steel plate should conform to the wall of the tank.
10. **HYDROTEST THE TANK WITH STANDING WATER FOR AT LEAST TWO HOURS BEFORE PLACING INTO SERVICE.**

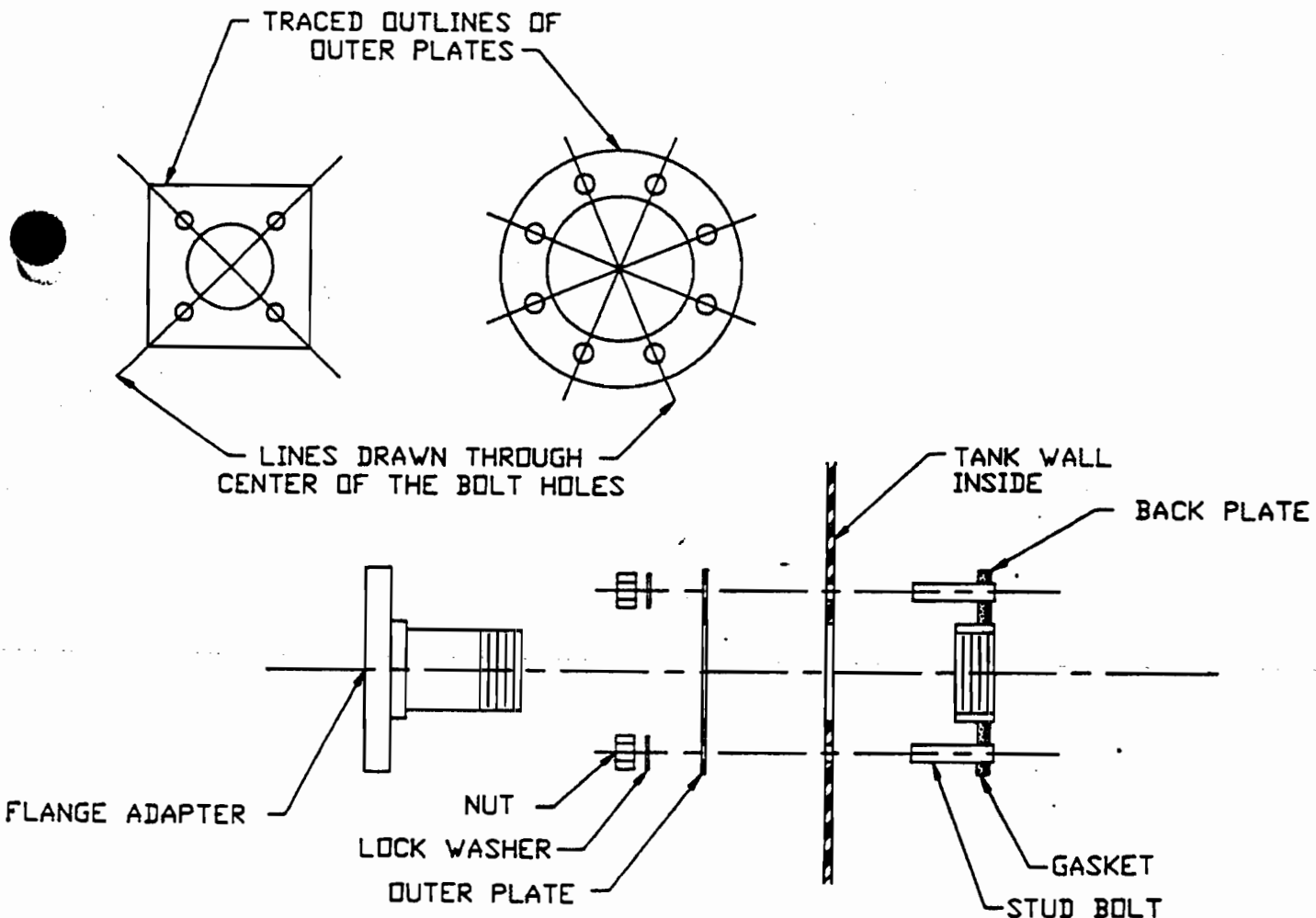


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■ IMFO - COMPANION FLANGE ASSEMBLY

1. This assembly will come assembled on the Integrally Molded Flanged Outlet. This information is supplied should you need to disassemble or replace the companion flange assembly.
2. The molded flange face will be prepared in accordance with the Technical Training Document, "Requirements for Molding and Finishing IMFO Nozzles". Contact the factory for this document.
3. From the two styles of IMFO's select the style you have and refer to the drawing below. This will illustrate the parts involved in this assembly.
4. Place the split back-up ring at the back of the molded flange and place the bolts through the ring. Note that the tapered style has beveled washers that must be in place to achieve a seal.
5. After the assembly of the split back up-ring, the full face gasket, and outer plastic flange, then begin the bolting process. Tighten the bolts as you would an automobile tire, tightening the alternate bolts such as twelve o'clock and six o'clock and then three o'clock and nine o'clock. (Approximately 15/20 ft. lbs. on a torque wrench.)
6. It is important to know that the dimension designation of the IMFO is not necessarily the bore size of the molded outlet. For example the 2" size will have a 2" bore. However, a 3" size will have minimum 2-1/4" bore, a 4" size will have a minimum 3" bore and a 6" size will have a minimum 3-1/4" bore. This minimum size is usually exceeded with a few exceptions. Extra heavy wall vessels and those with special requirements will be exceptions.
7. When storing IMFO style tanks, it is important to recognize that the flanged nozzle protrudes below the tank bottom. IMFO style tanks must be stored in a manner to protect the IMFO. This can be accomplished by allowing the tank to lie on its side with the IMFO unobstructed or to sit upright on a pallet or pad with the IMFO free and unstressed.
8. **HYDROTEST THE TANK WITH STANDING WATER FOR AT LEAST TWO HOURS BEFORE PLACING INTO SERVICE.**

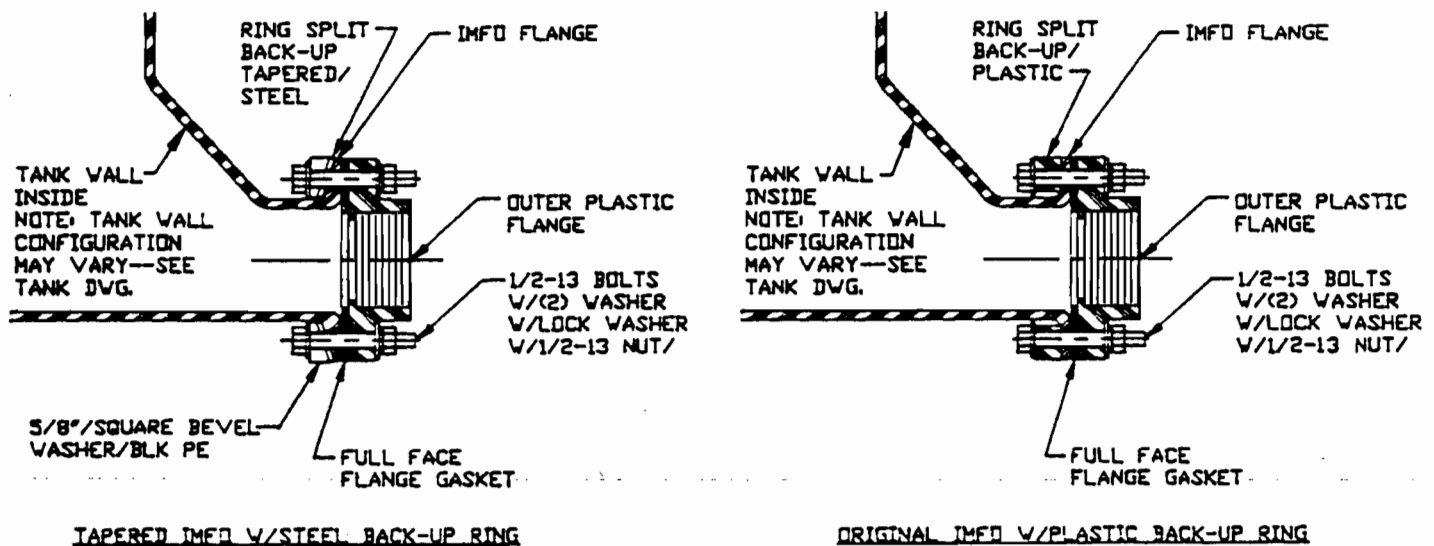


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■ TRANSITION FITTING (FOR SAFE-Tanks)

Note: This does not apply to 1600 gallon SAFE-Tank.

Upon placement of the tanks in a vertical position, it will be necessary to determine the alignment of the inner fitting with the center hole for the transition fitting. Loosen the nuts on the bolts holding the slotted plate and remove the plates and grommet to be able to view the inner fitting.

- Determine that the two tanks are aligned. The fitting on the inner tank should be aligned so that it is ideally centered top to bottom and left to right in the hole on the outer tank. This can be offset as much as 1/2" left to right and not be a problem.
- Should the tanks not be aligned as described above, call the factory (800-523-9871) to determine how this alignment may be accomplished. After this alignment is accomplished then continue this process.
- Place thread sealant such as Teflon tape or Teflon paste on the threaded area of the long (12") nipple and install the nipple into the fitting on the inner tank. Be careful to not crossthread or overtighten the nipple, causing the inner fitting to turn.

IT IS VERY IMPORTANT TO HYDROTEST THE INNER TANK BEFORE COMPLETION OF THE INSTALLATION OF THE REMAINDER OF THE TRANSITION FITTING TO ALLOW THE INNER TANK TO SETTLE INTO PLACE IN THE OUTER TANK.

- Place the transition fitting gasket and the seal plate (thickest) over the nipple and slide to the tank wall.
- Slide the grommet and push plate over the nipple and slide to the seal plate.
- Place the slotted plate over the nipple and slide to the push plate.
- Begin placing the flat washer, lock washer, and double nuts on all the bolts (Tighten to 15# on a torque wrench.)
- Tighten the bolts in the same manner as an auto tire (twelve o'clock and six o'clock, etc.). Replace or retighten any items that may have been changed when aligning the fittings in step 3.
- BE SURE TO HYDROTEST FOR AT LEAST FOUR HOURS OR OVERNIGHT IF POSSIBLE TO DETERMINE IF THE FITTINGS ARE INSTALLED PROPERLY.**
- Use of a leak detection device is recommended to determine if there is any leaking between the two tanks.
- A drain fitting in the outer tank is recommended in order to drain the outer tank should this become necessary.

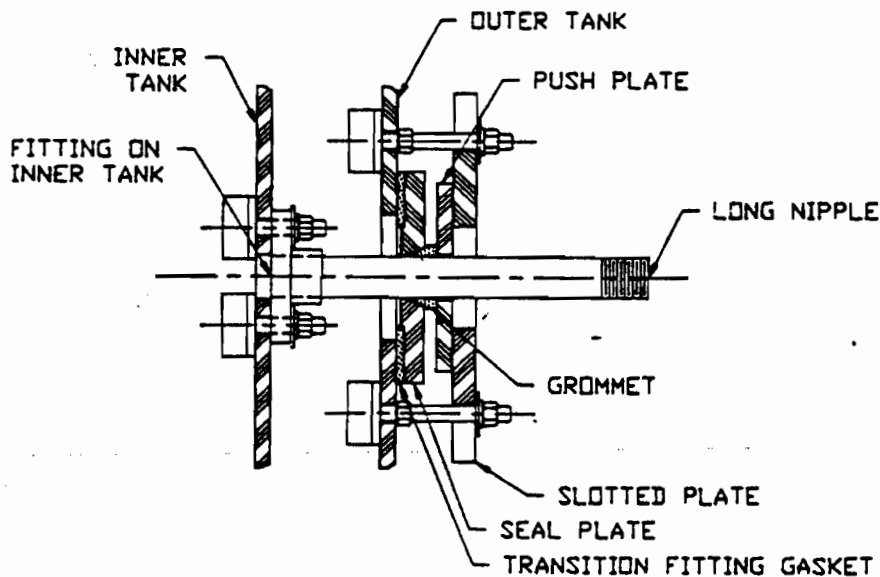


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■ "UNIVERSAL DOME" FITTINGS (BULKHEAD FITTING STYLE)

1. Remove the large fitting nut from the fitting body. Note that the gasket is located immediately below this nut. The gasket and remainder of the fitting should be set aside for later use.
2. Using the nut as a template, locate the desired position of the fitting. Trace the nut inside and out. Draw a line through the center of the traced outline from each of the points of the nut (See illustration). This will locate the center of the fitting.
3. Before drilling, the hole saw should match the O. D. portion of the fitting that must go through the hole in the tank. Drill the tank with a hole saw. Remove any flashing with your pocket knife and brush away any shavings around the hole.
4. Working from the inside of the tank, slide the fitting body through the hole in the tank. The gasket should be between the back of the shoulder of the fitting and the inside wall of the tank.
5. Install the large fitting nut on the outside of the tank. Tighten the nut securely, hand tight plus one half turn to three quarter turn.
6. Inspect the gasket to make sure it has not jumped from the shoulder of the fitting. If so, loosen the nut on the outside of the tank. The gasket will jump back into place. Retighten the nut carefully.
7. Piping such as a flange adapter should be threaded into the "ball" of the fitting now. Teflon sealant tape or other thread sealant should be applied to all pipe threads. Piping may be adjusted to any angle desired within the limits of the fitting.
8. Note, universal ball fittings are adjusted at the factory to provide vertical entry into the tank dome. (They sometimes are knocked out of adjustment during transit.) If necessary gently loosen the ball retainer ring located on top of the fitting ball, adjust to desired angle, and then tighten retainer ring, taking care to not over tighten and crack.
9. For a flanged connection Flange Adaptors may be used.

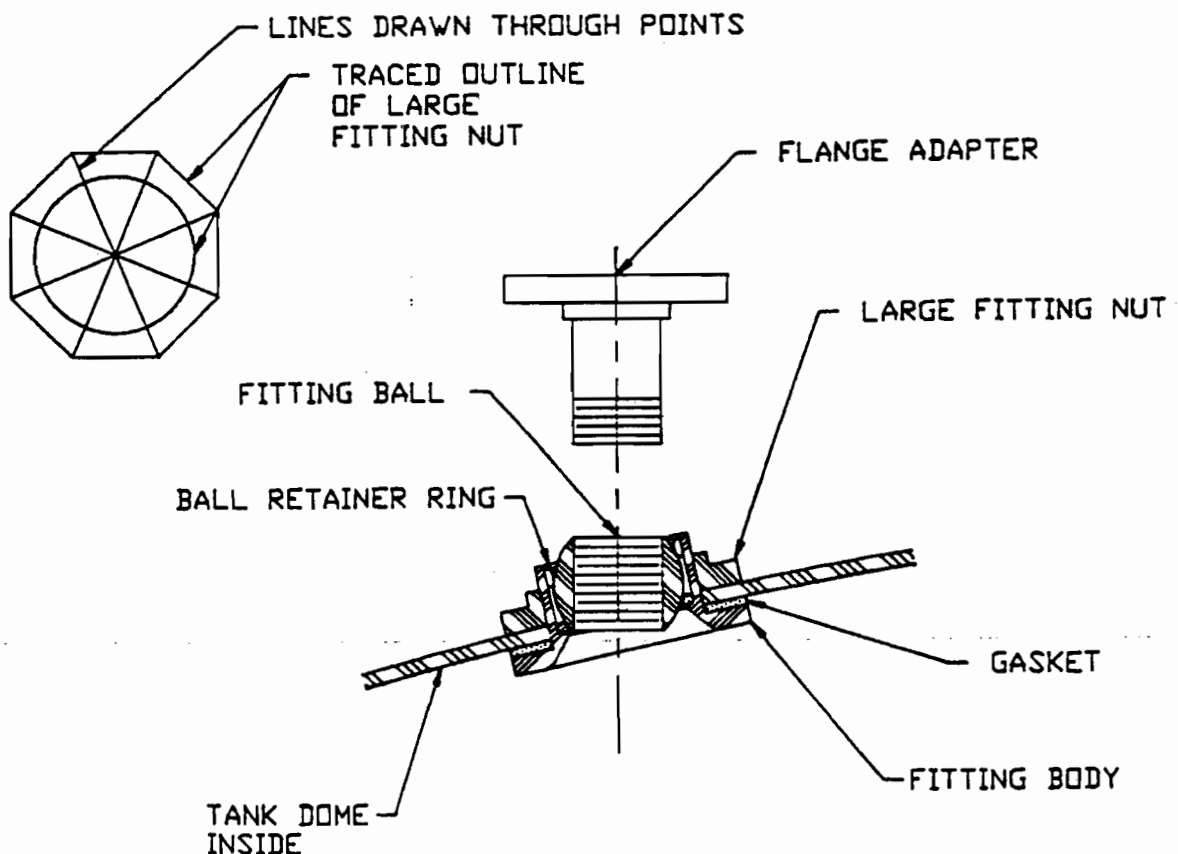


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■ "UNIVERSAL DOME" FITTINGS (FLANGE STYLE)

1. Disassemble the fitting as shipped.
2. If the holes are not drilled, place the full face flange gasket against the tank in the desired location and use as a template.
3. Drill the center hole using the proper size hole saw. Hole must be at least 1/2" larger than the hole in back of the flange in order for ball to turn.
4. Drill the bolt holes using a 9/16" bit.
5. Remove any flashing with a pocket knife.
6. From the outside of the tank, reach through the center hole and place the threaded end of the stud bolts with their gaskets on them through the bolt holes on the inside.
7. Place the full face flange gasket over the stud bolts on the outside surface of the tank.
8. Place the flange style universal dome fitting over the stud bolts and the full face flange gasket.
9. Put the washers and nuts on the stud bolts. (Note: Be sure to lubricate the threads of the bolt.)
10. Tighten a little on each nut bringing the fitting down to the gasket evenly. Tighten until the gasket is fully compressed (Approximately 15/20 ft. lbs. on a torque wrench).
11. Inspect the fitting and the gaskets. The gaskets should be compressed and the fitting should be drawn down evenly.
12. Piping such as a flange adapter should be threaded into the ball of the fitting now. Teflon sealant tape or other thread sealant should be applied to pipe threads. Piping may be adjusted to any angle desired within the limits of the fitting.
13. Note, universal dome fittings are adjusted at the factory to provide vertical entry into the tank dome. They are sometimes knocked out of adjustment during transit. If necessary, gently loosen the ball retainer ring located on top of the ball, adjust to desired angle and tighten the ball retainer ring.

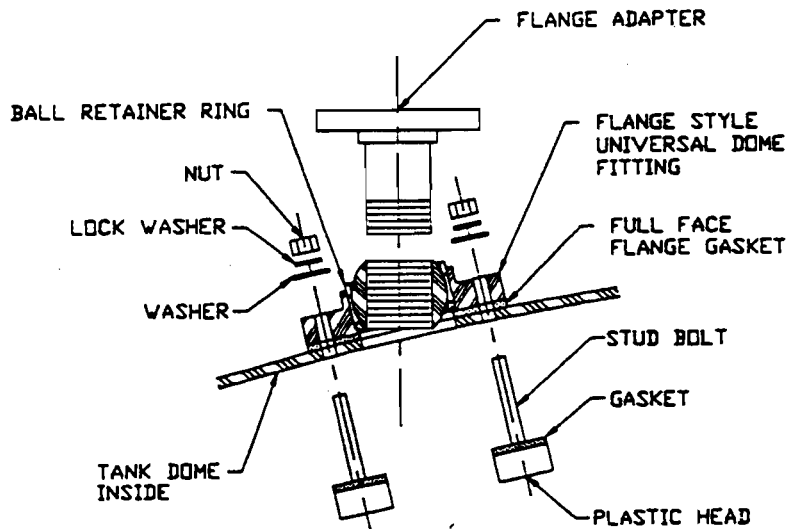


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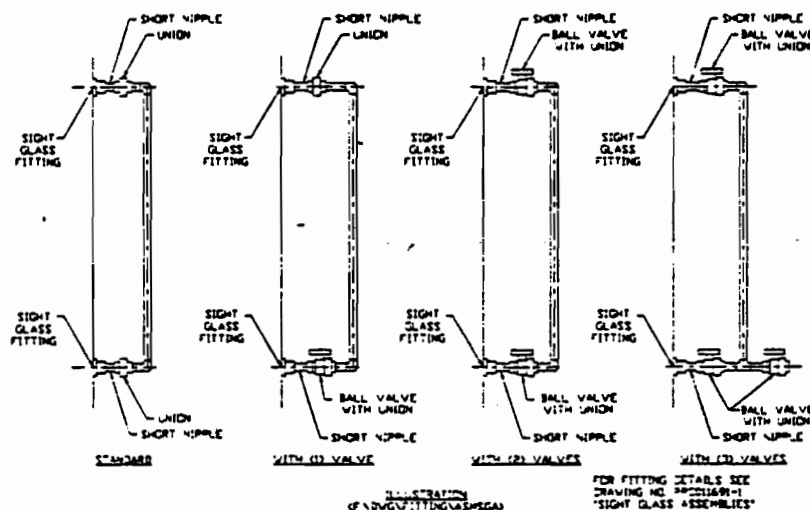
■ VENTS

2" vents and larger will not be installed for shipping in order to protect against breakage. Installation will require threading the vent into the proper fitting.

IX. LIQUID LEVEL GAUGE ASSEMBLIES

■ SIGHT GLASS STYLE

Sight glass assemblies are made up complete at the factory when ordered with your tank. They are usually shipped "loose" since they can easily be damaged in transit. To install a sight glass assembly, "break" the two unions apart on either end of the sight glass. Screw the short nipple and one half of the union into the sight glass fittings which have been mounted onto the tank wall at the factory. Rejoin the unions on the assembly and tighten carefully to complete the installation. For your convenience and ease of assembly, drawings of standard sight glass assemblies are shown below. (Also, see instructions on "Uninstalled Parts" on page 3.) If sight gauge is added later to tank, tank fittings must be drilled according to previous installation instructions. Clear sight glass will be provided loose from sight gauge assembly, to be cut down and custom fitted to tank. **IF FIELD INSTALLED HYDROTEST WITH STANDING WATER FOR TWO HOURS BEFORE PUTTING INTO SERVICE.**



■ REVERSE FLOAT STYLE

Liquid level gauges of a float type are shipped complete but with the exterior portion uninstalled. This exterior portion of the assembly will be shipped inside the tank and upon retrieving, the installation can begin. The installation is a simple matter of connecting the threaded pipe or nipple on the end of the gauge into the dome fitting installed for this purpose. The pipe portion of the gauge will be attached to the combination support pipe bracket on the side wall of the tank. This is usually done with a hose clamp that fits around the exterior pipe and attaches to the pipe support bracket. Review the drawing to understand how these parts fit and this will be a simple installation.

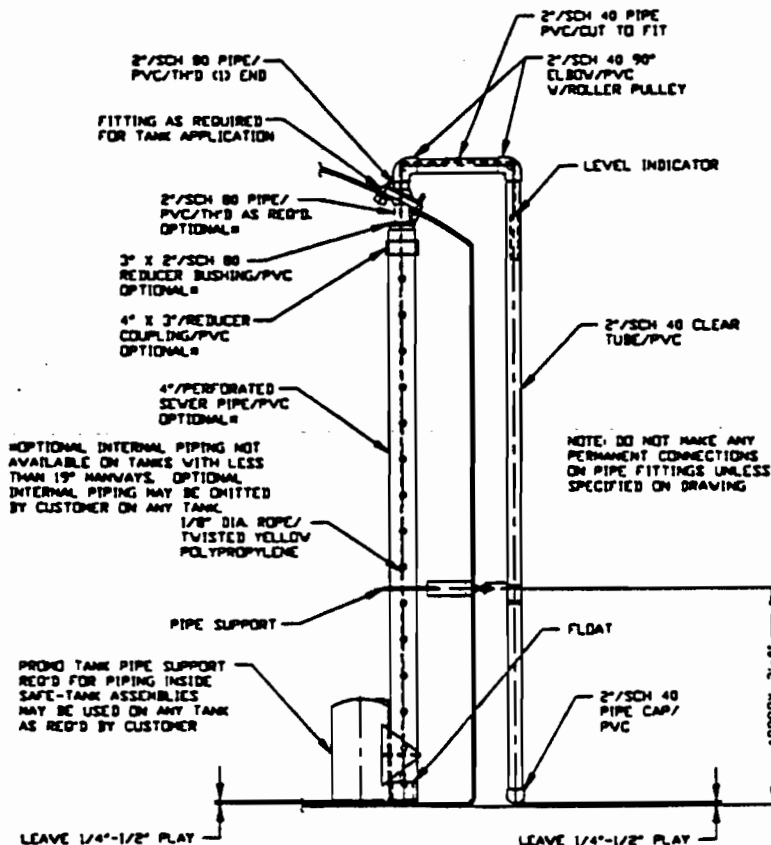


ILLUSTRATION
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X. LADDER INSTALLATION

1. Locate the ladder band or bands that have (2) 1/2" square holes punched approximately 20" apart. From the bolts provided, insert two 1/2" x 1-1/2" long carriage bolts such that the threaded end of the bolt sticks out in the same direction as the bent ends of the band (i.e., away from the tank).
2. Bolt the ladder band(s) to the attachment legs of the ladder.
3. Stand the ladder up against the tank in the position desired. Mark the holes at the ladder base where the anchor bolts go.
4. Anchor ladder base with approved type anchor bolts. Removal of the ladder may be required for anchor installation.
5. Replace the ladder in its desired position. Using a stepladder or approved personnel lifting device, bolt the remaining bands around the tank.
6. Secure all connections.
7. If a return or cage is required, they will be welded to the ladder and no other assembly will be required. These items ARE NOT field additions.

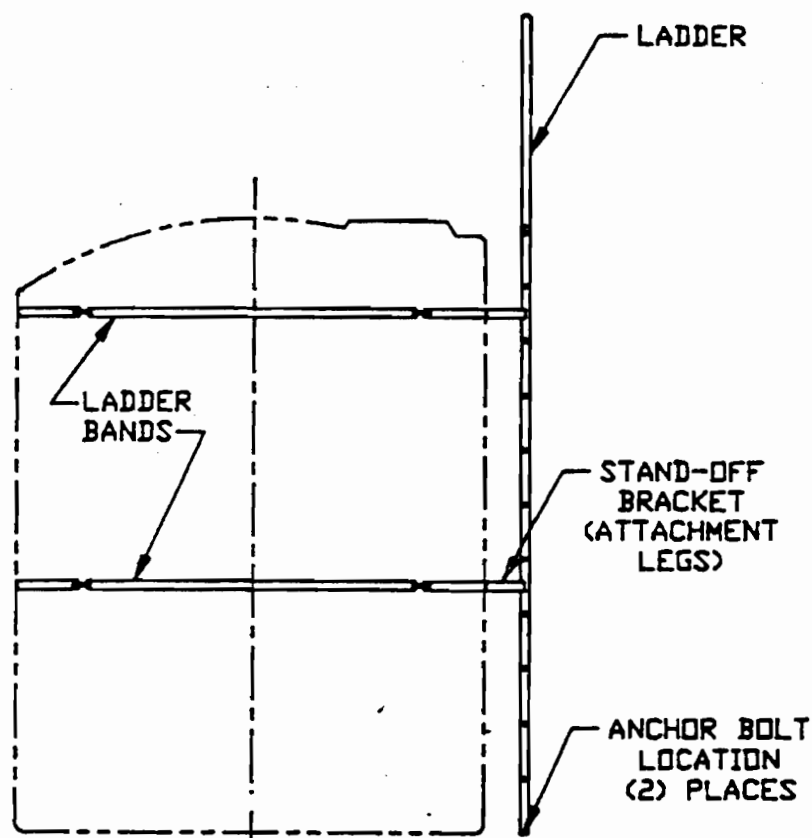
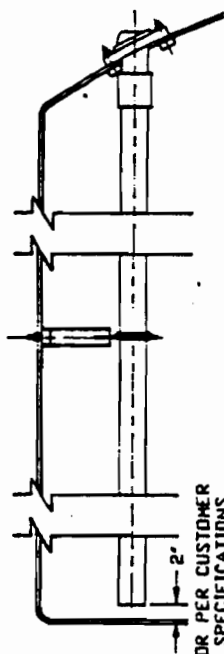


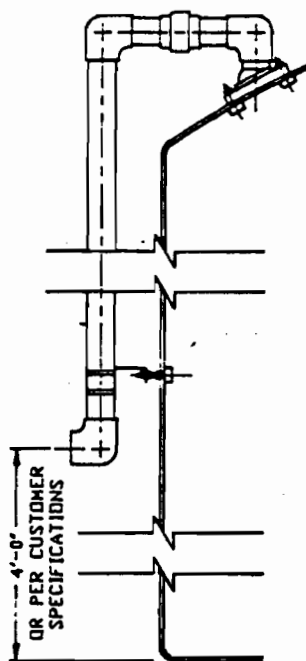
ILLUSTRATION
(F:\DWG\METAL\ASMLDR)

XI. FILL LINE ASSEMBLIES & PIPE SUPPORT ASSEMBLIES

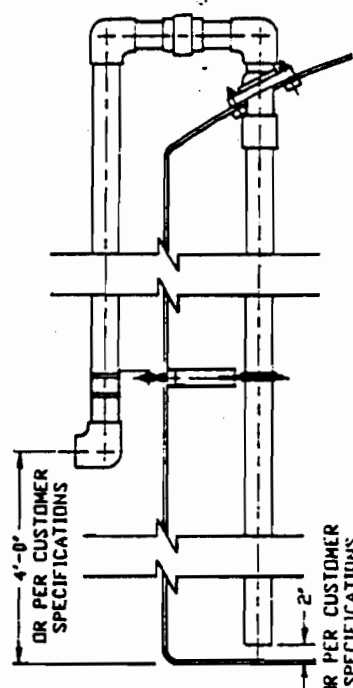
Poly Processing Company has a variety of fill assemblies for both vertical and horizontal tanks. We term these assemblies "drop pipes" and offer internal, external, and internal/external drop pipe assemblies. Standard drop pipes require at least one drop pipe support bracket, usually a special bolt which extends through the tank wall and may be tightened with a wrench. Drop pipes and downpipe brackets are often shipped "loose" to prevent damage in transit. They will require a minimal amount of assembly. For your convenience and ease of assembly, drawings of standard drop pipe assemblies are shown below. (Also, see instructions on "Uninstalled Parts" on page 3.)



INTERIOR DROP PIPE



EXTERIOR DROP PIPE



COMBINATION DROP PIPE

This pipe support assembly requires that the correct size be chosen for the size pipe involved and is not adjustable. If a field replacement is required, four things will be required to order. A. Dimension A on the sketch below, the distance from the tank wall to the center line of the pipe hole. B. The outside pipe diameter. C. The type of metal of the bolt. D. The gasket material.

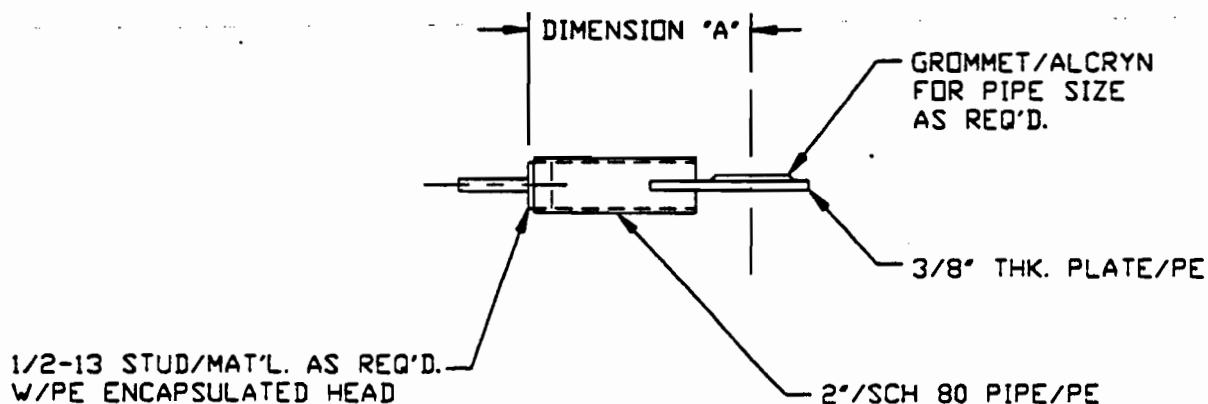


ILLUSTRATION
(F:\DWG\CUSTOM\GPS)

XII. TANK RESTRAINT SYSTEMS

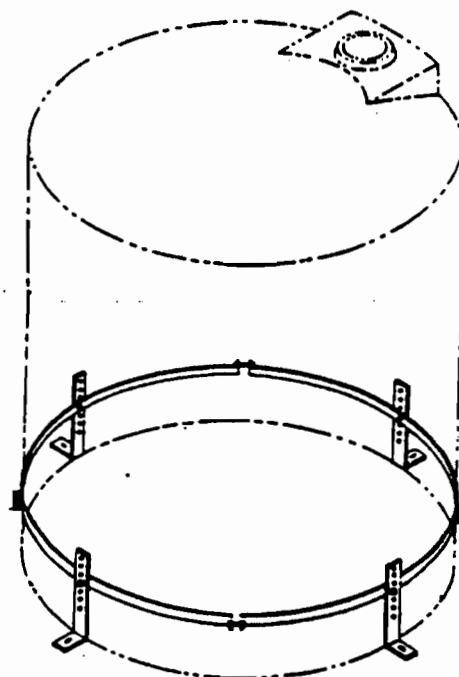
The Poly Processing Tie Down System is an effective, easily assembled method of anchoring your tank to a concrete slab.

To assemble the system you will need:

1. Concrete anchor bolts (1/2" size max.)
2. A method to install these bolts (unless pre-set)
3. A ratchet wrench with a 9/16" socket and a 3/4" socket
4. An adjustable wrench (i.e., crescent wrench)

To assemble the system:

1. Locate the tank on the slab.
2. Lay out all the contents of the hold down system and check to ensure that all parts are included. (See the list below.)
3. Insert a 1/2" x 1" long carriage bolt provided into each of the square holes punched in the bands. The threaded end of the carriage bolt should stick out in the same direction as the bent ends of the band (i.e., away from the tank).
4. After the bands have all been joined with the 3/8" Ø x 5" Lg. bolts orient them in such a manner that the 1/2" carriage bolt protruding from each band is in a desirable location. This is an **IMPORTANT STEP**, as these bolts provide the attachment to the anchor clips.
5. Raise the bands to the desired height and install the anchor clips onto the protruding bolts. By installing the clips one at a time, the bands can be "leveled" quite easily. Note that there are many holes in the vertical leg of the anchor clip to allow adjustment above or below any fitting on the tank. Tighten the anchor clips onto the bands.
6. After checking to make sure the bands are level, tighten the 3/8" x 5" long bolts to draw the bands securely to the tank.
7. Mark the slot locations of the anchor clips on the slab. Remove the clips from the bands and install the concrete anchor bolts into the slab. **IF THE ANCHOR CLIPS ARE PROPERLY PRESET, THIS STEP MAY BE OMITTED.**
8. Replace the anchor clips and secure to both the slab and the tank bands.
9. Recheck all bolts.



Parts List For Tie-Down System

Tank O.D.	Gallons	No. & Size of Bands	No. Anchor Clips	No. 3/8" Ø X 5" Lg. Bolts W/Washers & Nuts	No 1/2" Ø X 1" Lg. Carriage Bolts W/Nuts
1' - 11"	55, 100	(2) 35"	2	2	2
2' - 7"	150, 200	(2) 48"	2	2	2
3' - 10"	300, 400	(4) 35"	4	4	4
4' - 0"	550, 800	(3) 48"	3	3	3
5' - 4"	525, 805, 1000, 1200, 1500	(4) 48"	4	4	4
6' - 5"	550 MR	(2) 65" & (2) 48" or (4) 58-5/8"	4	4	4
7' - 1" or 7' - 2"	1100, 1450, 2000 IMFO, 2500 IMFO, 3000 IMFO	(4) 65"	4	4	4
7' - 10" or 8' - 0"	2000, 2500, 3000, 4000, 5000, 1600 MR	(4) 72"	4	4	4
10' - 0"	3000 MR, 6400, 6400 IMFO, 6400 MR, 7000, 8500, 8500 MR	(2) 72" (2) 111"	6	4	6
11' - 11"	4200, 4300 IMFO, 6400, 6400 IMFO, 8000, 8000 IMFO, 10000, 10000 IMFO, 12000, 12000 IMFO	(4) 111"	8	4	8

NOTE: Poly Processing Company's Tie Down Restraint System is for lateral restraint only and has no seismic or wind load ratings. Special restraint systems with seismic and/or wind load requirements will be quoted on a case by case basis. For restraint systems with seismic and/or wind load requirements contact the factory.

XIII. HORIZONTAL TANK STANDS

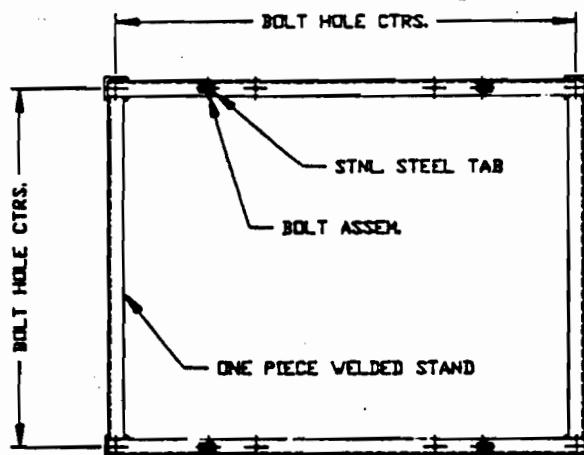
NOTE: HORIZONTAL TANK STANDS ARE DESIGNED TO BE ERECTED ON LEVEL CONCRETE (OR OTHER APPROVED SURFACES) SUPPORT PADS. WE STRONGLY RECOMMEND THAT TANK STANDS BE BOLTED TO THE SUPPORT PADS. (Please see the section marked "Foundations and Supports" on page 3.)

■ SMALL HORIZONTAL TANK STANDS

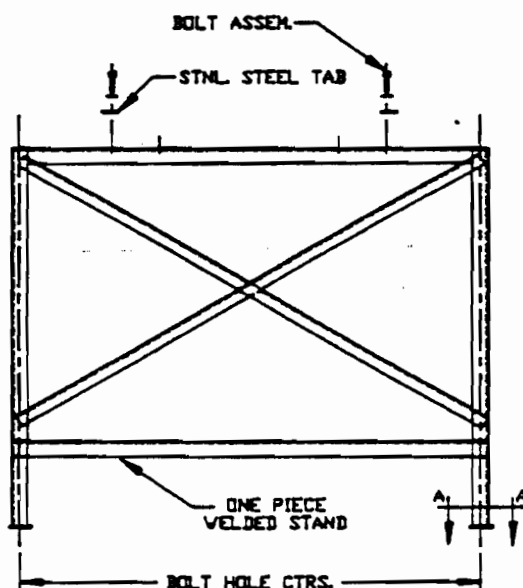
Stands for small horizontal tanks (tanks up to and including 500 gallons in capacity) are normally designed as one piece welded units. The stands are shrink wrapped for protection during shipping.

1. **CHECK TO ENSURE THAT ALL COMPONENTS HAVE BEEN RECEIVED.** The shrink wrapped package should contain:

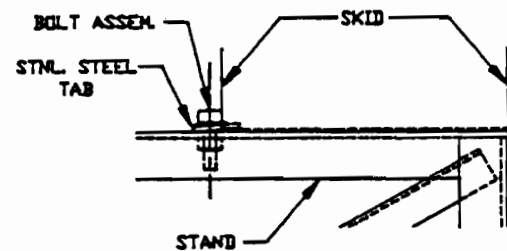
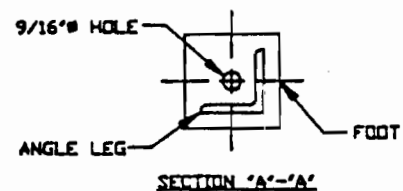
- (A.) Welded one piece stand
- (B.) Four (4) stainless steel tabs and four (4) bolt assemblies attached to the top of the stand.
A bolt assembly consists of (1) 1/2-13 bolt 2" long, (2) washers, (1) lock washer, and (1) 1/2-13 nut.



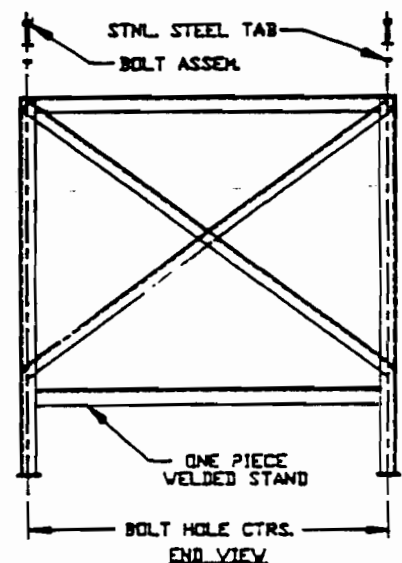
PLAN VIEW



SIDE VIEW



TANK & SKID ASSEMBLY ATTACHMENT DETAIL
SIDE VIEW



END VIEW

ILLUSTRATION
(FADVG/METAL/ASHSSTD)

Anchor Bolt Spacing For Small Horizontal Tank Stands

Tank Size	Distance Between Anchor Bolt Holes On Side View	Distance Between Anchor Bolt Holes On End View
150 gal.	58"	29-1/2"
200 gal. 32" dia.	58"	29-1/2"
200 gal. 38" dia.	36-1/2"	35-1/2"
300 gal.	58"	35-1/2"
400 gal.	58"	45-1/2"
500 gal.	58"	45-1/2"

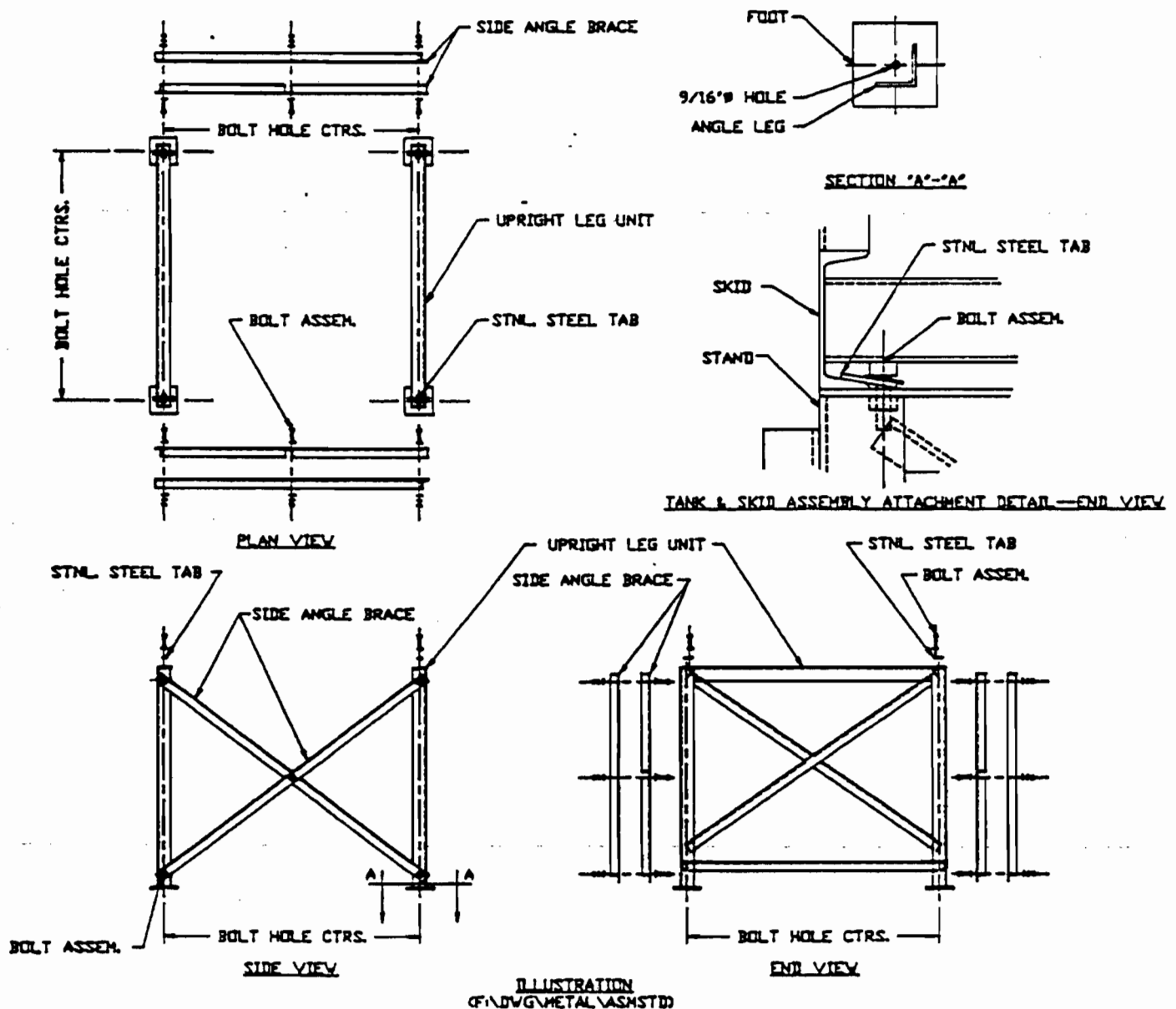
In addition to the above you will need:

- (1) Wrenches for tightening the bolt assemblies
 - (2) A forklift, crane or other suitable lifting device
 - (3) Anchor bolts -- (4) required each stand
 - (4) A wrench to fit the anchor bolts
 - (5) A tape measure
 - (6) A framing square
 - (7) A chalk line
2. **INSTALL THE STAND.** Carefully set the stand up in the location required ensuring that the foundation upon which the stand rests is level.
 3. **INSTALL THE ANCHOR BOLTS.** After the stand has been set up, measure the hole centers in the feet of the stand. 9/16" diameter holes have been provided in the feet of the stand. If larger holes are required they will need to be drilled out. Lay out the anchor bolts. Install the anchor bolts in the foundation. It may be necessary to move the stand to install the anchor bolts. It is extremely important that the bolts be laid out accurately and square. If the stand was moved to install the anchor bolts, lift the stand over the anchor bolts and settle into place. Attach the anchor bolt nuts and tighten.
 4. **PLACE THE TANK IN THE SKID ON THE STAND.** With a forklift, crane, or other lifting device, raise the tank and skid unit onto the stand being careful to not damage the skid or paint. You will note that there are four (4) holes located in the top of each stand. Center the tank and skid unit on the stand. NOTE: The formed flat bar bases of the tank skid will lie close to these holes but will not cover the holes. The holes will lie between the formed flat bar bases of the tank skid.
 5. **INSTALL THE STAINLESS STEEL TABS.** Stainless steel tabs are used to attach the skid to the stand. See "Attachment Detail--Side View" in the illustration on page 15. Place the hole of one of the stainless steel tabs over one of the holes in the top of the stand. Use one of the bolt assemblies to attach the tab to the stand. Place the long side of the tab over the formed flat bar base of the skid. Snug the nut onto the bolt--do not tighten at this time. Attach the remaining tabs to the stand in the same way placing the long side of the tab over the formed flat bar base of the skid. Tighten all the bolts attaching the skid to the stand.
 6. **HYDROTEST.** The factory recommends that all tanks be hydrotested before being placed into service.

■ LARGE HORIZONTAL TANK STANDS

Stands for large horizontal tanks (tanks over 500 gallons in capacity) are designed to be broken down for shipping to reduce freight costs. The components of the stand are packaged and shrink wrapped for protection during shipping.

1. **CHECK TO ENSURE THAT ALL COMPONENTS HAVE BEEN RECEIVED.** The shrink wrapped package should contain:
 - (A.) Upright leg units
 - (B.) Side angle braces
 - (C.) One (1) cloth bag containing stainless steel tabs and bolt assemblies. A bolt assembly consists of (1) 1/2-13 bolt 2" long, (2) washers, (1) lock washer, and (1) 1/2-13 nut.



Components For Large Horizontal Tank Stands

Tank Size	No. Upright Leg Units	No. Side Angle Braces	No. Of Bolt Assemblies	No. Of Tabs	Distance Between Anchor Bolt Holes In Upright Leg Units	Distance Between Upright Leg Units
750 gal.	2	4	14	4	46"	62"
1,000 gal.	2	4	14	4	54"	55"
1,025 gal.	3	8	22	6	45"	48-1/2"
1,625 gal.	3	8	22	6	54"	51-1/2"
2,000 gal.	3	8	22	6	54"	57"
2,500 gal.	4	12	30	8	54"	52" on ends 54" in ctr.

In addition to the above you will need:

- (1) Wrenches for tightening the bolt assemblies
 - (2) A forklift, crane or other suitable lifting device
 - (3) Anchor bolts -- (2) required each upright leg unit
 - (4) A wrench to fit the anchor bolts
 - (5) A tape measure
 - (6) A framing square
 - (7) A chalk line
2. **INSTALL THE UPRIGHT LEG UNITS.** Carefully stand up the upright leg units placing them so that the anchor bolt holes in the feet are on the proper grid. See chart above for grid.
 3. **INSTALL THE SIDE ANGLE BRACES.** Install the side angle braces between the upright leg units using the bolt assemblies provided. The side angle braces when properly installed form X's. The side angle braces will be notched out where necessary to allow the vertical leg to lie flat. Lay the side angle braces out on the ground before installing to determine which side angle brace fits next to the upright leg unit and which side angle brace fits on top of another side angle brace. For stands where there are more than two (2) upright leg units this is a very important step. On stands where there are more than three (3) upright leg units, bolt the angle brace "X" to the center upright leg units first. Bolt the side angle braces to the upright leg units and bolt the cross pieces together in the center of the "X".
 4. **INSTALL THE ANCHOR BOLTS.** After the stand has been completely assembled, measure the hole centers in the feet of the upright leg units. 9/16" diameter holes have been provided in the feet of the upright leg units. If larger holes are required they will need to be drilled out. Lay out the anchor bolts. Install the anchor bolts in the foundation. It may be necessary to move the stand to install the anchor bolts. It is extremely important that the bolts be laid out accurately and square. If the stand was moved to install the anchor bolts, lift the stand over the anchor bolts and settle into place. Attach the anchor bolt nuts and tighten.
 5. **PLACE THE TANK IN THE SKID ON THE STAND.** With a forklift, crane, or other lifting device, raise the tank and skid unit onto the stand being careful to not damage the skid or paint. You will note that there are two (2) holes located in the top of each upright leg unit of the stand. Center the tank and skid unit on the stand. The channel iron runners of the skid will be at right angles to the upright leg units. NOTE: the channel iron runners of the tank skid will lie close to these holes but will not cover the holes. The holes will lie inside the channel iron runners of the tank skid.
 6. **INSTALL THE STAINLESS STEEL TABS.** Stainless steel tabs are used to attach the skid to the stand. See "Attachment Detail--End View" in the illustration on page 17. Place the hole of one (1) of the stainless steel tabs over one of the holes in the top of the upright leg unit of the stand. Use one of the bolt assemblies to attach the tab to the stand. Place the long side of the tab over the flange of the channel iron runner of the skid. Snug the nut onto the bolt--do not tighten at this time. Attach the remaining tabs to the stand in the same way placing the long side of the tab over the flange of the channel iron runner of the skid. Tighten all the bolts attaching the skid to the stand.
 7. **HYDROTEST.** The factory recommends that all tanks be hydrotested before being placed into service.

XIV. OTHER ACCESSORIES

HEAT TRACING – There is a small booklet enclosed for trouble shooting Thermon Heat Tracing Systems. Please follow this booklet to resolve any start up problems you may encounter. If the problem persists please contact the factory for further help.

INSULATION – The 2" polyurethane insulation is relatively soft under the white mastic coating and can be dented. This is easily repaired with foam insulation in an aerosol can found in most hardware stores. If the unit has numerous dents upon receipt, please note this on the shipping papers with the driver and then contact the factory for further help.

AGITATOR BRACKETS – These are relatively simple to assemble and install. If you should encounter difficulties in assembly, contact the factory for further instruction. The clamp style has bands that attach around the tank in much the same manner as the bands used in the ladder and lateral restraint systems. Please refer to these within this manual. The free standing units require bolting to the foundation and follow the same procedure as noted in the ladder instructions in this manual.

SIDE MANWAYS – This item should be fully installed at the factory, however it is possible to have a very heavy item such as this leak upon arrival. Its installation and tightening of the bolts is very similar to the two flange fitting except for more bolts. Please refer to the section in the manual for two flange fittings to understand the tightening, bolt sequence and torque ratings for installation of the accessory.

SMALL TANK STANDS – These should not require any installation. You may wish to bolt the stand to the foundation on which it sits. This would follow the same directions given for bolting the feet of ladders to the foundation. Please refer to this section of instructions.

CUSTOM FABRICATED ACCESSORIES – Many times custom fabricated parts are used in "outfitting" a tank. While it would be impossible to include all types within this manual, we are available to field your questions and provide guidance with this type of installation. Please contact the factory to discuss this type of accessory.

XV. LIMITATIONS

TEMPERATURE LIMITATIONS – Tanks are designed for a maximum continuous temperature use of 100 degrees F. Continuous temperature above 100 degrees F reduces the design hoop stress, which will require a thicker wall for a given application. Consult factory for any continuous use above 100 degrees F.

CHEMICAL COMPATIBILITY – In all cases the chemical resistance of the assembly (tank, fittings, accessories and gaskets) must be confirmed by chemical resistance data. This should have been done before the tank is ordered, however the service of the tank can change and it is important to be sure the tank and assembly are compatible with the chemical. It should be noted that the effect of the storage of sulfuric acid, hydrochloric acid, and aqua ammonia darkens the tank over time and this is not an indication of weakness or failure of the tank. This change of color is simply a reaction of the reagent with the additives in the plastic (e.g., UV stabilizers, anti-oxidants, etc.).

FITTINGS AND VENTS – Tank fittings are installed and sealed at the factory per your specifications. Temperature variations, road vibrations and other factors may influence these fittings, requiring minor adjustments before use. All bolted fittings should have the outer nuts checked before the tank is hydrotested or put into service. Non-bolted fittings have at least one outer nut which should be checked as well. **REMEMBER – PLASTIC FITTINGS CANNOT BE TIGHTENED LIKE STEEL.** Review that portion of the manual related to the particular fitting involved for complete instructions for installation.

The biggest trouble spot with tank fittings is improper plumbing. All piping and valves must be supported. All plumbing lines need a flexible connection in the line to allow the tank to "flex". Rotationally-molded tanks expand and contract as they are filled and emptied. They actually get their "toughness" from this ability to flex. **RIGID PIPING SHOULD NOT BE USED.** Be sure that all vents, pressure relief devices, vacuum relief devices, fill assemblies, and other connecting accessories are clear of any obstruction before attempting to use.

XVI. LIMITED WARRANTY & LIABILITY

STANDARD PRODUCTS

Poly Processing Company (SELLER) warrants all standard products manufactured and furnished by it to be free of defects in the material and workmanship for a period of TWO YEARS from the date of shipment from SELLER'S factory AND FURTHER warrants all such standard products for an additional four years on a prorated basis. Warranty periods for Linear Products, UL Listed tanks, Custom Products and tanks in sodium hypochlorite service differ from the warranty periods described herein. Please consult with SELLER for particulars. SELLER warrants all parts, fittings, and accessories manufactured by SELLER to be free from defects in material and workmanship for a period of ONE YEAR from date of shipment from SELLER'S factory. **THESE WARRANTIES ARE SUBJECT TO THE FOLLOWING TERMS, CONDITIONS, LIMITATIONS AND EXCLUSIONS:**

1. SELLER'S obligation under the warranty as described herein shall be enforceable only if BUYER installs, uses and maintains SELLER'S products, parts and accessories in accordance with the following:
 - (a) the manual titled "General Chemical Resistance Chart" and the manual "Tank Installation, Use and Maintenance" furnished by SELLER; and
 - (b) generally accepted operating practices within the applicable and appropriate industry.
2. SELLER'S obligation under the warranty as described herein shall not apply to any products, parts, fittings, and accessories which
 - (a) have been repaired or altered outside of SELLER'S factory unless by a SELLER'S factory repair person or authorized warranty Service Stations; or
 - (b) have been subjected to misuse, negligence, fire, accident, act of War or act of God.
3. SELLER'S obligation under the warranty as described herein shall not be enforceable unless and until BUYER has paid for all such product, parts, fittings and accessories in full.
4. SELLER'S obligation under the warranty as described herein shall not be enforceable where BUYER'S use of SELLER'S product is in violation of federal, state or local laws or regulations.
5. **EXCLUSIONS OF WARRANTIES AND LIMITATION OF BUYER'S REMEDIES:** BUYER and SELLER hereby expressly agree that BUYER'S sole and exclusive remedy against SELLER shall be for the repair or, at the SELLER'S option, replacement of any product, part, fitting or accessory that upon SELLER'S examination is found to SELLER'S satisfaction to have been defective when shipped from SELLER'S factory, and only then if:
 - (a) BUYER notifies SELLER in writing of the defects and SELLER receives such notification within the warranty period; and
 - (b) BUYER, within thirty (30) days of such notification, either at SELLER'S option:
 - (i) tenders such product, part, fitting or accessory to SELLER for inspection; or
 - (ii) properly disposes of such product, part, fitting or accessory in accordance with all applicable federal, state and local laws and regulations. BUYER expressly agrees that no other remedy (including but not limited to incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available to BUYER. **THE WARRANTY DESCRIBED IN THIS PARAGRAPH SHALL BE IN LIEU OF ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE.**
6. **STANDARD PRODUCTS PRORATED WARRANTY:** BUYER shall be responsible for paying a percentage of the replacement tank purchase price for any tank replaced under the prorated portion of the warranty. That percentage shall be calculated as follows:

First Two Years	Full Warranty
Third Year	BUYER pays 42.8% of Original Purchase Price
Fourth Year	BUYER pays 57.1% of Original Purchase Price
Fifth Year	BUYER pays 71.4% of Original Purchase Price
Sixth Year	BUYER pays 85.7% of Original Purchase Price
7. **MERGER CLAUSE:** THE WARRANTY DESCRIBED HEREIN IS THE SELLER'S SOLE WARRANTY. SELLER'S sales representative may have made oral statements about the product, parts, fittings or accessories. Such statements do not constitute warranties, shall not be relied on by BUYER, and are not part of the contract for sale. The entire warranty is embodied in this writing. This writing constitutes the final expression of SELLER'S warranty, and it is a complete and exclusive statement of the terms of that warranty. SELLER'S warranty and liability as stated herein cannot be altered or enlarged except by a writing signed by an officer of SELLER.

Building 820 POL Site Equipment Data



**OHM Remediation
Services Corp.**
A Subsidiary of OHM Corporation

Component Group: Vapor Extraction Unit

Equipment Data

Component Name Sutorbilt Series 6000 Blower
Manufacturer Gardner Denver
Model Number GFJGEBA
Serial Number U88449
Description 2304 SCFM Blower

OEM Vendor Data

Original Vendor REP Inc.
Spare Part Vendor Gardner Denver Machinery Inc.
Service/Maintenance Vendor REP Inc.

Notes



2405 Murphy Blvd.
Gainesville, GA 30504
Telephone: 770-538-0020
Facsimile: 770-538-0022
Toll Free: 800-536-9933

PERFORMANCE DATA SHEET

Project 970525 Site UST 820

BLOWER PACKAGE: V4GFJGP1BNST1
DRIVE ASSEMBLY: DK132EW187ES112

BLOWER PERFORMANCE	
GAS	AIR
INLET VOLUME	3600 ACFM
INLET VOLUME	2304 SCFM
ELEVATION	0 FT
BAROMETRIC PRESSURE	29.92 INHGA
RELATIVE HUMIDITY	100 %RH
INLET PRESSURE	10.44 IN HGG
INLET TEMPERATURE	70 °F
DISCHARGE PRESSURE	14.88 PSIA
DISCHARGE TEMPERATURE	173 °F
DIFFERENTIAL PRESSURE	10.81 INHG
BLOWER BRAKE HORSEPOWER	105.5 HP
BLOWER SPEED	1272 RPM

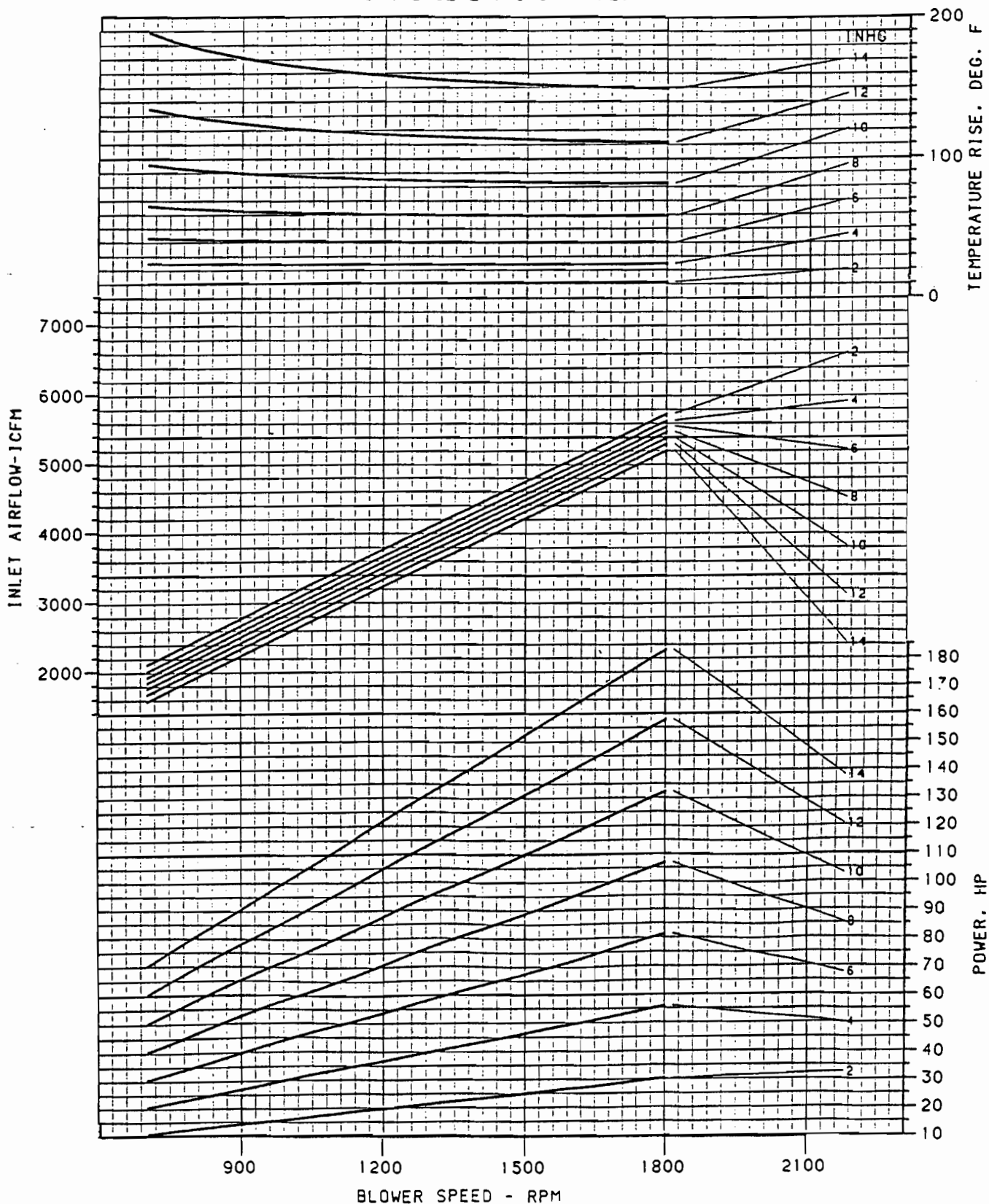
MOTOR DATA	
HORSEPOWER	125 HP
SYNC SPEED/ACTUAL	1800/1780 RPM
VOLTAGE	460 V
FREQUENCY	60 HERTZ
POWER SUPPLY PHASE	3 PH
ENCLOSURE TYPE	X-P, CLASS 1 DIV 2, GRP D
NEMA FRAME SIZE	444T
EFFICIENCY	93.6% NOMINAL

server-d:\Project Files\970525\Site UST820 Perf Data

SUTORBILT®

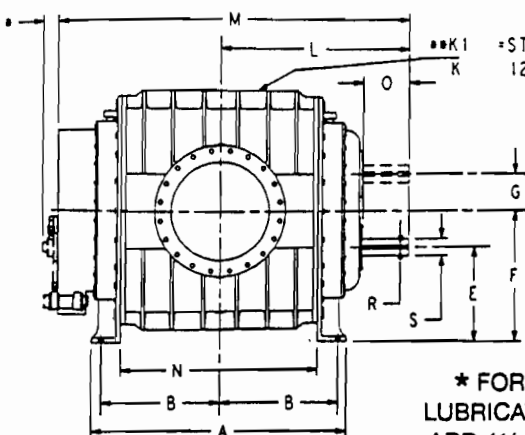
SERIES 6000 MODEL 1024

VACUUM PERFORMANCE CURVE
INLET AIR AT 68 DEG F. SPECIFIC GRAVITY=1.0. DISCHARGE AT 29.92 IN HG ABS
DISPLACEMENT 3.3 FT³/REV

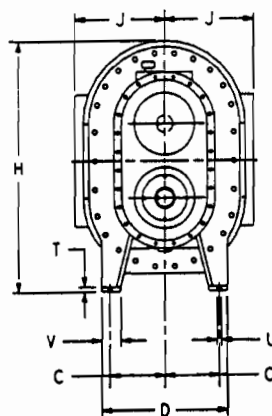


Series 5000/6000

Dimensions - Vertical



• K1 = STANDARD PIPE FLANGE
125 LB. DRILLING

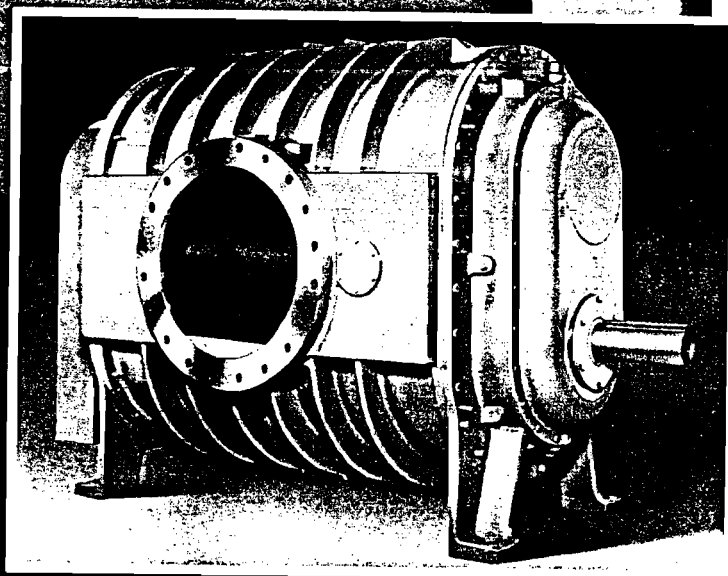


* FOR UNITS WITH FORCE FEED
LUBRICATION SYSTEM AND COOLER,
ADD 4 1/2 INCHES TO "M" DIMENSION
* * K₁ DIM'S FOR 6000 SERIES ONLY.

BLOWER SIZE	A	B	C	D	E	F	G	H	J	K	K ₁	L	M	N	O	R	S	T	U	V
1008	16 3/4	7	7 1/2	18	14	19	5	34 3/4	17 3/4	6	8	19 3/4	35 3/4	8	7 7/8	1/2	2.250	1	7/8	4 1/4
1011	19 3/4	8 1/2	7 1/2	18	14	19	5	34 3/4	17 3/4	8	8	20 7/8	38 3/4	11	7 7/8	1/2	2.250	1	7/8	4 1/4
1013	22	9 3/4	7 1/2	18	14	19	5	34 3/4	17 3/4	8	10	22	40 7/8	13 1/4	7 7/8	1/2	2.250	1	7/8	4 1/4
1016	24 3/4	11	7 1/2	18	14	19	5	34 3/4	12	10	10	23 3/4	43 3/4	16	7 7/8	1/2	2.250	1	7/8	4 1/4
1018	26 3/4	12	7 1/2	18	14	19	5	34 3/4	12	10	10	24 3/4	45 3/4	18	7 7/8	1/2	2.250	1	7/8	4 1/4
4021	29 3/4	13 1/4	7 1/2	18	14	19	5	34 3/4	12	10	12	26 3/4	48 3/4	24	7 7/8	1/2	2.250	1	7/8	4 1/4
1024	32 3/4	15	7 1/2	18	14	19	5	35 1/4	14	12	14	27 3/4	51 3/4	24	7 7/8	1/2	2.250	1	7/8	4 1/4
4030	38 3/4	18	7 1/2	18	14	19	5	35 1/4	14	12	14	30 3/4	57 3/4	30	7 7/8	1/2	2.250	1	7/8	4 1/4
1213	22 1/2	9 1/2	9	22	16 1/2	22 1/2	6	40 3/4	19 3/4	10	10	24	45	13	8 7/8	5/8	2.625	1 1/4	7/8	6 1/2
1216	25 1/2	11 1/2	9	22	16 1/2	22 1/2	6	40 3/4	19 3/4	10	10	25 1/2	48	16	8 7/8	5/8	2.625	1 1/4	7/8	6 1/2
1218	28 1/2	12 1/4	9	22	16 1/2	22 1/2	6	41 3/4	16	12	12	26 3/4	50 3/4	18 1/2	8 7/8	5/8	2.625	1 1/4	7/8	6 1/2
1220	29 1/2	13	9	22	16 1/2	22 1/2	6	41 3/4	16	12	12	27 1/2	52	20	8 7/8	5/8	2.625	1 1/4	7/8	6 1/2
1223	32 1/2	14 1/2	9	22	16 1/2	22 1/2	6	41 3/4	16	14	14	29 1/2	55	23	8 7/8	5/8	2.625	1 1/4	7/8	6 1/2
1226	35 1/2	16	9	22	16 1/2	22 1/2	6	41 3/4	16	14	14	30 1/2	58	26	8 7/8	5/8	2.625	1 1/4	7/8	6 1/2
1230	39 1/2	18	9	22	16 1/2	22 1/2	6	41 3/4	16	16	16	32 1/2	62	30	8 7/8	5/8	2.625	1 1/4	7/8	6 1/2
1236	45 1/2	21 1/4	9	22	16 1/2	22 1/2	6	41 3/4	16	16	16	35 1/2	68	36	8 7/8	5/8	2.625	1 1/4	7/8	6 1/2
1415	25 1/2	11 1/2	11	26	19	26	7	47 1/4	21 3/4	10	12	26 1/4	48 1/4	15	9 7/8	3/4	3.125	1 1/8	7/8	4 3/8
1419	29 1/2	13 1/2	11	26	19	26	7	47 1/4	21 3/4	12	12	28 1/4	52 1/4	19	9 7/8	3/4	3.125	1 1/8	7/8	4 3/8
1421	31 1/2	14 1/2	11	26	19	26	7	48 1/2	18	14	14	29 3/4	54 1/4	21	9 7/8	3/4	3.125	1 1/8	7/8	4 3/8
1423	33 1/2	15 1/2	11	26	19	26	7	48 1/2	18	14	14	30 3/4	56 1/4	23	9 7/8	3/4	3.125	1 1/8	7/8	4 3/8
1426	36 1/2	17	11	26	19	26	7	48 1/2	18	14	14	31 3/4	59 1/4	26	9 7/8	3/4	3.125	1 1/8	7/8	4 3/8
1431	41 1/2	19 1/2	11	26	19	26	7	48 1/2	18	18	18	34 1/4	64 1/4	31	9 7/8	3/4	3.125	1 1/8	7/8	4 3/8
1437	47 1/2	22 1/2	11	26	19	26	7	48 1/2	18	18	18	37 1/4	70 1/4	37	9 7/8	3/4	3.125	1 1/8	7/8	4 3/8
1442	52 1/2	25	11	26	19	26	7	48 1/2	18	18	18	39 3/4	75 1/4	42	9 7/8	3/4	3.125	1 1/8	7/8	4 3/8
1619	28 1/2	12 1/2	13	31	22	30	8	54 1/4	24 1/4	12	12	28 7/8	51 3/4	17	10 3/8	7/8	3.625	1 1/8	1 1/4	5 1/2
1623	34 1/2	15 1/2	13	31	22	30	8	54 1/4	24 1/4	14	14	31 7/8	57 3/4	23	10 3/8	7/8	3.625	1 1/8	1 1/4	5 1/2
1626	37 1/2	17 1/2	13	31	22	30	8	55 1/4	20	16	16	33 3/4	60 3/4	26	10 3/8	7/8	3.625	1 1/8	1 1/4	5 1/2
1630	41 1/2	19 1/2	13	31	22	30	8	55 1/4	20	16	16	35 3/4	64 3/4	30	10 3/8	7/8	3.625	1 1/8	1 1/4	5 1/2
1636	47 1/2	22 1/2	13	31	22	30	8	55 1/4	20	18 1/2	20	38 3/4	70 3/4	36	10 3/8	7/8	3.625	1 1/8	1 1/4	5 1/2
1640	51 1/2	24 1/2	13	31	22	30	8	55 1/4	20	18 1/2	20	40 3/4	74 3/4	40	10 3/8	7/8	3.625	1 1/8	1 1/4	5 1/2
1643	54 1/2	25 1/2	13	31	22	30	8	55 1/4	20	20	24	41 7/8	77 3/4	43	10 3/8	7/8	3.625	1 1/8	1 1/4	5 1/2
1648	59 1/2	28 3/4	13	31	22	30	8	55 1/4	20	20	24	44 3/4	82 3/4	48	10 3/8	7/8	3.625	1 1/8	1 1/4	5 1/2
1818	32	14	13 1/2	31	23 1/8	32 1/8	9	59 3/4	26	14	14	31	55 3/4	18	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
1821	35	15 1/2	13 1/2	31	23 1/8	32 1/8	9	59 3/4	26	14	14	32 1/2	58 3/4	21	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
1824	38	17	13 1/2	31	23 1/8	32 1/8	9	59 3/4	26	16	16	34	61 3/4	24	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
1830	44	20	13 1/2	31	23 1/8	32 1/8	9	61 1/4	22	18	20	37	67 3/4	30	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
1833	47 1/2	21 3/4	13 1/2	31	23 1/8	32 1/8	9	61 1/4	22	18	20	38 3/4	70 3/4	33 1/2	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
1842	56	26	13 1/2	31	23 1/8	32 1/8	9	61 1/4	22	18	24	43	79 3/4	42	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
1845	59	27 1/2	13 1/2	31	23 1/8	32 1/8	9	61 1/4	22	18	24	44 1/2	82 3/4	45	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
1848	62	29	13 1/2	31	23 1/8	32 1/8	9	61 1/4	22	24	24	46	85 3/4	48	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
1854	68	32	13 1/2	31	23 1/8	32 1/8	9	61 1/4	22	24	24	49	91 3/4	54	11 3/8	1	4.250	1 1/4	1 1/8	4 3/8
2020	34	15 1/2	15	34	25	35	10	64 1/2	29 1/2	16	16	34	60 1/4	20	12 3/4	1	4.625	1 1/4	1 1/4	5 3/4
2024	38	17 1/2	15	34	25	35	10	64 1/2	29 1/2	16	16	36	64 1/4	24	12 3/4	1	4.625	1 1/4	1 1/4	5 3/4
2031	45	20 1/2	15	34	25	35	10	65 1/2	24	20	24	39 1/2	71 1/4	31	12 3/4	1	4.625	1 1/4	1 1/4	5 3/4
2037	51 1/2	23 3/4	15	34	25	35	10	65 1/2	24	20	24	42 3/4	77 3/4	37 1/2	12 3/4	1	4.625	1 1/4	1 1/4	5 3/4
2040	54	25 3/4	15	34	25	35	10	65 1/2	24	20	24	44	80 1/4	40	12 3/4	1	4.625	1 1/4	1 1/4	5 3/4
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2060	74	35	15	34	25	35	10	65 1/2	24	24	30	54	100 1/4	60	12 3/4	1	4.625	1 1/4	1 1/4	5 3/4
2224	39	17	17	40	28	39	11	71	31	18	18	38	67	24	14 3/8	1 1/4	5.000	1 1/2	1 1/2	9
2231	46 1/2	20 3/4	17	40	28	39	11	73	27	24	24	41 3/4	74 1/2	31 1/2	14 3/8	1 1/4	5.000	1 1/2	1 1/2	9
2236	51	23	17	40	28	39	11	73	27	24	24	44	79	36	14 3/8	1 1/4	5.000	1 1/2	1 1/2	9
2242	57	26	17	40	28	39	11	73	27	24	24	47	85	42	14 3/8	1 1/4	5.000	1 1/2	1 1/2	9
2248	63	29	17	40	28	39	11	73	27	24	24	50	91	48	14 3/8	1 1/4	5.000	1 1/2	1 1/2	9
2254	69	32	17	40	28	39	11	73	27	30	30	53	97	54	14 3/8	1 1/4	5.000	1 1/2	1 1/2	9
2260	75	35	17	40	28	39	11	73	27	30	30	56	103	60	14 3/8	1 1/4	5.000	1 1/2	1 1/2	9
2266	81	38	17	40	28	39	11	73	27	30	30	59	109	66	14 3/8	1 1/4	5.000	1 1/2	1 1/2	9

Sutorbilt

Series 5000/6000



**Rotary Positive Displacement Blowers,
Gas Pumps and Vacuum Pumps**

Sutorbilt Series 5000/6000 Vital Power for Crucial Jobs.

Take advantage of all our advantages. In the face of varying pressures and vacuums, there's one constant — Sutorbilt blowers and gas pumps. That's because there's no guesswork about the quantity of delivered air or gas from a Sutorbilt blower. With each revolution, a Sutorbilt blower delivers a metered amount of air measured at inlet conditions. At a constant speed, and against constant pressure, the blower delivers a constant amount of air. Likewise, increasing the blower speed against a constant pressure or vacuum increases the volume by an amount equal to the displacement of the blower times the increased number of revolutions.

What Makes a Blower a Sutorbilt?

Experienced people. A modern plant. The latest tooling and equipment. Production controlled by close inspection, rigid testing and attention to the smallest detail. Reliable field service provided by factory-trained personnel. Strategically located distributors and

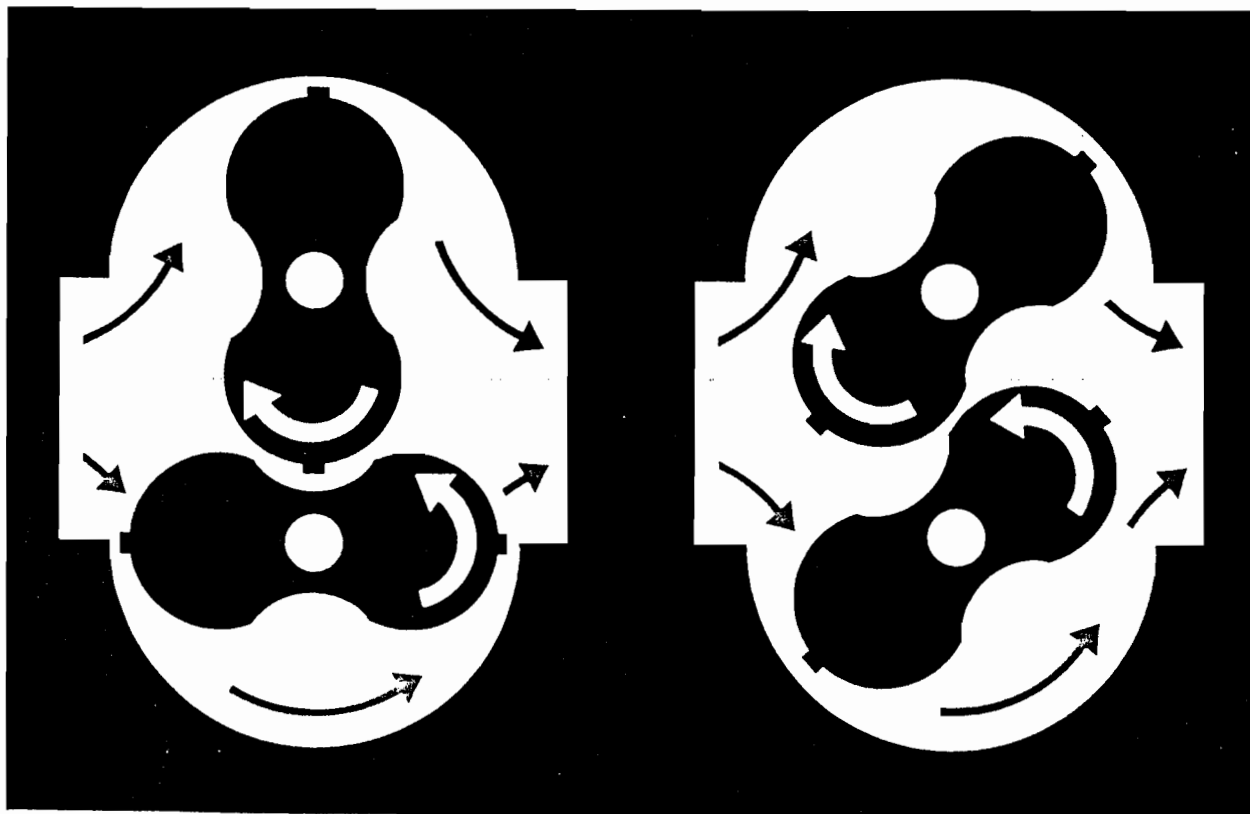
factory-authorized service centers that carry a full complement of spare parts. Plus an outstanding warranty. All of these features make a blower a Sutorbilt.

The Sutorbilt at Work.

The Sutorbilt design has two figure-eight impellers rotating in opposite directions. As each lobe passes the blower inlet, it traps air equal to one-fourth of the blower's displacement. This process happens four times per revolution, moving the trapped air around the case to the blower outlet, and increasing its velocity. Timing gears accurately position the impellers in relation to each other, maintaining the blower's high volumetric efficiency.

Sutorbilt Means Advanced Design and Engineering, Structural Integrity, High Quality and Proven Performance.

With Sutorbilt Series 5000/6000 blowers, you get quality materials, tested performance and easy maintenance combined in each



heavy-duty blower. And you get a blower ideally suited for any air-or gas-moving application — industrial, mobile or municipal. No wonder Sutorbilt is the preferred choice of the OEM.

To simplify design and installation requirements, all Series 5000 and 6000 blowers and gas pumps come in **both horizontal and vertical designs**. Vertical units are available with top- or bottom-hand drive, right or left discharge. Horizontal units are available with right- or left-hand drive, top or bottom discharge. Application data, construction and dimensions are identical.

Flexibility.

Sutorbilt Series 5000/6000 blowers come in a complete range of sizes and types to meet your needs, from 946-32,863 CFM.

High Efficiency, Low Friction.

Sutorbilt blowers are built to precision tolerances by skilled craftsmen. And because our blowers require no internal lubrication or seal, volumetric efficiency is a direct function of the quality castings, accurate machining

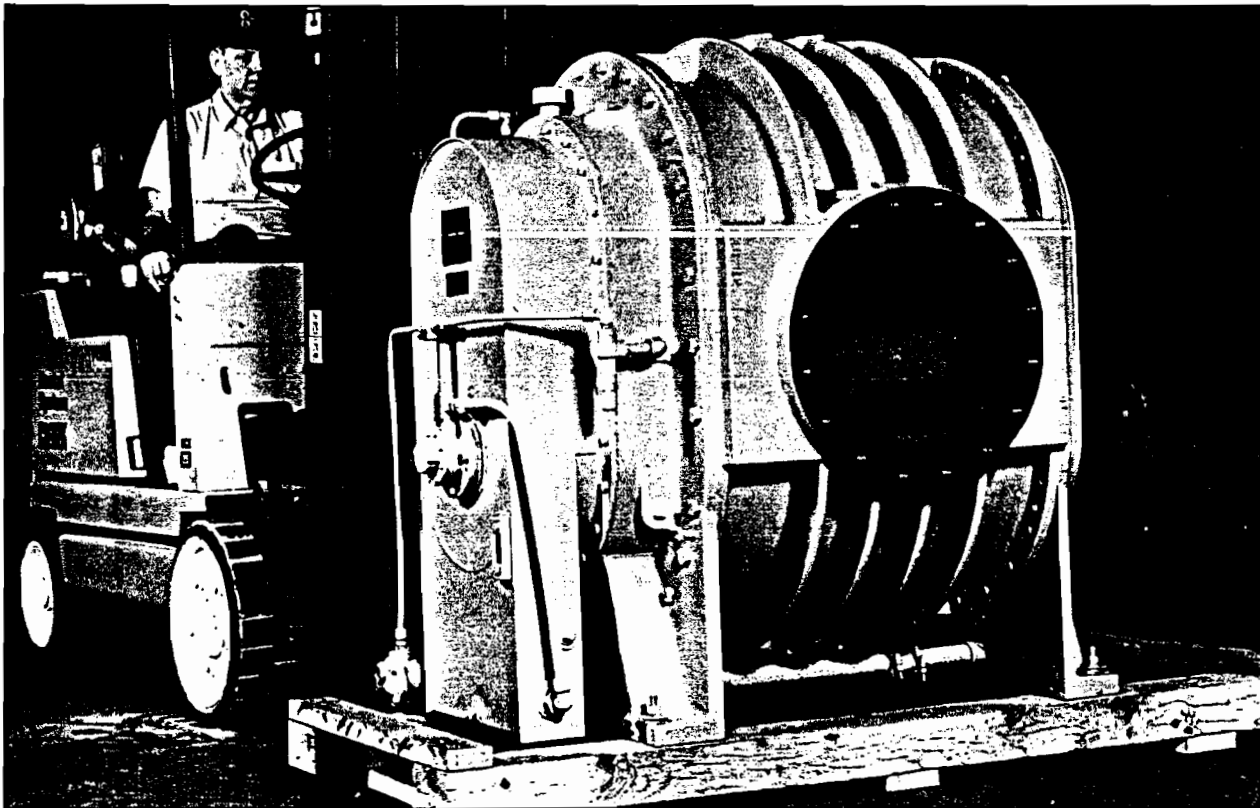
and expert assembly methods we employ. The only mechanical friction encountered is in the timing gears and bearings. And that is minimized by anti-friction bearings and wide-faced, precision helical or spur timing gears.

Oil-Free Air.

Because the Sutorbilt design has no metal-to-metal contact within the impeller case, internal lubrication is unnecessary. That allows gas or air to be delivered free of contaminating lubricants.

The Right Horsepower For Any Job.

The Sutorbilt design automatically adjusts to any application pressure, without sacrificing any horsepower due to overestimated pressure needs. And you don't have to port a Sutorbilt for a specific pressure. It adapts immediately to changes in operating conditions, avoiding the generation of unnecessarily high pressures, and the high costs that go with it.



Sutorbilt Provides The Standard Features You Expect.

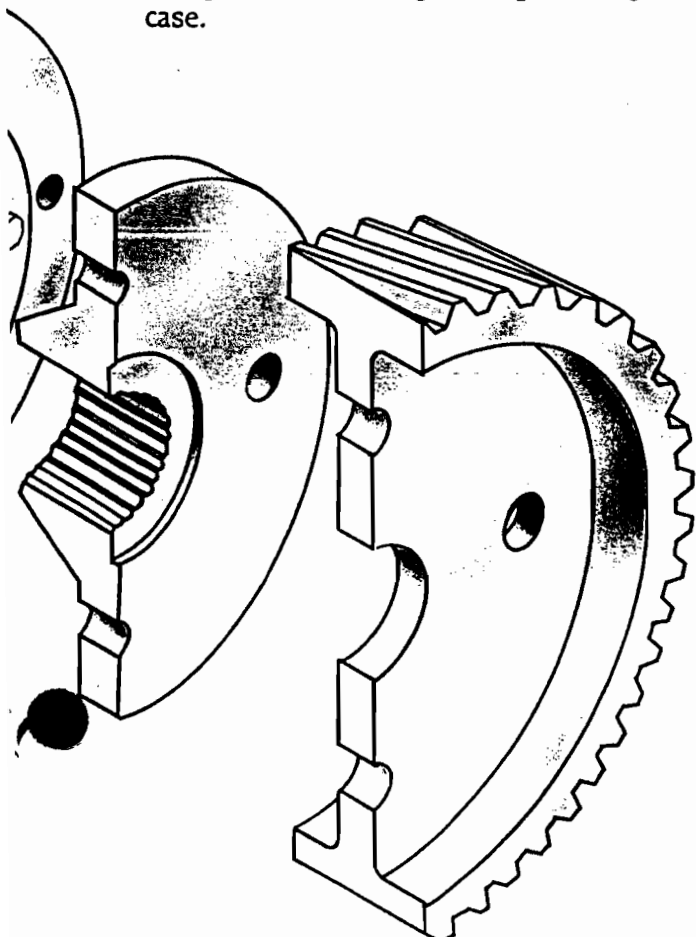
Sutorbilt Series 5000/6000 models are packed with high-performance features to deliver more work, for more years:

High-tensile, cast-iron headplates keep all internals perfectly aligned.
Generous seal vent areas assure better sealing and longer life.
Large machined footpads offer excellent, permanent mounting surfaces.
New one-piece case assures greater rigidity under pressure or vacuum.
Viton lip seals provide longer life and positive sealing at any temperature.

■ **One-piece chrome alloy steel shafts** are slip-fit through the impeller and **flanged to the gear end**. The advanced design allows a larger diameter in the critical area between impeller and gears, to greatly reduce torsional deflection while increasing pressure ratings and efficiencies. At the same time, the design permits higher working loads for V-belt drive without additional bearings.

■ **Dynamically balanced impellers** mean smooth running and lower bearing loads. Series 5000 impellers are high-density cast-iron; Series 6000 impellers are ductile-iron for higher rotating speeds.

- **Heat-treated, alloy-steel timing gears** are cut and shaved on precision machines for greater capacity, lower horsepower and quieter operation. Gears are attached to timing hubs by a set of high tensile strength bolts. Timing gears in 10" through 14" are of helical design, 16" through 22" gears are of straight spur design.
- **Timing hubs are accurately positioned** by splines on the drive shaft. This positive drive arrangement simplifies timing and contributes to the serviceability of the unit once placed into operation.
- **Heavy-duty, double-row, spherical roller bearings** are specified to handle maximum loading. Bearings are held in machined bearing cartridges which permit easy field maintenance. Gear end bearings are fixed axially against shaft shoulder to control thrust loads and maintain end clearances.
- **Efficient lubrication.** Basic Series 5000 and 6000 units provide splash lubrication of all bearings and timing gears. An optional pressure lubrication system with oil cooler is available with a unidirectional, shaft-mounted pump that delivers oil to bearings and gears from a single sump in the gear case.



- **Energy-saving ports.** Selected sizes in Series 6000 are available with larger inlet and discharge ports for greater air flow and optimum air velocity.

Performance Capabilities:

Series 5000

- Pressures to 15 PSIG
- Vacuums to 15" Hg
- Flows to 24,303 CFM

Series 6000

- Pressures to 15 PSIG
- Vacuums to 15" Hg
- Flows to 32,863 CFM

(See enclosed Performance Data Sheet SB-4-235 for complete performance tables.)

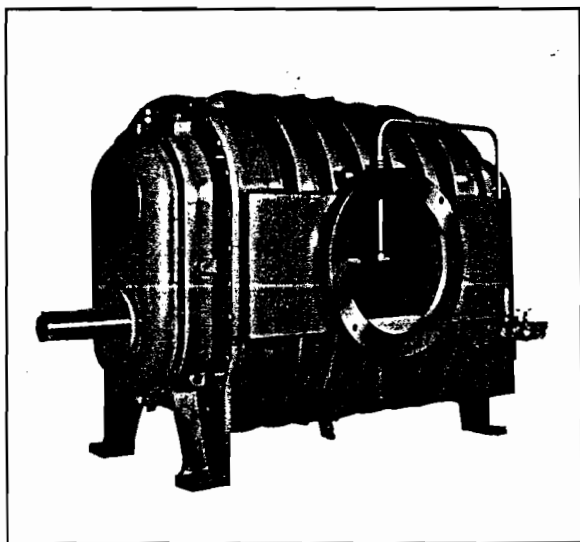
New Optional Mechanical Seals Prevent Gas Leakage.

Sutorbilt Series 5000 and 6000 MS units are identical to our other blowers except for the air seals.

Mechanical seals put a stop to gas leakage. This special Sutorbilt Series 5000/6000 option assures containment of the transmitted gas and is recommended for all gas-handling service, pressure or vacuum. Unlike competitive units, MS models are available with either **splash lubrication** or **optional pressure lubrication system**, with or without oil cooler.

Wet Vacuum Models for Single- and Two-Stage Applications.

Wet vacuum pumps are available for single or two stage applications in both the Series 5000 and Series 6000. The wet vacuum pumps deliver vacuum to 22" Hg single-stage and 27" Hg two-stage. Flow capacities are in excess of 30,000 CFM.



Sutorbilt wet vacuum pumps are designed to produce maximum performance from minimal quantities of seal water (4 to 12 GPM). Seal water is metered into the pump inlet and dispersed across the impeller by strategically-placed spray nozzles. The vapor/water spray is then discharged with the air or gas. In addition to increasing volumetric efficiency, the seal water also removes much of the heat of compression, resulting in lower power requirements and longer life.

The wet vacuum pumps incorporate all the features described on the previous pages. In addition, they offer these benefits:

- Specifically-designed rotor profiles produce high displacements and low slip characteristics, require less horsepower and are tolerant of non-compressible fluids used for sealing.
- An integral water injection system composed of spray nozzle, seal water flow-meter, flow control valve, solenoid-operated case drain valve (vertical units), seal water indicating flow switch, intake port drain valve (as required), and inter-connecting piping.

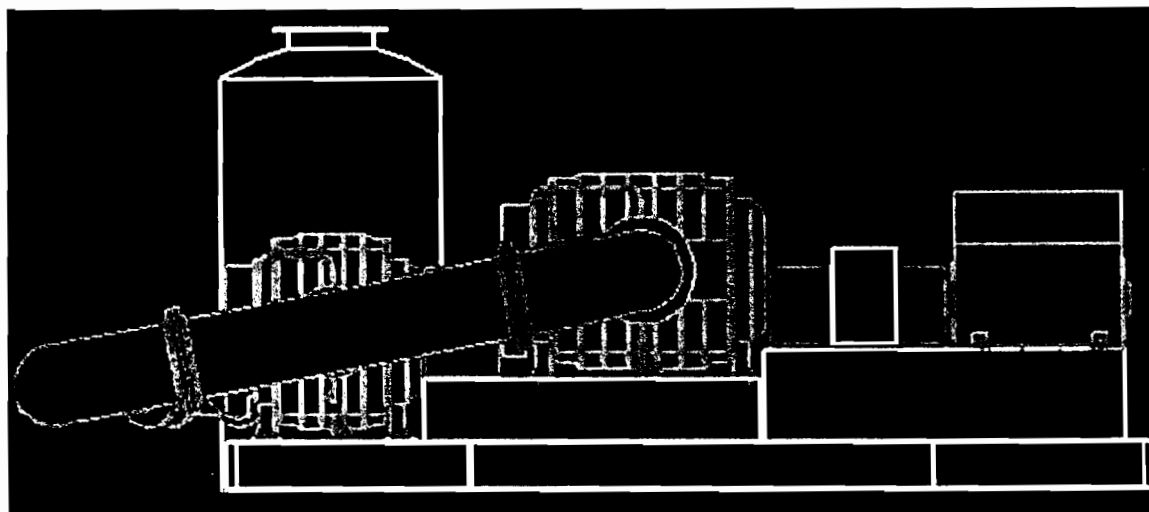
The Sutorbilt Advantage.

With a multitude of sizes available, Sutorbilt can custom engineer a system to match your requirements.

Vacuum pump selection and engineering are handled with sophisticated computer and CAD systems, by staff engineers with exten-

sive experience in compressed air and vacuum technology.

Bare units or skidded packages are available. The factory-assembled package includes — but is not limited to — base, motor, drive, inter-stage piping, instrumentation and separator/silencer.



CAD drawing of a typical two-stage wet vacuum train.

(See enclosed Performance Data Sheet SB-4-238 for complete wet vacuum performance data.)

A Sutorbilt Series 5000/6000 Comes With All These Valuable Extras.

Inventory Support

When you need parts fast, you'll get them fast. Our Master Distribution Center uses state-of-the-art order entry and material-handling systems to ensure you get the parts you need, when you need them.

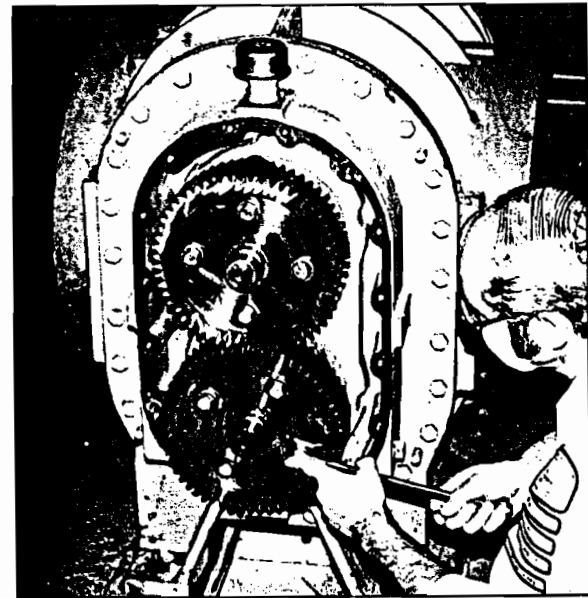
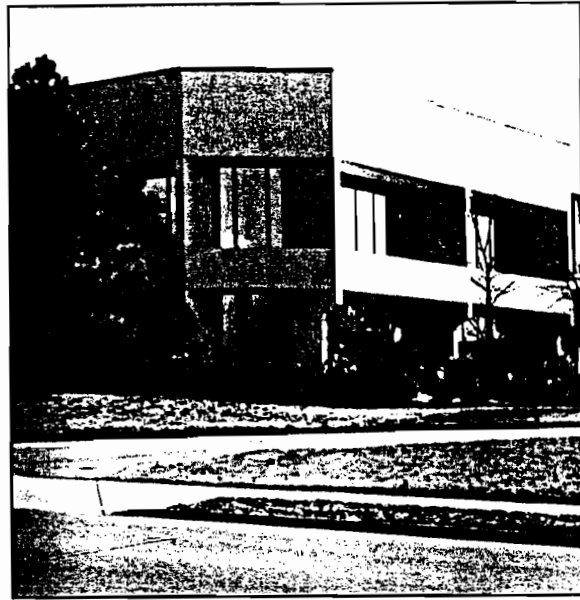
Service Commitment

Sutorbilt backs you with an international organization of factory-trained service personnel at your disposal — around-the-clock and around the world. Whether you need routine or emergency repairs, they're there to keep your equipment running at maximum efficiency.

Plus, Sutorbilt has an international network of distributors and factory-authorized service centers strategically located around the globe, providing everything from routine overhauls to major component replacements.

Warranty

Sutorbilt Series 5000/6000 blowers carry one of the industry's most complete warranties — 12 months from the date of initial use, or 18 months from the date of shipment to the first purchaser, whichever comes first. And, if your blower ever has to be repaired at one of our factory authorized service centers, that repair work is backed by our factory warranty. You simply can't beat the combination of a Sutorbilt Series 5000/6000 blower and a Sutorbilt warranty.



Contact Your Local Sutorbilt Representative

**There's a Sutorbilt Blower
For Every Need — Write
or Call Your Distributor
for Information on These
Other Models.**

Series 5000/6000

Gardner Denver

Bulletin SB-4-230 1st Edition
9/95 5M

Printed in U.S.A.

For additional information contact your local representative or
Gardner Denver Machinery Inc., Customer Service Department,
1800 Gardner Expressway, Quincy, Illinois 62301
Telephone: (800) 682-9868 FAX: (217) 224-7814



Sales and Service in all major cities.

For parts information, contact Gardner Denver,
Master Distribution Center, Memphis, TN
Telephone: (800) 245-4946 FAX: (901) 542-6159

Specifications subject to change without notice.
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GARDNER DENVER®

SB-7-624
1st Edition
December, 1996
Replaces SB-7-620

Sutorbilt™
BLOWERS

5000/6000 SERIES

10" – 22" GEAR DIAMETER

**OPERATING AND
SERVICE MANUAL**

**Gardner
Denver**

**MAINTAIN BLOWER RELIABILITY AND PERFORMANCE
WITH GENUINE GARDNER DENVER MACHINERY INC.
PARTS AND SUPPORT SERVICES**

Factory genuine parts, engineered to original tolerances, are designed for optimum dependability — specifically for your blower. Design and material innovations are born from years of experience with hundreds of different blower applications. When you specify factory genuine parts you are assured of receiving parts that incorporate the most current design advancements ... manufactured in our state-of-the-art blower factory under exacting quality standards.

Your **AUTHORIZED DISTRIBUTOR** offers all the backup you require. A worldwide network of authorized distributors provides the finest product support in the blower industry.

Your local **AUTHORIZED DISTRIBUTOR** maintains a large inventory of genuine parts and is also backed by direct access to our Master Distribution Center (MDC)

in Memphis, Tennessee, for immediate emergency response.

Your **AUTHORIZED DISTRIBUTOR** can support your blower investment with these services:

1. Trained parts technical representatives to assist you in selecting the correct replacement parts.
2. Complete inventory of new machines and new, genuine factory parts.
3. A full line of factory tested AEON™ PD blower lubricants specifically formulated for optimum performance in all blowers.
4. Authorized Distributor service technicians are factory-trained and skilled in blower maintenance and repair. They are ready to respond and assist you by providing fast, expert maintenance and repair services.

For the location of your local authorized Gardner Denver Machinery Inc. blower distributor refer to the yellow pages of your phone directory or contact:

Distribution Center:
Gardner Denver Machinery Inc.
Master Distribution Center
5585 East Shelby Drive
Memphis, TN 38141
Phone: (901) 542-6100
(800) 245-4946
Fax: (901) 542-6159

Factory:
Gardner Denver Machinery Inc.
1800 Gardner Expressway
Quincy, IL 62301
Phone: (217) 222-5400
Fax: (217) 224-7814

INSTRUCTIONS FOR ORDERING REPAIR PARTS

For pricing and ordering information, contact your nearest **AUTHORIZED FACTORY DISTRIBUTOR**.

When ordering parts, specify Blower **MODEL** and **SERIAL NUMBER** (see nameplate on unit).

Use this Parts List to select the parts you require. Where **NOT** specified, quantity of parts required per blower is one (1); where more than one is required per unit, quantity is indicated.

Rely upon the knowledge and experience of your **AUTHORIZED DISTRIBUTOR** and let them assist you in making the proper parts selection for your blower.

INSTRUCTIONS FOR DETERMINING BLOWER CONFIGURATION

1. Face the blower drive shaft.
2. In a **VERTICAL** configuration, air flow is horizontal.
3. In a **HORIZONTAL** configuration, air flow is vertical.
4. In a vertical configuration, a **BOTTOM HAND** exists when the drive shaft is below the horizontal center line of the blower. A **TOP HAND** exists when the drive shaft is above the horizontal center line of the blower.
5. In a horizontal configuration, a **RIGHT HAND** exists when the drive shaft is to the right of the vertical center line of the blower. A **LEFT HAND** exists when the drive shaft is to the left of the vertical center line of the blower.

FOREWORD

Sutorbilt® blowers are the result of advanced engineering and skilled manufacturing. To be assured of receiving maximum service from this machine the owner must exercise care in its operation and maintenance. This book is written to give the operator and maintenance department essential information for day-to-day operation, maintenance and adjustment. Careful adherence to these instructions will result in economical operation and minimum downtime.



DANGER

Danger is used to indicate the presence of a hazard which will cause severe personal injury, death, or substantial property damage if the warning is ignored.



WARNING

Warning is used to indicate the presence of a hazard which can cause severe personal injury, death, or substantial property damage if the warning is ignored.



CAUTION

Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.

NOTICE

Notice is used to notify people of installation, operation or maintenance information which is important but not hazard-related.

For Part List information, see:

Gear Diameter	Parts List
10"	SB-7-521
12"	SB-7-522
14"	SB-7-523
16"	SB-7-524
18"	SB-7-525
20"	SB-7-526
22"	SB-7-527

SAFETY PRECAUTIONS

Safety is everybody's business and is based on your use of good common sense. All situations or circumstances cannot always be predicted and covered by established rules. Therefore, use your past experience, watch out for safety hazards and be cautious. Some general safety precautions are given below:



DANGER

Failure to observe these notices could result in injury to or death of personnel.

- Keep fingers and clothing away from blower inlet and discharge ports, revolving belts, sheaves, drive coupling, etc.
- Do not use the air discharge from this unit for breathing – not suitable for human consumption.
- Do not loosen or remove the oil filler plug, drain plugs, covers, or break any connections, etc., in the blower air or oil system until the unit is shut down and the air pressure has been relieved.
- Electrical shock can and may be fatal.
- Blower unit must be grounded in accordance with the National Electrical Code.
- Open main disconnect switch, tag and lockout before working on the control.
- Disconnect the blower unit from its power source, tag and lockout before working on the unit – the machine may be automatically controlled and may start at any time.



WARNING

Failure to observe these notices could result in damage to equipment.

- Stop the unit if any repairs or adjustments on or around the blower are required.
- Disconnect the blower unit from its power source, tag and lockout before working on the unit – the machine may be automatically controlled and may start at any time.
- Do not exceed the rated maximum speed shown on the nameplate.
- Do not operate unit if safety devices are not operating properly. Check periodically. Never bypass safety devices.

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INTRODUCTION

YOUR KEY TO TROUBLE FREE SERVICE

Thank you for investing in Sutorbilt quality. The Sutorbilt reputation for rugged dependability has been earned by over 50 years of service in demanding, industrial operations where downtime cannot be tolerated and efficient blower performance is expected.

Your Sutorbilt blower is a precision engineered blower that has been carefully manufactured and thoroughly tested at the state-of-the-art Gardner Denver Machinery Inc. Blower Factory in Sedalia, Missouri.

As with other precision machinery, there are several relatively simple installation, operation and maintenance procedures that you must observe to assure optimum blower performance. There is no guesswork in the manufacture of your highly advanced Sutorbilt blower and there must be none in preparing the blower to get the job done in the field.

The purpose of this manual is to help you properly install, operate and maintain your Sutorbilt blower. It is essential that you review all sections of this manual in preparation for installing your blower. Follow the instructions carefully and you will be rewarded with trouble-free Sutorbilt service . . . year in and year out.

OPERATING PRINCIPLES – The 5000 – 6000 Series rotary blowers are the positive displacement type with two figure-eight shaped impellers rotating in opposite directions inside the casing. As each lobe of an impeller passes the blower inlet, it traps a quantity of air equal to exactly one-fourth the displacement of the blower. This entrapped air is forced around the case to the blower outlet. Timing gears accurately position the impellers in relation to each other to maintain the minute clearances so vital to the high volumetric efficiency of the rotary positive blower. See FIGURE 1.

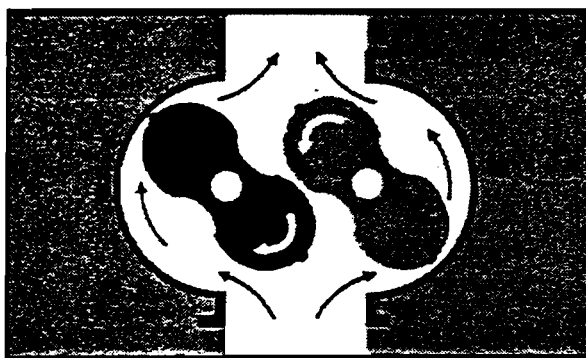


FIGURE 1 – OPERATING PRINCIPLES

WHERE TO CALL FOR SUTORBILT BLOWER ASSISTANCE:

For prompt professional Sutorbilt service always contact your authorized Sutorbilt Distributor first. If you do not know your authorized Sutorbilt Distributor, contact the numbers below for immediate assistance.

SUTORBILT CUSTOMER SERVICE	(217) 224-8800
SUTORBILT FACTORY SERVICE DEPARTMENT	(217) 222-5400
SUTORBILT HEADQUARTERS:	GARDNER DENVER MACHINERY INC.
	1800 GARDNER EXPRESSWAY
	QUINCY, IL 62301
	(217) 224-8800

IMPORTANT SUTORBILT TELEPHONE NUMBERS

YOUR AUTHORIZED SUTORBILT DISTRIBUTOR

NAME: _____

TELEPHONE: _____

FAX: _____

CONTACT: _____

THANKS . . . FOR THE PRIVILEGE OF SERVING YOU WITH DEPENDABLE SUTORBILT QUALITY.

SECTION 1 EQUIPMENT CHECK

Before uncrating, check the packing slip carefully to be sure all the parts have been received. All accessories are listed as separate items on the packing slip, and small important accessories such as relief valves can be overlooked or lost. After every item on the packing slip has been checked off, uncrate carefully. Register a claim with the carrier for lost or damaged equipment.

WARNING

Customers are cautioned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in installation and operation of this equipment in the system or facility.

STORAGE

Your Sutorbilt Blower was packaged at the factory with adequate protection to permit normal storage for up to six (6) months.

If the unit is to be stored under adverse conditions or for extended periods of time, the following additional measures should be taken to prevent damage.

1. Store the blower in a clean, dry, heated (if possible) area.
2. Make certain inlet and discharge air ports are tightly covered to prevent foreign material from entering the air box.
3. All exposed, non-painted surfaces should be protected against rust and corrosion.
4. Provide adequate protection to avoid accidental mechanical damage.
5. In high humidity or corrosive environments, additional measures may be required to prevent rusting of the blower internal surfaces.
6. To prevent rusting of gears, bearings, etc., the oil reservoirs may be filled with normal operating oil.

CAUTION

Before running the blower, drain the oil and replace to the proper operating level with clean, fresh lubricant.

7. Rotate the blower shaft (10 to 25 turns) monthly during storage. Inspect the blower shaft (near the shaft seal area) monthly and spray with rust inhibitor if needed.
8. For long term storage (over six (6) months), contact Quincy Customer Service for recommendations.

REMOVING PROTECTIVE MATERIALS

The shaft extension is protected with rust inhibitor which can be removed with any standard safety solvent.

CAUTION

Follow the safety directions of the safety solvent manufacturer.

Blower inlet and outlet are temporarily capped to keep out dirt and other contaminants during shipment. These covers must be removed before start-up.

The internal surfaces of all Sutorbilt units are mist sprayed with a rust preventative to protect the machine during shipment. Remove this film upon initial startup, using any commercial safety solvent.

Position the blower so that the inlet and discharge connections are in the vertical position (vertical airflow). On vertically mounted units, it will be necessary to lay the unit on its side supporting the ends of the unit so as not to restrict the port on the bottom side. Place a shallow pan on the under side of the unit. With the blower disconnected from power, spray the solvent in the top port, rotating the impellers by spinning the shaft manually. Continue this procedure until the unit is visibly clean.

WARNING

Rotating components will cause severe injury in case of personal contact. Keep hands away from blower inlet and discharge ports.

SECTION 2 INSTALLATION

LOCATION

If possible, install the blower in a well lit, clean, dry place with plenty of room for inspection and maintenance.

FOUNDATIONS

For permanent installations we recommend concrete foundations be provided, and the equipment should be grouted to the concrete. It is necessary that a suitable base be used, such as a steel combination base under blower and motor, or a separate sole plate under each. Before grouting, equipment must be leveled, free of all strains, and anchored so no movement will occur during setting of grout. After grout has completely hardened, a recheck is necessary to compensate for shrinkage, etc. If required, add shims under blower feet after final tightening of foundation anchor bolts to remove strain from the blower housing.

Where jack screws or wedges are used during grouting, they must be backed off or removed before final tightening of anchor bolts.

Where a concrete foundation is not feasible, care must be taken to insure that equipment is firmly anchored to adequate structural members.

Refer to grouting instructions.

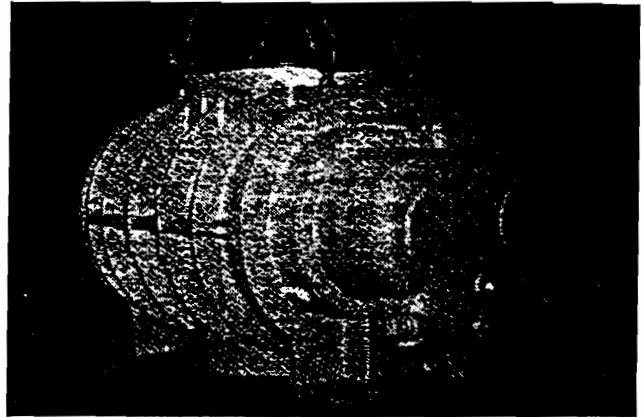


FIGURE 2 - LIFTING THE BLOWER

LIFTING AND HANDLING

Reasonable care should be taken during unloading and moving to insure against undue strain on the blower.

Eye bolts and lifting lugs are designed to support the weight of the blower only. They are not intended to be used to lift packages or components. See FIGURE 2.

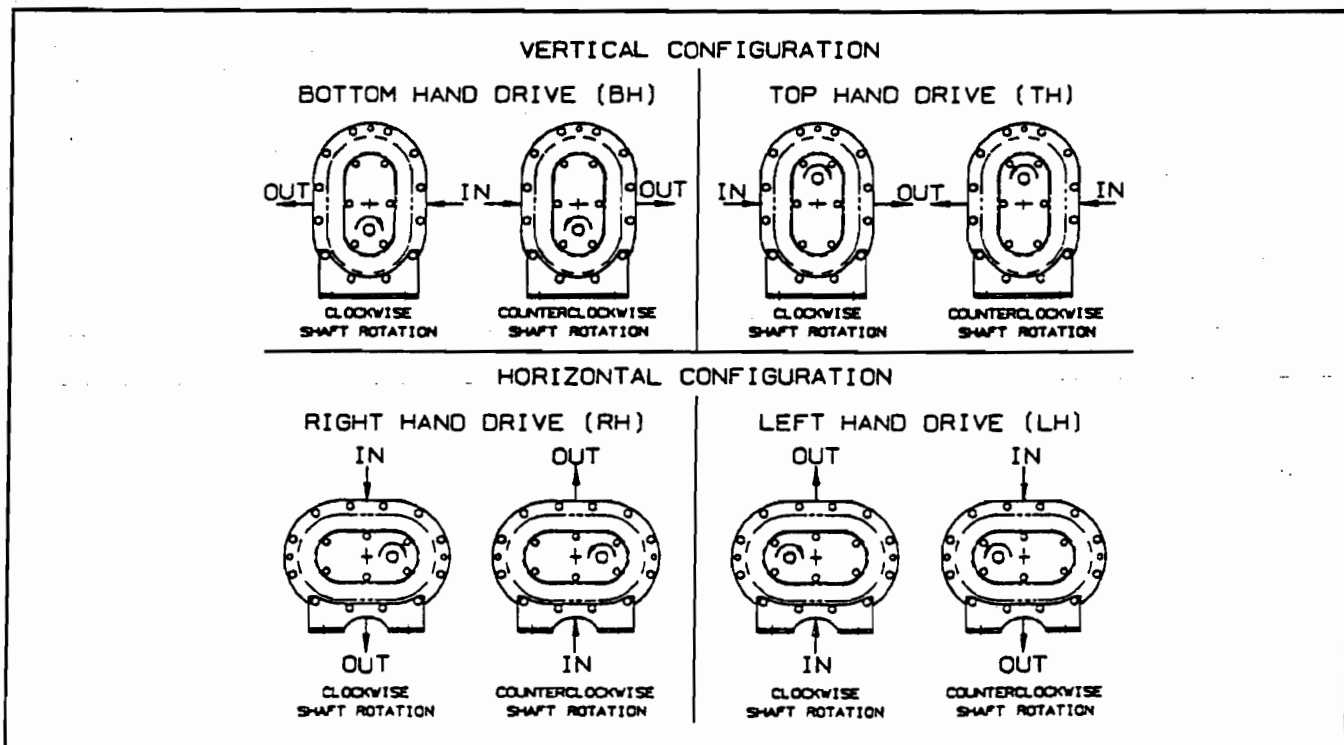


FIGURE 3 - BLOWER MOUNTING CONFIGURATIONS

Protective covers and rust preventatives should be left in place until just prior to installation.

DRIVE INSTALLATION

Large blowers are generally driven by a coupling. On the direct connected units, adjustments and lubrication of couplings to the specifications of the coupling manufacturer are very important. When mounted drives are supplied from the factory, proper alignment has been established before shipment. However, during shipping, handling and installation, it is likely that the alignment has been disturbed and final adjustment must be made before startup. To reduce vibration, the coupling must be aligned to 0.003"/0.005" for both parallel and angular alignment.

WARNING

Overtightening belts leads to heavy bearing loads and premature failure.

When selecting a V-belt drive, check to be sure the shaft overhung load limitation is not exceeded. Refer to FIGURE 4, page 5, for overhung load calculations and limitations.

Belt drives must be carefully aligned. Motor and blower pulleys must be parallel to each other and in the same plane within 1/32 inch. Belt tension should be carefully adjusted to the belt manufacturer's recommendation using a belt tension gauge. Check tension frequently during the first day of operation.

WARNING

Exceeding overhung load limitations leads to unwarrantable premature bearing failure and shaft breakage.

The location of the sheave on the blower shaft greatly affects the stress in the shaft. The optimum blower sheave positioning is as close as possible to the blower drive cover, not to exceed dimension "C" in Drive Shaft Illustration, FIGURE 4, page 5.

The calculated shaft moment must not exceed the maximum allowable moment listed in Maximum Allow-

able Moment Chart, FIGURE 4, page 5. If the calculated shaft moment exceeds the maximum allowable moment:

- Increase Sheave Diameters to Reduce Belt Pull
- Use Jackshaft Drive
- Use Direct Coupled or Gearbox Drive

To calculate shaft moment for a given V-Belt Drive Arrangement:

1. Use the formula for Calculation of Belt Pull, FIGURE 4, page 5, to calculate belt pull. Refer to Arc of Contact Factor Chart, FIGURE 4, page 5.
2. Insert the calculated belt pull into the formula for Calculation of Shaft Moment, FIGURE 4, page 5, to arrive at the calculated shaft moment.

PIPING

Inlet and discharge connections on all blowers are large enough to handle maximum volume with minimum friction loss. Reducing the pipe diameter on either inlet or discharge will only create additional line loss and increase the overall pressure differential, causing increased power and temperature rise.

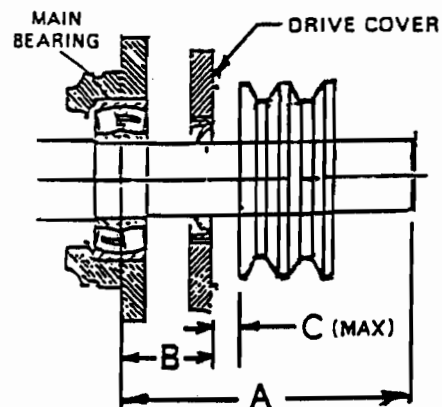
Excessive weight of piping and fittings will cause internal misalignment and premature wear. Never allow the blower to carry the weight of the pipe. If possible, a spool or sleeve-type expansion joint should be installed between the unit and the piping. Where a flexible connection is not practical, the weight of the rigid connection must be separately supported, and provisions must be made for thermal growth.

All system piping must be cleaned internally before connecting to the blower.

WARNING

Sutorbilt blowers are shipped dry from the factory. Do not attempt to operate the blower before following proper lubrication instructions. Permanent damage to the gears, bearings and seals will occur.

Gear Diameter (Inches)	Dimensions (Inches)			Maximum Allowable Moment	
	A	B	C (Max)	(LB-IN)	Kg M
10	11.50	3.50	.75	11730	135,1
12	12.81	3.81	.75	19551	225,3
14	14.19	4.19	.75	34646	399,2
16	15.38	4.38	.75	58752	676,9
18	17.00	5.00	.75	81650	940,7
20	18.75	5.25	.75	108290	1247,7
22	20.19	5.19	.75	124847	1553,6



MAXIMUM ALLOWABLE MOMENT

DRIVE SHAFT ILLUSTRATION

Z	Ac	Z	Ac	Z	Ac	Z	Ac	Z	Ac	Z	Ac
0.000	1.000	0.250	0.966	0.500	0.926	0.750	0.879	1.000	0.823	1.250	0.751
0.025	0.997	0.275	0.962	0.525	0.922	0.775	0.874	1.025	0.816	1.275	0.742
0.050	0.994	0.300	0.958	0.550	0.917	0.800	0.869	1.050	0.810	1.300	0.734
0.075	0.990	0.325	0.954	0.575	0.913	0.825	0.864	1.075	0.803	1.325	0.725
0.100	0.987	0.350	0.951	0.600	0.908	0.850	0.858	1.100	0.796	1.350	0.716
0.125	0.983	0.375	0.947	0.625	0.904	0.875	0.852	1.125	0.789	1.375	0.706
0.150	0.980	0.400	0.943	0.650	0.899	0.900	0.847	1.150	0.782	1.400	0.697
0.175	0.977	0.425	0.939	0.675	0.894	0.925	0.841	1.175	0.774	1.425	0.687
0.200	0.973	0.450	0.935	0.700	0.889	0.950	0.835	1.200	0.767		
0.225	0.969	0.475	0.930	0.725	0.884	0.975	0.829	1.225	0.759		

ARC OF CONTACT FACTORS

$$\text{Belt Pull} = \left[\frac{2.5 - A_c}{A_c} \right] \left[\frac{125954 \times H_p \times S.F.}{D \times \text{RPM}} \right]$$

Key: A_c = Arc of Contact Factor (Refer to Arc of Contact Factors Chart above)
 H_p = Blower Horsepower for Operating Conditions
 $S.F.$ = Drive Service Factor (use 1.4 S.F. for continuous duty applications)
 D = Blower Sheave Pitch Diameter in Inches
 RPM = Blower Sheave Speed
 Z = $\frac{\text{Large Sheave Pitch Diameter (in)} - \text{Small Sheave Pitch Diameter (in)}}{\text{Sheave Center Distance (in)}}$

CALCULATION OF BELT PULL

$$\text{Shaft Moment (LB-IN)} = \text{Belt Pull} \times \left[B + C + \left(\frac{\text{Sheave Width}}{2} \right) \right]$$

CALCULATION OF SHAFT MOMENT

FIGURE 4 - BELT DRIVE OVERHUNG LOAD CALCULATIONS

SECTION 3 PRE-START

LUBRICATION

Force Feed Lubrication – Timing gears and bearings are lubricated by a pressure system which features large diameter piping. A reversible oil pump brings oil from an oversize sump which is large enough to eliminate the need for an oil cooler at discharge temperatures up to 275° F. (Oil coolers are available as optional equipment when the unit is to be operated at higher temperatures.) An oil filter is located in the sump.

After one minute of operation, there should be a register of pressure in the gauge (D) (FIGURE 5). If there is none, prime the oil pump (E) (FIGURE 5). During initial operation, it will be necessary to add oil to the sump to compensate for filling of passages and distribution lines. Maintain oil level at the mid point of the sight glass during operation. Use the grade lubricant specified on the instruction plate attached to the blower (see chart, FIGURE 7, page 8). Oil should be changed every 1500 hours under normal service and more frequently if necessary. Drain oil at the drive headplate and gear sump. The mesh-type strainer (G) (FIGURE 5), located in the sump should be cleaned each time the oil is changed. There are two perforated brass screens located at the oil line connection to the headplates (F). These should be removed and cleaned or replaced as necessary. Oil pressure should be in the range of 10 to 15 psi.

Oil pressure is controlled by the relief valve (J) in the by-pass line from the pump to the oil sump. If it is necessary to change the pressure adjustment, remove lower cap and gasket from the relief valve. Loosen the locking nut and turn the adjusting screw clockwise to increase, and counter-clockwise to decrease the oil pressure. Tighten locknut and replace gasket and cap.

Mount the oil pressure gauge (D) (FIGURE 5) on a vibration free panel to prevent gauge damage and inaccurate reading.

Splash-Lubrication – The gear and drive end of the blower are lubricated by the splash method by oil being picked up from the sump and thrown out by the gears on the gear end and oil slingers on the drive end. Both gears and bearings are lubricated in this manner.

NOTICE

Units are shipped without oil in the sumps (A) (FIGURE 5). Do not operate before lubricating.

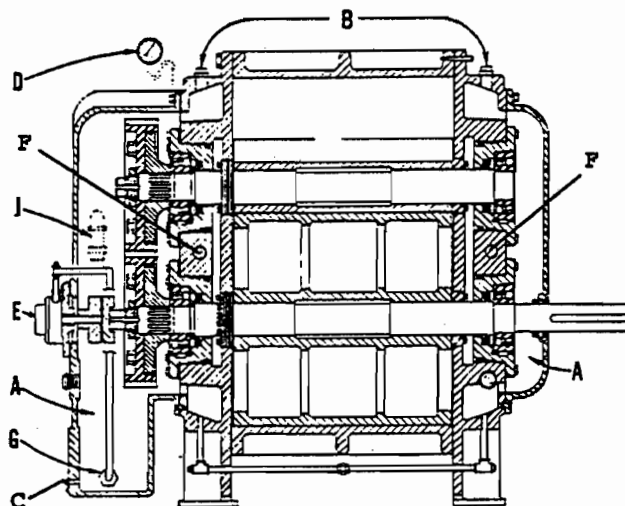


FIGURE 5 – LUBRICATION LOCATION

SUMP FILLING PROCEDURE – Use the following steps to fill the sumps.

1. Remove the vented fill caps (B) (FIGURE 5).
2. Fill the sumps until the oil level reaches the center of the sight glass. Use the grade of lubricant specified on the instruction plate attached to the blower. See chart, FIGURE 7, page 8.
3. When filling housing with oil, stop filling as soon as the oil appears in the sight glass and allow a few minutes for the level to stabilize.
4. Once level has stabilized, add or drain as necessary to adjust the level.
5. It may be necessary to add oil during initial operation as oil should be maintained at mid point of the sight glass during operation. See new oil level tag.
6. Be sure fill caps are secured in place once proper oil level is obtained.

LUBRICATION SERVICE

Add fresh oil as required to maintain proper level. If premium grade mineral oil is used, the oil should be drained, the gearbox flushed and the oil replaced every 1500 hours or more frequently if inspection so indicates. The oil drain plug is located at (C) (FIGURE 5). With AEON PD synthetic blower lubricant, perform the

above oil-change maintenance after 4500 to 7500 hours.

WARNING

Do not overfill as this will tend to cause excessive heating of the gears and may damage the unit.

Order AEON PD from your Sutorbilt Distributor or call Sutorbilt direct at 800-245-4946.

AEON PD	1 Quart Bottle	Part No. 28G23
AEON PD	12 Quart Case	Part No. 28G24
AEON PD	5 Gal. Pail	Part No. 28G25
AEON PD	55 Gal. Drum	Part No. 28G28

Blower Discharge Temperature *		Factory Tested Recommended and Approved Lubricant
° F	° C	
32°	0°	AEON PD Synthetic Blower Lubricant One Superior Lubricant For All Operating Temperatures
100°	38°	
275°	135°	
350°	177°	

* OPERATION BELOW 32° F. REQUIRES A SUMP HEATER.

FIGURE 6 - TEMPERATURE CHART

GEAR AND DRIVE END LUBRICATION

AEON PD is formulated especially for positive displacement blower service to provide maximum blower

protection at any temperature. One filling of AEON PD will last a minimum of 4 times longer than a premium mineral oil. Refer to FIGURE 6.

If not using AEON PD synthetic blower lubricant, use oils with rust and oxidation inhibitors, anti-foam additives and the viscosities listed in FIGURE 7, page 8.

AIR FILTERS AND FILTER SILENCERS

WARNING

Servicing the air filters is one of the most important maintenance operations to be performed to insure long blower life.

Servicing frequency of filter elements is not time predictable. A differential pressure indicator, with a continuous gauge reading, should be installed across the inlet filter. It will tell how much of the service life of the filter element has been used. It will also eliminate both premature filter servicing and premature blower failure due to a plugged filter when the filter pressure drop is used to establish maintenance points.

In all cases refer to the filter manufacturer's service instructions. Due to the many types of filters, it is not practical to give specific instructions covering all models.

NOTICE

No matter what type of filter is used, always make sure all seats, gaskets, clamps and hose connections on the filter and inlet line are absolutely air tight. Each time the filter is serviced, inspect interior of the blower for dirt.

Blower Discharge Temperature	Oil Grade ISO	Oil Viscosity SUS @ 100° F
32° to 100° F (0° to 38° C)	100	465
100° to 275° F (38° F to 135° F)	150	700
275° F to 300° F (135° to 149° C)	220	1000
Over 300° F (149° C)	*	*

* The oil viscosity must be 70 SUS minimum at discharge temperature minus 50° F.

FIGURE 7 – LUBRICATION RECOMMENDATION

SECTION 4 OPERATION

Future operating problems can be avoided if proper precautions are observed when the equipment is first put into service.

Before starting under power, the blower should be turned over by hand to make certain there is no binding, or internal contact.

Each size blower has limits on pressure differential, running speed, and discharge temperature which must not be exceeded. For information regarding limitations, refer to "Maximum Operating Limitations," FIGURE 8, page 11.

WARNING

Operating beyond the specified operating limitations will result in damage to the unit.

It is important that the pressures and temperatures are measured directly at the ports of the blower to avoid error that may be caused by intervening pipe runs, fittings, etc.

Relief valves must be used to protect against excessive pressure or vacuum conditions. These valves should be tested at initial startup to be sure they are adjusted to relieve at or below the maximum pressure differential rating of the blower.

NOTICE

Relief valves should be placed as close as possible to the blower inlet or discharge.

In some instances, pressure may be relieved at a lower level than the blower maximum in order to protect the motor and/or the system components.

LIMITATIONS

For information regarding limitations, refer to "Maximum Operating Limitations," FIGURE 8, page 11.

WARNING

Do not operate equipment without adequate silencing devices installed since high noise level may cause hearing damage. (Reference OSHA standards.)

After the unit has been started, the load should be applied gradually. A blow-off valve for unloaded starting is recommended.

The first few minutes of operation are the most critical, in so far as potential problems are concerned, so all equipment should be observed closely for excessive heat, noise or vibration during this period. Speeds, pressures, temperatures, vacuums and other operating conditions should be checked to insure that specified limits are not exceeded. See FIGURE 8, page 11.

ROUTINE OPERATION

Since the unit is a positive displacement type, the volume flow is fixed for constant speed so no regulation can be achieved by restricting the pipe or adjusting the valves. Excess air flow may be discharged through a relief valve or blow-off to atmosphere. Volume flow is essentially proportional to the speed and this offers a method of flow adjustment with V-belt driven machines.

Although these units are extremely rugged and are designed with adequate factors of safety, it is possible to cause serious damage by exceeding the manufacturer's limits.

Periodically the gauges, instruments, and safety devices used to monitor the blower should be checked for calibration and functioning.

NOTICE

Full rated pressure is full pressure differential from the inlet flange to the discharge flange.

CAUTION

Precaution should be taken to insure that the unit cannot be started accidentally and cause injury to personnel or damage to equipment.

SHUT DOWN

The blower should be unloaded before shut down. Consideration should be given to possible backflow and reverse rotation of the equipment as a result of pressure on the discharge side of the unit. A check valve is recommended.

If the unit is to be shut down for extended periods of time, it may be desirable to take some steps to prevent rust forming inside the casing. Condensation, gas vapors, or seal water can close up internal clearances and cause the unit to bind. Injection of oil or other rust retardant will help to prevent this problem.

MAXIMUM OPERATING LIMITATIONS													
SIZE	5000 Series RPM	6000 Series RPM	PRESSURE		VACUUM		SIZE	5000 Series RPM	6000 Series RPM	PRESSURE		VACUUM	
			PSI	M BAR	IN.HG	mm HG				PSI	M BAR	IN.HG	mm HG
1008	1335	1800	15	1035	16	406	1818	740	1000	15	1035	16	406
1011	1335	1800	15	1035	16	406	1821	740	1000	15	1035	16	406
1013	1335	1800	14.3	986	16	406	1824	740	1000	14.2	979	16	406
1016	1335	1800	12	828	16	406	1830	740	1000	11.4	786	16	406
1018	1335	1800	10.6	731	16	406	1833	740	1000	10.3	710	16	406
1021	1335	1800	9	620	16	406	1836	740	1000	9.5	655	16	406
1024	1335	1800	7.9	545	16	406	1842	740	1000	8.1	559	16	406
1030	1335	1800	6.3	434	12	305	1845	740	1000	7.6	524	15	381
							1848	740	1000	7.1	490	14	356
							1854	740	1000	6.3	435	12	305
1213	1115	1500	15	1035	16	406	2020	665	900	15	1035	16	406
1216	1115	1500	14.3	986	16	406	2024	665	900	15	1035	16	406
1218	1115	1500	12.3	848	16	406	2031	665	900	12.3	848	16	406
1220	1115	1500	11.4	786	16	406	2034	665	900	11.2	772	16	406
1223	1115	1500	9.9	683	16	406	2037	665	900	10.1	697	16	406
1226	1115	1500	8.8	607	16	406	2040	665	900	9.5	655	16	406
1230	1115	1500	7.6	524	15	381	2048	665	900	8	552	16	406
1236	1115	1500	6.3	434	12	305	2055	665	900	6.9	476	14	356
							2060	665	900	6.3	434	12	305
1415	955	1285	15	1035	16	406	2224	605	800	15	1035	16	406
1419	955	1285	14	966	16	406	2231	605	800	13.3	917	16	406
1421	955	1285	12.7	876	16	406	2236	605	800	11.6	800	16	406
1423	955	1285	11.6	800	16	406	2242	605	800	10	690	16	406
1426	955	1285	10.2	703	16	406	2248	605	800	8.7	600	16	406
1431	955	1285	8.6	593	16	406	2254	605	800	7.7	531	15	381
1437	955	1285	7.5	517	14	356	2260	605	800	7	483	14	356
1442	955	1285	6.3	434	12	305	2266	605	800	6.3	434	12	305
1617	835	1125	15	1035	16	406	DO NOT EXCEED THESE LIMITS						
1623	835	1125	13.2	910	16	406							
1626	835	1125	11.7	807	16	406							
1630	835	1125	10.1	697	16	406							
1636	835	1125	8.4	579	16	406							
1640	835	1125	7.6	524	15	381							
1643	835	1125	7.0	483	14	356							
1648	835	1125	6.3	434	12	305							

CAUTION

The maximum speed at which a 5000 series and 6000 series unit can be safely operated varies as listed on the above chart. Be certain of the size and series before applying these maximum speeds.

NOTICE

Blower speed, line losses, elevation, and increased inlet temperatures will affect the maximum operating limitations.

FIGURE 8 - MAXIMUM OPERATING LIMITATIONS

BLOWER STARTUP CHECKLIST

This startup procedure should be followed during the initial installation and after any shutdown periods or after the blower has been worked on or moved to a new location. It is suggested that the steps be followed in sequence and checked off (✓) in the boxes provided.

- ☐ 1. Check the unit and all piping for foreign material and clean if required.
- ☐ 2. Check the flatness of the feet and the alignment of the drive. Feet that are bolted down in a bind can cause case distortion and internal rubbing. Misaligned V-drives can cause the impellers to rub against the headplates and cause a reduction in the volumetric efficiency of the unit. Misaligned couplings can ruin bearings.
- ☐ 3. If blower is V-belt driven, check the belt tension and alignment. Over-tensioned belts create heavy bearing loads which leads to premature failure.
- ☐ 4. Be sure adequate drive guards are in place to protect the operator from severe personal injury from incidental contact.
- ☐ 5. Check the unit for proper lubrication. Proper oil level cannot be overemphasized. Too little oil will ruin bearings and gears. Too much oil will cause overheating and can ruin gears and cause other damage.
- ☐ 6. With motor locked out, turn the drive shaft by hand to be certain the impellers do not bind.
- ☐ 7. "Jog" the unit with the motor a few times to check rotation and to be certain it turns freely and smoothly.
- ☐ 8. The internal surfaces of all Sutorbilt units are mist sprayed with a rust preventive to protect the machine during the shipping and installation period. This film should be removed upon initial start-up.
- ☐ 9. Start the unit and operate 15 minutes at no load. During this time, check for hot spots and other indications of interference.
- ☐ 10. Apply the load and observe the operation of the unit for one hour. Check frequently during the first day of operation.
- ☐ 11. If malfunctions occur, do not continue to operate. Problems such as knocking impellers can cause serious damage if the unit is operated without correction.

SAFETY PRECAUTIONS

1. Do not operate blower with open inlet or outlet port.
2. Do not exceed specified vacuum or pressure limitations.
3. Do not operate above or below recommended blower speed range.
4. Blower is not to be used where non-sparking equipment is specified.
5. Do not operate without belt guard or coupling shield.

WARNING

Do not exceed sheave or coupling manufacturers' rim speed limit.

6. The blower and blower discharge piping may be extremely hot and can cause skin burns on contact.

TROUBLE SHOOTING

No matter how well the equipment is designed and manufactured, there may be times when servicing will be required due to normal wear, the need for adjustment, or various external causes. Whenever equip-

ment needs attention, the operator or repairman should be able to locate the cause and correct the trouble quickly. The Trouble Shooting Chart below is provided to assist the mechanic in those respects.

PROBLEM	POSSIBLE CAUSES	SOLUTION
Knocking	1. Unit out of time. 2. Distortion due to improper mounting or pipe strains. 3. Excessive pressure differential. 4. Worn gears. 5. Worn bearings. 6. Worn bearing cartridges.	1. Retime impellers. 2. Check mounting alignment and relieve pipe strains. 3. Reduce to manufacturer's recommended pressure. Examine relief valve, re-set if necessary. 4. Replace timing gears. 5. Replace bearings. 6. Replace cartridges.
Excessive blower temperature.	1. Too much oil in gear case. 2. Too low operating speed. 3. Clogged filter or muffler. 4. Excessive pressure differential. 5. Worn impeller clearances. 6. Internal contact.	1. Reduce oil level. 2. Increase blower speed. 3. Remove cause of obstruction. 4. Reduce pressure differential across the blower. 5. Replace impeller. 6. Correct clearances.
Impeller end or tip drag.	1. Insufficient assembled clearances. 2. Case or frame distortion. 3. Excessive operating pressure. 4. Excessive operating temperature.	1. Correct clearances. 2. Check mounting and pipe strain. 3. Remove cause. 4. Remove cause.

TROUBLE SHOOTING (Continued)

PROBLEM	POSSIBLE CAUSES	SOLUTION
Lack of volume.	1. Slipping belts. 2. Worn clearances.	1. Tighten belts. 2. Re-establish proper clearances.
Excessive bearing or gear wear.	1. Improper lubrication.	1. Correct lubrication level. Replace dirty and/or improper oil.
Loss of oil.	1. Headplate, gear case or drive cover vents plugged. 2. Worn seal.	1. Clean vents. 2. Replace seals.
Lack of oil pressure.	1. Dirty suction screen. 2. Leak in suction line. 3. Lubrication pump losing its prime.	1. Clean suction screen. 2. Repair leak. 3. Reprime, by removing pipe plug and priming.

SECTION 5 MAINTENANCE

GEAR INSPECTION

Inspection of the timing gears may be accomplished by removing the gear case. Refer to FIGURE 9. Prior to removing the gear case the oil should be drained from the gear case sump. On units with force feed lubrication, remove the oil pump adaptor plate with the oil pump attached using the tapped jacking holes in the plate. After removing gear case flange bolts, the gear case may be removed. Be sure to support the gear case adequately while removing. Timing gears and gear end bearings are now exposed.

On completion of maintenance work, be certain that the oil pump and/or the gear case is returned to the original position. Use a paste type gasket compound on the mating surfaces. Always relubricate before starting.

IMPELLER INSPECTION

Series 5000/6000 impellers can be inspected through the intake and discharge ports. This will reveal such conditions as out of time, excessive or insufficient clearances, abrasion of parts from passing foreign material, etc.

REPAIR

Assembly

WARNING

When rotation of the impellers is required in the assembly process, insure that all personnel are clear of lobes and gears to guard against serious injury.

TIMING

The impellers of the unit are separated by pre-determined minute clearances built into the machine. The timing of a unit is the setting of one impeller with respect to the other so they do not touch or knock during normal operation. The impellers are held 'in time' by timing gears which are bolted to a timing hub, which in turn is secured to the serrated impeller shaft by a lock washer and locknut. Retiming is necessary to restore proper impeller clearances after a unit has been jammed and the removal of the strain or foreign material does not stop the knocking or pounding during operation.

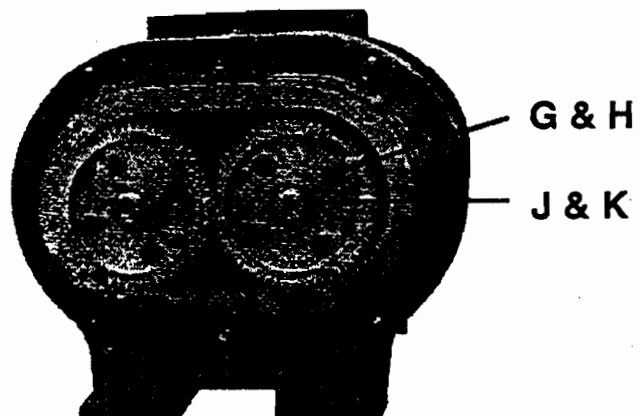
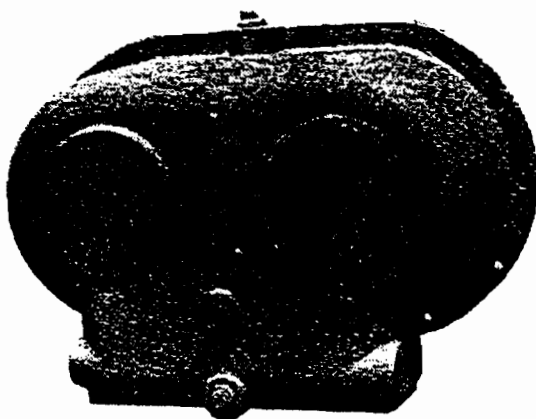


FIGURE 9 - LOCATION OF TIMING GEAR BOLTS

Gear End Clearance		
Gear Dia. In.	Min.	
	In.	CM
1008 to 1016	.006	.015
1018 to 1030	.007	.018
12	.007	.018
14	.008	.020
16	.009	.023
18	.009	.023
20	.010	.025
22	.011	.028

FIGURE 10 – GEAR END CLEARANCE

Torque Requirements Timing Gear Cap Screws		
Gear Dia.	Ft. Lbs. Torque	Nm Torque
10	70 – 100	95 – 136
12	160 – 225	217 – 305
14	210 – 350	285 – 475
16	250 – 350	339 – 475
18	250 – 350	339 – 475
20	400 – 500	542 – 678
22	400 – 600	542 – 813

FIGURE 11 – TORQUE REQUIREMENTS – TIMING GEAR
CAP SCREWS

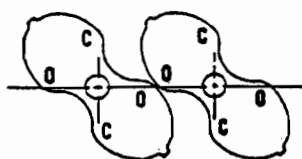
Determining Proper Impeller Clearances (FIGURE 12) – The clearances between impellers are measured at points 0-0 and c-c when the impellers are in the positions shown. Note that the impellers are shown viewed from the drive end of the blower; always face the drive shaft end when determining clearance. Select the illustration from the sketches which is applicable to your unit.

If the drive shaft is on the right side of centerline, it is a 'right hand' unit; if it is on the left, it is a 'left hand' unit. For vertical units: if the drive shaft is on the bottom side of the center line, it is a 'bottom hand' unit. Check above the drive shaft for a rotational arrow. If the arrow

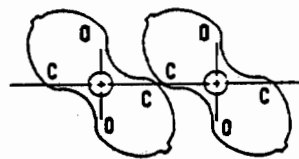
appears, the unit is timed for rotation only in that direction. If no arrow appears, it is 'center timed' for rotation in either direction.

To determine total clearance, place the impellers in the 0-0 position. Measure the distance between 0-0 with a feeler gauge. Rotate the impellers 90° to position c-c and repeat the measurement between c-c. Add these figures together for total clearance.

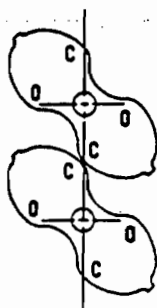
To determine correct clearances for a unit originally timed for rotation in one direction only, return the impellers to position 0-0. Divide the total clearance figure into three parts. Two parts (2/3) will be the clearance setting between points 0-0 and the remaining part (1/3)



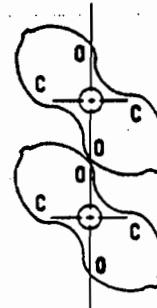
Right Hand – Top Discharge
Left Hand – Bottom Discharge



Right Hand – Bottom Discharge
Left Hand – Top Discharge



Bottom Hand – Right Discharge
Top Hand – Left Discharge



Bottom Hand – Left Discharge
Top Hand – Right Discharge

FIGURE 12 – IMPELLER LOBE CLEARANCES

will be set between points c-c. Blowers originally timed for rotation in either direction are retimed by dividing the total clearance evenly between points 0-0 and c-c.

RESETTING IMPELLER CLEARANCE

Impellers are held in time by gears which are bolted to a timing hub, which in turn is secured to the serrated impeller shaft by a locknut. The timing gear can be rotated in relation to the hub by loosening the cap screws. Because the cap screw holes in the gear are oversized, the gear will rotate – within limits – when the screws are loosened.

Refer to FIGURE 9, page 15, for the following instructions.

1. Remove the gear case.
2. To retime, remove the cap screws (G) and washers (H), loosen the locknut (J) and the lock washer (K) in one gear only.
3. Wedge the two impellers together against the exact amount of shim stock required to establish proper clearances as calculated in "Determining Proper Impeller Clearances," page 16.
4. Secure the gear in the new position with cap screws and washers (always reverse washers (H) when replacing) but do not tighten.
5. Rotate impellers by hand.
6. Recheck clearances. If proper timing has been re-established, tighten cap screws with a torque wrench. Refer to FIGURE 13 for correct torque values.
7. Tighten lock washer and locknut.
8. Obtain a piece of pipe of sufficient diameter to fit over the locknut and rest against the gear. Shock load the gear by striking the pipe with a sledge hammer, the retighten locknut. Repeat this procedure several times until all gear end components are drawn together and locknut is tight.
9. Check the end clearance before and after any work has been performed.

End Clearance – To check the gear end clearance, the locknut (J) (FIGURE 9, page 15) must be tight.

Torque Requirements Gear End Shaft Assembly		
Blower Size	Ft. Lbs. Torque	Nm Torque
10	40	54
12	65	88
14	65	88
16	125	169
18	125	169
20	225	305
22	330	447

FIGURE 13 – TORQUE REQUIREMENTS – GEAR END SHAFT ASSEMBLY

1. Remove two diametrically opposed timing bolts (G) and replace with long jack screws.
2. Tighten these against the bearing cartridge only enough to remove the axial play from the bearing.
3. Check the clearance inside the machine between the end of the impeller and the gear headplate. If the end clearance is less than that shown in the accompanying table, loosen the bearing cartridge (see "Bearing and Seal Replacement," page 20) and delete shims as required. Increase shims to reduce the clearance.
4. After completion of the work, replace the gear case and relubricate.

NOTICE

Follow Blower Startup Checklist on page 12 after every shutdown.

Shaft Replacement – One piece 4140 forged steel shafts are slip fitted through the impellers and bolted to them at the gear end. This advanced shaft design allows the diameter to be increased in the critical area between the impeller and gears without decreasing impeller strength with an enlarged bore, and avoids the use of the drive impeller to transmit power. By using a larger shaft at the gear end, torsional deflection of the shafts between timing gears and impellers is greatly reduced; therefore, increased pressure and horsepower ratings can be allowed with safety. The shafts can be removed from the impellers without removing the head-

plates from the case. One piece shafts permit normal working loads for V-belt drives without the addition of outboard bearings.

In rare instances, shaft replacement might be necessary. Although removal is somewhat involved, it is fairly simple if the following procedure is adhered to.

1. Remove any obstructing oil lines from both ends of the unit.
2. Remove the gear case (see "Gear Inspection," page 15).
3. Check the fixed end impeller clearance. This clearance should be duplicated when repairs are completed.
4. Remove timing gears and hubs per instructions on page 19.
5. The impellers will now rotate freely in the case. Position both impellers so that one-half of the tip of the impellers can be seen when looking inside the unit from either the intake or discharge openings. Wedge a shim between the tips and the case on both the top and bottom of each impeller, locking them both in this position.
6. Unbolt and remove the cover on the drive end of the unit.
7. Unbolt and remove the bearing cartridges from both ends of the shaft being replaced as described in "Bearing and Seal Replacement," page 20.
8. Remove the socket head cap screws on the gear end of the shaft.
9. The shaft can now be removed by driving it from the drive side of the unit with a lead hammer and hydraulic press.
10. Before installing a new shaft, remove all burrs and coat the new shaft with anti-seize compound.

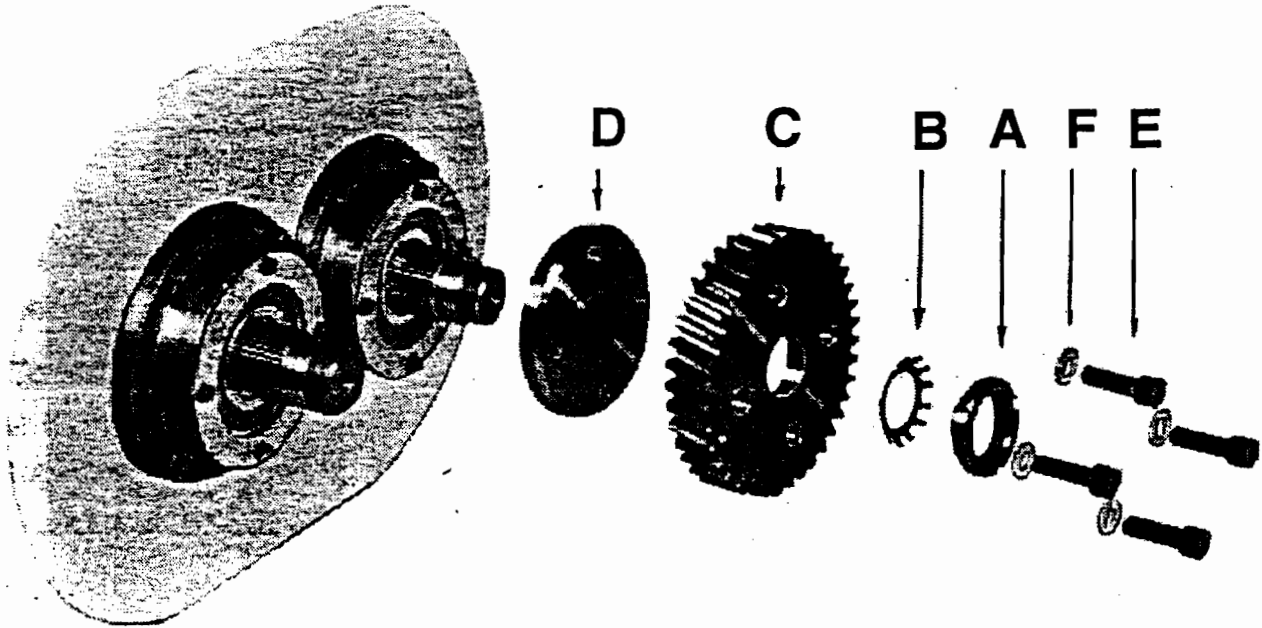
Slide the shaft in from the gear or fixed end toward the drive end.

11. Rebolt the shaft, using new cap screws, to the impellers and tighten with a torque wrench. See FIGURE 13, page 17, for torque values.
12. Replace bearing cartridge per instructions on page in "Bearing and Seal Replacement," page 20.
13. Remove the shims that are locking the impellers inside the case.
14. Set the impellers in the central timing position, making certain that the tip and throat match marks correspond. See "Determining Impeller Clearances," page 16, and replace timing gears and hubs as outlined on page 19.
15. Retime the blower according to instructions on page 17.
16. Remove the seal from the seal retainer mounted on the drive cover.
17. Replace the cover on the drive end.
18. Install a new oil seal in the retainer that mounts to the drive cover. Carefully center the seal on the shaft.
19. Replace the gear case and any oil lines.
20. Relubricate and follow "Blower Startup Checklist," page 12.

NOTICE

Follow Blower Startup Checklist on page 12 after every shutdown.

SECTION 6 REPAIR & REPLACEMENT



With proper maintenance and lubrication, normal life of bearings, gears and seals can be expected. To maintain the efficiency of your unit, however, these parts must be repaired or replaced when required.

Timing Gear and Hub Removal – Refer to FIGURE 14.

1. Remove the gear case (Gear Inspection, page 15).
2. Remove the cap screws (E), washers (F), lock nuts (A), and lock washers (B) from both shafts.
3. Match mark the shafts, gears and hubs to assure proper repositioning on completion of the work.
4. Remove gears (C) from hubs (D) and hubs from shafts. A gear puller may facilitate removal. Always match mark hubs in relation to shafts.

To reassemble:

1. Replace the hubs. When installing hubs, apply anti-seize compound on the splines. Do not use

force to install hub. In most cases it will be necessary to heat the hub to about 175° to 200° F.

CAUTION

Take care that the hubs are assembled to their original position on the shafts.

2. Replace gears.
3. Replace cap screws, washers (always turn washers over when replacing), locknuts, and lock washers to each shaft.
4. Establish a position for one gear, tighten the cap screws and locknut on that gear only. Then proceed with retiming according to instructions outlined in "Resetting Impeller Clearances," page 16.
5. Tighten the lock washers and nuts and use a torque wrench to tighten cap screws on the timing hub. Refer to FIGURE 13, page 17, for torque requirements.

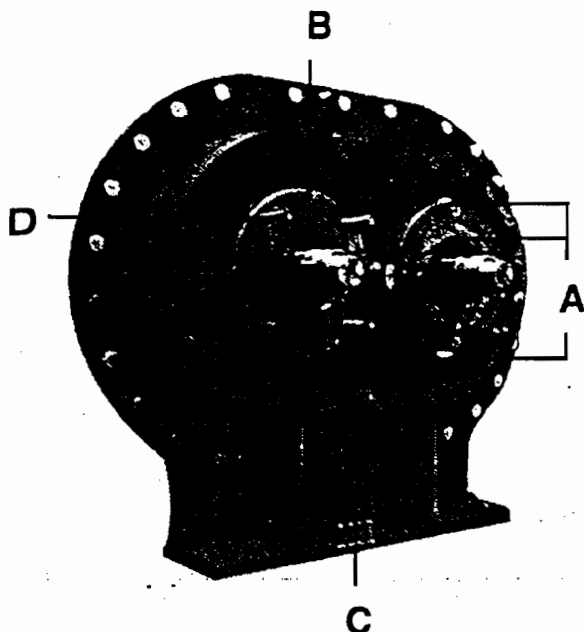


FIGURE 15 – BEARING CARTRIDGE REMOVAL

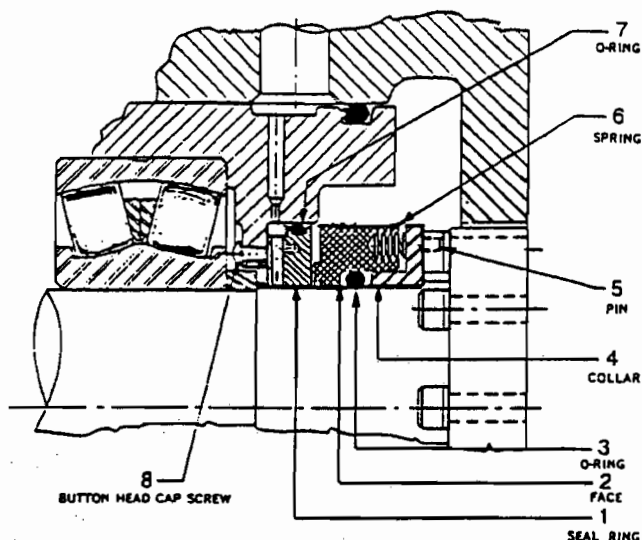


FIGURE 16 – MECHANICAL SEAL INSTALLATION

6. Check the gear end clearance.
7. Replace the gear case.

NOTICE

Follow Blower Startup Checklist on page 12 after every shutdown.

BEARING AND SEAL REPLACEMENT

Gear End

1. Remove the gear case. Refer to "Gear Inspection," page 15.
2. Check the fixed gear end impeller clearance. This clearance must be duplicated when repairs are completed.
3. Remove the locknuts and washers from the ends of both shafts and match-mark the shafts, gears, hubs and bearing cartridges to assure repositioning during reassembly.
4. Remove gears and hubs using the procedure outlined in "Timing Gear and Hub Removal," page 19.

Refer to FIGURE 15. Shim spacers (A) added during production will now be exposed behind the bearing cartridge (B) on the gear end of the unit. The spacers were installed to assure accurate positioning of the impellers between the head-plates; hence, it is important that they be returned to their exact positions on reassembly.

NOTICE

The number of spacers fastened behind each bearing cartridge varies. It is essential that each set of spacers be identified with its respective position during withdrawal.

To remove spacers:

1. Loosen, but do not remove, the bearing cartridge attachment bolts (C) (FIGURE 15).
2. Insert the jack screws (D) and back out the bearing cartridge until the shim spacers are loose.
3. Remove one bolt at a time, taking out the shims and marking them for accurate repositioning.

4. On removal of all bolts, continue using the jack screws to complete the bearing and cartridge removal.
5. Remove the bearing retaining ring from the face of the cartridge.

A lip type oil seal or mechanical seal is located behind each bearing on a blower, and a mechanical seal on a pump.

Lip Type Oil Seal – Whenever a cartridge is removed for repair purposes, always install a new seal before re-assembly. This can best be accomplished by using a driving instrument having the same approximate O.D. as the seal; use caution not to damage the new seal during installation. Always install the seal with the lip facing the bearing. Extreme care must be taken to avoid damaging the sealing elements when they are moved over the shafts.

Mechanical Seal (FIGURE 16, page 20) – Whenever a mechanical seal must be replaced, the following procedure should be followed.

1. Remove the old seal components.
2. Clean the shaft thoroughly, especially where the face (item 2) is located.
3. Coat the shaft with light oil.
4. It is necessary to use a tapered assembly tool when installing seal assembly, consisting of items 2 through 6. Be sure that the spring holder (item 4) is pushed against the cap screws.
5. When installing the seat (item 1) and "O"-ring (item 7) in the bearing cartridge, it is also necessary to use a tapered assembly tool to prevent the "O"-ring from being damaged. Secure the seal ring (item 1) with three button head cap screws (item 8).

6. Tightened cap screws snugly.



WARNING

Do not overtighten capscrews. Overtightening will pull seal ring out of flatness.

On completion of repair or replacement work, replace the "O"-ring on the bearing cartridge. Return the bearing cartridges to their respective shafts and restore the shim spacers to their original positions.

Bearing backup rings are factory installed against a shaft shoulder behind each gear and bearing. If these were removed during bearing cartridge disassembly, reinstall making certain that the 45° Chamfer faces the shaft shoulder.

Return bearings and secure in position. On force feed lubricated units the bearing retainer ring must be installed so that the lubrication notch is at the top and aligned with the oil passage in the bearing cartridge. Replace the gears and hubs using the procedure outlined in "Timing Gear and Hub Removal," page 19. Check the fixed end clearances. If necessary, add or delete shims behind the bearing cartridge flange as needed to restore original fixed gear end clearance.

Drive End – Remove the drive cover. A drive seal is located in the seal retainer on the drive cover. Always replace the drive seal when the drive cover is removed. Extreme care must be taken to avoid damaging the drive seal when moving it over the shaft keyway. Wrap a piece of light shim stock around the shaft to prevent keyway from cutting the seal element.

To replace the drive end bearings and seals follow the procedure as described for the gear end, page 20.

Gardner Denver

1800 GARDNER EXPRESSWAY
QUINCY, IL 62301
TEL: (217) 222-5400 • FAX: (217) 228-8249

WARRANTY

**SUTORBILT BLOWERS
4500 SERIES
5000/6000 SERIES**

GENERAL PROVISIONS AND LIMITATIONS

Gardner Denver Machinery Inc. (the "Company") warrants to each original retail purchaser ("Purchaser") of its products from the Company or its authorized distributor that such products are, at the time of delivery to the Purchaser, made with good material and workmanship. No warranty is made with respect to:

1. Any product which has been repaired or altered in such a way, in the Company's judgment, as to affect the product adversely.
2. Any product which has, in the Company's judgment, been subject to negligence, accident, improper storage, or improper installation or application.
3. Any product which has not been operated or maintained in accordance with the recommendations of the Company.
4. Components or accessories manufactured, warranted and serviced by others.

Claims for items described in (4) above should be submitted directly to the manufacturer.

WARRANTY PERIOD

The Company's obligation under this warranty is limited to repairing or, at its option, replacing, during normal business hours at an authorized service facility of the Company, any part which in its judgment proved not to be as warranted within the applicable Warranty Period as follows.

BARE BLOWERS

Basic bare blowers, consisting of all parts within, are warranted for 12 months from date of initial use or 18 months from date of shipment to the first purchaser, whichever occurs first.

Any disassembly or partial disassembly of the blower, or failure to return the "unopened" blower per Company instructions, will be cause for denial of warranty.

OTHER COMPONENTS

All other components are warranted for 12 months from date of initial use or 18 months from date of shipment to first purchaser, whichever comes first.

The Company reserves the right to withdraw the Warranty where evidence indicates application outside the stated performance area, or where there is evidence of abuse.

LABOR TRANSPORTATION AND INSPECTION

The Company will provide labor, by Company representative or authorized service personnel, for repair or re-

placement of any product or part thereof which in the Company's judgment is proved not to be as warranted. Labor shall be limited to the amount specified in the Company's labor rate schedule.

Labor costs in excess of the Company rate schedules caused by, but not limited to, location or inaccessibility of equipment, or labor provided by unauthorized service personnel is not provided by this warranty.

All costs of transportation of product, labor or parts claimed not to be as warranted and, of repaired or replacement parts to or from such service facilities shall be borne by the Purchaser. The Company may require the return of any part claimed not to be as warranted to one of its facilities as designated by the Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of the warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components.

DISCLAIMER

THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO THE PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented within 30 days after the date upon which the product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which the cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

SUTORBILT®

**SB-7-519
1st Edition
October, 1995**

**5000/6000 SERIES
(GE) (GF)**

10" - 14" GEAR DIAMETER

PARTS LIST

**Gardner
Denver**

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**MAINTAIN BLOWER RELIABILITY AND PERFORMANCE
WITH GENUINE GARDNER DENVER MACHINERY INC.
PARTS AND SUPPORT SERVICES**

Factory genuine parts, engineered to original tolerances, are designed for optimum dependability — specifically for your blower. Design and material innovations are born from years of experience with hundreds of different blower applications. When you specify factory genuine parts you are assured of receiving parts that incorporate the most current design advancements... manufactured in our state-of-the-art blower manufactory under exacting quality standards.

Your **AUTHORIZED DISTRIBUTOR** offers all the backup you require. A worldwide network of authorized distributors provides the finest product support in the blower industry.

Your local **AUTHORIZED DISTRIBUTOR** maintains a large inventory of genuine parts and is also backed by direct access to our Master Distribution Center (MDC) in Memphis, Tennessee for immediate emergency response.

For the location of your local authorized Gardner Denver Machinery Inc. blower distributor refer to the yellow pages of your phone directory or contact:

Gardner Denver Machinery, Inc.
1800 Gardner Expressway
Quincy, IL 62305-4024
Phone: (217) 224-8800 (Customer Service)
Fax: (217) 224-7814

Your **AUTHORIZED DISTRIBUTOR** can support your blower investment with these services:

1. Trained parts technical representatives to assist you in selecting the correct replacement parts.
2. Complete inventory of new machines and new, genuine factory parts.
3. A full line of factory tested AEON™ PD blower lubricants specifically formulated for optimum performance in all blowers.
4. Authorized distributor service technicians are factory-trained and skilled in blower maintenance and repair. They are ready to respond and assist you by providing fast, expert maintenance and repair services.

REPAIR PARTS

For pricing, and ordering information contact your nearest **AUTHORIZED FACTORY DISTRIBUTOR**.

When ordering parts, specify Blower **MODEL** and **SERIAL NUMBER** (see nameplate on unit).

Use this Parts List to select the parts you require. Where **NOT** specified, quantity of parts required per blower is one (1); where more than one is required per unit, quantity is indicated.

Specify **EXACTLY** the number of parts required. do not order by sets or groups.

Rely upon the knowledge and experience of your **AUTHORIZED DISTRIBUTOR** and let them assist you in making the proper parts selection for your blower.

INSTRUCTION FOR DETERMINING BLOWER CONFIGURATION

1. Face the blower drive shaft.
2. In a **VERTICAL** configuration the air flow is horizontal.
3. In a **HORIZONTAL** configuration the air flow is vertical.
4. In a vertical configuration, a **BOTTOM HAND** exists when the drive shaft is below the horizontal center line of the blower. A **TOP HAND** exists when the drive shaft is above the horizontal center line of the blower.
5. In a horizontal configuration, a **RIGHT HAND** exists when the drive shaft is to the right of the vertical center line of the blower. A **LEFT HAND** exists when the drive shaft is to the left of the vertical center line of the blower.

MATRIX/MENU
10" THRU 14" 5000/6000 SUTORBILT BLOWERS

NOTICE TO CUSTOMER - To find the construction options for your Blower unit, FILL IN THE BALANCE OF LETTERS OR NUMBERS FROM YOUR UNIT NAMEPLATE.

COLUMN NUMBER:

G

1 2 3 4 5 6 7 8 9 10 11

FOLLOW THE LINE DOWN AND OVER FROM EACH SPACE THUS FILLED IN TO FIND THE APPROPRIATE CONSTRUCTION WITH WHICH YOUR MACHINE IS EQUIPPED.

COLUMN 1 - BASIC DESIGNATOR

COLUMN 2 - PRODUCT FAMILY

E. 5000 SERIES
F. 6000 SERIES

COLUMN 3 - GEAR DIAMETER

J. 10" K. 12" L. 14"

COLUMN 4 - CASE LENGTH

A.	8"	13"	15"
B.	11"	16"	19"
C.	13"	18"	21"
D.	16"	20"	23"
E.	18"	23"	26"
F.	21"	26"	31"
G.	24"	30"	37"
H.	30"	36"	42"

COLUMN 5 - CONSTRUCTION

A. VERTICAL-TOP HAND-CENTRAL TIMED
B. VERTICAL-BOTTOM HAND-CENTRAL TIMED
C. HORIZONTAL-LEFT HAND-CENTRAL TIMED
D. HORIZONTAL-RIGHT HAND-CENTRAL TIMED
E. VERTICAL-BOTTOM HAND-RIGHT DISCHARGED TIMED
F. VERTICAL-BOTTOM HAND-LEFT DISCHARGED TIMED
G. VERTICAL-TOP HAND-RIGHT DISCHARGED TIMED
H. VERTICAL-TOP HAND-LEFT DISCHARGED TIMED
J. HORIZONTAL-RIGHT HAND-BOTTOM DISCHARGED TIMED
K. HORIZONTAL-RIGHT HAND-TOP DISCHARGED TIMED
L. HORIZONTAL-LEFT HAND-TOP DISCHARGED TIMED
M. HORIZONTAL-LEFT HAND-BOTTOM DISCHARGED TIMED

COLUMN 6 - DESIGN VERSION

COLUMN 7 - ADDITIONAL DESCRIPTION

A. LIP SEAL-STD CLEARANCES-SPLASH LUBE
B. MECHANICAL SEAL-STD CLEARANCES-SPLASH LUBE
C. LIP SEAL-HIGH TEMP CLEARANCES-SPLASH LUBE
D. MECHANICAL SEAL-HIGH TEMP CLEARANCES-SPLASH LUBE
* E. LIP SEAL-WET VAC PROFILE-SPLASH LUBE
* F. MECHANICAL SEAL-WET VAC PROFILE-SPLASH LUBE
G. LIP SEAL-STD CLEARANCES-FORCE FEED LUBE
H. MECHANICAL SEAL-STD CLEARANCES-FORCE FEED LUBE
J. LIP SEAL-HIGH TEMP CLEARANCES-FORCE FEED LUBE
K. MECHANICAL SEAL-HIGH TEMP CLEARANCES-FORCE FEED LUBE
* L. LIP SEAL-WET VAC PROFILE-FORCE FEED LUBE
* M. MECHANICAL SEAL-WET VAC PROFILE-FORCE FEED LUBE
N. LIP SEAL-STD CLEARANCES-FORCE FEED LUBE WITH COOLER
P. MECHANICAL SEAL-STD CLEARANCES-FORCE FEED LUBE WITH COOLER
Q. LIP SEAL-HIGH TEMP CLEARANCES-FORCE FEED LUBE WITH COOLER
R. MECHANICAL SEAL-HIGH TEMP CLEARANCES-FORCE FEED LUBE WITH COOLER
* S. LIP SEAL-WET VAC PROFILE-FORCE FEED LUBE WITH COOLER
* T. MECHANICAL SEAL-WET VAC PROFILE-FORCE FEED LUBE WITH COOLER
* U. PACKING GLAND-STD CLEARANCES-SPLASH/GREASE LUBE

COLUMNS 8 THRU 11 - MODIFICATION NUMBER *

* NOT INCLUDED IN THIS PUBLICATION, CONSULT FACTORY.

SECTION A VERTICAL CONSTRUCTION

Order by Part Number and Description. Reference Numbers for your convenience only.

10" VERTICAL Reference Figure 1 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1008 (G_JA)	Size 1011 (G_JB)	Size 1013 (G_JC)
1	HEADPLATE	2	918784101201	918784101201	918784101201
	HEADPLATE (GAS PUMP)	2	918784101202	918784101202	918784101202
	HEADPLATE (FORCE FEED LUBE)	2	907684101501	907684101501	907684101501
	HEADPLATE-VERT	2	907684101502	907684101502	907684101502
	(FORCE FEED LUBE-GAS PUMP)				
2	GROUP-IMPELLER CASE	1	200GFJ4042	201GFJ4042	202GFJ4042
3	SCREW-HX HD CAP	32	655EF080	655EF080	655EF080
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER(THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
5	PLATE-TOP PIPE (GEJ 5000)	1	907613193110	907603672110	907613062210
	PLATE-TOP PIPE (GFJ 6000)	1	918793100801	907603672110	918793100301
7	SCREW-HX HD CAP	12	655EF070 **	655EF070	655EF070
	(PIPE PLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEJ 5000)	1	208GEJ4028	201GEJ4028	209GEJ4028
	GROUP-ROTOR (GFJ 6000)	1	208GFJ4028	209GFJ4028	210GFJ4028
9	CARTRIDGE-BEARING	4	200GEJ571	200GEJ571	200GEJ571
	CARTRIDGE-BEARING	4	202GEJ571	202GEJ571	202GEJ571
	(FORCE FEED LUBE)				
	CARTRIDGE-BEARING (GAS PUMP)	4	204GEJ571	204GEJ571	204GEJ571
* 10	SCREW-SOC HD CAP/NYLOK	16	75P76N	75P76N	75P76N
	(BEARING CARTRIDGE TO HEADPLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC398	25BC398	25BC398
* 13	SEAL-MAIN (VTON)	4	918761104801	918761104801	918761104801
	SEAL-MECHANICAL (GAS PUMP)	4	907639060110	907639060110	907639060110
* 14	BEARING (DRIVE END)	2	907639100110	907639100110	907639100110
* 15	BEARING (GEAR END)	2	907639100810	907639100810	907639100810
16	RETAINER-BEARING	2	907613225310	907613225310	907613225310
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743102001	918743102001	918743102001
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180610	907612180610	907612180610
* 22	O-RING	1	25BC390	25BC390	25BC390
	(DRIVE END OIL SLINGER)				
23	COVER-DRIVE	1	907684100701	907684100701	907684100701
24	SCREW-HX HD CAP	16	655EE050	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101301	918783101301	918783101301

Ref. No.	DESCRIPTION	No. Req'd	Size 1008 (G_JA)	Size 1011 (G_JB)	Size 1013 (G_JC)
27	SCREW-HX HD CAP (DRIVE SEAL RETAINER TO DRIVE COVER)	4	655ED030	655ED030	655ED030
* 28	SEAL-DRIVE (MITON).....	1	60DD659	60DD659	60DD659
29	GEAR SET-TIMING.....	1	910723103900	910723103900	910723103900
30	HUB-TIMING.....	2	907613063110	907613063110	907613063110
31	BOLT-TIMING GEAR.....	8	655EE070	655EE070	655EE070
32	WASHER-TIMING GEAR.....	8	907649440410	907649440410	907649440410
33	CASE-GEAR.....	1	918754100801	918754100801	918754100801
	CASE-GEAR.....	1	918794103601	918794103601	918794103601
	(FORCE FEED LUBE)				
	CASE-GEAR.....	1	918794103602	918794103602	918794103602
	(FORCE FEED LUBE W/CLR)				
34	SCREW-HX HD CAP.....	16	655EE050	655EE050	655EE050
	(GEAR CASE TO HEADPLATE)				
36	KEY-DRIVE.....	1	907639911110	907639911110	907639911110
38	GLASS-SIGHT.....	1	918811100101	918811100101	918811100101
	(GEAR CASE OIL LEVEL)				
39	CAP-BREATHER FILLER.....	2	907651097510	907651097510	907651097510
40	PIPE-VENT.....	2	201GEJ126	201GEJ126	201GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL-SPLASH ONLY)	1	40L15	40L15	40L15
	PLUG-SQ HD (HEADPLATE DRAIN- SPLASH ONLY)	2	64A7	64A7	64A7
43	PLUG-SQ HD (GEAR CASE DRAIN- SPLASH ONLY)	1	64AA7	64AA7	64AA7
77	LOCKNUT-BEARING (SHAFT).....	2	50Z10	50Z10	50Z10
78	LOCWASHER-BEARING (SHAFT).....	2	95N10	95N10	95N10
79	SCREW-HX HD CAP.....	16	655EF060	655EF060	655EF060
	(PIPE PLATE TO HEADPLATE)				
83	PLUG-CS HD (SIGHT GLASS CONN.....	1	64B4	64B4	64B4
	GEAR END HEADPLATE-SPL/LUBE)				
	PLUG-CS HD (SIGHT GLASS CONN.....	2	64B4	64B4	64B4
	HEADPLATE-FF/LUBE)				
84	PLUG-CS HD (PRESS TAP.....	8	64B2	64B2	64B2
	CONN. IMPELLER CASE)				
+	GROUP-LUBE PIPING.....	1	918791103301	918791103301	918791103301
	(FORCE FEED LUBE)				
+	GROUP-LUBE PIPING.....	1	918791107301	918791107301	918791107301
	(FORCE FEED LUBE W/CLR)				
*	KIT-OVERHAUL.....	0	201GEJ6010	201GEJ6010	201GEJ6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

** Only (8) Required.

Order by Part Number and Description. Reference Numbers for your convenience only.

10" VERTICAL
Reference Figure 2 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1016 (G_JD)	Size 1018 (G_JE)	Size 1021 (G_JF)
1	HEADPLATE	2	918774101101	918774101101	918774101101
	HEADPLATE (GAS PUMP)	2	918774101102	918774101102	918774101102
	HEADPLATE (FORCE FEED LUBE)	2	907684101301	907684101301	907684101301
	HEADPLATE	2	907684101302	907684101302	907684101302
	(FORCE FEED LUBE-GAS PUMP)				
2	CASE-IMPELLER (GEJ 5000)	1	907659040410	907659040510	907659040610
	CASE-IMPELLER (GFJ 6000)	1	907659040410	907659040510	918783102201
3	SCREW-HX HD CAP	48	655EF080	655EF080	655EF080
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER (THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEJ 5000)	1	210GEJ4028	211GEJ4028	212GEJ4028
	GROUP-ROTOR (GFJ 6000)	1	211GFJ4028	212GFJ4028	213GFJ4028
9	CARTRIDGE-BEARING	4	200GEJ571	200GEJ571	200GEJ571
	CARTRIDGE-BEARING (FORCE FEED LUBE) ...	4	202GEJ571	202GEJ571	202GEJ571
	CARTRIDGE-BEARING (GAS PUMP)	4	204GEJ571	204GEJ571	204GEJ571
* 10	SCREW-SOC HD CAP/NYLOK	16	75P76N	75P76N	75P76N
	(BEARING CARTRIDGE TO HEAD-PLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC398	25BC398	25BC398
* 13	SEAL-MAIN (MTON)	4	918761104801	918761104801	918761104801
	SEAL-MECANICAL (GAS PUMP)	4	907639060110	907639060110	907639060110
* 14	BEARING (DRIVE END)	2	907639100110	907639100110	907639100110
* 15	BEARING (GEAR END)	2	907639100810	907639100810	907639100810
16	RETAINER-BEARING	2	907613225310	907613225310	907613225310
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743102001	918743102001	918743102001
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180610	907612180610	907612180610
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC390	25BC390	25BC390
23	COVER-DRIVE	1	907684100701	907684100701	907684100701
24	SCREW-HX HD CAP	16	655EE050	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101301	918783101301	918783101301
27	SCREW-HX HD CAP (DRIVE SEAL	4	655ED030	655ED030	655ED030
	RETAINER TO DRIVE COVER)				
* 28	SEAL-DRIVE (MTON)	1	60DD659	60DD659	60DD659
29	GEAR SET-TIMING	1	910723103900	910723103900	910723103900
30	HUB-TIMING	2	907613063110	907613063110	907613063110
31	BOLT-TIMING GEAR	8	655EE070	655EE070	655EE070

Ref. No.	DESCRIPTION	No. Req'd	Size 1016 (G_JD)	Size 1018 (G_JE)	Size 1021 (G_JF)
32	WASHER-TIMING GEAR.....	8	907649440410	907649440410	907649440410
33	CASE-GEAR.....	1	918754100801	918754100801	918754100801
	CASE-GEAR (FORCE FEED LUBE)	1	918794103601	918794103601	918794103601
	CASE-GEAR (FORCE FEED LUBE W/CLR).....	1	918794103602	918794103602	918794103602
34	SCREW-HX HD CAP..... (GEAR CASE TO HEADPLATE)	16	655EE050	655EE050	655EE050
36	KEY-DRIVE	1	907639911110	907639911110	907639911110
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHER FILLER.....	2	907651097510	907651097510	907651097510
40	PIPE-VENT.....	2	201GEJ126	201GEJ126	201GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL	1	40L15	40L15	40L15
	LEVEL-SPLASH ONLY)				
42	PLUG-SQ HD	2	64A7	64A7	64A7
	(HEADPLATE DRAIN-SPLASH ONLY)				
43	PLUG-SQ HD (GEAR CASE DRAIN-.....	1	64AA7	64AA7	64AA7
	SPLASH ONLY)				
77	LOCKNUT-BEARING (SHAFT)	2	50Z10	50Z10	50Z10
78	LOCWASHER-BEARING (SHAFT).....	2	95N10	95N10	95N10
83	PLUG-CS HD (SIGHT GLASS CONN.	1	64B4	64B4	64B4
	GEAR END HEADPLATE-SPL/LUBE)				
	PLUG-CS HD (SIGHT GLASS CONN.	2	64B4	64B4	64B4
	HEADPLATE-FF/LUBE)				
84	PLUG-CS HD (PRESS TAP CONN.....	2	64B2	64B2	64B2
	IMPELLER CASE)				
+	GROUP-LUBE PIPING (FORCE FEED LUBE) ...	1	918791103301	918791103301	918791103301
+	GROUP-LUBE PIPING.....	1	918791107301	918791107301	918791107301
	(FORCE FEED LUBE W/CLR)				
*	KIT-OVERHAUL	0	201GEJ6010	201GEJ6010	201GEJ6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

10" VERTICAL
Reference Figure 2 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1024 (G_JG)	Size 1030 (G_JH)
1	HEADPLATE	2	918774101101	918774101101
	HEADPLATE (GAS PUMP)	2	918774101102	918774101102
	HEADPLATE (FORCE FEED LUBE)	2	907684101301	907684101301
	HEADPLATE (FORCE FEED LUBE-GAS PUMP)	2	907684101302	907684101302
2	CASE-IMPELLER (GEJ 5000)	1	907699400110	907699400210
	CASE-IMPELLER (GFJ 6000)	1	918783102301	918783102302
3	SCREW-HX HD CAP (HEADPLATE TO IMPELLER CASE)	48	655EF070	655EF070
4	PIN-TAPER(THREADED)	8	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)			
8	GROUP-ROTOR (GEJ 5000)	1	213GEJ4028	214GEJ4028
	GROUP-ROTOR (GFJ 6000)	1	214GFJ4028	215GFJ4028
9	CARTRIDGE-BEARING	4	200GEJ571	200GEJ571
	CARTRIDGE-BEARING (FORCE FEED LUBE)	4	202GEJ571	202GEJ571
	CARTRIDGE-BEARING (GAS PUMP)	4	204GEJ571	204GEJ571
* 10	SCREW-SOC HD CAP/NYLOK	16	75P76N	75P76N
	(BEARING CARTRIDGE TO HEADPLATE)			
* 12	O-RING (BEARING CARTRIDGE)	4	25BC398	25BC398
* 13	SEAL-MAIN (VITON)	4	918761104801	918761104801
	SEAL-MECHANICAL (GAS PUMP)	4	907639060110	907639060110
* 14	BEARING (DRIVE END)	2	907639100110	907639100110
* 15	BEARING (GEAR END)	2	907639100810	907639100810
16	RETAINER-BEARING	2	907613225310	907613225310
* 17	SCREW-HX HD CAP/NYLOK (BEARING RETAINER TO	8	75A33N	75A33N
	BEARING CARTRIDGE)			
* 18	SHIM SET	1	907649460010	907649460010
19	SLINGER-OIL	1	918743102001	918743102001
* 20	SCREW-SOC HD CAP/NYLOK (OIL SLINGER)	1	75P9N	75P9N
21	RING-BACK UP	2	907612180610	907612180610
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC390	25BC390
23	COVER-DRIVE	1	907684100701	907684100701
24	SCREW-HX HD CAP (DRIVE COVER TO HEADPLATE)	16	655EE050	655EE050
25	PIN-DOWEL (DRIVE COVER AND GEAR CASE TO	2	62M82	62M82
	HEADPLATE)			
26	RETAINER-DRIVE SEAL	1	918783101301	918783101301
27	SCREW-HX HD CAP	4	655ED030	655ED030
	(DRIVE SEAL RETAINER TO DRIVE COVER)			
* 28	SEAL-DRIVE (VITON)	1	60DD659	60DD659
29	GEAR SET-TIMING	1	910723103900	910723103900
30	HUB-TIMING	2	907613063110	907613063110
31	BOLT-TIMING GEAR	8	655EE070	655EE070
32	WASHER-TIMING GEAR	8	907649440410	907649440410

Ref. No.	DESCRIPTION	No. Req'd	Size 1024 (G_JG)	Size 1030 (G_JH)
33	CASE-GEAR.....	1	918754100801	918754100801
	CASE-GEAR (FORCE FEED LUBE)	1	918794103601	918794103601
	CASE-GEAR (FORCE FEED LUBE W/CLR).....	1	918794103602	918794103602
34	SCREW-HX HD CAP (GEAR CASE TO HEADPLATE)	16	655EE050	655EE050
36	KEY-DRIVE.....	1	907639911110	907639911110
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101
39	CAP-BREATHER FILLER.....	2	907651097510	907651097510
40	PIPE-VENT.....	2	201GEJ126	201GEJ126
41	GLASS-SIGHT..... (DRIVE COVER OIL LEVEL-SPLASH ONLY)	1	40L15	40L15
42	PLUG-SQ HD (HEADPLATE DRAIN-SPLASH ONLY)	2	64A7	64A7
43	PLUG-SQ HD (GEAR CASE DRAIN SPLASH ONLY).....	1	64AA7	64AA7
77	LOCKNUT-BEARING (SHAFT)	2	50Z10	50Z10
78	LOCWASHER-BEARING (SHAFT).....	2	95N1	95N10
83	PLUG-CS HD (SIGHT GLASS CONN. GEAR END HEADPLATE-SPL/LUBE)	1	64B4	64B4
	PLUG-CS HD (SIGHT GLASS CONN. HEADPLATE-FF/LUBE)	2	64B4	64B4
84	PLUG-CS HD (PRESS TAP CONN. IMPELLER CASE)	2	64B2	64B2
+	GROUP-LUBE PIPING (FORCE FEED LUBE)	1	918791103301	918791103301
	GROUP-LUBE PIPING (FORCE FEED LUBE W/CLR).....	1	918791107301	918791107301
*	KIT-OVERHAUL	0	201GEJ6010	201GEJ6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

12" VERTICAL
Reference Figure 1 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1213 (G_KA)	Size 1216 (G_KB)
1	HEADPLATE	2	918784121101	918784121101
	HEADPLATE (GAS PUMP)	2	918784121102	918784121102
	HEADPLATE (FORCE FEED LUBE)	2	907684122001	907684122001
	HEADPLATE (FORCE FEED LUBE-GAS PUMP)	2	907684122002	907684122002
2	GROUP-IMPELLER CASE	1	200GFK4042	201GFK4042
3	SCREW-HX HD CAP (HEADPLATE TO IMPELLER CASE)	32	655EF090	655EF090
4	PIN-TAPER(THREADED)	8	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)			
5	PLATE-TOP PIPE	2	907603656312	907613074212
7	SCREW-HX HD CAP (PIPE PLATE TO IMPELLER CASE)	16	655EF080 **	655EF080
8	GROUP-ROTOR (GEK 5000)	1	208GEK4028	209GEK4028
	GROUP-ROTOR (GFK 6000)	1	200GFK4028	208GFK4028
9	CARTRIDGE-BEARING	4	918823121501	918823121501
	CARTRIDGE-BEARING (FORCE FEED LUBE)	4	907833120401	907833120401
	CARTRIDGE-BEARING (GAS PUMP)	4	907833120601	907833120601
* 10	SCREW-HEX CAP/NYLOK	16	655EE07N	655EE07N
	(BEARING CARTRIDGE TO HEADPLATE)			
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104802	918761104802
	SEAL-MECHANICAL (GAS PUMP)	4	907639060212	907639060212
* 14	BEARING (DRIVE END)	2	907639100212	907639100212
* 15	BEARING (GEAR END)	2	907639100912	907639100912
16	RETAINER-BEARING	2	907613076412	907613076412
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)			
* 18	SHIM SET	1	907649460010	907649460010
19	SLINGER-OIL	1	918743120601	918743120601
* 20	SCREW-SOC HD CAP/NYLOK (OIL SLINGER)	1	75P9N	75P9N
21	RING-BACK UP	2	907612180712	907612180712
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC391	25BC391
23	COVER-DRIVE	1	907643048712	907643048712
24	SCREW-HX HD CAP (DRIVE COVER TO HEADPLATE)	14	655EE050	655EE050
25	PIN-DOWEL (DRIVE COVER AND GEAR CASE TO	2	62M82	62M82
	HEADPLATE)			
26	RETAINER-DRIVE SEAL	1	918783101302	918783101302
27	SCREW-HX HD CAP	4	655ED030	655ED030
	(DRIVE SEAL RETAINER TO DRIVE COVER)			
* 28	SEAL-DRIVE (VITON)	1	60DD660	60DD660
29	GEAR SET-TIMING	1	907743121200	907743121200
30	HUB-TIMING	2	907613071112	907613071112
31	BOLT-TIMING GEAR	8	655EF080	655EF080
32	WASHER-TIMING GEAR	8	907649440712	907649440712

Ref. No.	DESCRIPTION	No. Req'd	Size 1213 (G_KA)	Size 1216 (G_KB)
33	CASE-GEAR	1	918754121801	918754121801
	CASE-GEAR (FORCE FEED LUBE)	1	918783123501	918783123501
	CASE-GEAR (FF LUBE W/COOLER)	1	918783123502	918783123502
34	SCREW-HX HD CAP	14	655EE050	655EE050
	(GEAR CASE TO HEADPLATE)			
36	KEY-DRIVE.....	1	907639911212	907639911212
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101
39	CAP-BREATHER FILLER	2	907651097510	907651097510
40	PIPE-VENT	2	202GEJ126	202GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL)(SPL/LUBE)	1	40L15	40L15
42	PLUG-SQ HD (HEADPLATE DRAIN)(SPL/LUBE)	2	64A7	64A7
43	PLUG-SQ HD (GEAR CASE DRAIN)(SPL/LUBE)	1	64AA7	64AA7
77	LOCKNUT-BEARING (SHAFT)	2	50Z12	50Z12
78	LOCWASHER-BEARING (SHAFT).....	2	95N12	95N12
79	SCREW-HX HD CAP (PIPE PLATE TO HEADPLATE).....	20	655EF070	655EF070
83	PLUG-CS HD (SIGHT GLASS CONN. GEAR END	1	64B4	64B4
	HEADPLATE-SPL/LUBE)			
	PLUG-CS HD	2	64B4	64B4
	(SIGHT GLASS CONN. HEADPLATE-FF/LUBE)			
84	PLUG-CS HD	8	64B2	64B2
	(PESS TAP CONN. IMPELLER CASE)			
+	GROUP-LUBE PIPING (FORCE FEED LUBE)	1	200GEK4012	200GEK4012
+	GROUP-LUBE PIPING (FORCE FEED W/COOLER)	1	918791126801	918791126801
*	KIT-OVERHAUL	0	201GEK6010	201GEK6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

** Only (12) Required.

Order by Part Number and Description. Reference Numbers for your convenience only.

12" VERTICAL
Reference Figure 2 for Exploded View

Ref. No.	Description	No Req'd	Size 1218 (G_KC)	Size 1220 (G_KD)	Size 1223 (G_KE)
1	HEADPLATE	2	918774122401	918774122401	918774122401
	HEADPLATE (GAS PUMP)	2	918774122402	918774122402	918774122402
	HEADPLATE (FORCE FEED LUBE)	2	907684121801	907684121801	907684121801
	HEADPLATE	2	907684121802	907684121802	907684121802
	(FORCE FEED LUBE-GAS PUMP)				
2	CASE-IMPELLER	1	907689240112	907689240212	907679060112
3	SCREW-HX HD CAP	44	655EF090	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER(THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEK 5000)	1	210GEK4028	211GEK4028	212GEK4028
	GROUP-ROTOR (GFK 6000)	1	209GFK4028	210GFK4028	211GFK4028
9	CARTRIDGE-BEARING	4	918823121501	918823121501	918823121501
	CARTRIDGE-BEARING (FORCE FEED LUBE) ..	4	907833120401	907833120401	907833120401
	CARTRIDGE-BEARING (GAS PUMP)	4	907833120601	907833120601	907833120601
* 10	SCREW-HEX CAP/NYLOK	16	655EE07N	655EE07N	655EE07N
	(BEARING CARTRIDGE TO HEAD-PLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104802	918761104802	918761104802
	SEAL-MECHANICAL (GAS PUMP)	4	907639060212	907639060212	907639060212
* 14	BEARING (DRIVE END)	2	907639100212	907639100212	907639100212
* 15	BEARING (GEAR END)	2	907639100912	907639100912	907639100912
16	RETAINER-BEARING	2	907613076412	907613076412	907613076412
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743120601	918743120601	918743120601
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180712	907612180712	907612180712
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC391	25BC391	25BC391
23	COVER-DRIVE	1	907643048712	907643048712	907643048712
24	SCREW-HX HD CAP	14	655EE050	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101302	918783101302	918783101302
27	SCREW-HX HD CAP (DRIVE SEAL RETAINER...	4	655ED030	655ED030	655ED030
	TO DRIVE COVER)				
* 28	SEAL-DRIVE (VITON)	1	60DD660	60DD660	60DD660
29	GEAR SET-TIMING	1	907743121200	907743121200	907743121200
30	HUB-TIMING	2	907613071112	907613071112	907613071112
31	BOLT-TIMING GEAR	8	655EF080	655EF080	655EF080
32	WASHER-TIMING GEAR	8	907649440712	907649440712	907649440712

Ref. No.	Description	No Req'd	Size 1218 (G_KC)	Size 1220 (G_KD)	Size 1223 (G_KE)
33	CASE-GEAR	1	918754121801	918754121801	918754121801
	CASE-GEAR (FORCE FEED LUBE)	1	918783123501	918783123501	918783123501
	CASE-GEAR (FF LUBE W/COOLER)	1	918783123502	918783123502	918783123502
34	SCREW-HX HD CAP..... (GEAR CASE TO HEADPLATE)	14	655EE050	655EE050	655EE050
36	KEY-DRIVE.....	1	907639911212	907639911212	907639911212
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHING FILLER	2	907651097510	907651097510	907651097510
40	PIPE-VENT	2	202GEJ126	202GEJ126	202GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL)..... (SPL/LUBE)	1	40L15	40L15	40L15
42	PLUG-SQ HD	2	64A7	64A7	64A7
	(HEADPLATE DRAIN)(SPL/LUBE)				
43	PLUG-SQ HD (GEAR CASE DRAIN)	1	64AA7	64AA7	64AA7
	(SPL/LUBE)				
77	LOCKNUT-BEARING (SHAFT)	1	50Z12	50Z12	50Z12
78	LOCWASHER-BEARING (SHAFT).....	1	95N12	95N12	95N12
83	PLUG-CS HD (SIGHT GLASS CONN.	1	64B4	64B4	64B4
	GEAR END HEADPLATE-SPL/LUBE)				
	PLUG-CS HD (SIGHT GLASS CONN.	2	64B4	64B4	64B4
	HEADPLATE-FF/LUBE)				
	PLUG-CS HD (PRESS TAP	2	64B2	64B2	64B2
	CONN. IMPELLER CASE)				
+	GROUP-LUBE PIPING	1	918791123301	918791123301	918791123301
	(FORCE FEED LUBE)				
+	GROUP-LUBE PIPING	1	201GEK4012	201GEK4012	201GEK4012
	(FORCE FEED LUBE W/COOLER)				
*	KIT-OVERHAUL	0	201GEK6010	201GEK6010	201GEK6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

12" VERTICAL
Reference Figure 2 for Exploded View

Ref. No.	Description	No Req'd	Size 1226 (G_KF)	Size 1230 (G_KG)	Size 1236 (G_KH)
1	HEADPLATE	2	918774122401	918774122401	918774122401
	HEADPLATE (GAS PUMP)	2	918774122402	918774122402	918774122402
	HEADPLATE (FORCE FEED LUBE)	2	907684121801	907684121801	907684121801
	HEADPLATE	2	907684121802	907684121802	907684121802
	(FORCE FEED LUBE-GAS PUMP)				
2	CASE-IMPELLER	1	907679060212	907679070112	907679070212
3	SCREW-HX HD CAP	44	655EF090	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER(THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEK 5000)	1	213GEK4028	214GEK4028	215GEK4028
	GROUP-ROTOR (GFK 6000)	1	212GFK4028	213GFK4028	214GFK4028
9	CARTRIDGE-BEARING	4	918823121501	918823121501	918823121501
	CARTRIDGE-BEARING (FORCE FEED LUBE) ..	4	907833120401	907833120401	907833120401
	CARTRIDGE-BEARING (GAS PUMP)	4	907833120601	907833120601	907833120601
* 10	SCREW-HEX CAP/NYLOK (BEARING	16	655EE07N	655EE07N	655EE07N
	CARTRIDGE TO HEAD-PLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400	25BC400
* 13	SEAL-MAIN (MTON)	4	918761104802	918761104802	918761104802
	SEAL-MECHANICAL (GAS PUMP)	4	907639060212	907639060212	907639060212
* 14	BEARING (DRIVE END)	2	907639100212	907639100212	907639100212
* 15	BEARING (GEAR END)	2	907639100912	907639100912	907639100912
16	RETAINER-BEARING	2	907613076412	907613076412	907613076412
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743120601	918743120601	918743120601
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180712	907612180712	907612180712
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC391	25BC391	25BC391
23	COVER-DRIVE	1	907643048712	907643048712	907643048712
24	SCREW-HX HD CAP	14	655EE050	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101302	918783101302	918783101302
27	SCREW-HX HD CAP (DRIVE SEAL	4	655ED030	655ED030	655ED030
	RETAINER TO DRIVE COVER)				
* 28	SEAL-DRIVE (VITON)	1	60DD660	60DD660	60DD660
29	GEAR SET-TIMING	1	907743121200	907743121200	907743121200
30	HUB-TIMING	2	907613071112	907613071112	907613071112
31	BOLT-TIMING GEAR	8	655EF080	655EF080	655EF080
32	WASHER-TIMING GEAR	8	907649440712	907649440712	907649440712

Ref. No.	Description	No Req'd	Size 1226 (G_KF)	Size 1230 (G_KG)	Size 1236 (G_KH)
33	CASE-GEAR	1	918754121801	918754121801	918754121801
	CASE-GEAR (FORCE FEED LUBE)	1	918783123501	918783123501	918783123501
	CASE-GEAR (FF LUBE W/COOLER)	1	918783123502	918783123502	918783123502
34	SCREW-HX HD CAP..... (GEAR CASE TO HEADPLATE)	14	655EE050	655EE050	655EE050
36	KEY-DRIVE.....	1	907639911212	907639911212	907639911212
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHING FILLER	2	907651097510	907651097510	907651097510
40	PIPE-VENT	2	202GEJ126	202GEJ126	202GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL)..... (SPL/LUBE)	1	40L15	40L15	40L15
42	PLUG-SQ HD (HEADPLATE DRAIN)	2	64A7	64A7	64A7
	(SPL/LUBE)				
43	PLUG-SQ HD (GEAR CASE DRAIN)	1	64AA7	64AA7	64AA7
	(SPL/LUBE)				
77	LOCKNUT-BEARING (SHAFT)	1	50Z12	50Z12	50Z12
78	LOCWASHER-BEARING (SHAFT).....	1	95N12	95N12	95N12
83	PLUG-CS HD (SIGHT GLASS CONN.GEAR END HEADPLATE-SPL/LUBE)	1	64B4	64B4	64B4
	PLUG-CS HD (SIGHT GLASS CONN..... HEADPLATE-FF/LUBE)	2	64B4	64B4	64B4
	PLUG-CS HD (PRESS TAP	2	64B2	64B2	64B2
	CONN. IMPELLER CASE)				
+	GROUP-LUBE PIPING..... (FORCE FEED LUBE)	1	918791123301	918791123301	918791123301
+	GROUP-LUBE PIPING	1	201GEK4012	201GEK4012	201GEK4012
	(FORCE FEED LUBE W/COOLER)				
*	KIT-OVERHAUL	0	201GEK6010	201GEK6010	201GEK6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

14" VERTICAL
Reference Figure 1 for Exploded View

Ref. No.	Description	No Req'd	Size 1415 (G_LA)	Size 1419 (G_LB)
1	HEADPLATE	2	918784143201	918784143201
	HEADPLATE (GAS PUMP)	2	918784143202	918784143202
	HEADPLATE (FORCE FEED LUBE)	2	907684140701	907684140701
	HEADPLATE (FORCE FEED LUBE-GAS PUMP)	2	907684140702	907684140702
2	GROUP-IMPELLER CASE	1	200GFL4042	201GFL4042
3	SCREW-HX HD CAP (HEADPLATE TO IMPELLER CASE)	40	655EF090	655EF090
4	PIN-TAPER (THREADED)	8	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)			
5	PLATE-TOP PIPE (GEL 5000)	1	907603669214	907603670114
	PLATE-TOP PIPE (GFL 6000)	1	918793140001	907603670114
7	SCREW-HX HD CAP	16	655EF080 **	655EF080
	(PIPE PLATE TO IMPELLER CASE)			
8	GROUP-ROTOR (GEL 5000)	1	208GEL4028	209GEL4028
	GROUP-ROTOR (GFL 6000)	1	208GFL4028	228GFL4028
9	CARTRIDGE-BEARING	4	918823142001	918823142001
	CARTRIDGE-BEARING (FORCE FEED LUBE)	4	907833140001	907833140001
	CARTRIDGE-BEARING (GAS PUMP)	4	907833140101	907833140101
10	SCREW-SOC HD CAP	16	655EE060	655EE060
	(BEARING CARTRIDGE TO HEADPLATE)			
* 11	CLIP-LOCKING	16	907721082303	907721082303
	(BEARING CARTRIDGE TO HEADPLATE)			
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104803	918761104803
	SEAL-MECHANICAL (GAS PUMP)	4	907639060314	907639060314
* 14	BEARING (DRIVE END)	2	907639100314	907639100314
* 15	BEARING (GEAR END)	2	907639101014	907639101014
16	RETAINER-BEARING	2	907613225414	907613225414
* 17	SCREW-HX HD CAP/NYLOK	8	75A33N	75A33N
	(BEARING RETAINER TO BEARING CARTRIDGE)			
* 18	SHIM SET	1	907649460010	907649460010
19	SLINGER-OIL	1	918743141201	918743141201
* 20	SCREW-SOC HD CAP/NYLOK (OIL SLINGER)	1	75P9N	75P9N
21	RING-BACK UP	2	907612180814	907612180814
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC392	25BC392
23	COVER-DRIVE	1	907613097214	907613097214
24	SCREW-HX HD CAP	24	655EE060	655EE060
	(DRIVE COVER TO HEADPLATE)			
25	PIN-DOWEL (DRIVE COVER AND GEAR CASE	2	62M82	62M82
	TO HEADPLATE)			
26	RETAINER-DRIVE SEAL	1	918783101303	918783101303
27	SCREW-HX HD CAP	4	655ED030	655ED030
	(DRIVE SEAL RETAINER TO DRIVE COVER)			
* 28	SEAL-DRIVE (VITON)	1	60DD661	60DD661
29	GEAR SET-TIMING	1	907743141600	907743141600
30	HUB-TIMING	2	907613098514	907613098514

Ref. No.	Description	No Req'd	Size 1415 (G_LA)	Size 1419 (G_LB)
31	BOLT-TIMING GEAR	12	655EG090	655EG090
32	WASHER-TIMING GEAR.....	12	907649440814	907649440814
33	CASE-GEAR.....	1	918754141301	918754141301
	CASE-GEAR (FORCE FEED LUBE)	1	918794142301	918794142301
	CASE-GEAR (FORCE FEED LUBE W/CLR).....	1	918794142302	918794142302
34	SCREW-HX HD CAP (GEAR CASE TO HEADPLATE)	24	655EE060	655EE060
36	KEY-DRIVE.....	1	907639911314	907639911314
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101
39	CAP-BREATHING FILLER.....	2	907651097510	907651097510
40	PIPE-VENT	2	203GEJ126	203GEJ126
41	GLASS-SIGHT..... (DRIVE COVER OIL LEVEL-SPLASH ONLY)	1	40L15	40L15
42	PLUG-SQ HD	2	64A7	64A7
	(HEADPLATE DRAIN-SPLASH ONLY)			
43	PLUG-SQ HD	1	64AA7	64AA7
	(GEAR CASE DRAIN SPLASH ONLY)			
77	LOCKNUT-BEARING (SHAFT)	2	50Z14	50Z14
78	LOCWASHER-BEARING (SHAFT).....	2	95N14	95N14
79	SCREW-HX HD CAP.....	20	655EF070	655EF070
	(PIPE PLATE TO HEADPLATE)			
	PLUG-CS HD (SIGHT GLASS CONN.	1	64B4	64B4
	GEAR END HEADPLATE-SPL/LUBE)			
	PLUG-CS HD	2	64B4	64B4
	(SIGHT GLASS CONN. HEADPLATE-FF/LUBE)			
84	PLUG-CS HD	8	64B2	64B2
	(PRESS TAP CONN. IMPELLER CASE)			
+	GROUP-LUBE PIPING.....	1	918791142201	918791142201
	(FORCE FEED LUBE)			
+	GROUP-LUBE PIPING.....	1	918791145501	918791145501
	(FORCE FEED LUBE W/CLR)			
*	KIT-OVERHAUL	0	201GEL6010	201GEL6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

** Only (12) required.

Order by Part Number and Description. Reference Numbers for your convenience only.

14" VERTICAL
Reference Figure 2 for Exploded View

Ref. No.	Description	No Req'd	Size 1421 (G_LC)	Size 1423 (G_LD)	Size 1426 (G_LE)
1	HEADPLATE	2	918774140701	918774140701	918774140701
	HEADPLATE (GAS PUMP)	2	918774140702	918774140702	918774140702
	HEADPLATE (FORCE FEED LUBE)	2	907684140501	907684140501	907684140501
	HEADPLATE (FORCE FEED LUBE-GAS PUMP)	2	907684140502	907684140502	907684140502
2	CASE-IMPELLER	1	907699060114	907699060214	907699060314
3	SCREW-HX HD CAP	52	655EF090	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER (THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEL 5000)	1	210GEL4028	211GEL4028	212GEL4028
	GROUP-ROTOR (GFL 6000)	1	209GFL4028	210GFL4028	211GFL4028
9	CARTRIDGE-BEARING	4	918823142001	918823142001	918823142001
	CARTRIDGE-BEARING (FORCE FEED LUBE) ..	4	907833140001	907833140001	907833140001
	CARTRIDGE-BEARING (GAS PUMP)	4	907833140101	907833140101	907833140101
10	SCREW-SOC HD CAP	16	655EE060	655EE060	655EE060
	(BEARING CARTRIDGE TO HEAD-PLATE)				
* 11	CLIP-LOCKING (BEARING	16	907721082303	907721082303	907721082303
	CARTRIDGE TO HEADPLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104803	918761104803	918761104803
	SEAL-MECHANICAL (GAS PUMP)	4	907639060314	907639060314	907639060314
* 14	BEARING (DRIVE END)	2	907639100314	907639100314	907639100314
* 15	BEARING (GEAR END)	2	907639101014	907639101014	907639101014
16	RETAINER-BEARING	2	907613225414	907613225414	907613225414
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743141201	918743141201	918743141201
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180814	907612180814	907612180814
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC392	25BC392	25BC392
23	COVER-DRIVE	1	907613097214	907613097214	907613097214
24	SCREW-HX HD CAP	24	655EE060	655EE060	655EE060
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101303	918783101303	918783101303
27	SCREW-HX HD CAP (DRIVE SEAL	4	655ED030	655ED030	655ED030
	RETAINER TO DRIVE COVER)				
* 28	SEAL-DRIVE (VITON)	1	60DD661	60DD661	60DD661
29	GEAR SET-TIMING	1	907743141600	907743141600	907743141600
30	HUB-TIMING	2	907613098514	907613098514	907613098514
31	BOLT-TIMING GEAR	12	655EG090	655EG090	655EG090
32	WASHER-TIMING GEAR	12	907649440814	907649440814	907649440814

Ref. No.	Description	No Req'd	Size 1421 (G_LC)	Size 1423 (G_LD)	Size 1426 (G_LE)
33	CASE-GEAR	1	918754141301	918754141301	918754141301
	CASE-GEAR (FORCE FEED LUBE)	1	918794142301	918794142301	918794142301
	CASE-GEAR (FORCE FEED LUBE W/CLR).....	1	918794142302	918794142302	918794142302
34	SCREW-HX HD CAP..... (GEAR CASE TO HEADPLATE)	24	655EE060	655EE060	655EE060
36	KEY-DRIVE.....	1	907639911314	907639911314	907639911314
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHER FILLER	2	907651097510	907651097510	907651097510
40	PIPE-VENT	2	203GEJ126	203GEJ126	203GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL-..... SPLASH ONLY)	1	40L15	40L15	40L15
42	PLUG-SQ HD	2	64A7	64A7	64A7
	(HEADPLATE DRAIN-SPLASH ONLY)				
43	PLUG-SQ HD (GEAR CASE DRAIN-..... SPLASH ONLY)	1	64AA7	64AA7	64AA7
77	LOCKNUT-BEARING (SHAFT)	2	50Z14	50Z14	50Z14
78	LOCWASHER-BEARING (SHAFT).....	2	95N14	95N14	95N14
83	PLUG-CS HD (SIGHT GLASS CONN..... GEAR END HEADPLATE-SPL/LUBE)	1	64B4	64B4	64B4
	PLUG-CS HD (SIGHT GLASS CONN..... HEADPLATE-FF/LUBE)	2	64B4	64B4	64B4
84	PLUG-CS HD (PRESS TAP CONN. IMPELLER CASE)	2	64B2	64B2	64B2
+	GROUP-LUBE PIPING (FORCE FEED LUBE) ...	1	918791142201	918791142201	918791142201
+	GROUP-LUBE PIPING	1	918791145501	918791145501	918791145501
	(FORCE FEED LUBE W/CLR)				
*	KIT-OVERHAUL	0	201GEL6010	201GEL6010	201GEL6010

+ Not shown, refer to Section C for Parts List

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

14" VERTICAL

Reference Figure 2 for Exploded View

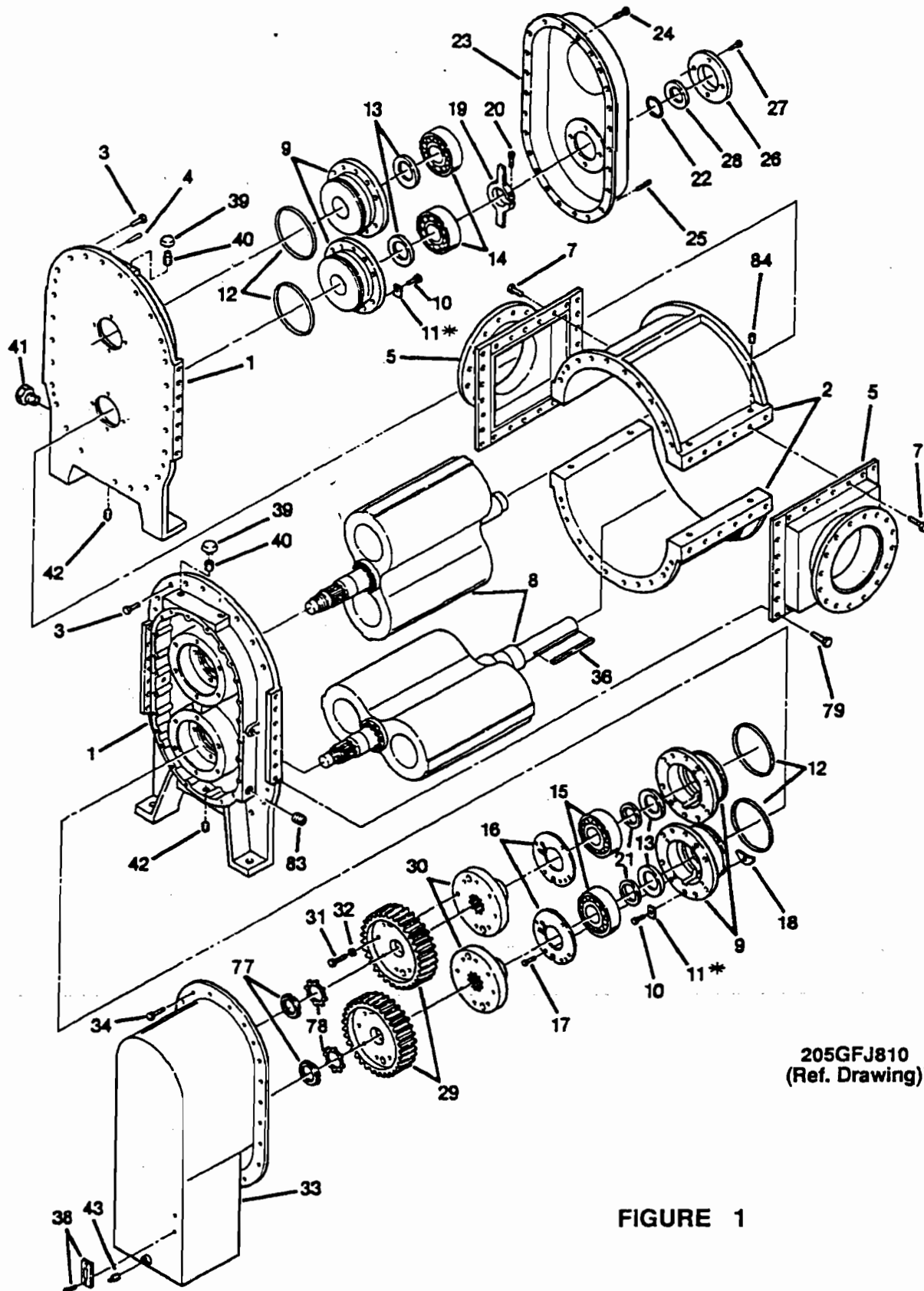
Ref. No.	Description	No Req'd	Size 1431 (G_LF)	Size 1437 (G_LG)	Size 1442 (G_LH)
1	HEADPLATE-	2	918774140701	918774140701	918774140701
	HEADPLATE (GAS PUMP)	2	918774140702	918774140702	918774140702
	HEADPLATE (FORCE FEED LUBE)	2	907684140501	907684140501	907684140501
	HEADPLATE (FORCE FEED LUBE-GAS PUMP)	2	907684140502	907684140502	907684140502
2	CASE-IMPELLER	1	907679080114	907679080214	907679080314
3	SCREW-HX HD CAP	52	655EF090	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER(THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEL 5000)	1	213GEL4028	214GEL4028	215GEL4028
	GROUP-ROTOR (GFL 6000)	1	212GFL4028	213GFL4028	214GFL4028
9	CARTRIDGE-BEARING	4	918823142001	918823142001	918823142001
	CARTRIDGE-BEARING (FORCE FEED LUBE) ..	4	907833140001	907833140001	907833140001
	CARTRIDGE-BEARING (GAS PUMP)	4	907833140101	907833140101	907833140101
10	SCREW-SOC HD CAP (BEARING	16	655EE060	655EE060	655EE060
	CARTRIDGE TO HEAD-PLATE)				
* 11	CLIP-LOCKING (BEARING	16	907721082303	907721082303	907721082303
	CARTRIDGE TO HEADPLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104803	918761104803	918761104803
	SEAL-MECHANICAL (GAS PUMP)	4	907639060314	907639060314	907639060314
* 14	BEARING (DRIVE END)	2	907639100314	907639100314	907639100314
* 15	BEARING (GEAR END)	2	907639101014	907639101014	907639101014
16	RETAINER-BEARING	2	907613225414	907613225414	907613225414
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743141201	918743141201	918743141201
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180814	907612180814	907612180814
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC392	25BC392	25BC392
23	COVER-DRIVE	1	907613097214	907613097214	907613097214
24	SCREW-HX HD CAP	24	655EE060	655EE060	655EE060
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101303	918783101303	918783101303
27	SCREW-HX HD CAP (DRIVE SEAL	4	655ED030	655ED030	655ED030
	RETAINER TO DRIVE COVER)				
* 28	SEAL-DRIVE (VITON)	1	60DD661	60DD661	60DD661
29	GEAR SET-TIMING	1	907743141600	907743141600	907743141600
30	HUB-TIMING	2	907613098514	907613098514	907613098514
31	BOLT-TIMING GEAR	12	655EG090	655EG090	655EG090

Ref. No.	Description	No Req'd	Size 1431 (G_LF)	Size 1437 (G_LG)	Size 1442 (G_LH)
32	WASHER-TIMING GEAR.....	12	907649440814	907649440814	907649440814
33	CASE-GEAR	1	918754141301	918754141301	918754141301
	CASE-GEAR (FORCE FEED LUBE)	1	918794142301	918794142301	918794142301
	CASE-GEAR	1	918794142302	918794142302	918794142302
	(FORCE FEED LUBE W/CLR)				
34	SCREW-HX HD CAP.....	24	655EE060	655EE060	655EE060
	(GEAR CASE TO HEADPLATE)				
36	KEY-DRIVE.....	1	907639911314	907639911314	907639911314
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHER FILLER.....	2	907651097510	907651097510	907651097510
40	PIPE-VENT	2	203GEJ126	203GEJ126	203GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL.....	1	40L15	40L15	40L15
	SPLASH ONLY)				
42	PLUG-SQ HD	2	64A7	64A7	64A7
	(HEADPLATE DRAIN-SPLASH ONLY)				
43	PLUG-SQ HD (GEAR CASE DRAIN.....	1	64AA7	64AA7	64AA7
	SPLASH ONLY)				
77	LOCKNUT-BEARING (SHAFT)	2	50Z14	50Z14	50Z14
78	LOCWASHER-BEARING (SHAFT).....	2	95N14	95N14	95N14
83	PLUG-CS HD (SIGHT GLASS CONN.....	1	64B4	64B4	64B4
	GEAR END HEADPLATE-SPL/LUBE)				
	PLUG-CS HD (SIGHT GLASS CONN.....	2	64B4	64B4	64B4
	HEADPLATE-FF/LUBE)				
84	PLUG-CS HD (PRESS TAP CONN.	2	64B2	64B2	64B2
	IMPELLER CASE)				
+	GROUP-LUBE PIPING.....	1	918791142201	918791142201	918791142201
	(FORCE FEED LUBE)				
+	GROUP-LUBE PIPING.....	1	918791145501	918791145501	918791145501
	(FORCE FEED LUBE W/CLR)				
*	KIT-OVERHAUL	0	201GEL6010	201GEL6010	201GEL6010

+ Not shown.

* Included in Overhaul Kit.

VERTICAL CONSTRUCTION
(TWO PIECE CASE)

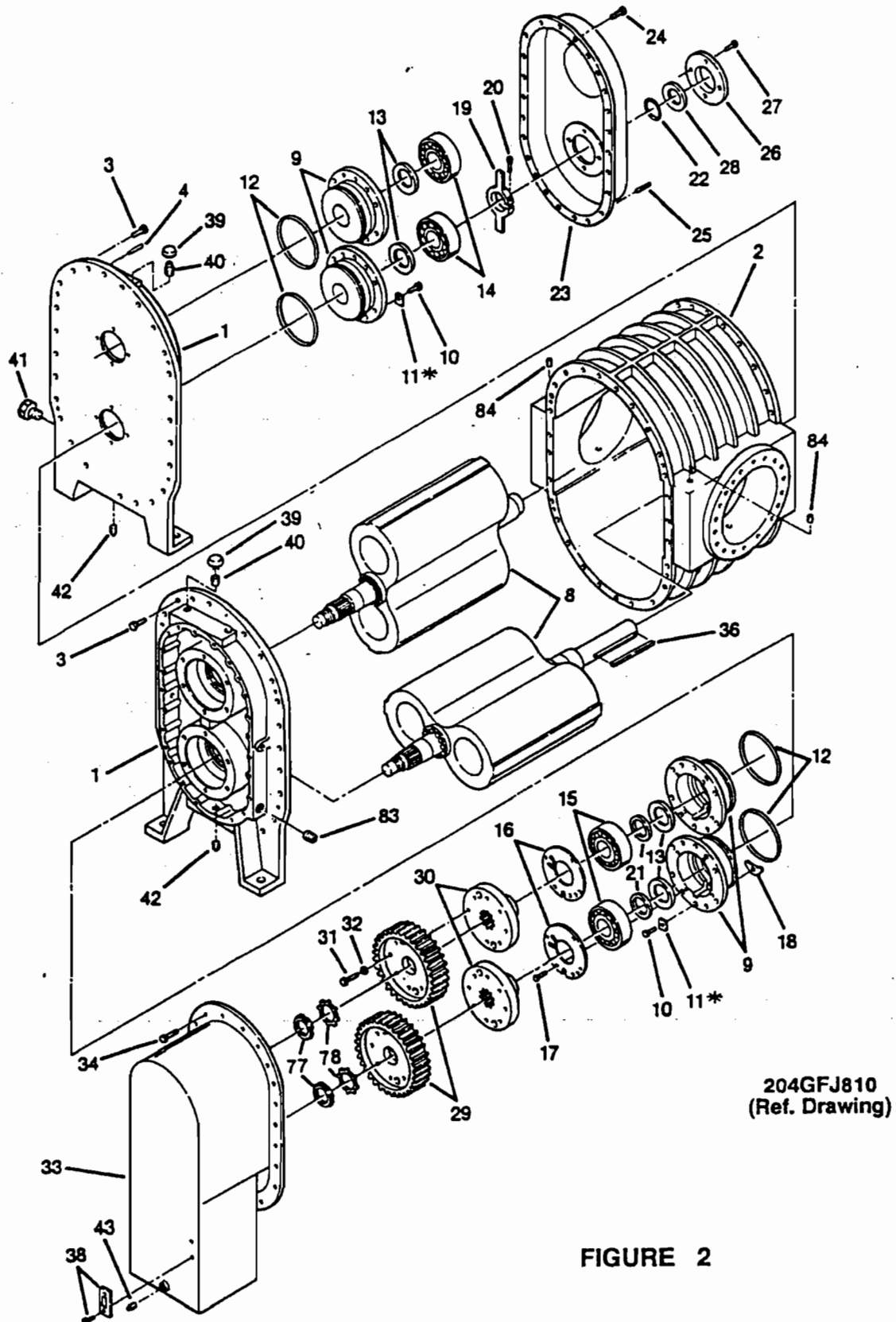


205GFJ810
(Ref. Drawing)

FIGURE 1

* USE WITH 14" GEAR DIA. ONLY.

VERTICAL CONSTRUCTION
(ONE PIECE CASE)



204GFJ810
(Ref. Drawing)

FIGURE 2

* USE WITH 14" GEAR DIA. ONLY.

SECTION B HORIZONTAL CONSTRUCTION

Order by Part Number and Description. Reference Numbers for your convenience only.

10" HORIZONTAL Reference Figure 3 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1008 (G_JA)	Size 1011 (G_JB)	Size 1013 (G_JC)
1	HEADPLATE	2	918794100701	918794100701	918794100701
	HEADPLATE (GAS PUMP)	2	918794100702	918794100702	918794100702
	HEADPLATE (FORCE FEED LUBE)	2	907684101101	907684101101	907684101101
	HEADPLATE (FORCE FEED LUBE- GAS PUMP)	2	907684101102	907684101102	907684101102
2	GROUP-IMPELLER CASE	1	200GFJ4042	201GFJ4042	202GFJ4042
3	SCREW-HX HD CAP	32	655EF080	655EF080	655EF080
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER (THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
5	PLATE-TOP PIPE (GEJ 5000)	1	907613193110	907603672110	907613062210
	PLATE-TOP PIPE (GFJ 6000)	1	918793100801	907603672110	918793100301
6	PLATE-BOTTOM PIPE (GEJ 5000)	1	907613193210	907603672210	907613062310
	PLATE-BOTTOM PIPE (GFJ 6000)	1	918793100901	907603672210	918793100401
7	SCREW-HX HD CAP	12	655EF070 **	655EF070	655EF070
	(PIPE PLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEJ 5000)	1	208GEJ4028	201GEJ4028	209GEJ4028
	GROUP-ROTOR (GFJ 6000)	1	208GFJ4028	209GFJ4028	210GFJ4028
9	CARTRIDGE-BEARING	4	200GEJ571	200GEJ571	200GEJ571
	CARTRIDGE-BEARING (FORCE FEED LUBE) ...	4	202GEJ571	202GEJ571	202GEJ571
	CARTRIDGE-BEARING (GAS PUMP)	4	204GEJ571	204GEJ571	204GEJ571
* 10	SCREW-SOC HD CAP/NYLOK	16	75P76N	75P76N	75P76N
	(BEARING CARTRIDGE TO HEAD-PLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC398	25BC398	25BC398
* 13	SEAL-MAIN (MITON)	4	918761104801	918761104801	918761104801
	SEAL-MECHANICAL (GAS PUMP)	4	907639060110	907639060110	907639060110
* 14	BEARING (DRIVE END)	2	907639100110	907639100110	907639100110
* 15	BEARING (GEAR END)	2	907639100810	907639100810	907639100810
16	RETAINER-BEARING	2	907613225310	907613225310	907613225310
* 17	SCREW-HX HD CAP/NYLOK (BEARING RETAINER TO BEARING CARTRIDGE)	8	75A33N	75A33N	75A33N
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743102001	918743102001	918743102001
* 20	SCREW-SOC HD CAP/NYLOK (OIL SLINGER)...	1	75P9N	75P9N	75P9N
21	RING-BACK UP	2	907612180610	907612180610	907612180610
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC390	25BC390	25BC390
23	COVER-DRIVE	1	907684100701	907684100701	907684100701
24	SCREW-HX HD CAP	15	655EE050	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND GEAR CASE TO HEADPLATE)	2	62M82	62M82	62M82

Ref. No.	DESCRIPTION	No. Req'd	Size 1008 (G_JA)	Size 1011 (G_JB)	Size 1013 (G_JC)
26	RETAINER-DRIVE SEAL	1	918783101301	918783101301	918783101301
27	SCREW-HX HD CAP (DRIVE SEAL RETAINER TO DRIVE COVER)	4	655ED030	655ED030	655ED030
* 28	SEAL-DRIVE (MTON).....	1	60DD659	60DD659	60DD659
29	GEAR SET-TIMING	1	910723103900	910723103900	910723103900
30	HUB-TIMING	2	907613063110	907613063110	907613063110
31	BOLT-TIMING GEAR	8	655EE070	655EE070	655EE070
32	WASHER-TIMING GEAR.....	8	907649440410	907649440410	907649440410
33	CASE-GEAR.....	1	907673154510	907673154510	907673154510
	CASE-GEAR (FORCE FEED LUBE)	1	918763105601	918763105601	918763105601
	CASE-GEAR	1	918763105602	918763105602	918763105602
	(FORCE FEED LUBE W/CLR)				
34	SCREW-HX HD CAP	16	655EE050	655EE050	655EE050
	(GEAR CASE TO HEADPLATE)				
36	KEY-DRIVE.....	1	907639911110	907639911110	907639911110
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHER FILLER.....	2	907651097510	907651097510	907651097510
40	PIPE-VENT	2	200GEJ126	200GEJ126	200GEJ126
41	GLASS-SIGHT (DRIVE COVER OILLEVEL- SPLASH ONLY)	1	40L15	40L15	40L15
	PLUG-SQ HD (HEADPLATE DRAIN- SPLASH ONLY)	2	64A7	64A7	64A7
43	PLUG-SQ HD (GEAR CASE DRAIN SPLASH ONLY)	1	64A6	64A6	64A6
77	LOCKNUT-BEARING (SHAFT)	2	50Z10	50Z10	50Z10
78	LOCWASHER-BEARING	2	95N10	95N10	95N10
	(SHAFT)				
79	SCREW-HX HD CAP	16	655EF060	655EF060	655EF060
	(PIPE PLATE TO HEADPLATE)				
83	PLUG-CS HD (SIGHT GLASS CONN.	1	64B4	64B4	64B4
	GEAR END HEADPLATE-SPL/LUBE)				
	PLUG-CS HD (SIGHT GLASS.....	2	64B4	64B4	64B4
	CONN. HEADPLATE-FF/LUBE)				
84	PLUG-CS HD (PRESS TAP CONN.	8	64B2	64B2	64B2
	IMPELLER CASE)				
+	GROUP-LUBE PIPING (FORCE FEED LUBE) ...	1	918791103401	918791103401	918791103401
+	GROUP-LUBE PIPING	1	918791106701	918791106701	918791106701
	(FORCE FEED LUBE W/CLR)				
*	KIT-OVERHAUL	0	201GEJ6010	201GEJ6010	201GEJ6010

+ Not shown, refer to Section C for Parts List.

* Included In Overhaul Kit

** Only (8) Required.

Order by Part Number and Description. Reference Numbers for your convenience only.

10" HORIZONTAL
Reference Figure 4 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1016 (G_JD)	Size 1018 (G_JE)	Size 1021 (G_JF)
1	HEADPLATE	2	918774101401	918774101401	918774101401
	HEADPLATE (GAS PUMP)	2	918774101402	918774101402	918774101402
	HEADPLATE	2	907684100901	907684100901	907684100901
	(FORCE FEED LUBE)				
	HEADPLATE	2	907684100902	907684100902	907684100902
	(FORCE FEED LUBE-GAS PUMP)				
2	CASE-IMPELLER (GEJ 5000).....	1	907659040410	907659040510	907659040610
	CASE-IMPELLER (GFJ 6000).....	1	907659040410	907659040510	918783102201
3	SCREW-HX HD CAP.....	48	655EF080	655EF080	655EF080
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER (THREADED)	8	62V51	62V51	62V5
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEJ 5000).....	1	210GEJ4028	211GEJ4028	212GEJ4028
	GROUP-ROTOR (GFJ 6000).....	1	211GFJ4028	212GFJ4028	213GFJ4028
9	CARTRIDGE-BEARING	4	200GEJ571	200GEJ571	200GEJ571
	CARTRIDGE-BEARING	4	202GEJ571	202GEJ571	202GEJ571
	(FORCE FEED LUBE)				
	CARTRIDGE-BEARING (GAS PUMP).....	4	204GEJ571	204GEJ571	204GEJ571
* 10	SCREW-SOC HD CAP/NYLOK	16	75P76N	75P76N	75P76N
	(BEARING CARTRIDGE TO HEAD-PLATE)				
* 12	O-RING (BEARING CARTRIDGE).....	4	25BC398	25BC398	25BC398
* 13	SEAL-MAIN (VITON)	4	918761104801	918761104801	918761104801
	SEAL-MECANICAL (GAS PUMP)	4	907639060110	907639060110	907639060110
* 14	BEARING (DRIVE END)	2	907639100110	907639100110	907639100110
* 15	BEARING (GEAR END).....	2	907639100810	907639100810	907639100810
16	RETAINER-BEARING	2	907613225310	907613225310	907613225310
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743102001	918743102001	918743102001
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180610	907612180610	907612180610
* 22	O-RING (DRIVE END OIL SLINGER).....	1	25BC390	25BC390	25BC390
23	COVER-DRIVE	1	907684100701	907684100701	907684100701
24	SCREW-HX HD CAP	16	655EE050	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101301	918783101301	918783101301
27	SCREW-HX HD CAP	4	655ED030	655ED030	655ED030
	(DRIVE SEAL RETAINER TO DRIVE COVER)				
* 28	SEAL-DRIVE (VITON).....	1	60DD659	60DD659	60DD659
29	GEAR SET-TIMING	1	910723103900	910723103900	910723103900
30	HUB-TIMING	2	907613063110	907613063110	907613063110
31	BOLT-TIMING GEAR	8	655EE070	655EE070	655EE070

Ref. No.	DESCRIPTION	No. Req'd	Size 1016 (G_JD)	Size 1018 (G_JE)	Size 1021 (G_JF)
32	WASHER-TIMING GEAR.....	8	907649440410	907649440410	907649440410
33	CASE-GEAR.....	1	907673154510	907673154510	907673154510
	CASE-GEAR (FORCE FEED LUBE)	1	918763105601	918763105601	918763105601
	CASE-GEAR (FORCE FEED LUBE W/CLR).....	1	918763105602	918763105602	918763105602
34	SCREW-HX HD CAP..... (GEAR CASE TO HEADPLATE)	16	655EE050	655EE050	655EE050
36	KEY-DRIVE.....	1	907639911110	907639911110	907639911110
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHING FILLER.....	2	907651097510	907651097510	907651097510
40	PIPE-VENT.....	2	918821100701	918821100701	918821100701
41	GLASS-SIGHT (DRIVE COVER OIL..... LEVEL-SPLASH ONLY)	1	200GEJ126	200GEJ126	200GEJ126
42	PLUG-SQ HD (HEADPLATE DRAIN..... SPLASH ONLY)	2	40L15	40L15	40L15
43	PLUG-SQ HD (GEAR CASE DRAIN..... SPLASH ONLY)	1	64A6	64A6	64A6
77	LOCKNUT-BEARING (SHAFT)	2	50Z10	50Z10	50Z10
78	LOCWASHER-BEARING (SHAFT).....	2	95N10	95N10	95N10
83	PLUG-CS HD (SIGHT GLASS CONN..... GEAR END HEADPLATE-SPL/LUBE)	1	64B4	64B4	64B4
	PLUG-CS HD (SIGHT GLASS CONN..... HEADPLATE-FF/LUBE)	2	64B4	64B4	64B4
84	PLUG-CS HD (PRESS TAP CONN. IMPELLER CASE)	2	64B2	64B2	64B2
+	GROUP-LUBE PIPING (FORCE FEED LUBE) ...	1	918791103401	918791103401	918791103401
+	GROUP-LUBE PIPING..... (FORCE FEED LUBE W/CLR)	1	918791106701	918791106701	918791106701
*	KIT-OVERHAUL	0	201GEJ6010	201GEJ6010	201GEJ6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

10" HORIZONTAL
Reference Figure 4 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1024 (G_JG)	Size 1030 (G_JH)
1	HEADPLATE	2	918774101401	918774101401
	HEADPLATE (GAS PUMP)	2	918774101402	918774101402
	HEADPLATE (FORCE FEED LUBE)	2	907684100901	907684100901
	HEADPLATE	2	907684100902	907684100902
	(FORCE FEED LUBE-GAS PUMP)			
2	CASE-IMPELLER (GEJ 5000)	1	907699400110	907699400210
	CASE-IMPELLER (GFJ 6000)	1	918783102301	918783102302
3	SCREW-HX HD CAP	48	655EF070	655EF070
	(HEADPLATE TO IMPELLER CASE)			
4	PIN-TAPER (THREADED)	8	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)			
8	GROUP-ROTOR (GEJ 5000)	1	213GEJ4028	214GEJ4028
	GROUP-ROTOR (GFJ 6000)	1	214GFJ4028	215GFJ4028
9	CARTRIDGE-BEARING	4	200GEJ571	200GEJ571
	CARTRIDGE-BEARING (FORCE FEED LUBE)	4	202GEJ571	202GEJ571
	CARTRIDGE-BEARING (GAS PUMP)	4	204GEJ571	204GEJ571
* 10	SCREW-SOC HD CAP/NYLOK (BEARING CARTRIDGE	16	75P76N	75P76N
	TO HEADPLATE)			
* 12	O-RING (BEARING CARTRIDGE)	4	25BC398	25BC398
* 13	SEAL-MAIN (VITON)	4	918761104801	918761104801
	SEAL-MECHANICAL (GAS PUMP)	4	907639060110	907639060110
* 14	BEARING (DRIVE END)	2	907639100110	907639100110
* 15	BEARING (GEAR END)	2	907639100810	907639100810
16	RETAINER-BEARING	2	907613225310	907613225310
* 17	SCREW-HX HD CAP/NYLOK (BEARING RETAINER TO	8	75A33N	75A33N
	BEARING CARTRIDGE)			
* 18	SHIM SET	1	907649460010	907649460010
19	SLINGER-OIL	1	918743102001	918743102001
* 20	SCREW-SOC HD CAP/NYLOK (OIL SLINGER)	1	75P9N	75P9N
21	RING-BACK UP	2	907612180610	907612180610
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC390	25BC390
23	COVER-DRIVE	1	907684100701	907684100701
24	SCREW-HX HD CAP (DRIVE COVER TO HEADPLATE)	16	655EE050	655EE050
25	PIN-DOWEL (DRIVE COVER AND GEAR CASE TO	2	62M82	62M82
	HEADPLATE)			
26	RETAINER-DRIVE SEAL	1	918783101301	918783101301
27	SCREW-HX HD CAP	4	655ED030	655ED030
	(DRIVE SEAL RETAINER TO DRIVE COVER)			
* 28	SEAL-DRIVE (VITON)	1	60DD659	60DD659
29	GEAR SET-TIMING	1	910723103900	910723103900
30	HUB-TIMING	2	907613063110	907613063110
31	BOLT-TIMING GEAR	8	655EE070	655EE070
32	WASHER-TIMING GEAR	8	907649440410	907649440410

Ref. No.	DESCRIPTION	No. Req'd	Size 1024 (G_JG)	Size 1030 (G_JH)
33	CASE-GEAR.....	1	907673154510	907673154510
	CASE-GEAR (FORCE FEED LUBE)	1	918763105601	918763105601
	CASE-GEAR (FORCE FEED LUBE W/CLR).....	1	918763105602	918763105602
34	SCREW-HX HD CAP (GEAR CASE TO HEAD PLATE)	16	655EE050	655EE050
36	KEY-DRIVE.....	1	907639911110	907639911110
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101
39	CAP-BREATHER FILLER.....	2	907651097510	907651097510
40	PIPE-VENT.....	2	200GEJ126	200GEJ126
41	GLASS-SIGHT..... (DRIVE COVER OIL LEVEL-SPLASH ONLY)	1	40L15	40L15
42	PLUG-SQ HD	2	64A7	64A7
	(HEADPLATE DRAIN-SPLASH ONLY)			
43	PLUG-SQ HD	1	64A6	64A6
	(GEAR CASE SPLASH ONLY)			
77	LOCKNUT-BEARING (SHAFT)	2	50Z10	50Z10
78	LOCWASHER-BEARING (SHAFT).....	2	95N10	95N10
83	PLUG-CS HD (SIGHT GLASS CONN. GEAR END	1	64B4	64B4
	HEADPLATE-SPL/LUBE)			
	PLUG-CS HD	2	64B4	64B4
	(SIGHT GLASS CONN. HEADPLATE-FF/LUBE)			
84	PLUG-CS HD	2	64B2	64B2
	(PRESS TAP CONN. IMPELLER CASE)			
+	GROUP-LUBE PIPING (FORCE FEED LUBE)	1	918791103401	918791103401
+	GROUP-LUBE PIPING.....	1	918791106701	918791106701
	(FORCE FEED LUBE W/CLR)			
*	KIT-OVERHAUL	0	201GEJ6010	201GEJ6010

+ Not Shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

12" HORIZONTAL
Reference Figure 3 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1213 (G_KA)	Size 1216 (G_KB)
1	HEADPLATE	2	918824120401	918824120401
	HEADPLATE (GAS PUMP)	2	918824120402	918824120402
	HEADPLATE (FORCE FEED LUBE)	2	907684121601	907684121601
	HEADPLATE (FORCE FEED LUBE-GAS PUMP)	2	907684121602	907684121602
2	GROUP-IMPELLER CASE	1	200GFK4042	201GFK4042
3	SCREW-HX HD CAP (HEADPLATE TO IMPELLER CASE)	32	655EF090	655EF090
4	PIN-TAPER (THREADED)	8	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)			
5	PLATE-TOP PIPE	1	907603656312	907613074212
6	PLATE-BOTTOM PIPE	1	907603656412	907613074312
7	SCREW-HX HD CAP	16	655EF080 **	655EF080
	(PIPE PLATE TO IMPELLER CASE)			
8	GROUP-ROTOR (GEK 5000)	1	208GEK4028	209GEK4028
	GROUP-ROTOR (GFK 6000)	1	200GFK4028	208GFK4028
9	CARTRIDGE-BEARING	4	918823121501	918823121501
	CARTRIDGE-BEARING (FORCE FEED LUBE)	4	907833120401	907833120401
	CARTRIDGE-BEARING (GAS PUMP)	4	907833120601	907833120601
* 10	SCREW-HEX CAP/NYLOK	16	655EE07N	655EE07N
	(BEARING CARTRIDGE TO HEADPLATE)			
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104802	918761104802
	SEAL-MECHANICAL (GAS PUMP)	4	907639060212	907639060212
* 14	BEARING (DRIVE END)	2	907639100212	907639100212
* 15	BEARING (GEAR END)	2	907639100912	907639100912
16	RETAINER-BEARING	2	907613076412	907613076412
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)			
* 18	SHIM SET	1	907649460010	907649460010
19	SLINGER-OIL	1	918743120601	918743120601
* 20	SCREW-SOC HD CAP/NYLOK (OIL SLINGER)	1	75P9N	75P9N
21	RING-BACK UP	2	907612180712	907612180712
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC391	25BC391
23	COVER-DRIVE	1	907643048712	907643048712
24	SCREW-HX HD CAP	14	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)			
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82
	GEAR CASE TO HEADPLATE)			
26	RETAINER-DRIVE SEAL	1	918783101302	918783101302
27	SCREW-HX HD CAP	4	655ED030	655ED030
	(DRIVE SEAL RETAINER TO DRIVE COVER)			
* 28	SEAL-DRIVE (VITON)	1	60DD660	60DD660
29	GEAR SET-TIMING	1	907743121200	907743121200
30	HUB-TIMING	2	907613071112	907613071112
31	BOLT-TIMING GEAR	8	655EF080	655EF080

Ref. No.	DESCRIPTION	No. Req'd	Size 1213 (G_KA)	Size 1216 (G_KB)
32	WASHER-TIMING GEAR.....	8	907649440712	907649440712
33	CASE-GEAR	1	907673089012	907673089012
	CASE-GEAR (FORCE FEED LUBE)	1	918763123401	918763123401
	CASE-GEAR (FF LUBE W/COOLER)	1	918763123402	918763123402
34	SCREW-HX HD CAP (GEAR CASE TO HEADPLATE)	14	655EE050	655EE050
36	KEY-DRIVE.....	1	907639911212	907639911212
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101
39	CAP-BREATHER FILLER	2	907651097510	907651097510
40	PIPE-VENT	2	200GEJ126	200GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL)..... (SPL/LUBE)	1	40L15	40L15
42	PLUG-SQ HD (HEADPLATE DRAIN)(SPL/LUBE)	2	64A7	64A7
43	PLUG-SQ HD (GEAR CASE DRAIN)(SPL/LUBE)	1	64A6	64A6
77	LOCKNUT-BEARING (SHAFT)	2	50Z12	50Z12
78	LOCWASHER-BEARING (SHAFT).....	2	95N12	95N12
79	SCREW-HX HD CAP	18	655EF070	655EF070
	(PIPE PLATE TO HEADPLATE)			
83	PLUG-CS HD (SIGHT GLASS CONN.GEAR END	1	64B4	64B4
	HEADPLATE-SPL/LUBE)			
	PLUG-CS HD	2	64B4	64B4
	(SIGHT GLASS CONN. HEADPLATE-FF/LUBE)			
84	PLUG-CS HD	8	64B2	64B2
	(PESS TAP CONN. IMPELLER CASE)			
+	GROUP-LUBE PIPING (FORCE FEED LUBE)	1	918791123401	918791123401
+	GROUP-LUBE PIPING (FORCE FEED W/COOLER)	1	918791126001	918791126001
*	KIT-OVERHAUL	0	201GEK6010	201GEK6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

** Only (12) Required.

Order by Part Number and Description. Reference Numbers for your convenience only.

12" HORIZONTAL
Reference Figure 4 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1218 (G_KC)	Size 1220 (G_KD)	Size 1223 (G_KE)
1	HEADPLATE	2	918774122901	918774122901	918774122901
	HEADPLATE (GAS PUMP)	2	918774122902	918774122902	918774122902
	HEADPLATE (FORCE FEED LUBE)	2	907684121401	907684121401	907684121401
	HEADPLATE	2	907684121402	907684121402	907684121402
	(FORCE FEED LUBE-GAS PUMP)				
2	CASE-IMPELLER	1	907689240112	907689240212	907679060112
3	SCREW-HX HD CAP	44	655EF090	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER (THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEK 5000)	1	210GEK4028	211GEK4028	212GEK4028
	GROUP-ROTOR (GFK 6000)	1	209GFK4028	210GFK4028	211GFK4028
9	CARTRIDGE-BEARING	4	918823121501	918823121501	918823121501
	CARTRIDGE-BEARING	4	907833120401	907833120401	907833120401
	(FORCE FEED LUBE)				
	CARTRIDGE-BEARING (GAS PUMP)	4	907833120601	907833120601	907833120601
* 10	SCREW-HEX CAP/NYLOK	16	655EE07N	655EE07N	655EE07N
	(BEARING CARTRIDGE TO HEADPLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400	25BC400
* 13	SEAL-MAIN (MTON)	4	918761104802	918761104802	918761104802
	SEAL-MECHANICAL (GAS PUMP)	4	907639060212	907639060212	907639060212
* 14	BEARING (DRIVE END)	2	907639100212	907639100212	907639100212
* 15	BEARING (GEAR END)	2	907639100912	907639100912	907639100912
16	RETAINER-BEARING	2	907613076412	907613076412	907613076412
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743120601	918743120601	918743120601
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180712	907612180712	907612180712
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC391	25BC391	25BC391
23	COVER-DRIVE	1	907643048712	907643048712	907643048712
24	SCREW-HX HD CAP	14	655EE050	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101302	918783101302	918783101302
27	SCREW-HX HD CAP (DRIVE SEAL	4	655ED030	655ED030	655ED030
	RETAINER TO DRIVE COVER)				
* 28	SEAL-DRIVE (MTON)	1	60DD660	60DD660	60DD660
29	GEAR SET-TIMING	1	907743121200	907743121200	907743121200
30	HUB-TIMING	2	907613071112	907613071112	907613071112
31	BOLT-TIMING GEAR	8	655EF080	655EF080	655EF080

Ref. No.	DESCRIPTION	No. Req'd	Size 1218 (G_KC)	Size 1220 (G_KD)	Size 1223 (G_KE)
32	WASHER-TIMING GEAR.....	8	907649440712	907649440712	907649440712
33	CASE-GEAR.....	1	907673089012	907673089012	907673089012
	CASE-GEAR (FORCE FEED LUBE)	1	918763123401	918763123401	918763123401
	CASE-GEAR (FF LUBE W/COOLER)	1	918763123402	918763123402	918763123402
34	SCREW-HX HD CAP..... (GEAR CASE TO HEADPLATE)	14	655EE050	655EE050	655EE050
36	KEY-DRIVE.....	1	907639911212	907639911212	907639911212
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHER FILLER.....	2	907651097510	907651097510	907651097510
40	PIPE-VENT.....	2	200GEJ126	200GEJ126	200GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL)..... (SPL/LUBE)	1	40L15	40L15	40L15
42	PLUG-SQ HD (HEADPLATE DRAIN)	2	64A7	64A7	64A7
	(SPL/LUBE)				
43	PLUG-SQ HD (GEAR CASE DRAIN)	1	64A6	64A6	64A6
	(SPL/LUBE)				
77	LOCKNUT-BEARING (SHAFT)	1	50Z12	50Z12	50Z12
78	LOCWASHER-BEARING (SHAFT).....	1	95N12	95N12	95N12
83	PLUG-CS HD (SIGHT GLASS CONN. GEAR END HEADPLATE-SPL/LUBE)	1	64B4	64B4	64B4
	PLUG-CS HD (SIGHT GLASS CONN. HEADPLATE-FF/LUBE)	2	64B4	64B4	64B4
84	PLUG-CS HD (PRESS TAP CONN. IMPELLER CASE)	2	64B2	64B2	64B2
+	GROUP-LUBE PIPING (FORCE FEED LUBE) ...	1	918791123401	918791123401	918791123401
+	GROUP-LUBE PIPING (FORCE FEED LUBE W/COOLER)	1	918791126001	918791126001	918791126001
*	KIT-OVERHAUL	0	201GEK6010	201GEK6010	201GEK6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

12" HORIZONTAL
Reference Figure 4 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1226 (G_KF)	Size 1230 (G_KG)	Size 1236 (G_KH)
1	HEADPLATE	2	918774122901	918774122901	918774122901
	HEADPLATE (GAS PUMP)	2	918774122902	918774122902	918774122902
	HEADPLATE (FORCE FEED LUBE)	2	907684121401	907684121401	907684121401
	HEADPLATE	2	907684121402	907684121402	907684121402
	(FORCE FEED LUBE-GAS PUMP)				
2	CASE-IMPELLER	1	907679060212	907679070112	907679070212
3	SCREW-HX HD CAP	44	655EF090	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER(THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEK 5000)	1	213GEK4028	214GEK4028	215GEK4028
	GROUP-ROTOR (GFK 6000)	1	212GFK4028	213GFK4028	214GFK4028
9	CARTRIDGE-BEARING	4	918823121501	918823121501	918823121501
	CARTRIDGE-BEARING	4	907833120401	907833120401	907833120401
	(FORCE FEED LUBE)				
	CARTRIDGE-BEARING	4	907833120601	907833120601	907833120601
	(GAS PUMP)				
* 10	SCREW-HEX CAP/NYLOK (BEARING	16	655EE07N	655EE07N	655EE07N
	CARTRIDGE TO HEAD-PLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104802	918761104802	918761104802
	SEAL-MECHANICAL (GAS PUMP)	4	907639060212	907639060212	907639060212
* 14	BEARING (DRIVE END)	2	907639100212	907639100212	907639100212
* 15	BEARING (GEAR END)	2	907639100912	907639100912	907639100912
16	RETAINER-BEARING	2	907613076412	907613076412	907613076412
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743120601	918743120601	918743120601
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180712	907612180712	907612180712
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC391	25BC391	25BC391
23	COVER-DRIVE	1	907643048712	907643048712	907643048712
24	SCREW-HX HD CAP	14	655EE050	655EE050	655EE050
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101302	918783101302	918783101302
27	SCREW-HX HD CAP (DRIVE SEAL	4	655ED030	655ED030	655ED030
	RETAINER TO DRIVE COVER)				
* 28	SEAL-DRIVE (VITON)	1	60DD660	60DD660	60DD660
29	GEAR SET-TIMING	1	907743121200	907743121200	907743121200
30	HUB-TIMING	2	907613071112	907613071112	907613071112
31	BOLT-TIMING GEAR	8	655EF080	655EF080	655EF080

Ref. No.	DESCRIPTION	No. Req'd	Size 1226 (G_KF)	Size 1230 (G_KG)	Size 1236 (G_KH)
32	WASHER-TIMING GEAR.....	8	907649440712	907649440712	907649440712
33	CASE-GEAR.....	1	907673089012	907673089012	907673089012
	CASE-GEAR (FORCE FEED LUBE).....	1	918763123401	918763123401	918763123401
	CASE-GEAR (FF LUBE W/COOLER).....	1	918763123402	918763123402	918763123402
34	SCREW-HX HD CAP..... (GEAR CASE TO HEADPLATE)	14	655EE050	655EE050	655EE050
36	KEY-DRIVE.....	1	907639911212	907639911212	907639911212
38	GLASS-SIGHT (GEAR CASE OIL LEVEL).....	1	918811100101	918811100101	918811100101
39	CAP-BREATHER FILLER.....	2	907651097510	907651097510	907651097510
40	PIPE-VENT.....	2	200GEJ126	200GEJ126	200GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL)..... (SPL/LUBE)	1	40L15	40L15	40L15
42	PLUG-SQ HD (HEADPLATE DRAIN)..... (SPL/LUBE)	2	64A7	64A7	64A7
43	PLUG-SQ HD (GEAR CASE DRAIN)..... (SPL/LUBE)	1	64A6	64A6	64A6
77	LOCKNUT-BEARING (SHAFT).....	1	50Z12	50Z12	50Z12
78	LOCWASHER-BEARING (SHAFT).....	1	95N12	95N12	95N12
83	PLUG-CS HD (SIGHT GLASS CONN. GEAR END HEADPLATE-SPL/LUBE)	1	64B4	64B4	64B4
	PLUG-CS HD (SIGHT GLASS CONN. HEADPLATE-FF/LUBE)	2	64B4	64B4	64B4
84	PLUG-CS HD (PRESS TAP CONN. IMPELLER CASE)	2	64B2	64B2	64B2
+	GROUP-LUBE PIPING (FORCE FEED LUBE)....	1	918791123401	918791123401	918791123401
+	GROUP-LUBE PIPING (FORCE FEED LUBE W/COOLER)	1	918791126001	918791126001	918791126001
*	KIT-OVERHAUL.....	0	201GEK6010	201GEK6010	201GEK6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

14" HORIZONTAL
Reference Figure 3 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1415 (G_LA)	Size 1419 (G_LB)
1	HEADPLATE	2	918784143101	918784143101
	HEADPLATE (GAS PUMP)	2	918784143102	918784143102
	HEADPLATE (FORCE FEED LUBE)	2	907684140301	907684140301
	HEADPLATE	2	907684140302	907684140302
	(FORCE FEED LUBE-GAS PUMP)			
2	GROUP-IMPELLER CASE	1	200GFL4042	201GFL4042
3	SCREW-HX HD CAP	40	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)			
4	PIN-TAPER(THREADED)	8	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)			
5	PLATE-TOP PIPE (GEL 5000)	1	907603669214	907603670114
	PLATE-TOP PIPE (GFL 6000)	1	918793140001	907603670114
6	PLATE-BOTTOM PIPE (GEL 5000)	1	907603669314	907603670014
	PLATE-BOTTOM PIPE (GFL 6000)	1	918793140101	907603670014
7	SCREW-HX HD CAP (PIPE PLATE TO IMPELLER CASE)	16	655EF080 **	655EF080
8	GROUP-ROTOR (GEL 5000)	1	208GEL4028	209GEL4028
	GROUP-ROTOR (GFL 6000)	1	208GFL4028	228GFL4028
9	CARTRIDGE-BEARING	4	918823142001	918823142001
	CARTRIDGE-BEARING (FORCE FEED LUBE)	4	907833140001	907833140001
	CARTRIDGE-BEARING (GAS PUMP)	4	907833140101	907833140101
10	SCREW-SOC HD CAP	16	655EE060	655EE060
	(BEARING CARTRIDGE TO HEADPLATE)			
* 11	CLIP-LOCKING	16	907721082303	907721082303
	(BEARING CARTRIDGE TO HEADPLATE)			
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104803	918761104803
	SEAL-MECHANICAL (GAS PUMP)	4	907639060314	907639060314
* 14	BEARING (DRIVE END)	2	907639100314	907639100314
* 15	BEARING (GEAR END)	2	907639101014	907639101014
16	RETAINER-BEARING	2	907613225414	907613225414
* 17	SCREW-HX HD CAP/NYLOK (BEARING RETAINER TO	8	75A33N	75A33N
	BEARING CARTRIDGE)			
* 18	SHIM SET	1	907649460010	907649460010
19	SLINGER-OIL	1	918743141201	918743141201
* 20	SCREW-SOC HD CAP/NYLOK (OIL SLINGER)	1	75P9N	75P9N
21	RING-BACK UP	2	907612180814	907612180814
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC392	25BC392
23	COVER-DRIVE	1	907613097214	907613097214
24	SCREW-HX HD CAP (DRIVE COVER TO HEADPLATE)	24	655EE060	655EE060
25	PIN-DOWEL (DRIVE COVER AND GEAR CASE TO	2	62M82	62M82
	HEADPLATE)			
26	RETAINER-DRIVE SEAL	1	918783101303	918783101303
27	SCREW-HX HD CAP	4	655ED030	655ED030
	(DRIVE SEAL RETAINER TO DRIVE COVER)			
* 28	SEAL-DRIVE (VITON)	1	60DD661	60DD661

Ref. No.	DESCRIPTION	No. Req'd	Size 1415 (G_LA)	Size 1419 (G_LB)
29	GEAR SET-TIMING	1	907743141600	907743141600
30	HUB-TIMING	2	907613098514	907613098514
31	BOLT-TIMING GEAR	12	655EG090	655EG090
32	WASHER-TIMING GEAR	12	907649440814	907649440814
33	CASE-GEAR	1	907663056314	907663056314
	CASE-GEAR (FORCE FEED LUBE)	1	918763143901	918763143901
	CASE-GEAR (FORCE FEED LUBE W/CLR)	1	918763143902	918763143902
34	SCREW-HX HD CAP	24	655EE060	655EE060
	(GEAR CASE TO HEADPLATE)			
36	KEY-DRIVE	1	907639911314	907639911314
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101
39	CAP-BREATHING FILLER	2	907651097510	907651097510
40	PIPE-VENT	2	206GEJ126	206GEJ126
41	GLASS-SIGHT	1	40L15	40L15
	(DRIVE COVER OIL LEVEL-SPLASH ONLY)			
42	PLUG-SQ HD (HEADPLATE DRAIN-SPLASH ONLY)	2	64A7	64A7
43	PLUG-SQ HD (GEAR CASE DRAIN SPLASH ONLY)	1	64A6	64A6
44	NIPPLE-PIPE (OIL BAFFLE)	2	63J30	63J30
77	LOCKNUT-BEARING (SHAFT)	2	50Z14	50Z14
78	LOCWASHER-BEARING (SHAFT)	2	95N14	95N14
79	SCREW-HX HD CAP (PIPE PLATE TO HEADPLATE)	20	655EF070	655EF070
83	PLUG-CS HD (SIGHT GLASS CONN. GEAR END	1	64B4	64B4
	HEADPLATE-SPL/LUBE)			
	PLUG-CS HD	2	64B4	64B4
	(SIGHT GLASS CONN. HEADPLATE-FF/LUBE)			
84	PLUG-CS HD (PRESS TAP CONN. IMPELLER CASE)	8	64B2	64B2
+	GROUP-LUBE PIPING (FORCE FEED LUBE)	1	918801140201	918801140201
+	GROUP-LUBE PIPING (FORCE FEED LUBE W/CLR)	1	918801140301	918801140301
*	KIT-OVERHAUL	0	201GEL6010	201GEL6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

** Only (12) Required.

Order by Part Number and Description. Reference Numbers for your convenience only.

14" HORIZONTAL
Reference Figure 4 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	Size 1421 (G_LC)	Size 1423 (G_LD)	Size 1426 (G_LE)
1	HEADPLATE	2	918774141001	918774141001	918774141001
	HEADPLATE (GAS PUMP)	2	918774141002	918774141002	918774141002
	HEADPLATE (FORCE FEED LUBE)	2	907684140101	907684140101	907684140101
	HEADPLATE	2	907684140102	907684140102	907684140102
	(FORCE FEED LUBE-GAS PUMP)				
2	CASE-IMPELLER	1	907699060114	907699060214	907699060314
3	SCREW-HX HD CAP	52	655EF090	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER(THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEL 5000)	1	210GEL4028	211GEL4028	212GEL4028
	GROUP-ROTOR (GFL 6000)	1	209GFL4028	210GFL4028	211GFL4028
9	CARTRIDGE-BEARING	4	918823142001	918823142001	918823142001
	CARTRIDGE-BEARING	4	907833140001	907833140001	907833140001
	(FORCE FEED LUBE)				
	CARTRIDGE-BEARING	4	907833140101	907833140101	907833140101
10	SCREW-SOC HD CAP (BEARING	16	655EE060	655EE060	655EE060
	CARTRIDGE TO HEADPLATE)				
* 11	CLIP-LOCKING (BEARING	16	907721082303	907721082303	907721082303
	CARTRIDGE TO HEADPLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400	25BC400
* 13	SEAL-MAIN (MTON)	4	918761104803	918761104803	918761104803
	SEAL-MECHANICAL (GAS PUMP)	4	907639060314	907639060314	907639060314
* 14	BEARING (DRIVE END)	2	907639100314	907639100314	907639100314
* 15	BEARING (GEAR END)	2	907639101014	907639101014	907639101014
16	RETAINER-BEARING	2	907613225414	907613225414	907613225414
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743141201	918743141201	918743141201
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180814	907612180814	907612180814
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC392	25BC392	25BC392
23	COVER-DRIVE	1	907613097214	907613097214	907613097214
24	SCREW-HX HD CAP	24	655EE060	655EE060	655EE060
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND GEAR	2	62M82	62M82	62M82
	CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101303	918783101303	918783101303
27	SCREW-HX HD CAP (DRIVE SEAL RETAINER ..	4	655ED030	655ED030	655ED030
	TO DRIVE COVER)				
* 28	SEAL-DRIVE (MTON)	1	60DD661	60DD661	60DD661
29	GEAR SET-TIMING	1	907743141600	907743141600	907743141600
30	HUB-TIMING	2	907613098514	907613098514	907613098514

Ref. No.	DESCRIPTION	No. Req'd	Size 1421 (G_LC)	Size 1423 (G_LD)	Size 1426 (G_LE)
31	BOLT-TIMING GEAR	12	655EG090	655EG090	655EG090
32	WASHER-TIMING GEAR.....	12	907649440814	907649440814	907649440814
33	CASE-GEAR.....	1	907663056314	907663056314	907663056314
	CASE-GEAR (FORCE FEED LUBE)	1	918763143901	918763143901	918763143901
	CASE-GEAR (FORCE FEED LUBE W/CLR).....	1	918763143902	918763143902	918763143902
34	SCREW-HX HD CAP..... (GEAR CASE TO HEADPLATE)	24	655EE060	655EE060	655EE060
36	KEY-DRIVE.....	1	907639911314	907639911314	907639911314
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHING FILLER.....	2	907651097510	907651097510	907651097510
40	PIPE-VENT	2	206GEJ126	206GEJ126	206GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL-..... SPLASH ONLY)	1	40L15	40L15	40L15
42	PLUG-SQ HD	2	64A7	64A7	64A7
	(HEADPLATE DRAIN-SPLASH ONLY)				
43	PLUG-SQ HD (GEAR CASE DRAIN-..... SPLASH ONLY)	1	64A6	64A6	64A6
44	NIPPLE-PIPE (OIL BAFFLE)	2	63J30	63J30	63J30
77	LOCKNUT-BEARING (SHAFT)	2	50Z14	50Z14	50Z14
78	LOCWASHER-BEARING (SHAFT).....	2	95N14	95N14	95N14
	PLUG-CS HD (SIGHT GLASS CONN..... GEAR END HEADPLATE-SPL/LUBE)	1	64B4	64B4	64B4
	PLUG-CS HD (SIGHT GLASS CONN..... HEADPLATE-FF/LUBE)	2	64B4	64B4	64B4
84	PLUG-CS HD (PRESS TAP CONN..... IMPELLER CASE)	2	64B2	64B2	64B2
+	GROUP-LUBE PIPING (FORCE FEED LUBE) ...	1	918801140201	918801140201	918801140201
+	GROUP-LUBE PIPING..... (FORCE FEED LUBE W/CLR)	1	918801140301	918801140301	918801140301
*	KIT-OVERHAUL	0	201GEL6010	201GEL6010	201GEL6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

Order by Part Number and Description. Reference Numbers for your convenience only.

14" HORIZONTAL
Reference Figure 4 for Exploded View

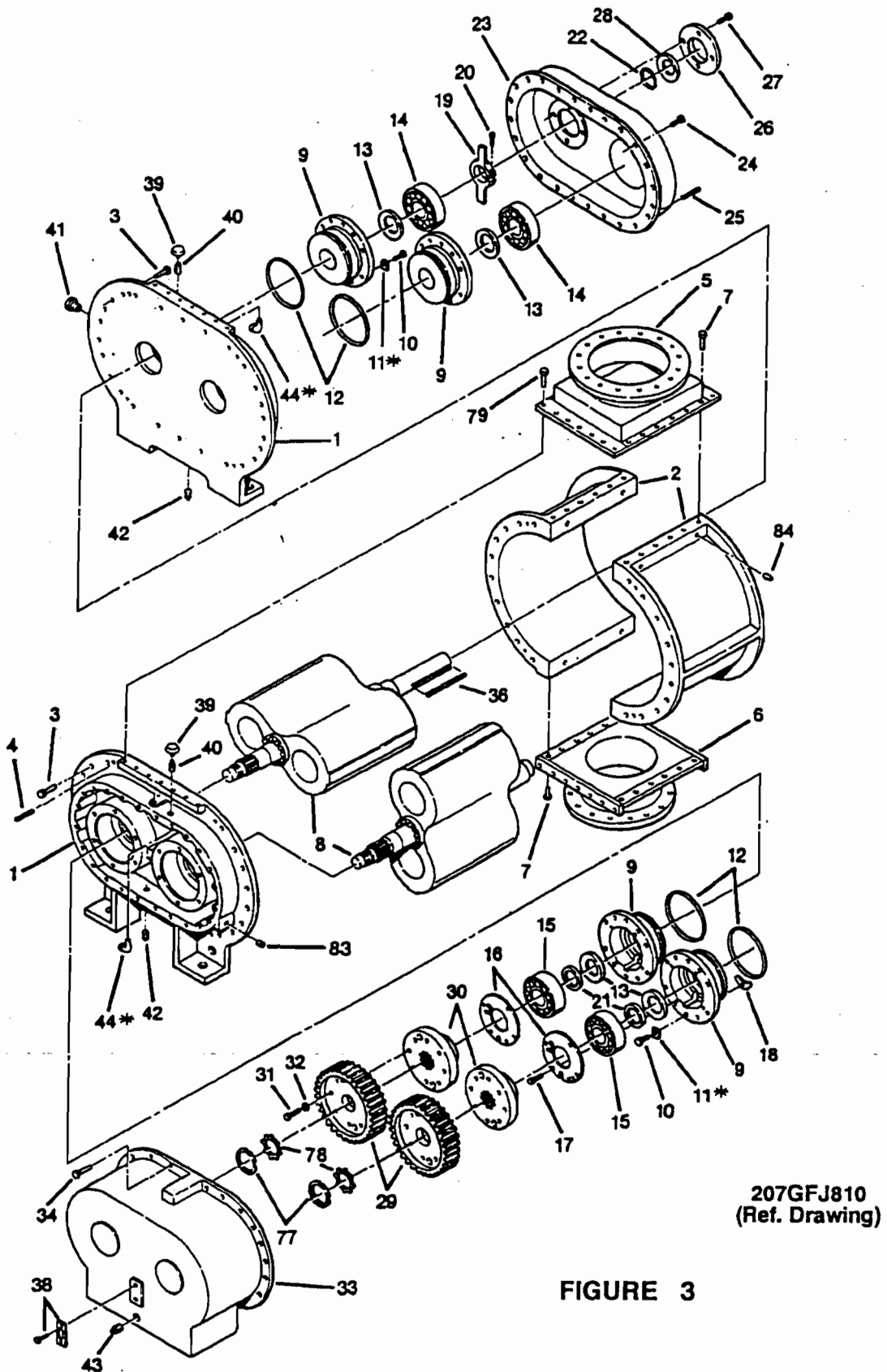
Ref. No.	DESCRIPTION	No. Req'd	Size 1431 (G_LF)	Size 1437 (G_LG)	Size 1442 (G_LH)
1	HEADPLATE	2	918774141001	918774141001	918774141001
	HEADPLATE (GAS PUMP)	2	918774141002	918774141002	918774141002
	HEADPLATE (FORCE FEED LUBE)	2	907684140101	907684140101	907684140101
	HEADPLATE	2	907684140102	907684140102	907684140102
	(FORCE FEED LUBE-GAS PUMP)				
2	CASE-IMPELLER	1	907679080114	907679080214	907679080314
3	SCREW-HX HD CAP	52	655EF090	655EF090	655EF090
	(HEADPLATE TO IMPELLER CASE)				
4	PIN-TAPER(THREADED)	8	62V51	62V51	62V51
	(HEADPLATE TO IMPELLER CASE)				
8	GROUP-ROTOR (GEL 5000)	1	213GEL4028	214GEL4028	215GEL4028
	GROUP-ROTOR (GFL 6000)	1	212GFL4028	213GFL4028	214GFL4028
9	CARTRIDGE-BEARING	4	918823142001	918823142001	918823142001
	CARTRIDGE-BEARING	4	907833140001	907833140001	907833140001
	(FORCE FEED LUBE)				
	CARTRIDGE-BEARING (GAS PUMP)	4	907833140101	907833140101	907833140101
10	SCREW-SOC HD CAP	16	655EE060	655EE060	655EE060
	(BEARING CARTRIDGE TO HEADPLATE)				
* 11	CLIP-LOCKING (BEARING CARTRIDGE TO	16	907721082303	907721082303	907721082303
	HEADPLATE)				
* 12	O-RING (BEARING CARTRIDGE)	4	25BC400	25BC400	25BC400
* 13	SEAL-MAIN (VITON)	4	918761104803	918761104803	918761104803
	SEAL-MECHANICAL (GAS PUMP)	4	907639060314	907639060314	907639060314
* 14	BEARING (DRIVE END)	2	907639100314	907639100314	907639100314
* 15	BEARING (GEAR END)	2	907639101014	907639101014	907639101014
16	RETAINER-BEARING	2	907613225414	907613225414	907613225414
* 17	SCREW-HX HD CAP/NYLOK (BEARING	8	75A33N	75A33N	75A33N
	RETAINER TO BEARING CARTRIDGE)				
* 18	SHIM SET	1	907649460010	907649460010	907649460010
19	SLINGER-OIL	1	918743141201	918743141201	918743141201
* 20	SCREW-SOC HD CAP/NYLOK	1	75P9N	75P9N	75P9N
	(OIL SLINGER)				
21	RING-BACK UP	2	907612180814	907612180814	907612180814
* 22	O-RING (DRIVE END OIL SLINGER)	1	25BC392	25BC392	25BC392
23	COVER-DRIVE	1	907613097214	907613097214	907613097214
24	SCREW-HX HD CAP	24	655EE060	655EE060	655EE060
	(DRIVE COVER TO HEADPLATE)				
25	PIN-DOWEL (DRIVE COVER AND	2	62M82	62M82	62M82
	GEAR CASE TO HEADPLATE)				
26	RETAINER-DRIVE SEAL	1	918783101303	918783101303	918783101303
27	SCREW-HX HD CAP (DRIVE SEAL	4	655ED030	655ED030	655ED030
	RETAINER TO DRIVE COVER)				
* 28	SEAL-DRIVE (VITON)	1	60DD661	60DD661	60DD661
29	GEAR SET-TIMING	1	907743141600	907743141600	907743141600
30	HUB-TIMING	2	907613098514	907613098514	907613098514

Ref. No.	DESCRIPTION	No. Req'd	Size 1431 (G_LF)	Size 1437 (G_LG)	Size 1442 (G_LH)
31	BOLT-TIMING GEAR	12	655EG090	655EG090	655EG090
32	WASHER-TIMING GEAR.....	12	907649440814	907649440814	907649440814
33	CASE-GEAR.....	1	907663056314	907663056314	907663056314
	CASE-GEAR (FORCE FEED LUBE)	1	918763143901	918763143901	918763143901
	CASE-GEAR	1	918763143902	918763143902	918763143902
	(FORCE FEED LUBE W/CLR)				
34	SCREW-HX HD CAP.....	24	655EE060	655EE060	655EE060
	(GEAR CASE TO HEADPLATE)				
36	KEY-DRIVE.....	1	907639911314	907639911314	907639911314
38	GLASS-SIGHT (GEAR CASE OIL LEVEL)	1	918811100101	918811100101	918811100101
39	CAP-BREATHER FILLER	2	907651097510	907651097510	907651097510
40	PIPE-VENT	2	206GEJ126	206GEJ126	206GEJ126
41	GLASS-SIGHT (DRIVE COVER OIL LEVEL..... SPLASH ONLY)	1	40L15	40L15	40L15
42	PLUG-SQ HD	2	64A7	64A7	64A7
	(HEADPLATE DRAIN-SPLASH ONLY)				
43	PLUG-SQ HD (GEAR CASE DRAIN..... SPLASH ONLY)	1	64A6	64A6	64A6
44	NIPPLE-PIPE (OIL BAFFLE)	2	63J30	63J30	63J30
77	LOCKNUT-BEARING (SHAFT)	2	50Z14	50Z14	50Z14
78	LOCWASHER-BEARING (SHAFT).....	2	95N14	95N14	95N14
83	PLUG-CS HD SIGHT GLASS CONN.	1	64B4	64B4	64B4
	(GEAR END HEADPLATE-SPL/LUBE)				
	PLUG-CS HD (SIGHT GLASS CONN..... HEADPLATE-FF/LUBE)	2	64B4	64B4	64B4
84	PLUG-CS HD	2	64B2	64B2	64B2
	(PRESS TAP CONN. IMPELLER CASE)				
+	GROUP-LUBE PIPING (FORCE FEED LUBE) ...	1	918801140201	918801140201	918801140201
+	GROUP-LUBE PIPING.....	1	918801140301	918801140301	918801140301
	(FORCE FEED LUBE W/CLR)				
*	KIT-OVERHAUL	0	201GEL6010	201GEL6010	201GEL6010

+ Not shown, refer to Section C for Parts List.

* Included in Overhaul Kit.

HORIZONTAL CONSTRUCTION
(TWO PIECE CASE)

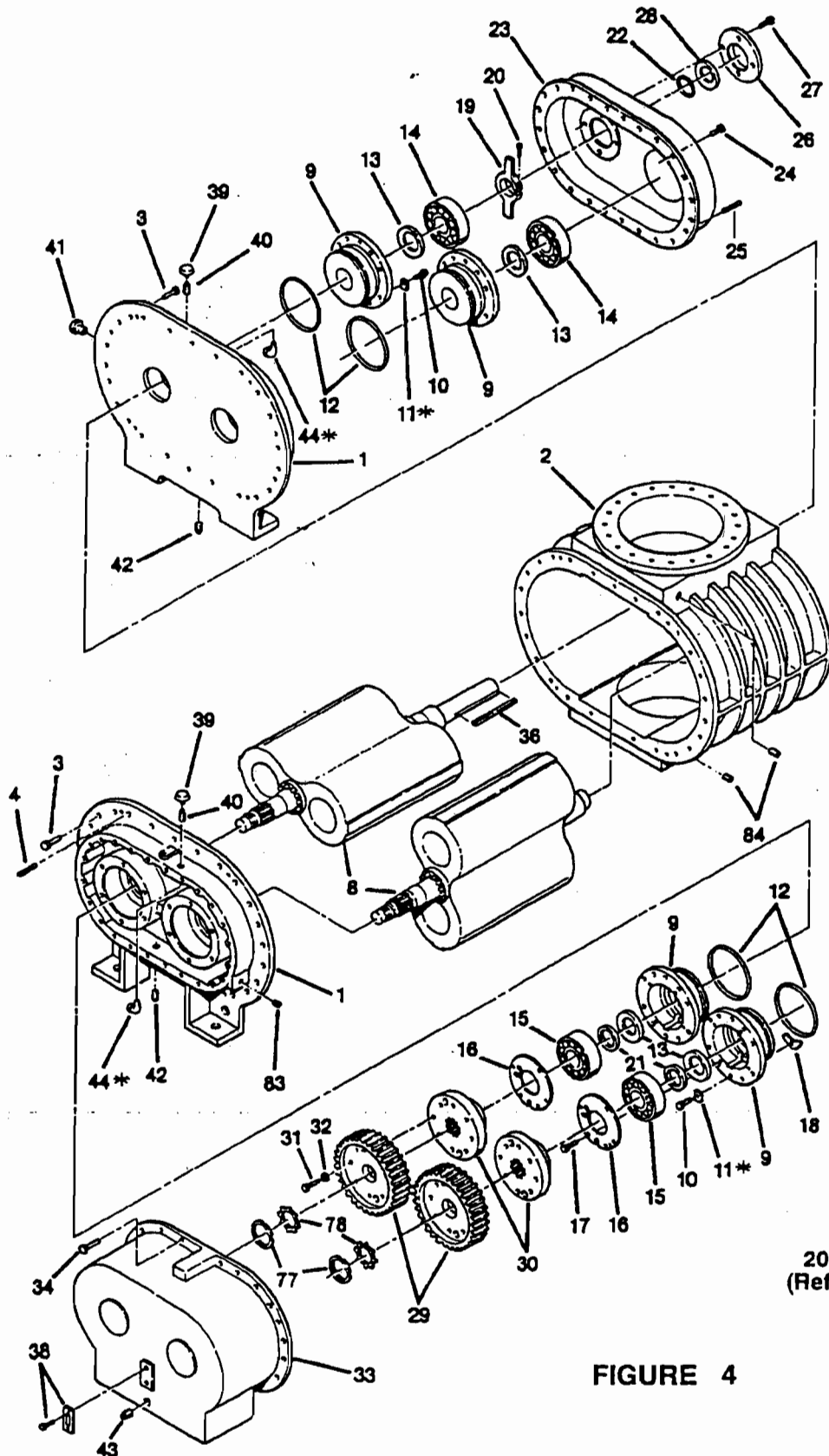


207GFJ810
(Ref. Drawing)

FIGURE 3

* USE WITH 14" GEAR DIA. ONLY.

HORIZONTAL CONSTRUCTION
(ONE PIECE CASE)



206GFJ810
(Ref. Drawing)

FIGURE 4

* USE WITH 14" GEAR DIA. ONLY.

SECTION C OPTIONS

VERTICAL - FORCE FEED LUBE Reference Figure 5 for Exploded View

Ref. NO.	DESCRIPTION	No. Req'd	10" (918791103301)	12" (200GEK4012)	14" (918791142201)
1	PUMP-LUBE	1	918803105601	918803105601	918803105601
2	PLATE-PUMP ASM.....	1	907673121801	907673121801	907673121801
3	COUPLING-HALF ASM..... (ROTOR SHAFT)	1	918802106201	918802106201	918802106201
4	COUPLING-HALF ASM..... (PUMP SHAFT)	1	204GFJ282	204GFJ282	204GFJ282
5	SCREEN-OIL.....	2	907652121510	907652121510	907652121510
6	VALVE-RELIEF	1	907651097210	907651097210	907651097210
7	GAUGE-PRESSURE	1	907651097310	907651097310	907651097310
8	FILTER-FLOW EZY	1	918761105701	918761105701	918761105701
9	TEE	1	907801100201	907801100201	907801100201
10	CONNECTOR-MALE	4	907689360110	907689360110	907689360110
11	HOSE-OIL	()	R41A (4 FT)	R41A (4 FT)	R41A (5 FT)
12	ELBOW-MALE	6	907689364510	907689364510	907689364510
13	TEE-UNION.....	1	907689360310	907689360310	907689360310
14	COUPLING-HOSE	2	907689364610	907689364610	907689364610
16	CONNECTOR-MALE	1	907689364810	907689364810	907689364810
17	BUSHING-PIPE	2	907689363510	907689363510	907689363510
18	ELBOW-MALE	1	907689365110	907689365110	907689365110
19	ELBOW-MALE	1	907689360410	907689360410	907689360410
21	COUPLING-FLEX.....	1	918841100001	918841100001	918841100001
24	BUSHING-PIPE	1	64E2	64E2	64E2
25	TUBE-STEEL.....	()	85M8 (8 FT)	85M8 (9 FT)	85M8 (9 FT)
27	TUBE-STEEL.....	()	85M12 (2 FT)	85M12 (3 FT)	85M12 (3 FT)
28	PLUG-PIPE.....	1	64A26	64A26	64A26
29	PLUG-PIPE.....	1	64AA5	64AA5	64AA5
32	PLUG-PIPE.....	4	64AA7	64AA7	64AA7
33	ELBOW-PIPE	1	64C7	64C7 **	64C7
35	ELBOW-PIPE	1	64C4 *	64C4	64C4
36	ELBOW	1	64C4	64C4	64C4
37	TEE-PIPE	1	64G6	64G6	64G6
38	TEE-PIPE	1	64G3	64G3	64G3
39	TEE-PIPE	1	64G2	64G2	64G2
40	TEE-PIPE	1	64G9	64G9	64G9
41	TEE-STR SERVICE	3	00906350 0003	00906350 0003	00906350 0003
42	NIPPLE-PIPE.....	1	63C1	63C1	63C1
43	NIPPLE-PIPE.....	1	63D1	63D1	63D1
44	NIPPLE-PIPE.....	2	63J30	63J5 **	63AP49
45	NIPPLE-PIPE.....	1	63F8 *	63F10	63F13
46	NIPPLE-PIPE.....	1	63F2	63F2	63F2
47	NIPPLE-PIPE.....	1	63C5	63C5	63C6
48	NIPPLE-PIPE.....	1	63F4	63F4	63F4
49	NIPPLE-PIPE.....	1	63F1	63F2	63F5

Ref. No.	DESCRIPTION	No. Req'd	10" (918791103301)	12" (200GEK4012)	14" (918791142201)
50	NIPPLE-PIPE.....	2		63J11**	
51	CLAMP-PIPE.....	2	98H1	98H1	98H1
52	SCREW-SELF TAPPING.....	4	75LM215	75LM215	75LM215
53	SCREW-FLAT SOC HD	3	120175N	120175N	120175N
54	NIPPLE-PIPE.....	1	63N20X360	63N20X420	63N20X540
70	PIN-DOWEL.....	2	62M33	62M33	62M33
71	SCREW-HEX HD.....	8	655EC080	655EC080	655EC080
72	SCREW-SOC HD.....	4	75P1	75P1	75P1
75	NIPPLE-PIPE.....	1	63F21	63F21	63F21
76	UNION.....	1	64Z3	64Z3	64Z3

* (2) Required

** 1218 thru 1236 use group 918791123301 which adds Ref No. 50, increases qty of Ref No. 33 to (5) and Ref No. 44 to (4).

VERTICAL - FORCE FEED LUBE WITH COOLER
Reference Figure 6 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	10" (918791107301)	12" (918791126801)	14" (918791145501)
1	PUMP-LUBE	1	918803105601	918803105601	918803105601
2	PLATE-PUMP ASM	1	907673121801	907673121801	907673121801
3	COUPLING-HALF ASM	1	918802106201	918802106201	918802106201
	(ROTOR SHAFT)				
4	COUPLING-HALF ASM	1	204GFJ282	204GFJ282	204GFJ282
	(PUMP SHAFT)				
5	SCREEN-OIL	2	907652121510	907652121510	907652121510
6	VALVE-RELIEF	1	907651097210	907651097210	907651097210
7	GAUGE-PRESSURE	1	907651097310	907651097310	907651097310
8	FILTER-FLOW EZY	1	918761105701	918761105701	918761105701
9	TEE	1	907801100201	907801100201	907801100201
10	CONNECTOR-MALE	6	907689360110	907689360110	907689360110
11	HOSE-OIL	()	R41A (4 FT)	R41A (4 FT)	R41A (5 FT)
12	ELBOW-MALE	6	907689364510	907689364510	907689364510
13	TEE-UNION	1	907689360310	907689360310	907689360310
14	COUPLING-HOSE	2	907689364610	907689364610	907689364610
16	CONNECTOR-MALE	1	907689364810	907689364810	907689364810
17	BUSHING-PIPE	2	907689363510	907689363510	907689363510
18	ELBOW-MALE	1	907689365110	907689365110	907689365110
19	ELBOW-MALE	1	907689360410	907689360410	907689360410
20	COOLER-OIL	1	918761104001	918761104001	918761104001
21	BRACKET (OIL COOLER)	2	918792106401	918792106401	918792106401
22	COUPLING-FLEX	1	918841100001	918841100001	918841100001
24	NIPPLE-PIPE	1	63N20X360	63N20X420	63N20X540
25	TUBE-STEEL	()	85M8 (8 FT)	85M8 (9 FT)	85M8 (9 FT)
27	TUBE-STEEL	()	85M12 (2 FT)	85M12 (3 FT)	85M12 (3 FT)
29	PLUG-PIPE	1	64AA5	64AA5	64AA5
30	PLUG-PIPE	4	64AA7	64AA7	64AA7
31	PLUG-PIPE	1	64A26	64A26	64A26
32	ELBOW-PIPE	1	64C4 *	64C4	64C4
33	NIPPLE-PIPE	2		63J11 **	
34	ELBOW-PIPE	1	64C7	64C7 **	64C7
35	TEE-STR SERVICE	3	00906350 0003	00906350 0003	00906350 0003
36	ELBOW	1	64C4	64C4	64C4
38	TEE-PIPE	1	64G2	64G2	64G2
39	TEE-PIPE	1	64G3	64G3	64G3
40	TEE-PIPE	1	64G6	64G6	64G6
41	TEE-PIPE	1	64G9	64G9	64G9
43	NIPPLE-PIPE	1	63C1	63C1	63C1
44	NIPPLE-PIPE	1	63D1	63D1	63D1
45	NIPPLE-PIPE	1	63F8 *	63F8	63F13
46	NIPPLE-PIPE	1	63C6	63C15	63C6
47	NIPPLE-PIPE	1	63F2	63F2	63F2
48	NIPPLE-PIPE	1	63F4	63F4	63F4
49	NIPPLE-PIPE	1	63F1	63F2	63F5

DESCRIPTION	No. Req'd	10" (918791107301)	12" (918791126801)	14" (918791145501)
NIPPLE-PIPE.....	2	63J30	63J5**	63AP49
BUSHING-PIPE.....	2	64E14	64E14	64E14
BUSHING-PIPE.....	1	64E2	64E2	64E2
CLAMP-PIPE.....	2	98H1	98H1	98H1
SCREW-SELF TAPPING.....	4	75LM215	75LM215	75LM215
SCREW-FLAT SOC HD.....	3	120175N	120175N	120175N
SCREW-HEX HD.....	2	655EC060	655EC060	655EC060
NUT-HEX.....	2	50AW24	50AW24	50AW24
NUT-HEX.....	4	50AQ2	50AQ2	50AQ2
WASHER-PLAIN.....	4	95A2	95A2	95A2
PIN-DOWEL.....	2	62M33	62M33	62M33
SCREW-HEX HD.....	8	655EC080	655EC080	655EC080
SCREW-SOC HD.....	4	75P1	75P1	75P1
NIPPLE-PIPE.....	1	63F21	63F21	63F21
UNION.....	1	64Z3	64Z3	64Z3

Required

8 thru 1236 use group 201GEK4012 which adds Ref No. 33, increases qty of Ref No. 34 to (5)
 Ref No. 50 to (4)

HORIZONTAL - FORCE FEED LUBE WITH COOLER
Reference Figure 8 for Exploded View

Ref. NO.	DESCRIPTION	No. Req'd	10" (918791106701)	12" (918791126001)	14" (918801140301)
1	PUMP-LUBE.....	1	918803105601	918803105601	918803105601
2	PLATE-PUMP ASM.....	1	907673121801	907673121801	907673121801
3	COUPLING-HALF ASM (ROTOR SHAFT).....	1	918802106201	918802106201	918802106201
4	COUPLING-HALF ASM (PUMP SHAFT).....	1	204GFJ282	204GFJ282	204GFJ282
5	SCREEN-OIL.....	2	907652121510	907652121510	907652121510
6	VALVE-RELIEF.....	1	907651097210	907651097210	907651097210
7	GAUGE-PRESSURE.....	1	907651097310	907651097310	907651097310
8	FILTER-FLOW EZY.....	1	918761105701	918761105701	918761105701
9	TEE.....	1	907801100201	907801100201	907801100201
10	CONNECTOR-MALE.....	5	907689360110	907689360110	907689360110
11	HOSE-OIL.....	()	R41A (4 FT)	R41A (4 FT)	R41A (5 FT)
12	ELBOW-MALE.....	6	907689364510	907689364510	907689364510
13	TEE-UNION.....	2	907689360310	907689360310	907689360310
15	COUPLING-HOSE.....	2	907689364610	907689364610	907689364610
17	CONNECTOR-MALE.....	1	907689364810	907689364810	907689364810
18	BUSHING-PIPE.....	2	907689363510	907689363510	907689363510
19	ELBOW-MALE.....	1	907689365110	907689365110	907689365110
20	COUPLING-FLEX.....	1	918841100001	918841100001	918841100001
22	ELBOW-MALE.....	1	907689360410	907689360410	907689360410
23	COOLER-OIL.....	1	918761104001	918761104001	918761104001
24	BRACKET (OIL COOLER).....	2	918792106401	918792106401	918792106401
26	BUSHING-PIPE.....	1	64E2	64E2	64E2
27	TUBE-STEEL.....	()	85M8 (8 FT)	85M8 (9 FT)	85M8 (9 FT)
29	TUBE-STEEL.....	()	85M12 (2 FT)	85M12 (3 FT)	85M12 (3 FT)
31	PLUG-PIPE.....	2	64AA7	64AA7	64AA7
32	PLUG-PIPE.....	1	64A6	64A6	64A6
33	BUSHING-PIPE.....	2	64E14	64E14	64E14
34	ELBOW-PIPE.....	1	64C7	64C7	64C7
35	ELBOW-PIPE.....	1	64C4	64C4	64C4
36	ELBOW-PIPE STR.....	2	64D7	64D7	64D7
37	ELBOW-PIPE STR.....	1	64D5	64D5	64D5
38	ELBOW-PIPE STR.....	2	64X7	64X7	64X7
39	TEE-PIPE.....	1	64G2	64G2	64G2
41	TEE-STR SERVICE.....	3	00906350 0003	00906350 0003	00906350 0003
42	TEE-PIPE.....	1	64G9	64G9	64G9
43	NIPPLE-PIPE.....	1	63F21	63F21	63F21
44	NIPPLE-PIPE.....	1	63C1	63C1	63C1
46	PLUG-PIPE.....	1	64A26	64A26	64A26
47	NIPPLE-PIPE.....	1	63C6	63C15	63C5
48	NIPPLE-PIPE.....	1	63F1	63F2	63F2
50	CLAMP-PIPE.....	2	98H1	98H1	98H1
51	SCREW-SELF TAPPING.....	4	75LM215	75LM215	75LM215
52	SCREW-FLAT SOC HD.....	3	120175N	120175N	120175N
53	NUT-HEX.....	4	50AQ2	50AQ2	50AQ2
54	WASHER-PLAIN.....	4	95A2	95A2	95A2

Ref. No.	DESCRIPTION	No. Req'd	10" (918791106701)	12" (918791126001)	14" (918801140301)
55	SCREW-HEX HD.....	2	655EC060	655EC060	655EC060
56	NUT-HEX.....	2	50AW24	50AW24	50AW24
57	NIPPLE-PIPE.....	1	63N20X720	63N20X840	63N20X1080
70	PIN-DOWEL.....	2	62M33	62M33	62M33
71	SCREW-HEX HD.....	8	655EC080	655EC080	655EC080
72	SCREW-SOC HD.....	4	75P1	75P1	75P1

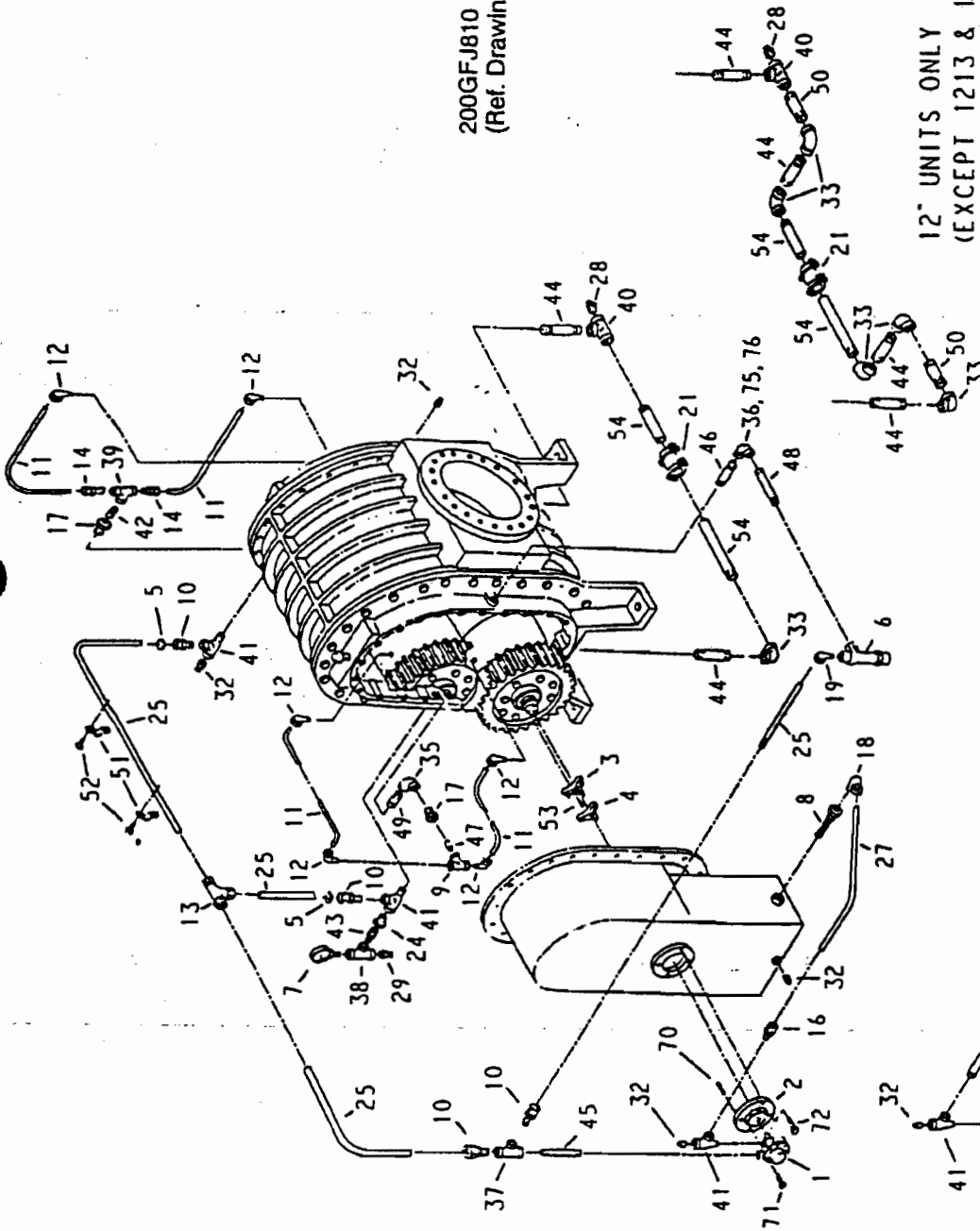
HORIZONTAL - FORCE FEED LUBE
Reference Figure 7 for Exploded View

Ref. No.	DESCRIPTION	No. Req'd	10" (918791103401)	12" (918791123401)	14" (918801140201)
1	PUMP-LUBE	1	918803105601	918803105601	918803105601
2	PLATE-PUMP ASM	1	907673121801	907673121801	907673121801
3	COUPLING-HALF ASM (ROTOR SHAFT)	1	918802106201	918802106201	918802106201
4	COUPLING-HALF ASM (PUMP SHAFT)	1	204GFJ282	204GFJ282	204GFJ282
5	SCREEN-OIL	2	907652121510	907652121510	907652121510
6	VALVE-RELIEF	1	907651097210	907651097210	907651097210
7	GAUGE-PRESSURE	1	907651097310	907651097310	907651097310
8	FILTER-FLOW EZY	1	918761105701	918761105701	918761105701
9	TEE	1	907801100201	907801100201	907801100201
10	CONNECTOR-MALE	3	907689360110	907689360110	907689360110
11	HOSE-OIL	()	R41A (4 FT)	R41A (4 FT)	R41A (5 FT)
12	ELBOW-MALE	6	907689364510	907689364510	907689364510
13	TEE-UNION	1	907689360310	907689360310	907689360310
14	COUPLING-HOSE	2	907689364610	907689364610	907689364610
16	CONNECTOR-MALE	1	907689364810	907689364810	907689364810
17	BUSHING-PIPE	2	907689363510	907689363510	907689363510
18	ELBOW-MALE	1	907689365110	907689365110	907689365110
19	ELBOW-MALE	2	907689360410	907689360410	907689360410
20	COUPLING-FLEX	1	918841100001	918841100001	918841100001
22	BUSHING-PIPE	1	64E2	64E2	64E2
23	TUBE-STEEL	()	85M8 (8 FT)	85M8 (9 FT)	85M8 (9 FT)
25	TUBE-STEEL	()	85M12 (2 FT)	85M12 (3 FT)	85M12 (3 FT)
27	PLUG-PIPE	2	64AA7	64AA7	64AA7
28	PLUG-PIPE	1	64A6	64A6	64A6
29	PLUG-PIPE	1	64A26	64A26	64A26
30	ELBOW-PIPE	1	64C7	64C7	64C7
31	ELBOW-PIPE	1	64C4	64C4	64C4
32	ELBOW-PIPE STR	2	64D7	64D7	64D7
33	ELBOW-PIPE STR	2	64X7	64X7	64X7
35	TEE-PIPE	1	64G2	64G2	64G2
37	TEE-STR SERVICE	4	00906350 0003	00906350 0003	00906350 0003
38	TEE-PIPE	1	64G9	64G9	64G9
39	NIPPLE-PIPE	1	63F21	63F21	63F21
40	NIPPLE-PIPE	1	63C1	63C1	63C1
43	NIPPLE-PIPE	1	63C8	63C15	63C15
44	NIPPLE-PIPE	1	63F1	63F2	63F2
46	CLAMP-PIPE	2	98H1	98H1	98H1
47	SCREW-SELF TAPPING	4	75LM215	75LM215	75LM215
48	SCREW-FLAT SOC HD	3	120175N	120175N	120175N
49	NIPPLE-PIPE	1	63N20X720	63N20X840	63N20X1080
70	PIN-DOWEL	2	62M33	62M33	62M33
71	SCREW-HEX HD	8	655EC080	655EC080	655EC080
72	SCREW-SOC HD	4	75P1	75P1	75P1

200GFJ810
(Ref. Drawing)

12" UNITS ONLY
(EXCEPT 1213 & 1216)

FIGURE 5



10" UNITS ONLY

VERTICAL - FORCE FEED LUBE

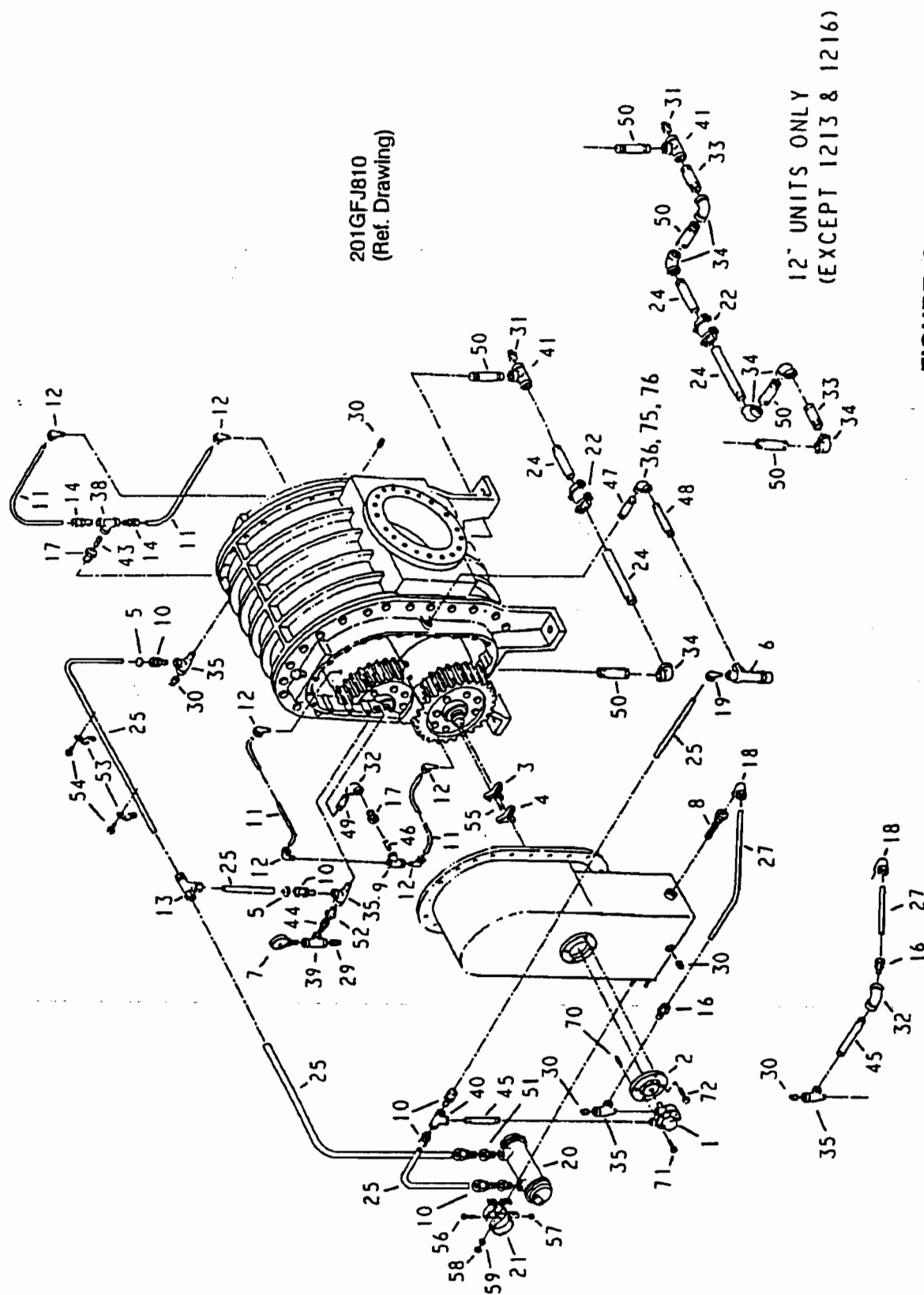
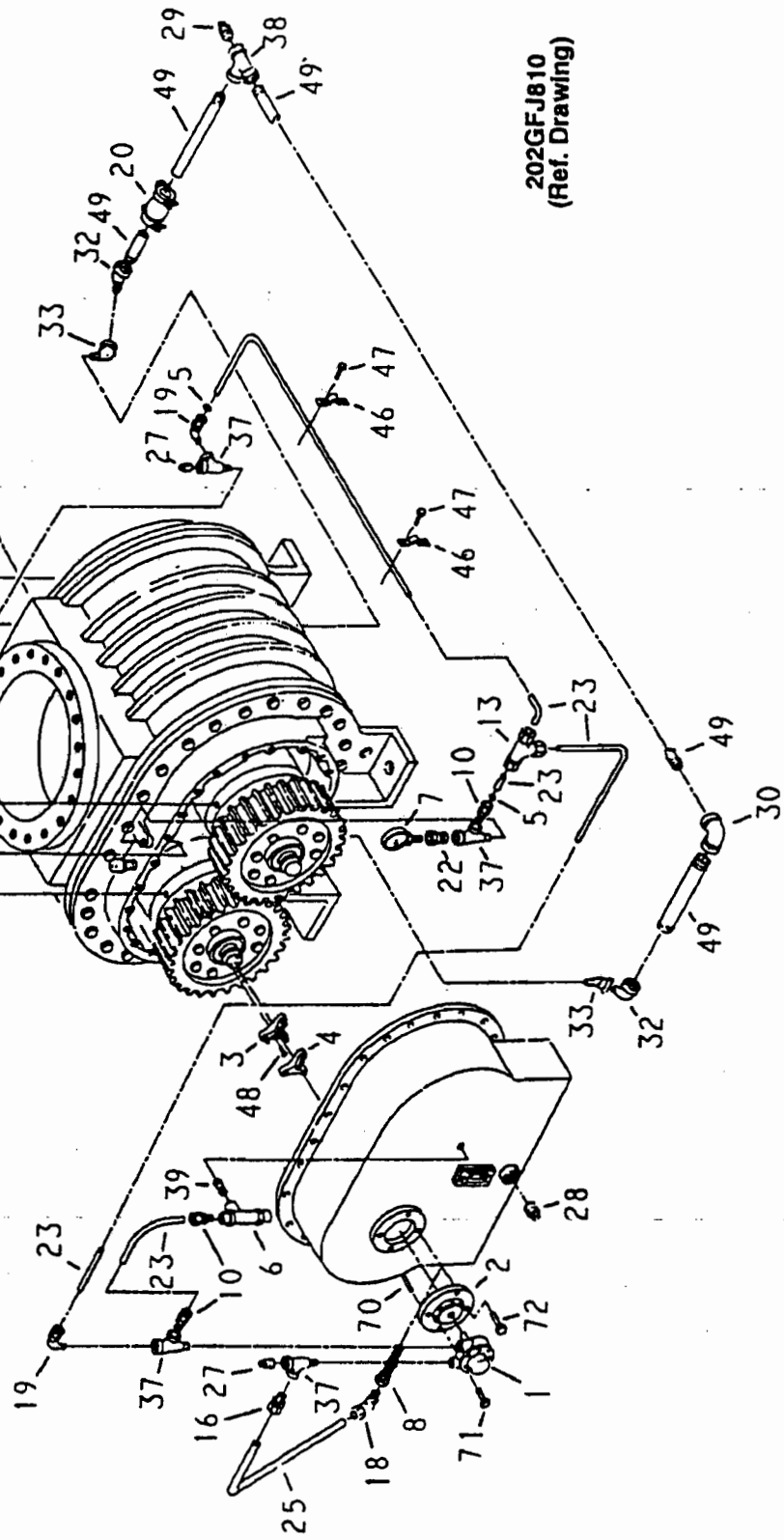


FIGURE 6

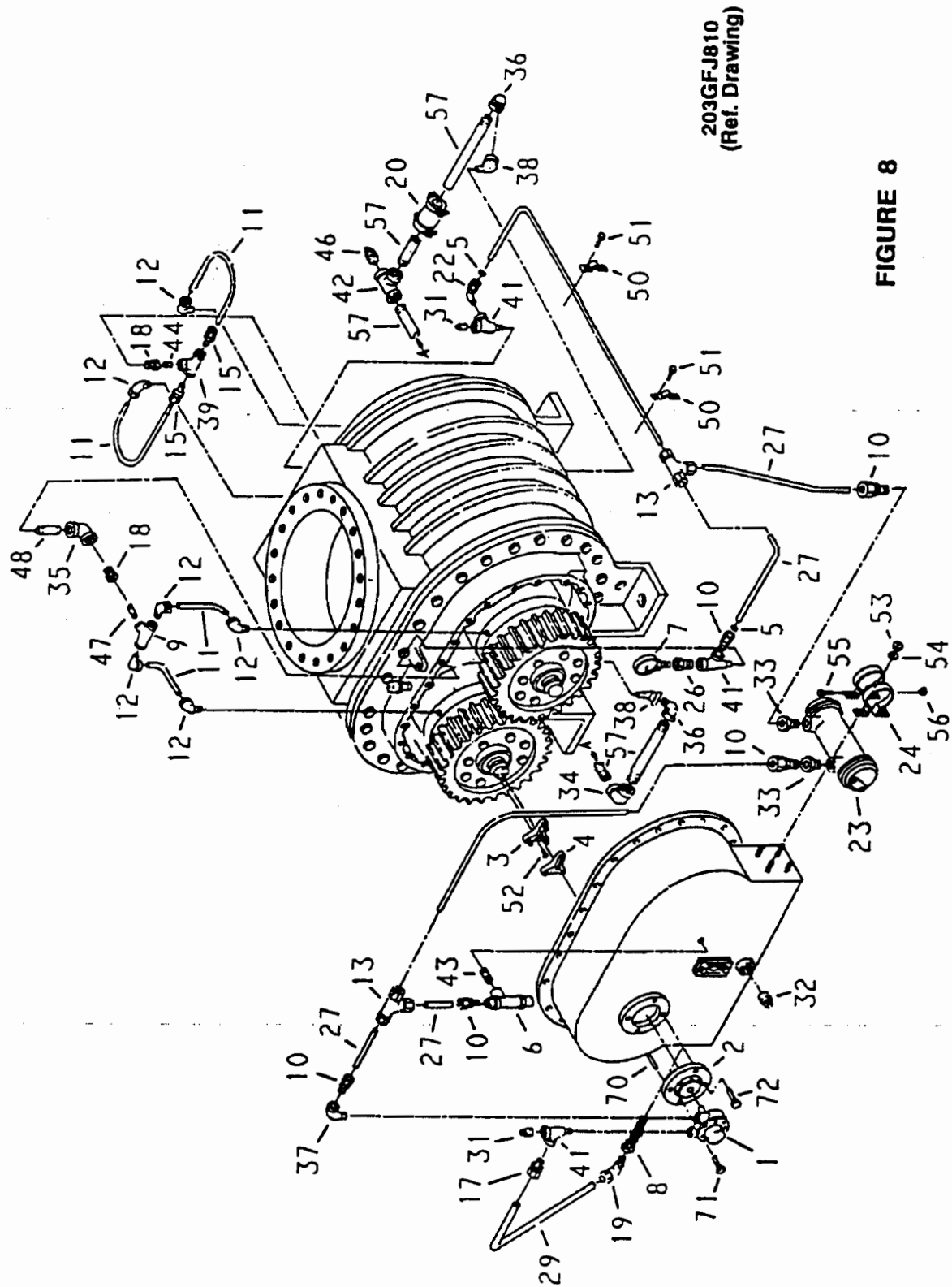
202GFJ810
(Ref. Drawing)

FIGURE 7

HORIZONTAL - FORCE FEED LUBE



HORIZONTAL - FORCE FEED LUBE WITH COOLER



HI-TEMP CLEARANCE ROTOR GROUPS

PART NUMBER	SIZE
215GEJ4028	1013-5000 (GEJC)
225GFJ4028	1016-6000 (GFJD)
220GFJ4028	1018-6000 (GFJE)
227GFJ4028	1021-6000 (GFJF)
218GFJ4028	1024-6000 (GFJG)
216GFK4028	1226-6000 (GFKF)
218GFK4028	1214-6000 (GFKJ)