HOPE BAY PROJECT INCINERATOR MANAGEMENT PLAN

HOPE BAY, NUNAVUT

MARCH 2019

Hope Bay Project Incinerator Management Plan

Plain Language Overview:

This Plan describes the waste management processes at Hope Bay relevant to on site incineration. This Plan ensures that 1) only appropriate burnable material enters the incinerator waste stream, 2) animal attractants are promptly incinerated, 3) the incinerator is operated in a manner that reduces harmful emissions, 4) residual ash is handled and disposed of properly, and 5) that all compliance monitoring and reporting associated with incinerator operations occurs.

Hope Bay, Nunavut

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Revisions

Revision #	Date	Section	Changes Summary	Author	Approver
0	May 2009		Initial issuance of Incinerator Management Plan		HBML
1	Feb 2012		Update and revise Incinerator Management Plan	KBL Environmental	HBML
1.1	Mar 2012		General document revision	HBML	HBML
2	Sep 2015		Updated to TMAC ownership and format, added glossary, added plan implementation information, update 2AM- Licence number references and requirements, add related documents and relevant legislation tables, updated information on incinerators in use, updated ash management section, included reference to NPRI reporting, added contingencies section	TMAC	TMAC
3	December 2017		General document revision	TMAC	TMAC
4	March 2017		Update with new incinerator specifications and O&M manual. In addition, updated throughout to consider the recently issued Amended Type “A” Water Licence 2AM-DOH1335 (Amendment No. 2) for the Doris-Madrid Project and a new Type “A” Water Licence No. 2AM-BOS1835 for the Boston Project.	TMAC	TMAC
5	March 2019		2019 update	TMAC	TMAC

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Glossary

Term	Definition
3Rs	Reduce, Reuse, and Recycle
CCME	Canadian Council of Ministers of the Environment
CWS	Canada-wide Standards
NIRB	Nunavut Impact Review Board
NPRI	National Pollutant Release Inventory
NWB	Nunavut Water Board
PCDD	Poly-chlorinated dibenzo-dioxin
PCDF	Poly-chlorinated dibenzo-furan
PVC	Poly-vinyl chloride
TDG	Transport of Dangerous Goods (Act or Regulations)
TMAC	TMAC Resources Inc.

1 Introduction

This Hope Bay Incinerator Management Plan (the Plan) has been prepared by TMAC Resources Inc. (TMAC) in accordance with the water licences held by TMAC. The Plan is intended primarily for use by TMAC and its contractors to ensure that best practices for domestic waste incineration are followed, and that the conditions of water licences and project permits are met.

This Plan is structured in a manner such that one document pertaining to domestic waste incineration is approved and implemented across all TMAC Hope Bay project sites, while still addressing site- and licence-specific needs. The main document outlines TMAC's approach to domestic waste stream segregation and incinerator management as it pertains to all TMAC Hope Bay developments. Appended modules provide details for each site and the associated water licence. In the event of a new water licence, or an existing licence amendment, only the specific modules pertaining to that licence and site will need to be revised. This is intended for consistency and efficiency across operations and for compliance management.

1.1 Objectives

The main objective of this Plan is to ensure domestic waste incinerators are operated in a safe, efficient and environmentally-compliant manner. Consistent with TMAC's intent to be a responsible operator, these objectives are described as follows:

- Compliance with the Environmental Guidelines for the Burning and Incineration of Solid Waste (Government of Nunavut Environmental Protection Division);
- Compliance with the Environment Canada Technical Document for Batch Waste Incineration;
- Compliance with the Canadian Council of Ministers of the Environment Canada-Wide Standards for Mercury Emissions and Dioxins and Furans;
- Compliance with Project Certificate and Water Licence requirements;
- Prevention of public health risk;
- Protection of the operator;
- Protection of surface and ground water;
- Protection of land;
- Protection of local flora and fauna species; and
- Conservation of resources.

This Incinerator Management Plan has been developed to ensure that these factors are built into the TMAC operational approach at Hope Bay. It discusses the importance of waste management and reduction of specific waste streams to ensure Canada Wide Standards (CWS) for dioxins, furans and mercury are achieved.

1.2 Relevant Legislation and Guidance

Table 1.1 provides a summary of federal and territorial regulations governing this Plan and associated guidelines.

Table 1.1. List of federal and territorial regulations governing the Hope Bay Incinerator Management Plan

Regulation/Guideline	Year	Governing Body	Relevance
Canada Wide Standards for Dioxins and Furans	2001	Environment Canada	Contains stack testing requirements triggered by waste volumes incinerated, and numeric targets for dioxins and furans.
Canada Wide Standards for Mercury Emissions	2000	Environment Canada	Contains numeric targets for mercury.
Technical Document for Batch Waste Incineration	2010	Environment Canada	Contains recommendations for batch waste incineration to achieve emissions compliance.
Environmental Guideline for the Burning and Incineration of Solid Waste	2012	Government of Nunavut – Department of Environment	Identifies pollutants of concern, outlines best management practices for burning of wastes, types of wastes that can be burned, and ash management.
Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities	2011	Government of Nunavut – Department of Environment	Provides the criteria that determine if process residuals (including incinerator ash) may be disposed in a municipal landfill, or is classified as a hazardous waste.

Canada-wide Standards (CWSs) are intergovernmental agreements developed under the *Canadian Council of Ministers of the Environment* (CCME). CWSs can include qualitative or quantitative standards, guidelines, objectives and criteria for protecting the environment and reducing risks to human health. Canada has identified dioxins, furans and mercury as emission products that need to be managed as they pose a potentially significant health and environmental threat. Hope Bay's Project Certificate and NWB water license for the Doris North Project states that these emissions must be in compliance with the CWSs for dioxins, furans and mercury.

The Technical Document for Batch Waste Incineration was issued by Environment Canada in January 2010 and is intended to act as a guideline for owners and operators of various incinerators. The technical document focuses on batch waste incinerators ranging in size from 50 to 3,000 kg of waste per batch. Batch waste incinerators are those that operate in a non-continuous manner (i.e., they are charged with waste prior to the initiation of the burn cycle, and the door remains closed until the ash has cooled inside the primary chamber). Batch waste incineration is the type of incineration process utilized at Hope Bay for domestic wastes.

The document recommends and describes a six-step process for batch waste incineration:

- Step 1 – Understand Your Waste Stream;
- Step 2 – Select the Appropriate Incinerator (or Evaluate the Existing System);
- Step 3 – Properly Equip and Install the Incinerator;
- Step 4 – Operate the Incinerator for Optimum Combustion;
- Step 5 – Safely Handle and Dispose of Incinerator Residues; and
- Step 6 – Maintain Records and Report.

The batch waste incineration document addresses proper system selection, operation, maintenance and record keeping, with the goals of achieving the Canada-Wide Standards for dioxins/furans and mercury, and reducing releases of other toxic substances.

The Environmental Guideline for the Burning and Incineration of Solid Waste produced by the Government of Nunavut provides guidance for incineration and ash disposition best management practices to reduce risk to the environment.

The Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities governs deposition of process residuals into municipal landfills in Nunavut, but it is expected that the TMAC Landfill Management Plan (when developed), will contain similar criteria to determine acceptable wastes for landfilling at Hope Bay, or for determining alternate disposition of incinerator bottom ash classified as a hazardous waste if sampling determines it contains pollutants of concern.

1.3 Related TMAC Documents

The documents listed in Table 1.2 are expected to be referenced and utilized in conjunction with the Incinerator Management Plan.

Table 1.2. List of documents related to the Hope Bay Incinerator Management Plan

Document Title	Relevance
Non-Hazardous Waste Management Plan	Describes management of non-hazardous solid waste segregated from the incinerator waste stream and disposal of incinerator ash.
Hazardous Waste Management Plan	Describes management of items such as batteries, aerosol containers and other materials not acceptable for incineration or landfilling.
Air Quality Management Plan	Describes the air quality monitoring programs associated with the Hope Bay Project, including stack testing of incinerators.
Safe Waste Incineration Standard Operating Procedure	Describes safe work procedures for operation of incinerator units at Hope Bay.
Solid Waste Segregation, Handling and Disposal Standard Operating Procedure	Outlines waste segregation required by all personnel working at Hope Bay and proper handling and disposal procedures.
Kitchen Food and Waste Handling Storage	Describes proper handling and storage procedures of food wastes by all personnel at Hope Bay.
Incinerator Ash Sampling	Describes the procedure for collecting composite ash samples to be submitted for laboratory analysis.

The Incinerator Management Plan is supported by a set of working procedures that provide detailed instructions on such topics as waste sorting, operation of specific models of incinerators in use, and ash sampling protocols. The procedures contain the various forms and checklists required to ensure the appropriate records are maintained concerning all incinerator operations.

1.4 Plan Management

The Chief Operating Officer (COO) has the overall responsibility for implementing this management plan and will provide the on-site resources to operate, manage and maintain all incinerators located in the Hope Bay Belt in accordance with the operation manuals and regulatory requirements.

The Mine General Manager (MGM) is responsible for providing on-site support and resources for waste stream management and incineration of domestic waste, including monetary resources for completing maintenance and repairs.

The Site Services Supervisor is responsible for revising this management plan and will maintain waste incinerator records, conduct and record regular inspections of the incinerators, request maintenance or repairs and document completion of the request, provide feedback on operational procedures to improve performance, and will supervise the operation of the incinerators, including sampling and disposition of ash.

The Environmental Supervisor is responsible for supporting the Site Services Supervisor for revisions (where required) to this plan, coordinating ash characterization analyses to identify appropriate disposal options, conducting workplace inspections and performing regular audits of the waste management and incineration records.

1.5 Plan Implementation

In accordance with the requirements of the General Conditions (Part B) of the applicable water licences, this plan will be implemented following its submission, subject to any modifications proposed by the NWB as a result of the review and approval process.

This plan will be periodically reviewed and updated as required as the Project moves through operations and final closure and reclamation.

Additionally, the detail in the document will continue to be refined with subsequent revisions.

2 Incineration Management Issues

Waste management at Hope Bay has made substantial advances and improvements since activity in the Project area started. Dedicated facilities allow for centralized collection, sorting and proper packaging for various forms of waste products. This may include on-site incineration or preparing waste for transport to a waste transfer station for further recycling, treatment or disposal. Any waste that meets the requirements for on-site incineration is burned on site. For more information regarding hazardous or non-hazardous waste management at Hope Bay refer to the following documents:

- Hope Bay Hazardous Waste Management Plan; and
- Hope Bay Non-hazardous Waste Management Plan.

Under no circumstances does TMAC allow personnel or contractors to burn hazardous waste. Hazardous waste and industrial waste are kept separate and temporarily stored according to regulations until shipped off site for disposal or recycling at approved facilities. Site incinerators are only approved to burn "domestic" camp waste such as kitchen waste, food scraps, camp room and restroom garbage, cardboard, paper and sewage sludge cake.

2.1 Waste Stream Management

The first steps to ensuring that effective and compliant incineration occurs is to ensure proper waste segregation so that inappropriate wastes do not make it into the waste stream destined for the incinerator and to understand the resulting composition of the wastes to be incinerated.

2.1.1 Management Response

2.1.1.1 Waste Stream Composition and Segregation

Only appropriate domestic camp waste is permitted for incineration. All wastes are segregated at the source to ensure non-burnable waste streams do not enter the feed stock for the incinerator. All "burnable" waste is placed in specifically identified waste containers with transparent bags and in bins located throughout the camp facilities. Prior to loading the waste batches in the incinerator, the feed material is visually inspected by the incinerator operator to ensure it does not contain inappropriate waste materials. General classes of inappropriate wastes include, but are not limited to:

- Hazardous Wastes;
- Mercury-containing materials/waste (fluorescent lamps, thermometers, thermostats);
- Asbestos waste;
- Liquid wastes including petroleum hydrocarbons and untreated liquid sewage (sewage sludge cake may be burned);
- Metal and glass;
- Wastes containing mercury, pressure or chemically treated wood;

- Uncontaminated plastics, including chlorinated plastics;
- Bulky materials such as machinery parts or large metal goods such as appliances;
- Radioactive materials such as smoke detectors;
- Potentially explosive materials such as pressurized vessels, unused or ineffective explosives;
- Hazardous materials such as organic chemicals (e.g., PCBs, pesticides); and
- Electronics, batteries, fluorescent light bulbs, whole tires, rubber boots, etc.

When encountered, inappropriate waste material is removed from the incinerator feed, where possible. If the inappropriate waste is too intermixed with the incinerator feed, the bag will be rejected and not incinerated. Removed inappropriate wastes and rejected batches will be stored and handled in accordance with the Hazardous Waste Management Plan. The waste feed inspections shall be recorded on the appropriate forms, and issues with proper segregation and sorting at source in the waste management stream will be addressed by identifying the source or root cause of the issue, re-enforcing or improving training of site personnel, providing additional labelled receptacles, or implementing other measures as needed.

2.1.1.2 Reduce, Reuse and Recycle

TMAC has adopted the 3Rs of waste management: Reduce, Reuse, and Recycle. The objective of these activities is to divert as much material from becoming a waste (hazardous or otherwise) and therefore reduce the total volume of wastes requiring handling, storage, transportation and disposal. Some of the most significant actions in this regard include:

Reduce:

- Purchasing only the required amounts of materials and buying in bulk when the opportunity is available.
- Employing inventory control methods in an attempt to ensure that quantities of materials are completely utilized.
- Establishing maintenance schedules that are consistent with the equipment manufacturers' suggested replacement.
- Maintaining and protecting materials to prevent damage and breakage.
- Eliminating unnecessary plastic and bulky packaging by buying kitchen supplies in bulk (i.e., ketchup, salad dressings, syrups, etc.).
- Cutting down on plastic food packaging.
- Substituting less hazardous chemicals where possible.
- Selecting products that provide the maximum "life-of-material".

Re-Use:

- If appropriate, collect and return materials to the system (i.e., equipment, operations, etc.) following maintenance or repair.
- Waste oil burners will be used to heat selected facilities.
- Oil/water separators are used onsite to reduce the amount of contaminated water requiring shipment off site.
- If appropriate, filter and/or use additives to replenish lost properties of material in order to extend its useful life.
- Testing to ensure items (i.e., batteries) are "spent" before removing from service.

Recycle:

- Commercial companies are used to the maximum extent practical to recycle appropriate materials on a fee-for-service basis.
- Explore waste management options that allow for the recycling of a material or product instead of disposal.

2.1.1.3 Prevention of Wildlife Attraction

TMAC is required by the Water Licence and Project Certificate to incinerate food wastes to prevent attraction of wildlife. A comprehensive program exists to educate site personnel on the importance of proper food waste (or other potential attractant) management to ensure animals are not attracted to worksites. All food waste is returned daily to the main camp facilities so it is captured in the domestic waste stream. Collection and transfer of food wastes is performed so that these attractants are stored safely, moved between facilities securely and are burned in the incinerator promptly.

2.1.1.4 Targeting Pre-cursors to the Formation of Dioxins and Furans

Chlorine, in almost any form, is the key component required for dioxin and furan formation. Reducing or removing the chlorinated material that enters incinerators is the first minimization strategy to reduce the formation of dioxins and furans. Removing all chlorine compounds is extremely difficult because chlorine is used in the manufacture of a large variety of products, and in many cases there are no substitutes. Poly vinyl chloride (PVC) containing products are, however, eliminated from the incinerator waste stream to the extent possible. Sewage sludge also generally contains chlorinated compounds. TMAC may incinerate adequately dried sewage sludge or alternatively store this material in biodegradable bags (in a secure location not accessible to wildlife) until it can be buried in the overburden stockpile or beneath tailings in the Tailings Impoundment Area.

The following components of the waste stream must be removed before incineration to reduce the presence of potential catalysts and to reduce the presence of materials that may form or act as precursors for the formation of dioxins and furans:

- **Metals:** The inorganic component of the waste is largely made of metal-containing materials. During combustion, it is possible for these metals to become catalysts for the formation of dioxins and furans and it is, therefore, important that metal be eliminated from the waste stream destined for incineration. The metals include foils, batteries, nails and screws, painted wood products, aerosol cans, etc.
- **Plastic:** Plastics, particularly PVC, must be eliminated from the incinerator waste stream to the extent possible. The chlorine compounds contained in PVC and plastics are an ideal building block for the formation of dioxins and furans.
- **Medical Waste:** Medical waste can potentially be the biggest source of dioxin- and furan-forming material. Medical waste contains a mix of sharps made of metal, plastics (frequently PVC) and organic material which frequently contain chlorine compounds. This is an ideal mix for forming dioxins and furans. TMAC avoids incinerating these materials to the extent possible by segregating them from the incinerator waste stream.

By following these waste separation guidelines the extent of dioxin and furan formation will be reduced.

2.1.2 Management Response

TMAC's current waste segregation practices greatly reduce the volume of plastics, metals, glass, and other potential catalysts for dioxin and furan formation from ending up in the incinerator waste stream.

Containers are set up throughout camp buildings to collect batteries, aerosol cans, food cans and glass containers, domestic plastic containers (toiletries, etc.), refundable cans/bottles and medical wastes. Separate labelled waste containers are available for plastic construction debris, cardboard, non-burnable wood and rags/absorbent pads. All kitchen grease is securely stored for offsite disposal and does not enter the incinerator waste stream.

2.2 Dioxin and Furan Emissions

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), commonly known as dioxins and furans, respectively, are predominantly a result of human activity. These substances are toxic, persistent, and bio-accumulative. Due to their extraordinary environmental persistence and capacity to accumulate in biological tissues, dioxins and furans are slated for virtual elimination.

Dioxin and furan contamination found in soil, water, sediments, and tissues are the subject of national guidelines for dioxins and furans. The CWS Dioxin/Furan guideline for incineration is 80 pg I-TEQ/m^3, where pg = picogram, I-TEQ = international toxic equivalent, m^3 = cubic metre.

The exact mechanism of dioxin and furan formation in incinerators is poorly understood, but generally they form during the thermal breakdown of organic materials in the presence of transition metals and chlorinated compounds. Dioxin formation takes place as the flue gas cools from the initial 1,000°C to about 250°C, with peak dioxin and furan formation occurring in the range of 650°C to 250°C.

Regardless of how dioxins and furans are formed, certain operating conditions increase the potential for formation of these compounds including:

(a) Incomplete combustion of fuel;

(b) An oxidizing atmosphere;

(c) Presence of a chlorine source;

(d) Fly ash surfaces (carbon source);

(e) Fly ash with degenerated graphite structures; and

(f) Presence of catalytic metals (copper, iron, manganese, zinc, etc.).

2.2.1 Management Response

Dioxin and furan emissions from incinerators may be reduced by:

- Reducing or removing certain waste types from the incinerator waste stream as described above through appropriate waste sorting techniques;
- Placement of waste in the incinerator chamber and operating the incinerator according to manufacturer specifications to ensure optimal burning efficiency and provide adequate destruction of dioxins and furans; and
- Use of Pre-Operational, Operational and Maintenance Checklists and Log Books to ensure that the unit is operated in a safe and efficient manner.

TMAC has selected and will continue to select incinerator technology that should reduce the extent to which dioxins and furans can form. This is achieved through the following mechanisms:

- Use of dual or secondary chamber incinerator technology with a clear burn process defined which eliminates spurious burn conditions and operator error.
- Operating each incinerator unit within the manufacturer specifications to achieve adequate temperatures and residence time. This should allow the materials to be combusted completely so that no precursors are available for dioxin and furan formation during cooling.

2.3 Mercury Emissions

Waste incineration has historically been responsible for a portion of the mercury emitted in Canada; however reductions in emissions have been apparent nationwide since the implementation of the CWS and the requirement to monitor specific emissions. Improved exhaust gas controls can reduce emissions of acid gases and fine particulates in addition to new activated carbon injection systems that decrease emissions of mercury and dioxins and furans.

At the same time, action has been taken by many product manufacturers to reduce the mercury content of consumer goods which could end their life cycle in domestic solid waste (e.g., alkaline batteries) and thus have reduced the mercury available in the waste stream.

Emission limits are expressed as the concentrations of specific compounds and elements present in the exhaust gas exiting the stack of the facility. New or expanding facilities are expected to comply with the standard upon attaining normal full scale operation, while the limits for existing facilities are capable of being met using generally available technology (or waste diversion). Larger facilities are subject to annual stack testing to verify compliance with the limit. Mercury emission limits are presented in Table 2.1.

Table 2.1. Canada-Wide Standard for Mercury Emissions

Source	Mercury Standard
Municipal waste incineration	20 µg/Rm^3
Hazardous waste incineration	50 µg/Rm^3
Sewage sludge incineration	70 µg/Rm^3
Medical waste incineration	20 µg/Rm^3

µg = microgram, Rm^3 = reference cubic metre

2.3.1 Management Response

TMAC disposes of any waste stream that may contain mercury, including thermostats, thermometers, light bulbs, etc., at an off-site facility. These items are placed in labelled collection containers located throughout the camp and facility. Waste management employees screen for all possible mercury contaminated waste and ensure all relevant regulations are adhered to regarding handling, storage and transport for offsite disposal. For more information regarding the regulations and waste shipment procedures please refer to the Hope Bay Hazardous Waste Management Plan.

2.4 Incinerator Capacity and Operations

Incinerator capacity has been selected to ensure timely and effective management of the volumes of burnable domestic waste generated at Hope Bay. Incinerator details, including model, capacity, location, status and reference to operating details and manuals are provided in the site-specific modules appended to this plan.

2.4.1 Management Response

The Hope Bay site waste management facilities are closely supervised and waste management personnel are present to monitor incinerator burns and document burn conditions and other relevant information. Incinerator units may be enclosed within shelters to ensure efficiency of the burn process is optimized.

Employees are trained prior to commencement of work so that they are aware of the operational procedure and capacity of the incinerator, and health and safety risks associated with the incinerator and its operation.

2.4.1.1 Burn Process Operational Overview

Batch waste incineration is a process that occurs through charging the incinerator unit with a discrete load or quantity, and allowing a complete burn cycle to finish before the next load is burned.

This process is critical to the efficiency of the burn. Standard operating procedures outline the process to prepare and properly load each incinerator in accordance with manufacturer instructions to optimize burn efficiency.

2.4.1.2 Batch Preparation of Waste

Using categories defined by the supplier of the incinerator, the approximate waste composition of a batch is determined for each incinerator model used. Understanding the typical waste stream composition is important as it leads to key opportunities for waste management generally and specifically for incineration control on site. Periodic audits of the waste stream using incinerator logs and operational checklists will guide continuous improvement of batch preparation processes.

Daily record keeping and operator experience will assist in ensuring batches are prepared consistently and within the capacity of the specific incinerator unit. The weight of the various waste categories loaded into the incinerator determine the proper batch composition for efficient burn cycles.

An appropriate load composition would roughly be represented by:

55% Food Waste / 23% Paper or Cardboard Waste / 22% Other

2.4.1.3 Health and Safety

All incinerators at Hope Bay will be operated in accordance with the manufacturer's instructions. All operators will have appropriate training before being tasked with operating any unit or handling waste and will include the identification of any potential hazards that could be encountered while performing these tasks. Standard operating procedures outline the appropriate personal protective equipment that is required by all personnel operating the incinerator system.

2.4.1.4 Training

Personnel with the responsibility of operating incinerators at Hope Bay will be required to read and comprehend this Incinerator Management Plan, the Operating and Maintenance Manual(s) relevant to the unit they will be operating, and any Standard Operating Procedures that support this Plan or provide site-specific information required for safe and effective incinerator operations.

In addition, an on-site training program will be provided to cover all aspects of incinerator management including: equipment pre-checks, operation, maintenance, monitoring, and record keeping. The training also includes identification of activity related risks, knowledge and use of job-specific PPE, as well as proper handling, storage, and disposal of all ash generated from the facility. A supervised competency evaluation is conducted for all trainees.

The training is both job-specific and equipment-specific and is provided to any site personnel assigned the responsibility to oversee, inspect, maintain, or monitor the incinerator.

2.5 Ash Management

Bottom ash in the incinerator can contain pollutants of concern including mercury, lead and cadmium. These residuals in the ash can be reduced to acceptable levels with proper segregation of non-burnable items from the incinerator feed stock and through maximizing efficient burn practices. The *Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities* published by the Government of Nunavut in 2011 establishes the criteria for determining whether the bottom ash from open burning or incineration is appropriate for disposal in a landfill.

2.5.1 Management Response

The incinerator ash sampling program established for Hope Bay will determine the proper disposition of bottom ash. Once the combustion chamber of the incinerator is cool, the incinerator operator will remove the ash from the previous burn cycle before reloading the incinerator. During ash removal, the operator will inspect and clean the combustion air holes, inspect the burner tip for damage, and will also collect ash samples for analysis.

The remaining ash is placed into metal containers to be weighed. Once weighed and documented, these contents are then transferred into a labelled drum. When full, this drum is sealed and stored to await results of the ash sampling.

A composite sample of ash is sent to an external laboratory for analysis of:

- Leachable metals;
- Leachable mercury;
- Leachable benzene, toluene, xylenes, and ethylbenzene;
- Paint filter; and
- Flash point.

The details of this sampling program can be found in standard operating procedures for ash sampling for the site incinerators and burn pan. Results of the sampling will determine if the ash can be disposed of as non-hazardous waste (landfilled) or must be treated as hazardous waste and managed in accordance with the site Hazardous Waste Management Plan. Ash sampling analysis records are maintained on site, and may be conveyed offsite to receivers of ash shipments if warranted. Hazardous waste shipments will follow the Transportation of Dangerous Goods (TDG) regulations as well as the Interprovincial Movements of Hazardous Waste regulations. The Waste Management Facility maintains a tracking report of all ash shipped from Hope Bay. Certificates of Disposal for waste shipped off site are provided by the off-site waste handling facility. This is provided so waste generators can demonstrate to regulatory authorities that their waste is being handled by an approved facility and that the waste was disposed according to applicable federal and territorial regulations.

2.6 Fuel Storage

Incinerator units are supplied by dedicated diesel fuel tanks.

2.6.1 Management Response

The fuel storage, secondary containment and fuel delivery lines are subject to regular inspection. There are also spill kits available nearby in the event of a spill or leaking fuel line.

3 Monitoring and Evaluation

3.1 Inspections

Routine inspections of the incinerator and associated facilities will be conducted by a qualified individual prior to every use of the incinerator as per stand operating procedures.

Detailed standard operating procedures for each type of incinerator unit contain the specific inspection checklists that are utilized. All raw data records from the operation of the incinerator will be retained for inspection by the appropriate authorities.

3.2 Monitoring

3.2.1 Incinerator Stack Testing

The Water Licence requires that TMAC demonstrate that the incinerators are in compliance with the CCME CWS for air emissions of dioxin, furan and mercury. A third-party service provider is used for monitoring emissions when the stack testing requirement is triggered. The requirement for stack testing is outlined in the CWS for dioxins and furans and the CWS for Mercury, with triggers related to operational state, volumes and types of wastes burned. The testing will be conducted when the thresholds for monitoring are met, unless otherwise approved by Environment Canada, and in accordance with the project Air Quality Management Plan.

The following parameters are required to be monitored based on the CWSs:

- Dioxin;
- Furan; and
- Mercury.

Results of samping are reported annually to the NWB and the Nunavut Impact Review Board (NIRB), and emissions data is used for calculating and reporting non-fugitive (point source) emissions to the National Pollutant Release Inventory (NPRI).

3.3 Documentation and Reporting

TMAC maintains detailed records for the operation of the incinerator. Records will be kept on file for each burn and will be available for audit by TMAC management or regulatory agency representatives. Any out-of-specification situations will be raised immediately and the incinerator should not be used until maintenance or remedial measures have been applied.

To demonstrate appropriate operation and maintenance of the incinerator, the facility will maintain records containing, at minimum, the following information:

- A list of all staff who have been trained to operate the incinerator; type of training conducted and by whom; dates of the training; dates of the refresher courses;
- All preventative maintenance activities undertaken on the equipmen;
- Records of operation of the incinerator;
- Records of quantities and types of waste incinerated;
- Summarized annual auxiliary fuel usage;
- The quantity and disposal location of incinerator residual ash; and
- Results of any stack emission monitoring and ash sampling information.

Monthly Waste Summary

A monthly summary tracks incinerator burns per day, the weight and type of waste prior to the burn and the amount of ash produced. Notes from daily operations are included in this summary. A chart is produced that compares the volume of waste burned to the amount of ash produced. This information is used to determine any trends apparent in the incineration process and identify opportunities where improvements could be implemented. The summary of waste burned during the calendar year is also used for calculations and reporting to the NPRI, by July 1 each following year.

4 Contingencies

Multiple incinerators are utilized at the Hope Bay project. This redundancy ensures there is limited interruption to management of the incinerator waste stream, and reduces the possibility that stockpiling of any burnable domestic waste is required. In the event that temporary stockpiling is required, all food waste is packaged and stored securely from access by wildlife until functioning of the incinerator can resume.

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HOPE BAY PROJECT INCINERATOR MANAGEMENT PLAN

HOPE BAY, NUNAVUT

Module A: Doris

Conformity Table

Licence	Part	Item	Topic	Report Section
2AM-DOH1335	F	1	The Licensee shall implement the following waste management plans as approved by the Board: Hope Bay Project Incinerator Management Plan.	Full Document
	F	6	The Licensee shall dispose of all food Waste in an incinerator designed for this purpose and meets the requirements of the Canada-Wide Standards for Dioxins and Furans and Canada Wide Standards for Mercury emissions or other standards as they become available	Section 1.1, 2.2, 2.3

Contents: Module A

A1 Introduction

The Type A Water Licence No. 2AM-DOH1335 issued to TMAC by the Nunavut Water Board (NWB) allows the incineration of approved waste streams.

TMAC is required, under Part F of the Licence, to implement the Hope Bay Project Incinerator Management Plan and dispose of all food Waste in an incinerator designed for this purpose and meets the requirements of the Canada-Wide Standards for Dioxins and Furans and Canada Wide Standards for Mercury emissions or other standards as they become available.

A1.1 Background

A1.1.1 Overview of Doris Incineration Compliance

It is the aim of TMAC to continue implementing the practices that reduce the probability of formation of pollutant compounds during waste incineration. In addition, TMAC will comply with the relevant Canada-wide Standards for Incinerator emissions, through effective waste segregation and efficient burn practices.

A2 Incinerator Management at Doris

Two incinerators for the Doris project are currently located at the Roberts Bay laydown waste management facility with a third planned for installation in 2019. Two older incinerators units are CY‑2050-A-FA models with a capacity of burning 75 kg of waste per hour. The operating manual for these units is provided in Appendix A of this module.

The one new incinerator is a CY-100-CA-D model with a capacity of three (3) Batches/Day and about 150 to 185 kg/Batch. The CY-100-CA-D is a dual-chamber incinerator, operated under starved-air conditions with batch feeding. The operating manual for this unit is provided in Appendix B of this module.

Waste management at Doris involves comprehensive sort-at-source and segregation of domestic wastes generated at the Doris Camp, return of all food waste attractants from remote worksites to the Doris Camp domestic waste stream, and collection of wastes for transfer to the centralized waste management area at Roberts Bay for timely incineration.

A3 Monitoring and Evaluation

TMAC is required to report the results of Incinerator Stack Testing in the 2AM-DOH1323 Licence Annual Report by March 31 of each year when stack testing is required. A third-party consultant is contracted to conduct the test, and their report is forwarded to the NWB and NIRB; in addition, the results are summarized in annual reporting to those agencies.

Bottom ash for incinerators located at Doris Camp is sampled as outlined in Section 2.5.1 of the main body of this Incinerator Management Plan.

Records of materials deposited to the landfill (when constructed), including qualifying incinerator ash, will be reported annually to the NWB per the relevant requirements of the Licence.

HOPE BAY PROJECT INCINERATOR MANAGEMENT PLAN

HOPE BAY, NUNAVUT

Module A – Appendix A:
Operating and Maintenance Manual
CY-2050-A-FA

Forced Air Incineration Systems

Operating and Maintenance Manual

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1 INTRODUCTION

Thank you for selecting Westland Environmental Services Inc. (Westland) to provide you with a reliable, proven and cost-effective system to manage your waste in an environmentally sound manner. This manual has been prepared to allow you to operate and maintain the system safely and efficiently, thereby ensuring its proper operation and continued use for a long period of time.

It also contains information on the combustion process. We believe that understanding the basic principles would make you knowledgeable, and hence a better operator. Table 1 outlines the contents of this manual.

Table 1 Organization of Manual

Chapter Number	Title Brief Description
2	**Principles of waste incineration** What incineration or combustion process is, why waste is incinerated and the components of a waste, including heating value, and how waste properties affect the incinerator capacity.
3	**System Description** The components of both the single-chamber and dual chamber designs and their functions are described
4	**Operation and Maintenance** How to operate and maintain the system, including safety equipment to be used.
5	**Warranty** Terms of the warranty

2 PRINCIPLES OF WASTE INCINERATION

2.1 Combustion

Combustion, burning, incineration, and thermal oxidation all denote the same process, which is the reaction of a "combustible" matter with oxygen that occurs at temperatures higher than the ignition temperature [1] of that matter. The reaction is exothermic, meaning that it generates heat in the form of hot gas.

In the case of waste, it may also contain non-combustible matter which does not react with oxygen. In waste incineration, the non-combustible component ends up as ash and a small portion of it is also present in the hot gas in the form of particulate matter or dust.

[1] Below the ignition temperature combustion does not take place. Consider, for example, gasoline or wood: it has to be "ignited" for combustion to take place. That is, the temperature in some portion of the matter must be brought up to the ignition temperature for combustion to start..

Figure 1 shows schematically the process of waste incineration. The oxygen used comes from air, which contains 21% of oxygen by volume, and the hot gas is typically referred to as flue gas.

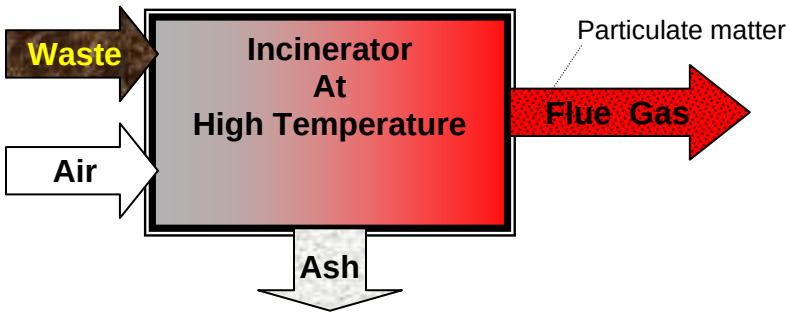

Figure 1 Schematic Diagram of Incineration Process

2.2 Why incinerate waste ?

The main purpose is to reduce the mass and volume for final disposal. Another important reason, since the waste may contain pathogenic, infectious or toxic materials, is to "detoxify" it. And in remote areas where wildlife is present, scavenging can be prevented by incineration.

In some cases, incineration is used to recover the energy contained in the waste in the form of electricity, steam, hot fluids or hot air. And in other cases, valuable materials can be recovered from the ash, or the ash as a whole can be used for soil amendment or as a construction material.

2.3 Waste components

There are different ways of characterizing waste, depending on the purpose for doing it. Here, it is sufficient to characterize the components as follows: [2]

A. Water is an important component because in incineration it has to be evaporated, which requires a lot of energy, [3] which in turn, has the effect of lowering the temperature of the flue gas.

B. Combustible is the component that reacts with oxygen and releases heat in the process. [4] The higher the combustible content in the waste the more air per kg of waste is needed for incineration.

This component can be further classified as:

---

[2] This is referred to as proximate analysis. Another method is elemental analysis, which produces the elemental composition (C, H, O, N, S, Cl …) of the waste.

[3] It takes ~ 2.3 MJ (2200 BTU or 90 cc of propane or 60 cc of diesel) to evaporate 1 L or 1 kg of water. This is referred to as the latent heat of evaporation.

[4] The term "organic" is also used, which is strictly incorrect in that some "inorganic" elements or compounds are combustible, such as carbon, sulphur and carbon monoxide.

(i) Volatile, which is released to the gas phase when the combustible matter is heated without the presence of oxygen, and

(ii) Fixed carbon which remains in the solid waste after the volatile has been released. This is often referred to as charcoal.

C. Non-combustible is the component that does not react with oxygen. [5] As previously mentioned, this forms ash, and some of it is entrained in the flue gas in the form of particulate matter or dust. The higher the non-combustible content in the waste, the less quantity of waste that can be incinerated without removing ash from the combustion chamber. Note also if the waste contains metals, such as lead and cadmium, these metals will be present in the ash as well as in the particulate matter.

2.4 Heating Value

Heating value, calorific value and heat of combustion are synonyms that quantify the heat released by the combustible component in the waste upon complete combustion. An understanding of the concept can be gained from the hypothetical processes shown in Figure 2.

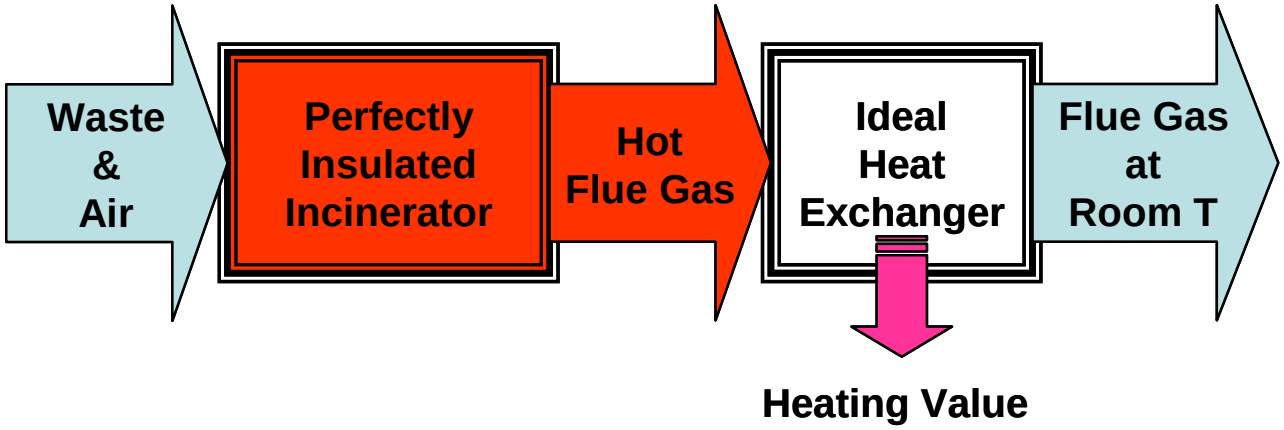

Figure 2 The Concept of Heating Value

A measured mass of dry waste and a sufficient amount of oxygen , at room temperature, are ignited, and the resulting hot flue gas is passed through a heat exchanger, where heat is extracted until the flue gas is brought back to room temperature. Let M be the mass (kg) of the dry waste fed, and H (MJ) the heat extracted from the heat exchanger. The heating value of the dry waste is H/M (MJ/kg).

[5] The terms "ash" and "inorganic" are also used. Note that the latter is inaccurate as explained previously.

2.5 Different Expressions for Heating Value

Two different values are reported in the literature (a) "high" or "gross", and (b) "low" or "net". The former corresponds to the case where the moisture in the flue gas is condensed, and hence the high or gross heating value *includes* the latent heat of evaporation of the water formed in combustion (see Footnote 3). The latter excludes the latent heat evaporation. The low or net heating value thus represents the maximum available energy that can be recovered from the flue gas without condensation.

To be noted also is the basis on which the heating value is expressed, which can be (a) as fired, (b) dry basis or (c) ash free. The distinction is illustrated in Figure 3. An understanding of the different bases can be gained by noting that heating value is a property of the combustible component in the waste. Water and the non-combustible component simply "dilute" the heating value. In terms of incinerator operation, the relevant basis is "as fired".

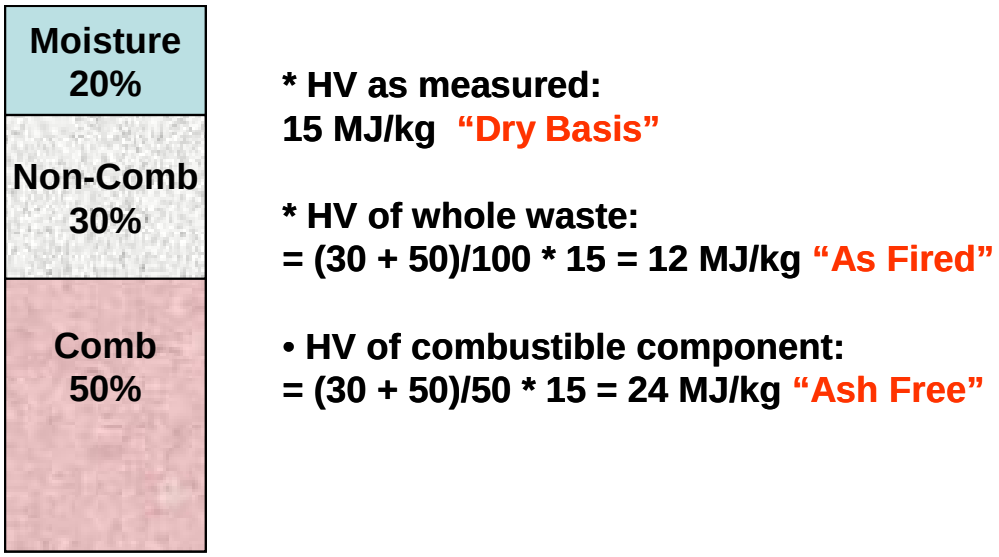

Figure 3 Different Bases for Expressing Heating Value (HV)

2.6 Examples of waste characteristics

Approximate compositions and heating values of commonly found wastes are given in Table 2.

Table 2 Classification and Properties of Common Wastes

Type*	Description	Components	Weight %			MJ/kg
			Moist	Comb	Non-C	HHV (A/F)
0	Trash	Paper, cardboard, cartons wood boxes and combustible floor sweepings from commercial and industrial activities. Up to 10% by weight of plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags and plastic or rubber scraps.	10%	85%	5%	19.7
I	Rubbish	Trash + Type 3 (up to 20%)	25%	65%	10%	15
2	Refuse	Rubbish and Garbage	50%	43%	7%	10
3	Garbage	Animal and vegetable wastes, restaurants, hotels, markets, institutional, commercial and club sources	70%	25%	5%	5.8
4	Animal/ Pathological	Carcasses, organs, hospital and laboratory abbatoir, animal pound, veterinary sources	85	10	5	2.3

Notes:
Moist = moisture, Comb = Combustible, Non-C = Non-combustible, HHV = High Heating Value, A/F = As Fired
* In some cases Roman numerals are used. That is Types 0, I, II, III and IV

2.7 Incinerator Capacity and Load Size

Incinerator capacity is dependent on waste composition. In general, the higher the heating value, the lower is the capacity in terms of kg/h that can be incinerated. This can be explained by noting that a waste that has a higher heating value requires more air per unit mass than that required to incinerate a waste with a lower heating value. To put it another way, for the same amount of air, more mass of a waste with a lower heating value can be incinerated.

Another important consideration is the size of the batch loaded to the incinerator. The higher the heating value, the smaller (lighter) the load should be. Otherwise, insufficient amount of air would generate black smoke.

Unfortunately, waste composition is not always known. Nevertheless there may be indications of the components present. To assist in getting a qualitative estimate of the heating value of a batch of waste, the heating values of common "generic" waste components are shown in Table 3.

Table 3 High Heating Values (Approximate) of Common Waste Components

Component	MJ/kg A/F *	Component	MJ/kg A/F *
Kerosene, Diesel …	44	Leather	16
Plastics	46	Wax paraffin	44
Rubber, Latex	23	Rags (linen, cotton)	17
Wood	18	Animal fats	39
Paper	17	Citrus rinds	4
Agricultural waste	17	Linoleum	25

* A/F: As Fired

Another important waste component is the volatile content in the waste. Table 4 shows the proximate components of various materials and wastes.

In general, this component is responsible for smoke generation. Therefore, as in the case with heating value, the higher the volatile content, the smaller the load that should be charged to the incinerator.

Table 4 Proximate Composition of Various Materials

Material	Volatile	Moisture	FC	Ash	FC/V
	%wt	%wt	%wt	%wt	-
Coal (bit.)	30	5	45	20	1.5
Peat	65	7	20	8	0.3
Wood	85	6	8	1	0.1
Paper	75	4	11	10	0.15
Sewage sludge	30	5	20	45	0.66
MSW	33	40	7	20	0.21
RDF	60	20	8	12	0.13
PDF	73	1	3	13	0.04
TDF	65	2	30	3	0.46
PE,PP,PS	100	0	0	0	0
Plastics + Colour	98	0	0	2	0
PVC	93	0	7	0	0.08

Notes: FC = Fixed Carbon; FC/V: Ratio of Fixed Carbon to Volatile

3 SYSTEM DESCRIPTION

3.1 Different Models

Westland's forced air incinerators are of two types:

- Single-chamber, referred to as the Primary Chamber; and
- Dual-chamber, which has an additional Secondary Chamber.

The term forced air denotes the use of one blower or two blowers to "force" combustion air into the combustion chamber(s).

Different sizes are produced, and the auxiliary fuel can be diesel, propane or natural gas, as specified by the user. Key design parameters of the different models are summarized in Table 5.

The combustion air blower characteristics are shown in Table 6. [6] Beckett's Oil Burner model SF is used when diesel is the auxiliary fuel. [7] When propane or natural gas is used, a Midco Incinomite burner is used. [8] The information sheets and manuals can be found in Appendix A: Information sheets and Manuals for Burners and Blowers.

3.2 System components

Regardless of the model of your incinerator, the components are similar. Figure 4 shows a schematic diagram of the dual-chamber design. If your incinerator is single-chamber,

[6] http://www.eccohtg.com/links/Product%20Listing/Ventilation%20Products/Miscellaneous%20Fans.pdf

[7] http://www.beckettcorp.com/res2.htm

[8] http://www.midcointernational.com/products/incinomite/

then ignore the Secondary Chamber and the associated burner and blower. Figure 5 and Figure 6 show photographs of the Single-Chamber (CY-1050-FA) and Dual-Chamber (CY-2050-FA) designs, respectively. Table 7 summarizes the components and their functions.

Table 5 Key Design Parameters of Westland's Forced Air Incinerators

Model	Air Blower Series No.	Burner Rating		PC Volume		Approximate Maximum Capacity* (Type 3 Waste)	
		1000 Btu/h	GJ/h	ft^3	m^3	lb/h	kg/h
CY-1013-FA	AMU 400	350	0.37	13	0.37	90	40
CY-1020-FA	AMU 400	490	0.51	20	0.5	110	50
CY-1050-FA	AMU 625	700	0.73	50	1.3	245	112
CY-2020-FA	PC: AMU 400 SC: AMU 245	PC: 490 SC: 280	PC: 0.51 SC: 0.29	20	0.5	110	50
CY-2050-FA	PC: AMU 625 SC: AMU 225	PC: 700 SC: 280	PC: 0.73 SC: 0.29	50	1.3	245	112

Notes: PC: Primary Chamber; SC: Secondary Chamber. * Actual capacity depends on properties of the waste being incinerated; see Table 2 for waste properties.

.

Table 6 Combustion Air Blowers Characteristics

MODEL	HP	RPM	AIR DELIVERY (CFM AT R.P.M. SPECIFIED)							
			Free Air	1/8" SP	1/4" SP	3/8" SP	1/2" SP	3/4" SP	1" SP	1-1/4" SP
AMU-75	1/60	3000	75	61	54	43	–	–	–	–
AMU-130	1/70	1550	130	107	87	30	–	–	–	–
AMU-245	1/20	1550	245	225	210	190	162	–	–	–
AMU-400	1/12	1550	400	380	365	340	315	200	–	–
AMU-525	1/4	1725	525	500	480	460	420	240	120	–
AMU-625	1/4	1725	625	600	560	540	500	420	280	100
AMU-845	1/2	1725	845	825	790	760	730	650	570	425
AMU-1100	1/3	1140	1100	1050	1000	950	860	700	–	–
Tested by The Nozzle Chamber Method as directed in A.M.C.A. Bulletin #210 Figure #4										

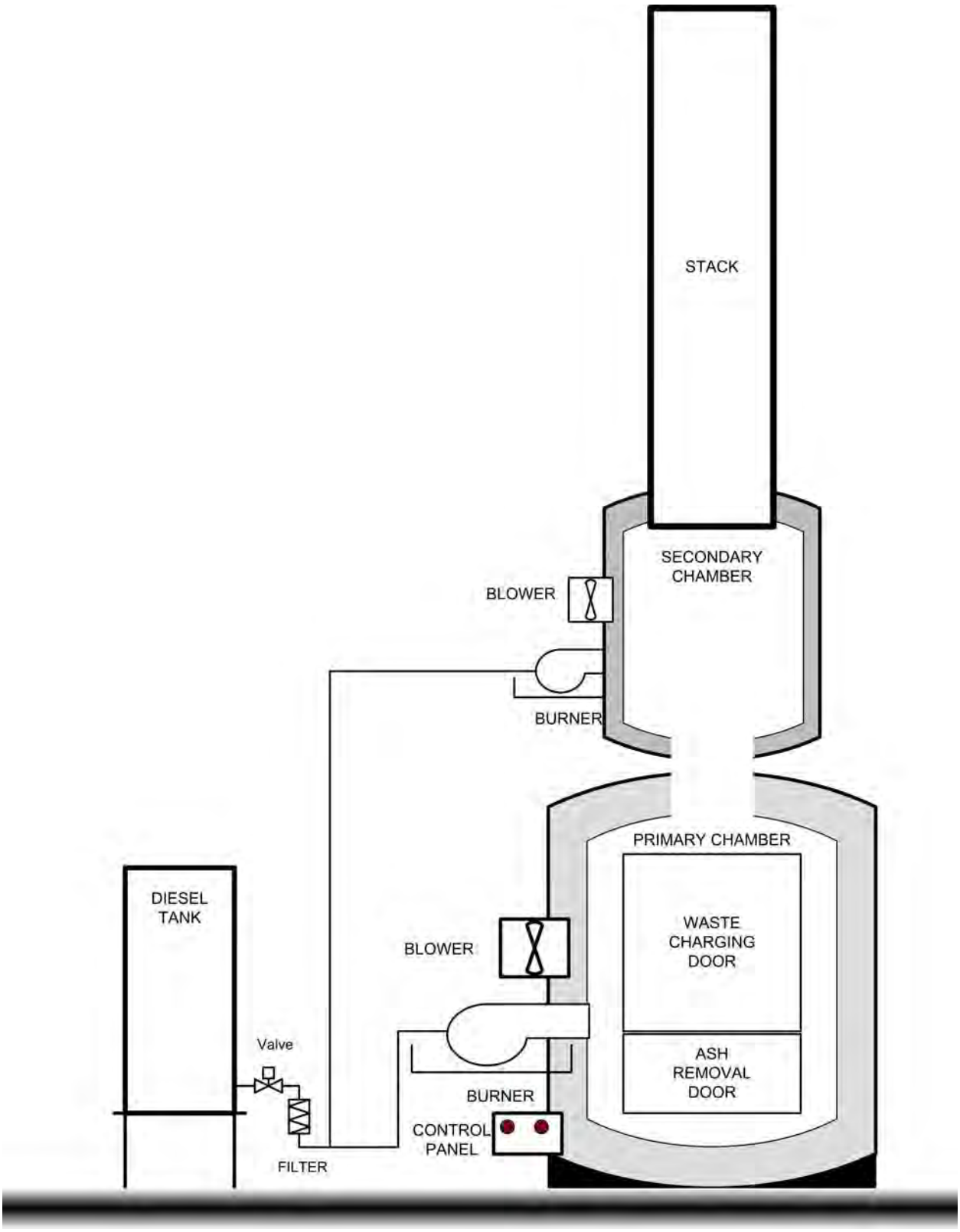

Figure 4 Schematic Diagram of Forced Air Dual-Chamber Design

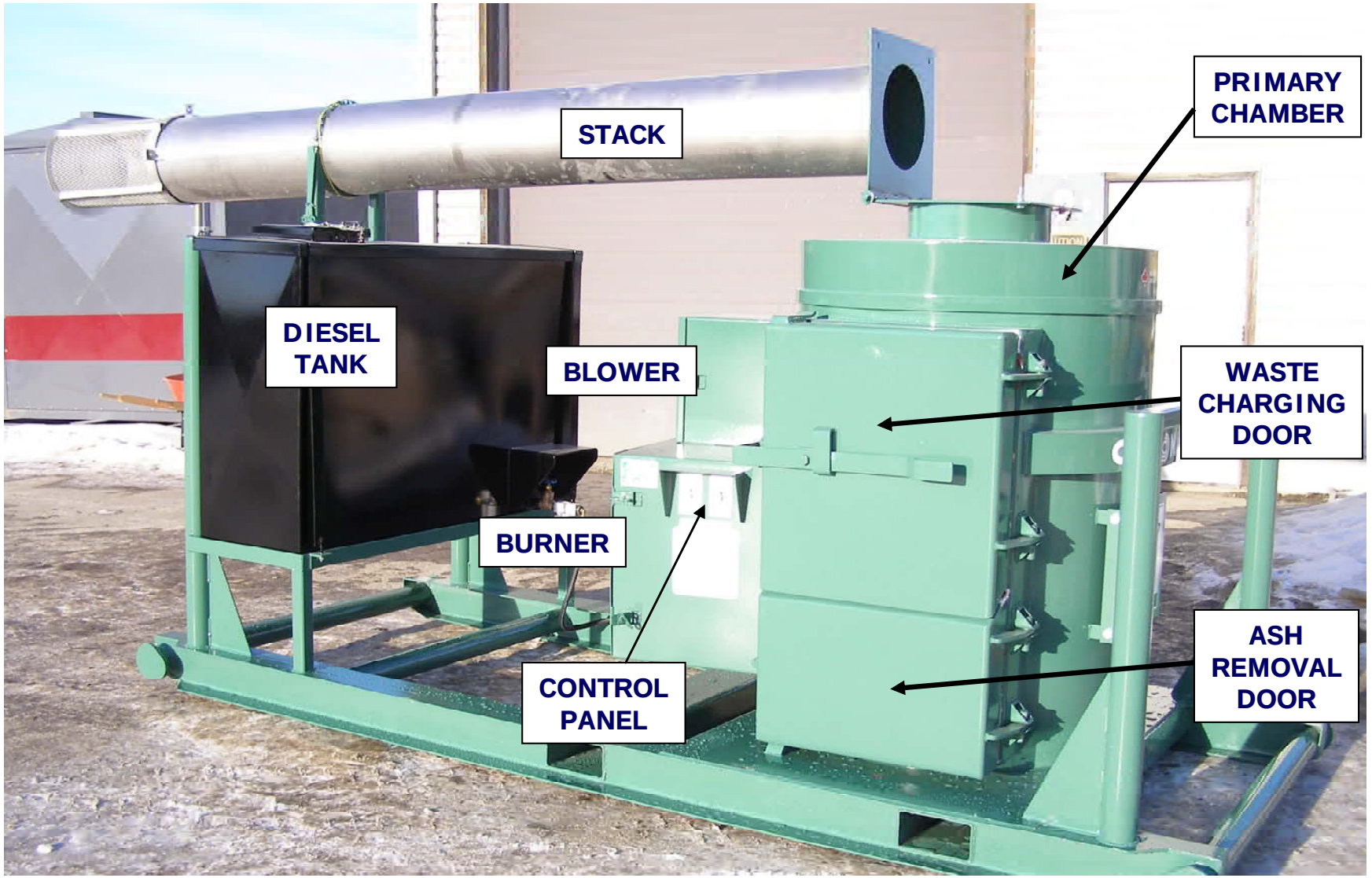

Figure 5 Photograph of the Single-Chamber Design

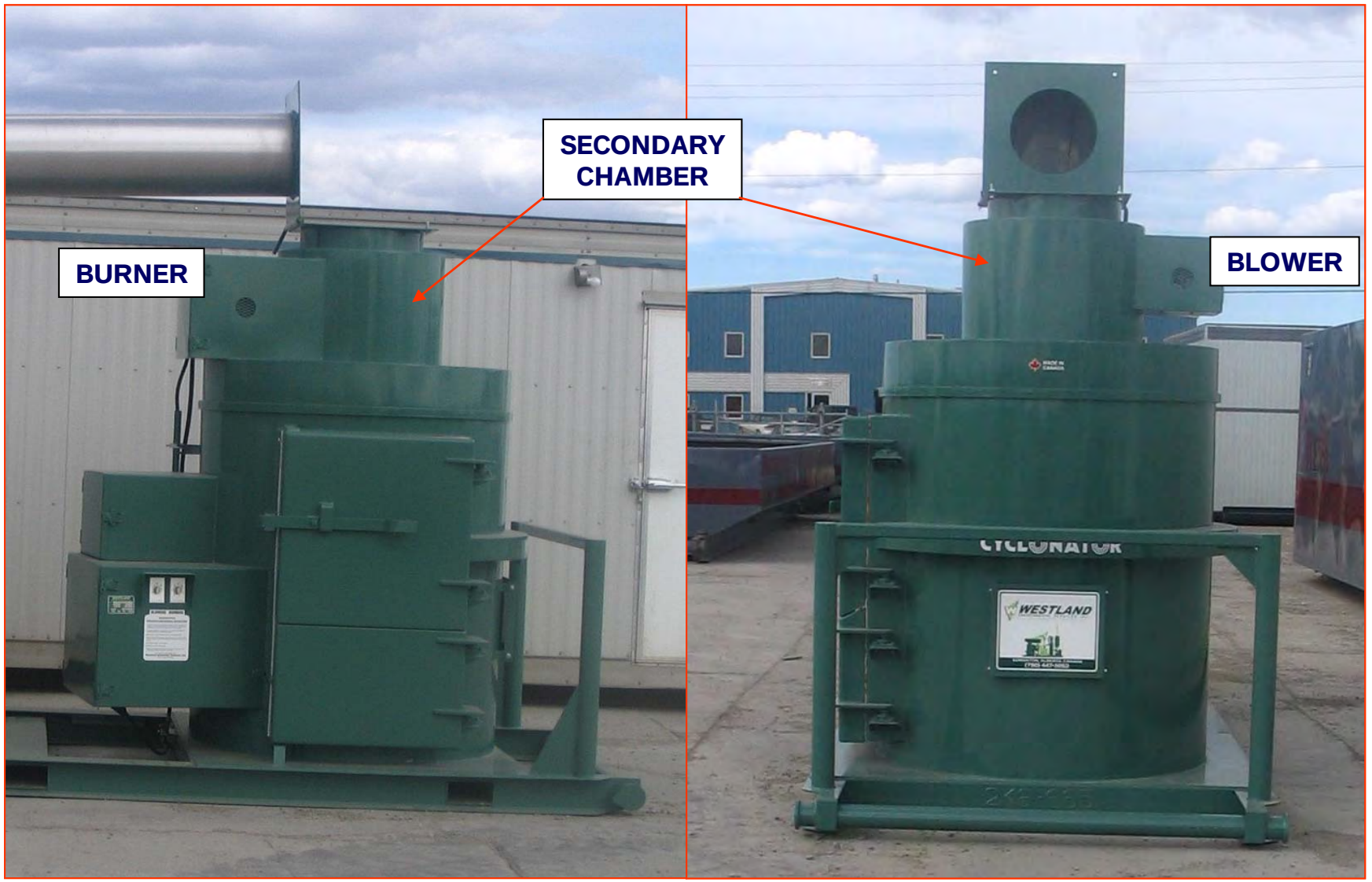

Figure 6 Photographs of the Dual-Chamber Design

Table 7 Components and Their Functions

COMPONENT	FUNCTION	DESCRIPTION
Primary Chamber	Waste combustion	WES *. Refractory lined (3 "), insulated (1")
▪ Burner	Supply heat to ignite and sustain combustion	Beckett SF or Midco Incinomite
▪ Blower	Supply air (oxygen) for combustion	AMU series
Secondary Chamber	Complete combustion	WES *. Refractory lined (3"), insulated (1")
▪ Burner	Supply heat to ignite and sustain combustion	Beckett SF or Midco Incinomite
▪ Blower	Supply air (oxygen) for combustion	AMU Series
Control Panel	Timers for burner and blower operations	Intermatic
Diesel Tank	Supply of auxiliary fuel	WES *
Valve	Cut off fuel to burner(s)	(General)
Filter	Prevent clogging of burner nozzle	LFF 22
Stack	Disperse hot flue gas	WES *. SS Stack
Electrical System	Burner and blower operations	WES *. 115 V, 60 Hz, Single Phase

Note: WES * : Manufactured in-house. Manuals for blowers and burners are in Appendix A: Information sheets and Manuals for Burners and Blowers

4 OPERATION AND MAINTENANCE

4.1 Safety equipment

The following personal protective equipment should be used while operating the incinerator system:

- Long sleeved shirt and long pants;
- Long cuffed, puncture resistant gloves;
- CSA approved, Grade 1 safety footwear;
- CSA/ANSI approved safety glasses.

The personal protective equipment related to specific tasks are listed below:

- Ash removal and handling: NIOSH N85 respirator
- Waste charging: (i) heat protective clothing and gloves, and (2) CSA/ANSI approved full face shield.

4.2 Routine inspection and maintenance

- Check fuel lines for leak and check connections
- Check spark arrestor to ensure no plugging
- During ash removal (see next section):
  - Inspect refractory for large cracks (not expansion cracks)

- Check combustion air hole for plugging
- Inspect door gaskets for damages

4.3 Ash removal

Typically the ash from previous operation was left to cool, and ash removal is done first prior to current operation.

- Make sure combustion chamber is sufficiently cool
- (Do NOT spray water into the combustion chamber)
- While removing ash, avoid plugging the combustion air holes and damaging the burner tip
- Use non-combustible container
- Minimize dust generation
- Light water spraying on ash in the container is OK to minimize dust generation
- Dispose of ash as specified in the guidelines or regulations

4.4 Pre-operational checks

- Install stack if necessary
- Check fuel tank to make sure enough fuel (Use 5 USG/h for single-chamber, and 7.5 USG/h for dual-chamber. Actual values depend on the size of the incinerator.)
- Open fuel valve
- Re-check that combustion chamber is empty and combustion air hoes are clear
- Connect electrical plug
- Prime pump if necessary

4.5 Waste batch preparation

As previously mentioned incinerator capacity in kg/h is dependent on the heating value of the waste, which is normally not known. The nominal capacity of your incinerator is as shown in Table 5 for Type 1 to Type 3 waste, and somewhat less for Type 0.

The following cautionary notes should be followed:

- NO explosives, aerosol cans or containers containing combustible liquids
- Make sure that every batch can go through the waste charging door easily, regardless of its weight. If others prepare the batches, the operator should tell them about the maximum batch size.
- Do not open batches and "rearrange" the contents for health reasons.

4.6 Incineration

1. Re-check the burner and blower operations
2. Pre-heat the combustion chambers for 10 minutes: close doors and set the burner timer for 10 minutes
3. Load waste to Primary Chamber up to 60% of its volume
4. Start incineration: close waste charging door, set blower timer for 120 minutes and burner timer for 30 – 60 minutes depending on the amount waste loaded.
5. Check status: set timers off, open waste charging door, inspect and rake if necessary

6. If combustion is not complete, repeat Steps 4 and 5 until it is.
7. If there is more waste to be burnt, repeat Steps 3 to 6. Otherwise, go to shut-down protocol.

4.7 Shut-down

- Make sure all timers are off
- Unplug electrical connection
- Turn off fuel valve
- Un-install stack if incinerator is to be moved elsewhere.

4.8 Maintenance

In addition to the routine inspection and maintenance previously mentioned, only the burner(s) and the blower(s) require maintenance, which is quite minimum; see manuals in Appendix A: Information sheets and Manuals for Burners and Blowers. The fuel filter should be replaced every three months.

4.9 Auxiliary Fuel Consumption Rate

Figure 7 shows the volumetric flow rates of propane and diesel as a function of burner rating.

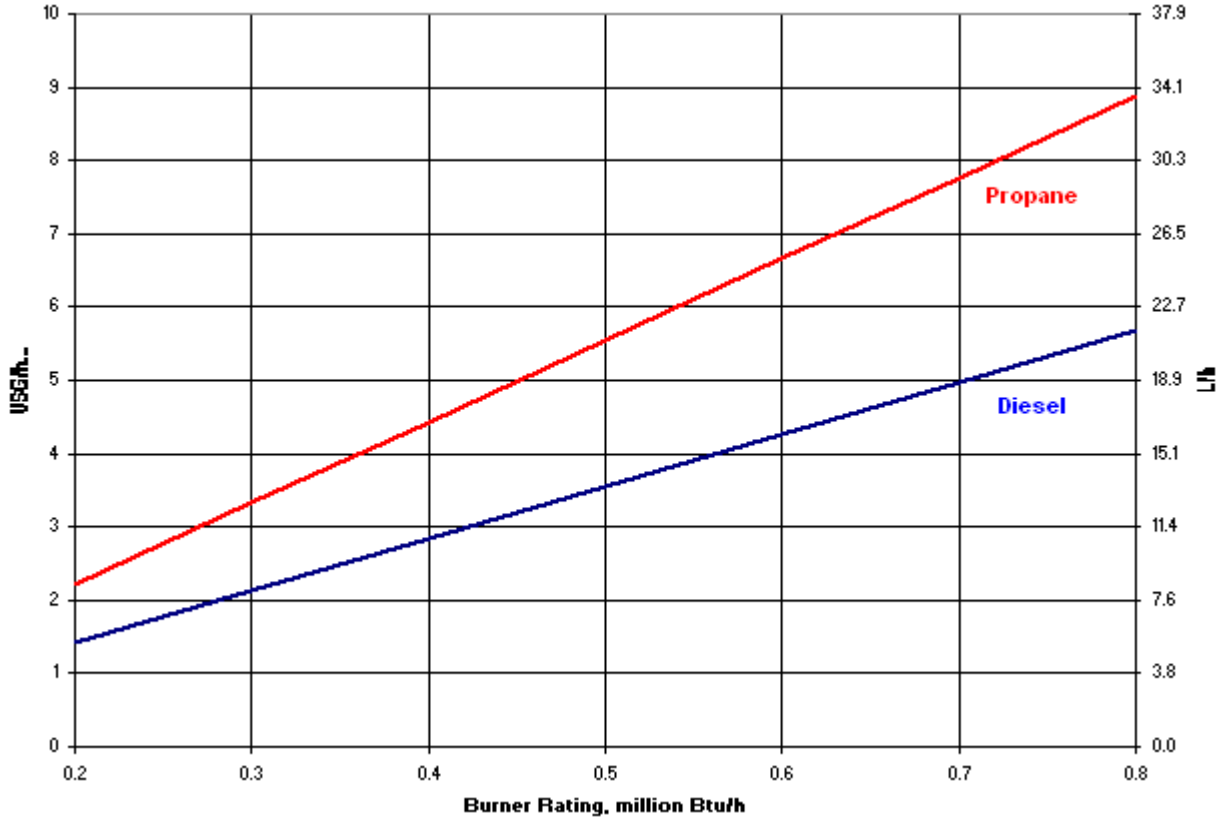

Figure 7 Consumption Rates of Propane and Diesel

5 WARRANTY

1. Westland Environmental Services Inc. hereby warrants to the Purchaser, for a one (1) year period of time from the date of acceptance and upon the conditions hereinafter set forth, each new product sold by it, to be free from defects in material and workmanship (specifically excluding therefrom component parts and accessories manufactured, furnished, and supplied by others) under normal use, maintenance and service. Except for the above Warranty, it is agreed and understood that no other WARRANTY or CONDITION whether express, implied, or statutory is made by Westland Environmental Services Inc.
2. The obligation of Westland Environmental Services Inc. under this Warranty shall be limited to the repair or replacement (**not in excess of its factory labour rate**) of its units; which, upon examination by Westland Environmental Services Inc., shall disclose to their satisfaction to have been defective in material and/or workmanship under normal use, maintenance, and service.
3. The foregoing shall be the Purchaser's sole and exclusive remedy whether in contract, tort, or otherwise; and Westland Environmental Services Inc. shall not be liable for injuries to persons, for damage to property or for loss of any kind which results (whether directly or indirectly) from such defects in material or workmanship, or for any other reason; and, it is agreed and understood that the Purchaser shall keep Westland Environmental Services Inc. indemnified against any such claim. In no event shall Westland Environmental Services Inc. be liable for incidental or consequential damages, or commercial losses, or for any loss or damage except as set forth in paragraph 2 herein.
4. This Warranty does not apply to, and no warranty or condition is made by Westland Environmental Services Inc. regarding any purchased components, parts, and accessories; manufactured, supplied and/or furnished by others, or any non-standard features or items specified by the Purchaser; nor does this Warranty expand, enlarge upon, or alter in any way, the warranties provided by the makers and suppliers of such component parts and accessories.
5. The liability of Westland Environmental Services Inc. under this Warranty shall cease and determine if:
   (a) The Purchaser shall not have paid in full all invoices as submitted by Westland Environmental Services Inc. or affiliated companies on or before their due dates:
   (b) Representatives of Westland Environmental Services Inc. are denied full and free right of access to the units:
   (c) The Purchaser permits persons other than the agents of Westland Environmental Services Inc. or those approved or authorized by Westland Environmental Services Inc. to effect any replacement of parts, maintenance, adjustments, or repairs to the units:
   (d) The Purchaser has not properly operated and maintained the units in accordance with instructions, pamphlets or directions given or issued by Westland Environmental Services Inc. at the time of the sale and/or from time to time thereafter:
   (e) The Purchaser uses any spare parts or replacements not manufactured by or on behalf of Westland Environmental Services Inc. and supplied by it, or by someone authorized by it, or fails to follow the instructions for the use of the same:
   (f) The Purchaser misuses, or uses this unit for any purpose other than that for which it was intended or manufactured:
   (g) The defective parts are not returned to Westland Environmental Services Inc. within 15 days of repair.

6. No condition is made or is to be implied, nor is any Warranty given or to be implied as to the life or wear of the units supplied; or that they will be suitable for use under any specific conditions; notwithstanding that such conditions may be known or made known to the seller.
7. Defects in material and/or workmanship must be brought to the attention of Westland Environmental Services Inc. by written notification within ten (10) days of discovery, and repairs must be commenced within forty-five (45) days thereafter.
8. It is agreed and understood that the Purchaser is responsible for and must pay for the transporting of the defective goods or of the replacement parts to the place of repair. Premium freight charges (such as air express or air fare charges for transportation of personnel, tools and for replacement parts) and other expenses, apart from servicemen's regular straight time travel, mileage, and regular straight time labour required to repair or replace defective parts and the cost of the parts, will be paid for by the customer at Westland Environmental Services Inc. regular billing rates on usual credit terms.
9. The liability of Westland Environmental Services Inc. under this Warranty is limited to the purchase price of the unit and in no case shall a claim be advanced for more than such amount.

10. All repairs and replacements are made and furnished subject to the same terms, conditions, warranties, disclaimer or warranty and limitations of liability and remedy as applied to each new unit sold.
11. This warranty and the Purchaser's rights under it, is not transferable, or is it assignable.

DATE IN SERVICE: _____

MODEL NUMBER: _____

SERIAL NUMBER: _____

6 APPENDIX A: INFORMATION SHEETS AND MANUALS FOR BURNERS AND BLOWERS

WESTLAND
ENVIRONMENTAL SERVICES INC.
www.westlandenvironmental.com

Forced Air Incinerator PARTS LIST
(CY 1013/1020/2020/1050/2050 FA "D")

Description	Part #
Gun Burner Beckett, WIC 201 x 6", diesel fired	7007006
Gun Burner Midco J83DS, natural gas or LPG fired	7009000
Air Tube Combination for WIC 201	7900188
Coupling, Flex for WIC 201	7009183
Fuel Pump A2YA7916 Suntec	7009182
Blower Wheel for WIC 201	7009184
Motor 1/3 HP for WIC 201	7009186
Transformer, Ignition "S" for WIC 201	7009187
Stainless Steel Stack, 15" dia x 10' (CY 1050/2050)	7030101
Stainless Steel Stack, 13" dia x 10' (CY 1020/2020)	7020101
Stainless Steel Stack, 10" dia x 2m (CY 1013)	
Spark Arrestor, Stainless Steel 15" (CY 1050/2050)	7030107
Spark Arrestor, Stainless Steel 13" (CY 1020/2020)	7020107
Spark Arrestor, Stainless Steel 10" (CY 1013)	
Stack crating for shipping 13" stack	7020102
Stack crating for shipping 15" stack	7030102
Nozzle (specify GPH, angle, pattern)	7006122
Gasket, Ceramic Fibre 1/8" x 2" (price per foot)	7000062
Gasket Cement, HT Silicone Tube	7000064
Refractory Cement Bag	7000120
Timer, 60 min Spring Wound	7000145
Timer, Blower 120m Spring Wound	7000146
Filter Adaptor	7001116
Filter, Fuel LFF22	7001117
Fuel Tank, 1000 L Double Wall Enviro	7041112
Delhi Blower D530 (CY 2050-models older than 2007)	7000054
AMU625 Blower (CY2050FA D)	7000058
AMU Secondary Blower 245 (CY2050/2020) (replaces the Delhi D530 on 2007 and newer models)	7000075
AMU 400 Blower (CY1020FA D) (CY 1020/ 2020/ 1013)	7000055

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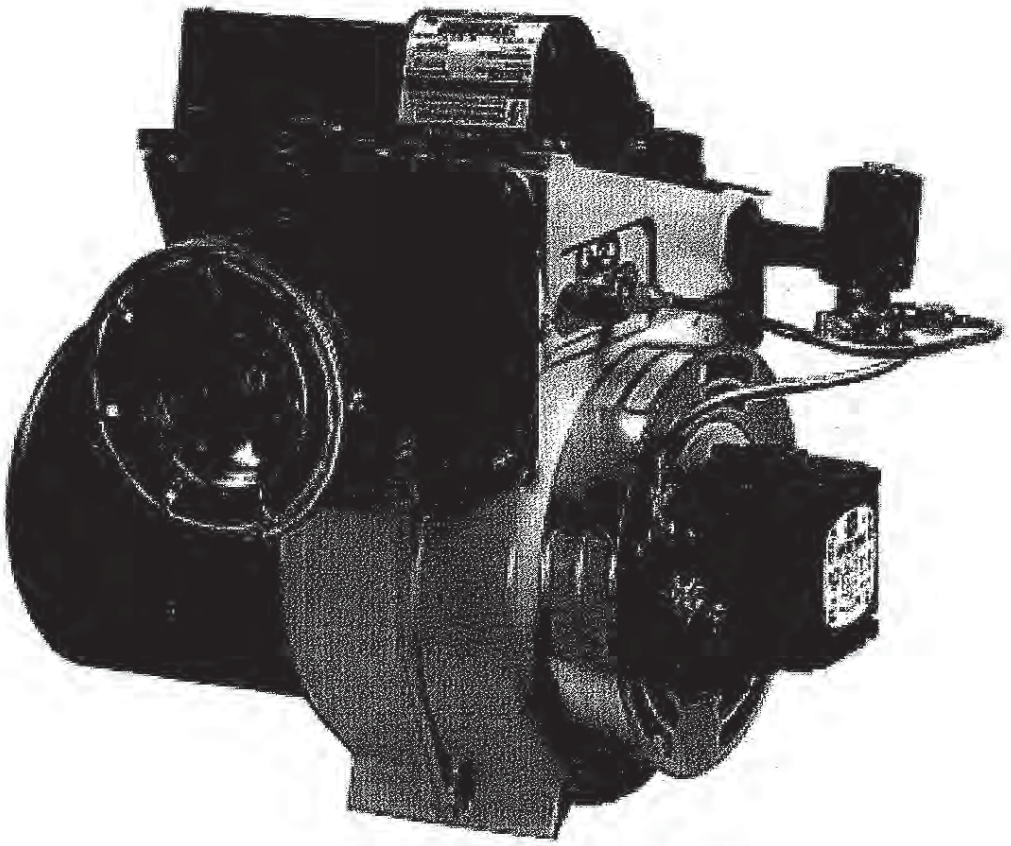
Models SF & SM Oil Burners

WIC 201 Burner



WARNING **Potential for Fire, Smoke and Asphyxiation Hazards**

Incorrect installation, adjustment, or misuse of this burner could result in death, severe personal injury, or substantial property damage.

To the Homeowner or Equipment Owner:

- Please read and carefully follow all instructions provided in this manual regarding your responsibilities in caring for your heating equipment.
- Contact a professional, qualified service agency for installation, start-up or service work.
- Save this manual for future reference.

To the Professional, Qualified Installer or Service Agency:

- Please read and carefully follow all instructions provided in this manual before installing, starting, or servicing this burner or heating system.
- The Installation must be made in accordance with all state and local codes having jurisdiction.

Table of Contents

Information To Be Used Only By Qualified Service Technicians

Owner's Information

To the Owner:

Thank you for purchasing a Beckett burner for use with your heating appliance. Please pay attention to the Safety Warnings contained within this instruction manual. Keep this manual for your records and provide it to your qualified service agency for use in professionally setting up and maintaining your oil burner.

Your Beckett burner will provide years of efficient operation if it is professionally installed and maintained by a qualified service technician. If at any time the burner does not appear to be operating properly, **immediately contact your qualified service agency** for consultation.

We recommend annual inspection/service of your oil heating system by a qualified service agency.

Daily – Check the room in which your burner/appliance is installed. Make sure:

- Air ventilation openings are clean and unobstructed
- Nothing is blocking burner inlet air openings
- No combustible materials are stored near the heating appliance
- There are no signs of oil or water leaking around the burner or appliance

Weekly

- Check your oil tank level. Always keep your oil tank full, especially during the summer, in order to prevent condensation of moisture on the inside surface of the tank.

WARNING **Owner's Responsibility**

Incorrect installation, adjustment, and use of this burner could result in severe personal injury, death, or substantial property damage from fire, carbon monoxide poisoning, soot or explosion.

Contact a professional, qualified service agency for the installation, adjustment and service of your oil heating system. This work requires technical training, trade experience, licensing or certification in some states and the proper use of special combustion test instruments.

Please carefully read and comply with the following instructions:

- Never store or use gasoline or other flammable liquids or vapors near this burner or appliance.
- Never attempt to burn garbage or refuse in this appliance.
- Never attempt to light the burner/appliance by throwing burning material into the appliance.
- Never attempt to burn any fuel not specified and approved for use in this burner.
- Never restrict the air inlet openings to the burner or the combustion air ventilation openings in the room.

NOTICE

This manual contains information that applies to both SM and SF burners. These burners may appear to be basically identical, but there are differences in design and performance. Please review the comparison chart below:

Feature	SM	SF
Firing Rate Range	1.25 to 3.00 gph	1.25 to 5.50 gph
Motor	1/5 HP	1/4 HP
Fuel pump capacity	3 gph (standard)	7 gph (standard)
UL Air Tube Combinations	See Table 2	See Table 2
Blocking oil solenoid valve	Optional	Required above 3 gph
Primary control lockout timing	15 to 45 seconds (optional)	15 seconds maximum

Hazard Definitions

DANGER **Indicates an imminently hazardous situation, which, if not avoided, will result in death, serious injury, or property damage.**

WARNING **Indicates a potentially hazardous situation, which, if not avoided, could result in death, severe personal injury, and/or substantial property damage.**

CAUTION **Indicates a potentially hazardous situation, which, if not avoided, may result in personal injury or property damage.**

Within the boundaries of the hazard warning, there will be information presented describing consequences if the warning is not heeded and instructions on how to avoid the hazard.

NOTICE

Intended to bring special attention to information, but not related to personal injury or property damage.

General Information

Table 1 – Burner Specifications

Model SM Capacity (Note1)	Firing rate range: .....01.25 – 3.00 GPH Input: ..... 175,000 – 420,000 Btu/hr
Model SF Capacity (Note1)	Firing rate range:.....1.25 - 5.50 GPH Input: .....175,000 – 770,000 Btu/hr
Certifications/ Approvals	Model SM - UL listed to comply with ANSI/ UL296 & certified to CSA B140.0. Model SF - UL listed to comply with ANSI/UL 296 & certified to CSA B140.0.
Fuels	U. S: No.1 or No.2 heating oil only (ASTM D396) Canada: No. 1 stove oil or No. 2 furnace oil only
Electrical	Power supply: ..... 120 volts AC, 60 Hz, single phase Operating load (SM): .....5.8 Amps max Operating load (SF): .....7.1 Amps max Motor (SM): ..... 1/5 hp, 3450 rpm, NEMA 'N' flange, manual reset over load protection Motor (SF): ..... 1/4 hp, 3450 rpm, NEMA 'N' flange, manual reset over load protection Ignition: ... Continuous duty solid-state igniter
Fuel pump	Outlet pressure: ..... Note 2
Air tube	ATC code: .....See Table 2
Dimensions (Standard)	Height .....12.5 inches Width .....15 inches Depth ..... 8.50 inches Air tube diameter ..... 4.00 inches
Air tube	ATC code: .....See Table 2

Note 1: *Approval agency listed rating for Model SM is 1.25 to 3.00 gph and Model SF is 1.25 to 5.50 gph. However, the firing rate range is limited by the specific air tube combination being used. Refer to Table 2.*

Note 2. *UL Recognized to 4.0 GPH with a CleanCut pump for use in pressure washers.*

Note 3. *See appliance manufacturer's burner specifications for recommended pump discharge pressure.*

• Notice Special Requirements

- For recommended installation practice in Canada, refer to the latest version of CSA Standard B139 & B140.
- Concealed damage — If you discover damage to the burner or controls during unpacking, notify the carrier at once and file the appropriate claim.
- When contacting Beckett for service information — Please record the burner serial number (and have available when calling or writing). You will find the serial number on the silver label located on the left rear of the burner. Refer to Figure 1.

WARNING **Professional Service Required**

Incorrect installation, adjustment, and use of this burner could result in severe personal injury, death, or substantial property damage from fire, carbon monoxide poisoning, soot or explosion.

Please read and understand the manual supplied with this equipment. This equipment must be installed, adjusted and put into operation only by a qualified individual or service agency that is:

- Licensed or certified to install and provide technical service to oil heating systems.
- Experienced with all applicable codes, standards and ordinances.
- Responsible for the correct installation and commission of this equipment.
- Skilled in the adjustment of oil burners using combustion test instruments.

The installation must strictly comply with all applicable codes, authorities having jurisdiction and the latest revision of the National Fire Protection Association Standard for the installation of Oil-burning Equipment, NFPA 31 (or CSA B139 and B140 in Canada).

Regulation by these authorities take precedence over the general instructions provided in this installation manual.

Table 2 – Air Tube Combination (ATC) codes

Firing Rate (gph)	Head	Static plate size	ATC Codes for usable air tube lengths ('A' in inches; See Figure 3.)			
(min-max)		(inches)	6-5/8	9	13	16
For SF Burner Only						
1.25-2.25	F12	2-3/4	SF65VW	SF90VW	SF130VW	SF160VW
1.75-2.75	F22	2-3/4	SF65VP	SF90VP	SF130VP	SF160VP
1.75-3.25	F220	None	SF65FD	SF90FD	SF130FD	SF160FD
2.5-5.5	F310	None	SF65FU	SF90FU	SF130FU	SF160FU
For SM Burner Only						
1.25-2.00	F12	2-3/4	SM65VW	SM90VW	SM130VW	SM160VW
2.00-3.00	F220	None	SM65FF	SM90FF	SM130FF	SM160FF
2.00-3.00	F22	None	SM65VM	SM90VM	SM130VM	SM160VM

Inspect/Prepare Installation Site

• Chimney or vent

- Inspect the chimney or vent, making sure it is properly sized and in good condition for use.
- For those installations not requiring a chimney, such as through-the-wall vented appliances, follow the instructions given by the appliance and power venter (if used) manufacturers.

• Combustion air supply

WARNING **Adequate Combustion and Ventilation Air Supply Required**

Failure to provide adequate air supply could seriously affect the burner performance and result in damage to the equipment, asphyxiation, explosion or fire hazards.

- The burner cannot properly burn the fuel if it is not supplied with a reliable combustion air source.
- Follow the guidelines in the latest editions of the NFPA 31 and CSA-B139 regarding providing adequate air for combustion and ventilation.

See NFPA 31 Standard for complete details.

Appliance located in confined space

The confined space should have two (2) permanent openings: one near the top of the enclosure and one near the bottom of the enclosure. Each opening shall have a free area of not less than (1) one square inch per 1,000 BTU's per hour of the total input rating of all appliances within the enclosure. The openings shall have free access to the building interior, which should have adequate infiltration from the outside.

Exhaust fans and other air-using devices

Size air openings large enough to allow for all air-using devices in addition to the minimum area required for combustion air. If there is any possibility of the equipment room developing negative pressure (because of exhaust fans or clothes dryers, for example), either pipe combustion air directly to the burner or provide a sealed enclosure for the burner and supply it with its own combustion air supply.

• Clearances to burner and appliance

- Provide space around burner and appliance for easy service and maintenance.
- Check minimum clearances against those shown by the appliance manufacturer and by applicable building codes.

• Combustion chamber — Burner retrofitting

Verify that the appliance combustion chamber provides at least the minimum dimensions given in Table 3.

Table 3. Chamber Dimensions

Chamber Dimensions (inches)					
Firing Rate (GPH)	Round I.D.	Rectangular		Height	Floor to nozzle
		Width	Length		
1.25	11	10	11	12	5-6
1.50	12	11	12	13	6-7
2.00	14	12	15	13	6-7
2.50	16	13	17	14	7-8
3.00	18	14	18	15	7-8
3.50	19	15	19	15	7-8
4.00	20	16	21	16	8-9
5.00	23	18	23	18	9-10
5.50	24	19	24	19	10-11

WARNING

Protect Steel Combustion Chamber From Burnout

Failure to comply could result in damage to the heating equipment and result in fire or asphyxiation hazards.

- When retrofitting appliances that have unlined stainless steel combustion chambers, protect the chamber by lining the inside surfaces with a ceramic fiber blanket, such as a wet-pac or other suitable refractory material.
- Some steel chambers may not require liners because the appliance was designed and tested for use with flame retention burners. Refer to the manufacturer's instructions.

Prepare the Burner

• Burner fuel unit

Verify that the burner fuel unit is compatible with the oil supply system. For more details, refer to "Connect fuel lines" later in this manual.

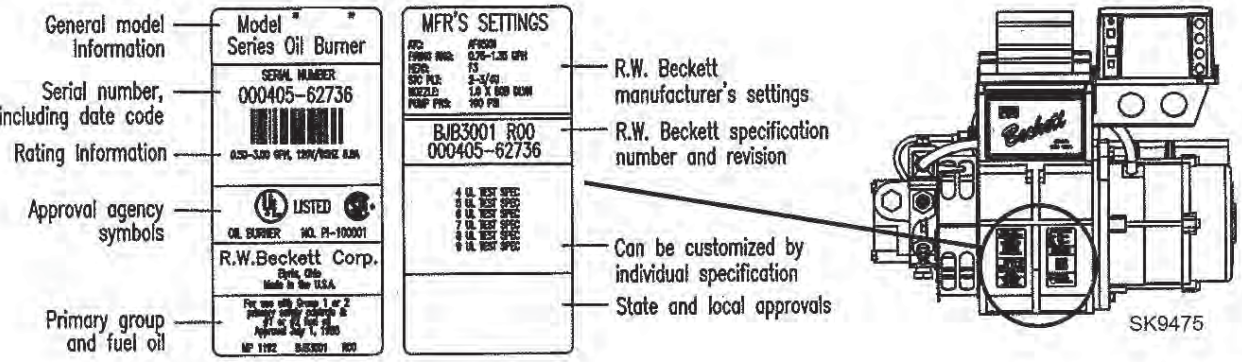
• Attach air tube (if not already installed)

If using a flange and gasket, slide them onto the air tube. Then attach the air tube to the burner chassis using the four sheet metal screws provided. Refer to Figure 3 for details.

• Install burner nozzle (if not already installed)

1. Remove the plastic plug protecting the nozzle adapter threads
2. Place a ¾" open-end wrench on the nozzle adapter. Insert the nozzle into the adapter and finger tighten. Finish tightening with a ⅝" open-end wrench. Use care to avoid bending the electrodes.

Figure 1. Burner Label Location



WARNING Correct Nozzle and Flow Rate Required

Incorrect nozzles and flow rates could result in impaired combustion, under-firing, over-firing, sooting, puff-back of hot gases, smoke and potential fire or asphyxiation hazards.

Use only nozzles having the brand, flow rate (gph), spray angle and pattern specified by the appliance manufacturer.

Follow the appliance manufacturer's specifications for the required pump outlet pressure for the nozzle, since this affects the flow rate.

- Nozzle manufacturers calibrate nozzle flow rates at 100 psig.
- When pump pressures are higher than 100 psig, the actual nozzle flow rate will be greater than the gph stamped on the nozzle body. (Example: A 1.00 gph nozzle at 140 psig = 1.18 gph)

Securely tighten the nozzle (torque to 90 inch pounds). For typical nozzle flow rates at various pressures refer to Table 5.

Table 5. Nozzle Flow Rate by Size

Nozzle flow rate U. S. gallons per hour of No. 2 fuel oil when pump pressure (psig) is:					
Nozzle size (rated at 100 psig)	**125 psi**	**140 psi**	**150 psi**	**175 psi**	**200 psi**
1.25	1.39	1.48	1.53	1.65	1.77
1.35	1.51	1.60	1.65	1.79	1.91
1.50	1.68	1.77	1.84	1.98	2.12
1.65	1.84	1.95	2.02	2.18	2.33
1.75	1.96	2.07	2.14	2.32	2.48
2.00	2.24	2.37	2.45	2.65	2.83
2.25	2.52	2.66	2.76	2.98	3.18
2.50	2.80	2.96	3.06	3.31	3.54
2.75	3.07	3.25	3.37	3.64	3.90
3.00	3.35	3.55	3.67	3.97	4.24
3.25	3.63	3.85	3.98	4.30	4.60
3.50	3.91	4.14	4.29	4.63	4.95
3.75	4.19	4.44	4.59	4.96	5.30
4.00	4.47	4.73	4.90	5.29	-
4.50	5.04	5.32	5.51	-	-
5.00	5.59	-	-	-	-
5.50	-	-	-	-	-

Table 6. Nozzle Spray Angles

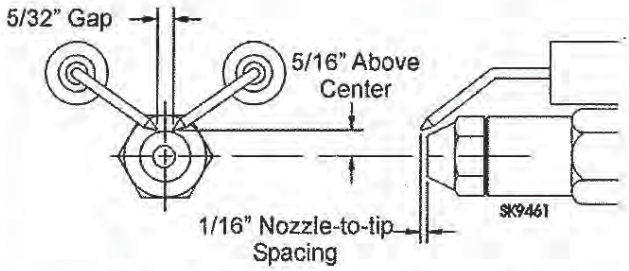
Recommended nozzle spray angles	
"F" head	70°, 80° or 90° nozzle

Note: Always follow the appliance manufacturer's nozzle specification, when available.

3. If the nozzle is already installed, remove the nozzle line assembly to verify that the nozzle size and spray pattern are correct for the application (per appliance manufacturer's information). Verify that the electrode tip settings comply with Figure 2.
4. If the nozzle is not installed, obtain a nozzle having the capacity and spray angle specified in the appliance manufacturer's information. For conversions or upgrades, when information is not available for the application:
   - Refer to Table 6 to select the mid-range nozzle spray angle for the head type being used.
   - Fire the burner and make sure the combustion is acceptable and the flame is not impinging on chamber surfaces.
   - If a shorter flame is needed, select a wider spray angle. If a longer flame is needed, select a narrower spray angle.
   - Either hollow or solid spray patterns may be used. If combustion results are not satisfactory with the selected spray pattern, try the other pattern.

• Check/adjust electrodes

Figure 2. – Electrode Tip Adjustment



Check the electrode tip settings. Adjust if necessary to comply with the dimensions shown in Figure 2. To adjust, loosen the electrode clamp screw and slide/rotate electrodes as necessary. Securely tighten the clamp screw when finished.

• Servicing nozzle line assembly

1. Turn off power to burner before proceeding.
2. Disconnect oil connector tube from nozzle line.
3. Loosen the two screws securing igniter retaining clips and rotate both clips to release igniter baseplate. Then tilt igniter back on its hinge.
4. Remove splined nut.
5. "F" head air tube. - Remove nozzle line assembly from burner, being careful not to damage the electrodes or insulators while handling. To ease removal of long assemblies (over 9 inches), rotate assembly 180° from installed position after pulling partially out of tube.
6. To replace the nozzle assembly, reverse the above steps.

Mount Burner on Appliance

WARNING **Do Not use Adjustable Mounting Flange on Mobile Units**

The shock and vibration could cause loss of burner alignment and insertion problems resulting in flame impingement, heavy smoke, fire and equipment damage.

- Only use specified factory-welded flange and air tube combinations.

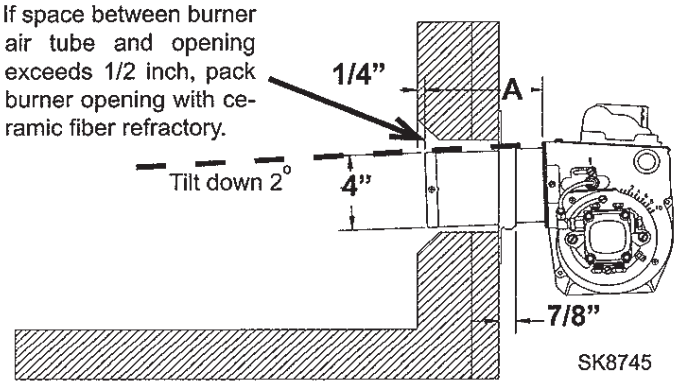
• Mounting options

Bolt the burner to the appliance using the factory-mounted flange or an adjustable flange.

• Mounting dimensions

1. When using the Beckett universal adjustable flange, mount the air tube at a 2° downward pitch unless otherwise specified by the appliance manufacturer.
2. Verify that the air tube installed on the burner provides the correct insertion depth. See Figure 3.
3. The end of the air tube should normally be ¼" back from the inside wall of the combustion chamber. Never allow the leading edge of the head assembly to extend into the chamber, unless otherwise specified by the heating appliance manufacturer. Carefully measure the insertion depth when using an adjustable flange. Verify the insertion depth when using a welded flange.

Figure 3. – Mounting Burner in Appliance



• Connect fuel lines

Carefully follow the fuel unit manufacturer's literature and the latest edition of NFPA 31 for oil supply system specifications.

WARNING **Do Not Install By-pass Plug with 1-Pipe System**

Failure to comply could cause immediate pump seal failure, pressurized oil leakage and the potential for a fire and injury hazard.

- The burner is shipped without the by-pass plug installed. **EXCEPTION**: Unless specified by the equipment manufacturer and noted on the label at top of pump cover.
- Install the by-pass plug in two-pipe oil supply systems ONLY.

CAUTION **Oil Supply Pressure Control Required**

Damage to the filter or pump seals could cause oil leakage and a fire hazard.

- The oil supply inlet pressure to the burner ***cannot exceed 3 psig***.
- Insure that a pressure limiting device is installed in accordance with the latest edition of NFPA 31.
- Do not install valves in the return line. (NFPA 31, Chapter 8)
- **Gravity Feed Systems:** Always install an anit-siphon valve in the oil supply line or a solenoid valve (RWB Part # 2182602U or 2233U) in the pump/nozzle discharge tubing to provide backup oil flow cut-off protection.

Fuel supply level with or above burner –
The burner may be equipped with a single-stage fuel unit for these installations. Connect the fuel supply to the burner with a single supply line if you want a one-pipe system (making sure the bypass plug is NOT installed in the fuel unit.) Manual bleeding of the fuel unit is required on initial start-up. If connecting a two-pipe fuel supply, install the fuel unit bypass plug.

Fuel supply below the level of the burner –
When the fuel supply is more than eight feet below the level of the burner, a two-pipe fuel supply system is required. Depending on the fuel line diameter and horizontal and vertical length, the installation may also require a two-stage pump. Consult the fuel unit manufacturer's literature for lift and vacuum capability.

Check/Adjust 'Z' Dimension for 'F' Heads

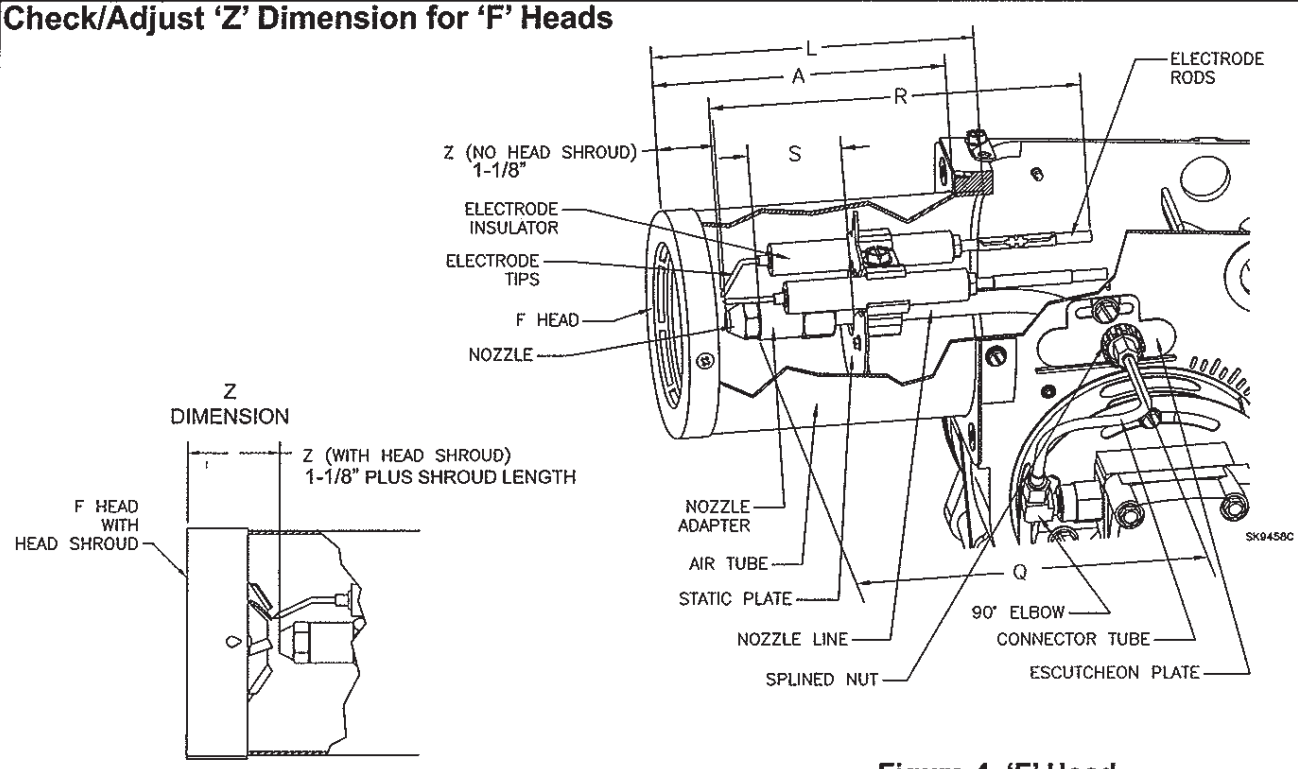


Figure 4. 'F' Head

• Check/Adjust 'Z' Dimension - 'F' heads

WARNING **Adjust the 'Z' dimension to the required specification.**

Incorrect Adjustments could cause combustion problems, carbon deposition from flame impingement, heavy smoke generation and fire hazard.

- Make all adjustments exactly as outlined in the following information.

1. The important 'Z' dimension is the distance from the face of the nozzle to the flat face of the head (or heat shield, if applicable). This distance for F heads is 1-⅛" (1-⅜" if the air tube has a heat shield). The "Z" dimension is factory set for burners shipped with the air tube installed. Even if factory set, verify that the "Z" dimension has not been changed.
2. Use the following procedure to adjust the "Z" dimension, if it is not correct:
   - Turn off power to the burner.
   - Disconnect the oil connector tube from the nozzle line
   - See above figure. Loosen the splined nut from the nozzle line. Loosen the hex head screw securing the escutcheon plate to the burner housing.
   - Place the end of a ruler at the face of the nozzle and, using a straight edge across the head, measure the distance to the face of the head. A Beckett T501 or T650 gauge may also be used.
   - Slide the nozzle line forward or back until the Z dimension for F heads is 1-⅛" (1-1/8" plus shroud length, if using a straight edge).
   - Tighten the hex head screw to secure the escutcheon plate to the burner chassis. Then tighten the splined nut and attach the oil connector tube.
3. Recheck the "Z" dimension periodically when servicing to ensure the escutcheon plate has not been moved. You will need to reset the "Z" dimension if you replace the air tube or nozzle line assembly. The Beckett Z gauge (part number Z-2000) is available to permit checking the F head "Z" dimension without removing the burner from the appliance.

• Burner Dimensions - Models SM & SF

Dimension (inches)	F Head
A = Usable air length (inches)	(Measure accurately)
L (Total tube length)	A+1/2
R (electrode length), ± 1/4	A+2-1/4
S (adapter to static plate), ± 1/16	(Note 1)
Q (nozzle line length),	A+ 15/16
Z (F head w/o head shroud) (F head-with head shroud)	1-1/8 1-1/8 + shroud length. (Note 2)

Note 1: 1-3/8 for dimension A less than 4"; 1-5/8 for dimension A from 4" through 4-1/2 ", 2-13/32 for dimension A greater than 4-1/2".
Note 2: When using a straight edge.

Fuel line installation –

CAUTION Do Not Use Teflon Tape

Damage to the pump could cause impaired burner operation, oil leakage and appliance soot-up.

- Never use Teflon tape on fuel oil fittings.
- Tape fragments can lodge in fuel line components and fuel unit, damaging the equipment and preventing proper operation.
- Use of Teflon tape will void the Suntec warranty.
- Use oil-resistant pipe sealant compounds.

Continuous lengths of heavy wall copper tubing are recommended. **Always use flare fittings. Never use compression fittings.**

- Always install fittings in accessible locations. Proper routing of fuel lines is required to prevent air cavitation and vibration.

Fuel line valve and filter –

- Install two high quality fusible-handle design shut-off valves in accessible locations on the oil supply line to comply with the NFPA 31 Standard and authorities having jurisdiction. Locate one close to the tank and the other close to the burner, upstream of the filter.
- Install a generous capacity filter inside the building between the fuel tank shutoff valve and the burner, locating both the filter and the valve close to the burner for ease of servicing. Filter should be rated for 50 microns or less.

Wire Burner

WARNING Electrical Shock Hazard

Electrical shock can cause severe personal injury or death.

- Disconnect electrical power before installing or servicing the burner.
- Provide ground wiring to the burner, metal control enclosures and accessories. (This may also be required to aid proper control system operation.)
- Perform all wiring in compliance with the National Electrical Code ANSI/NFPA 70 (Canada CSA C22.1)

• Burner packaged with appliance

Refer to appliance manufacturer's wiring diagram for electrical connections.

• Burner installed at jobsite

Refer to Figure 5, for typical burner wiring, showing cad cell primary controls. Burner wiring may vary, depending on primary control actually used.

The R7184 primary control with valve-on delay (prepurge) and burner motor-off delay (postpurge), requires a constant 120 volts AC power source supplied to the BLACK wire on the control. The RED wire goes to the appliance limit circuit. Please note that other control manufacturers may use different wire colors for power and limit connections.

Start Up Burner/Set Combustion

WARNING Explosion and Fire Hazard

Failure to follow these instructions could lead to equipment malfunction and result in heavy smoke emission, soot-up, hot gas puff-back, fire and asphyxiation hazards.

- Do not attempt to start the burner when excess oil has accumulated in the appliance, the appliance is full of vapor, or when the combustion chamber is very hot.
- Do not attempt to re-establish flame with the burner running if the flame becomes extinguished during start-up, venting, or adjustment.
- Vapor-Filled Appliance: Allow the unit to cool off and all vapors to dissipate before attempting another start.
- Oil-Flooded Appliance: Shut off the electrical power and the oil supply to the burner and then clear all accumulated oil before continuing.
- If the condition still appears unsafe, contact the Fire Department. Carefully follow their directions.
- Keep a fire extinguisher nearby and ready for use.

1. Open the shutoff valves in the oil supply line to the burner.
2. If the air control is not preset, close air band and partially open air shutter. This is an initial air setting for the pump bleeding procedure only. Additional adjustments must be made with instruments to prevent smoke and carbon monoxide generation.
3. Set the thermostat substantially above room temperature.

Typical Burner Wiring & Burner Sequence of Operation for R7184 Control.

Refer to the appliance manufacturer's wiring diagram for actual specifications.

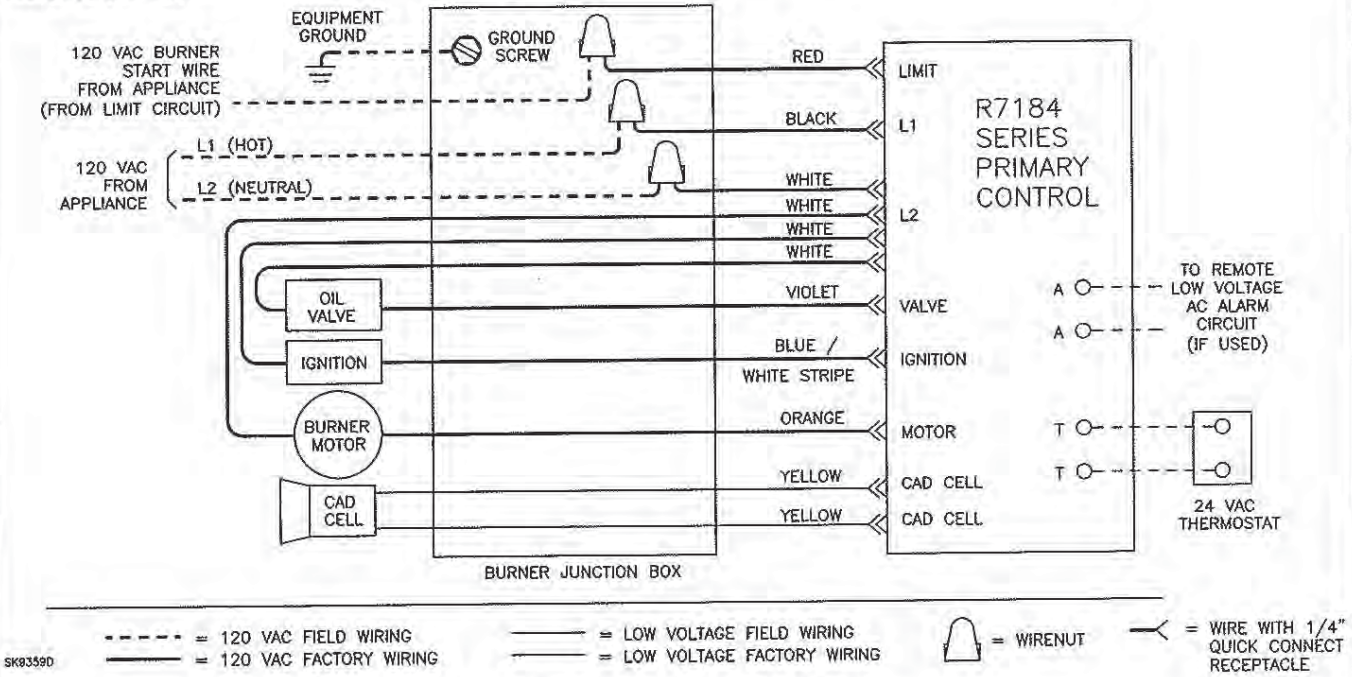
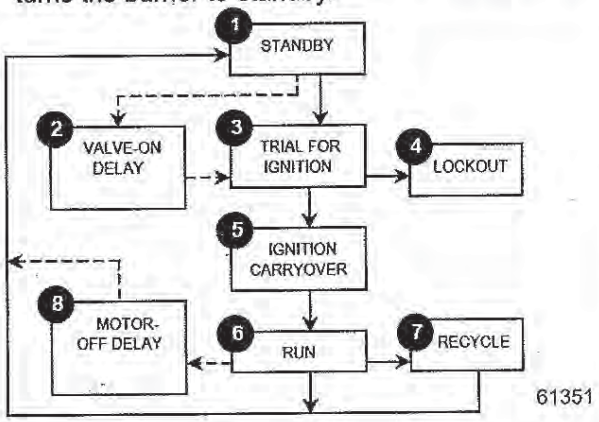


Figure 5. – Typical Burner Wiring

1. **STANDBY.** The burner is idle, waiting for a call for heat. When a call for heat is initiated, there is a 3-10 second delay while the control performs a safe start check.
2. **VALVE-ON DELAY.** The ignition and motor are turned on for a 15 second valve-on delay.
3. **TRIAL FOR IGNITION (TFI).** The fuel valve is opened. A flame should be established within the 15 second lockout time.
4. **LOCKOUT.** If flame is not sensed by the end of the TFI, the control shuts down on safety lockout and must be manually reset. If the control locks out three times in a row, the control enters restricted lockout.
5. **IGNITION CARRYOVER.** Once flame is established, the ignition remains on for 10 seconds to ensure flame stability before turning off. If the control is wired for intermittent duty ignition, the ignition unit stays on the entire time the motor is running.
6. **RUN.** The burner runs until the call for heat is satified. The burner is then sent to burner motor off delay, if applicable, or it is shut down and sent to standby.
7. **RECYCLE.** If the flame is lost while the burner is firing, the control shuts down the burner, enters a 60 second recycle delay, and then repeats the above ignition sequence. If flame is lost three times in a row, the control locks out to prevent cycling with repetitious flame loss due to poor combustion.
8. **BURNER MOTOR-OFF DELAY.** The fuel valve is closed and the burner motor is kept on for the selected motor-off delay time before the control returns the burner to standby.



Control System Features

Feature	Interrupted ignition	Limited reset, Limited recycle	Diagnostic LED, cad cell indicator	Valve-on delay	Burner motor off delay	Alarm Contacts
R7184A	YES	YES	YES	—	—	—
R7184B	YES	YES	YES	YES	—	—
R7184P	YES	YES	YES	YES	YES	Optional

4. Close the line voltage switch to start the burner. If the burner does not start immediately you may have to reset the safety switch of the burner primary control.
5. Bleed air from fuel unit as soon as burner motor starts rotating.
   - To bleed the fuel unit, attach a clear plastic hose over the vent fitting. Loosen the fitting and catch the oil in an empty container. Tighten the fitting when all air has been purged from the oil supply system.
   - If the burner locks out on safety during bleeding, reset the safety switch and complete the bleeding procedure. Note — Electronic safety switches can be reset immediately; others may require a three- to five-minute wait.
   - If burner stops after flame is established, additional bleeding is probably required. Repeat the bleeding procedure until the pump is primed and a flame is established when the vent fitting is closed.
   - For R7184 primary controls, see Technician's Quick Reference Guide, part number 61351 for special pump priming sequence.
   - Prepare for combustion tests by drilling a ¼" sampling hole in the flue pipe between the appliance and the barometric draft regulator.
6. Initial air adjustment — Test the flue gas for smoke. Adjust the air shutter (and air band, if necessary) to obtain a clean flame. Now the additional combustion tests with instruments can be made

• Set combustion with instruments

1. Allow the burner to run for approximately 5 to 10 minutes.
2. Set the stack or over-fire draft to the level specified by the appliance manufacturer.
   - **Natural Draft Applications;** typically over-fire draft is -0.01" or -0.02" w.c.
   - **Direct Venting**; typically may not require draft adjustment.
   - **High Efficiency/Positive Pressure Appliances**; also vary from traditional appliances (see manufacturer's recommendations).
3. Follow these four steps to properly adjust the burner:
   Step 1: Adjust the air shutter/band until a trace of smoke is achieved.
   Step 2: At the trace of smoke level, measure the CO_2 (or O_2) . This is the vital reference point for further adjustments. Example: 13.5% CO_2 (2.6% O_2)
   Step 3: Increase the air to reduce the CO_2 by 1.5 to 2 percentage points. (O_2 will be increased by approximately 2.0 to 2.7 percentage points.) Example: Reduce CO_2 from 13.5% to 11.5% (2.6% to 5.3% O_2).
   Step 4: Recheck smoke level. It should be Zero.
      - This procedure provides a margin of reserve air to accommodate variable conditions.
      - If the draft level has changed, recheck the smoke and CO2 levels and readjust the burner, if necessary
4. Once combustion is set, tighten all fasteners on air band, air shutter and escutcheon plate.
5. Start and stop the burner several times to ensure satisfactory operation. Test the primary control and all other appliance safety controls to verify that they function according to the manufacturer's specifications.

Perform Regular Maintenance

WARNING **Annual Professional Service Required**

Tampering with or making incorrect adjustments could lead to equipment malfunction and result in asphyxiation, explosion or fire.

- Do not tamper with the burner or controls or make any adjustments unless you are a trained and qualified service technician.
- To ensure continued reliable operation, a qualified service technician must service this burner annually.
- More frequent service intervals may be required in dusty or adverse environments.
- Operation and adjustment of the burner requires technical training and skillful use of combustion test instruments and other test equipment.

- ☐ Replace the oil supply line filter. The line filter cartridge must be replaced to avoid contamination of the fuel unit and nozzle.
- ☐ Inspect the oil supply system. All fittings should be leak-tight. The supply lines should be free of water, sludge and other restrictions.
- ☐ Remove and clean the pump strainer if applicable.
- ☐ Replace the nozzle with the exact brand, pattern, gph flow rate and spray angle..
- ☐ Clean and inspect the electrodes for damage, replacing any that are cracked or chipped.
- ☐ Check electrode tip settings. Replace electrodes if tips are rounded.
- ☐ Inspect the igniter spring contacts.
- ☐ Clean the cad cell lens surface, if necessary.
- ☐ Inspect all gaskets. Replace any that are damaged or would fail to seal adequately.
- ☐ Inspect the combustion head and air tube. Remove any carbon or foreign matter. Replace all damaged units with exact parts.
- ☐ Clean the blower wheel, air inlet, air guide, burner housing and static plate of any lint or foreign material.
- ☐ If motor is not permanently lubricated, oil motor with a few drops of SAE 20 nondetergent oil at each oil hole. DO NOT over oil motor. Excessive oiling can cause motor failure.
- ☐ Check motor current. The amp draw should not exceed the nameplate rating.
- ☐ Check all wiring for secure connections or insulation breaks.
- ☐ Check the pump pressure and cutoff function.
- ☐ Check primary control safety lockout timing.
- ☐ Check ignition system for proper operation.
- ☐ Inspect the vent system and chimney for soot accumulation or other restriction.
- ☐ Clean the appliance thoroughly according to the manufacturer's recommendations.
- ☐ Check the burner performance. Refer to the section "Set combustion with test instruments".
- ☐ It is good practice to make a record of the service performed and the combustion test results.

• Replacing the blower wheel:

- When replacing the blower wheel, insure that the wheel is centered between the two sides of the burner housing as shown below.

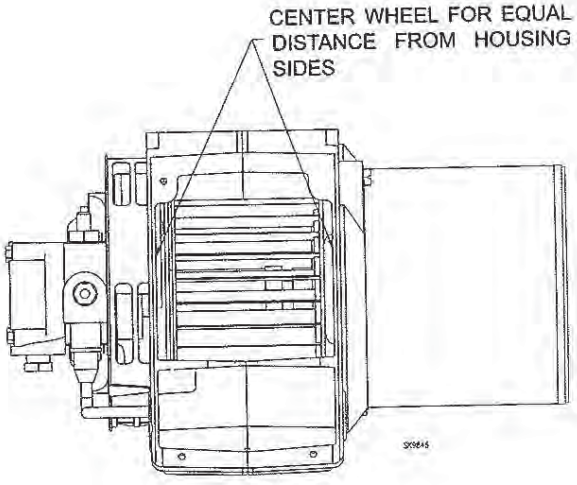
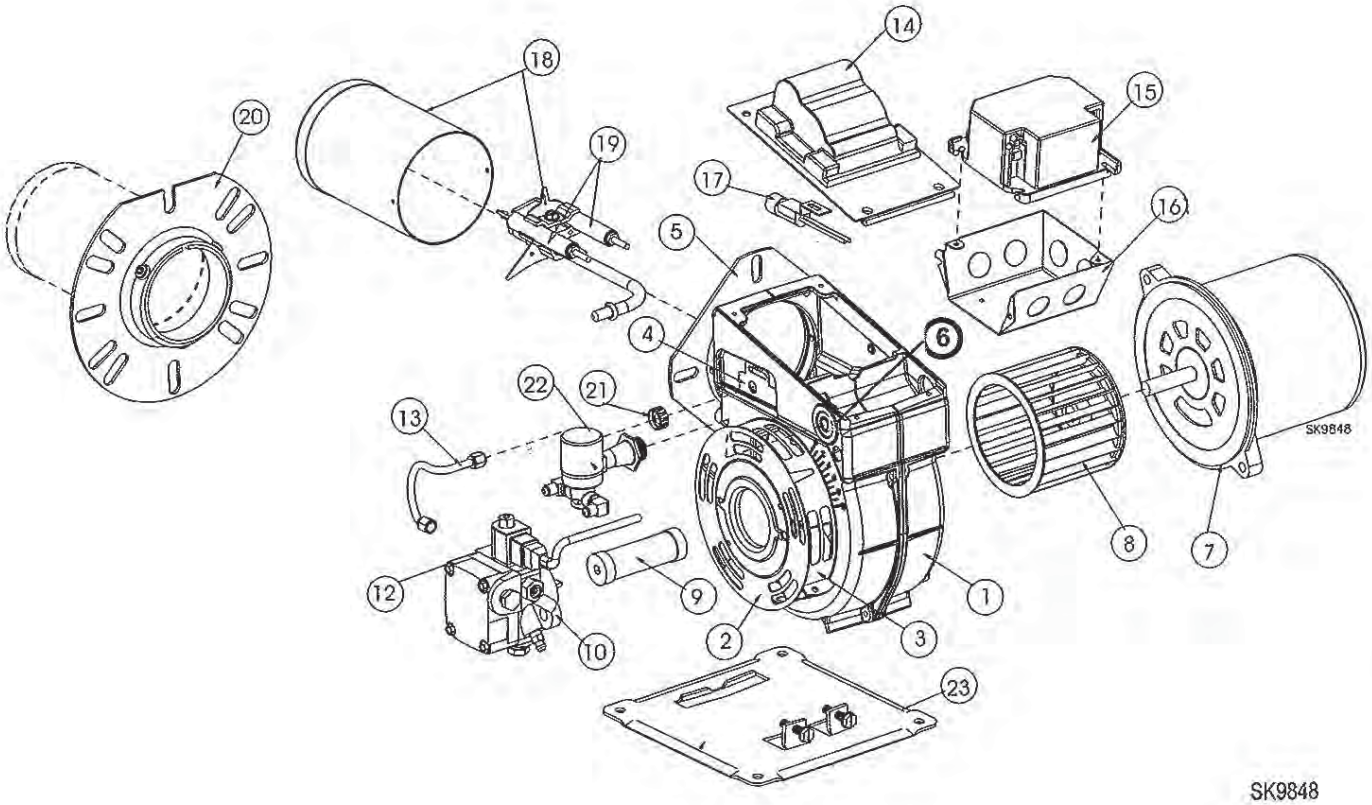


Figure 6. Blower Wheel Assembly

Burner Parts Diagram



SK9848

#	Part No.	Description
1		Burner Housing Assembly with Inlet Bell
2	3215	Air shutter, 10 Slot
3	3819	Bulk Air Band, 10 Slot
4	3493	Nozzle-line Escutcheon Plate
5	Specify ** 3399	Unit Flange or Square Plate
Not Shown	3416	Air Tube Gasket
6	2139	Hole Plug - Wiring Box
7	2900U 2364U	Drive Motor, 1/5 HP (SM Models) Drive Motor, 1/4 HP (SF Models)
8	2383U	Blower Wheel (6-1/4 X 3-7/16)
9	2433	Flexible Coupling (Fits 5/16" pump shaft)
10	 2591U 21188U	Fuel Units SF only Single-Stage 'A' Two-Stage 'B'
10	 2184404U 2460	Fuel Units SM only CleanCut Single-Stage 'A'
12	2256	Pump outlet fitting
	482	Pump holding screws (not shown)
13	5394	Connector tube assembly, pump to nozzle line

#	Part No.	Description
14	51824U	Igniter and Base Plate
14	2289U	Ignition Transformer (10,000 V/23mA)
15	7455U	R7184A - Interrupted Ignition
	7456U	R7184B - Pre-purge
	7457U	R7184P - Pre and Post-purge
	7458U	R7184P w/ Alarm Contacts
16	5770	Electrical Box
17	7006U	Cad Cell Detector
18	Specify **	Air Tube Combination
19	5780	Electrode Kit - F Head up to 9"
	5782	Electrode Kit - F Head over 9"
20	5432 3616	Universal Flange w/ Gasket Gasket Only
21	3666	Splined Nut
22	2182602U	Blocking Oil Solenoid Valve
23	5685	Base Pedestal Kit

** Contact your Beckett Representative for part number and pricing.

AIR MAKE-UP UNITS

AMU Series

Construction

Welded steel housing finished in grey enamel.

Application

Available in a wide range of sizes handling 75 c.f.m. to 1100 c.f.m.

Designed to use as Air Replacement and Air Make-Up Units, for permanent installation.

To exhaust foul air and replace with fresh outside air.

By drawing on its wide range of tooled, standard parts, **Airdex** engineers can design a blower to meet your specific needs whether high or low air flow. AC motors, high or low resistance, single or double inlet.

Performance Data

			Air Delivery (CFM) at R.P.M. Specified							
Description	H.P.	R.P.M.	Free Air	1/8" SP	1/4" SP	3/8" SP	1/2" SP	3/4" SP	1" SP	1 1/4" SP
AMU 75	1/60	3000	75	61	54	43	-	-	-	-
AMU 130	1/70	1550	130	107	87	30	-	-	-	-
AMU 160	1/40	1600	165	150	135	120	104	-	-	-
AMU 245	1/20	1550	245	225	210	190	162	-	-	-
AMU 265	1/20	1610	265	250	233	215	185	-	-	-
AMU 400	1/12	1550	400	380	365	340	315	200	-	-
AMU 465	1/15	1530	465	430	397	357	308	-	-	-
AMU 525	1/4	1725	525	500	480	460	420	240	120	-
AMU 625	1/4	1725	625	600	560	540	500	420	280	100
AMU 845	1/2	1725	845	825	790	760	730	650	570	425
AMU 1100	1/3	1140	1100	1050	1000	950	860	700	-	-

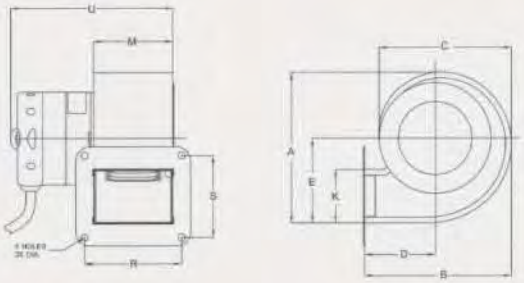
Tested by The Nozzle Chamber Method as directed in A.M.C.A. Bulletin #210. Figure #4.

Features

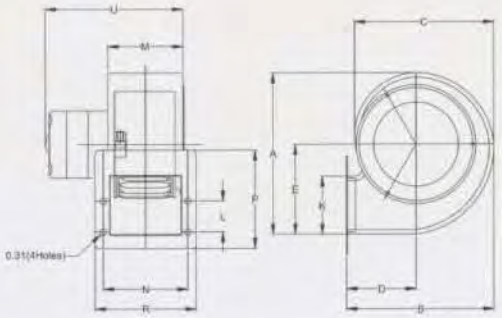
115 Volt, 60 Hz

- Thermal overload protection
- Conduit wiring box
- Permanently lubricated bearings
- Horizontal or vertical operation
- Counter clockwise rotation drive side
- AMU 245, 400, 525, 625, 845 and 1100 supplied with inlet collars.
- Sleeve bearings with oilers
- 4 discharge positions

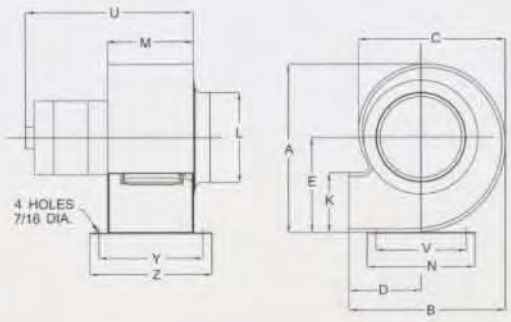
Specification Charts



Description	A	B	C	D	E	K	M	R	S	U	Weight (lbs)
AMU 75	5.34	5.17	4.68	2.50	3.02	1.92	2.75	3.38	2.88	5.35	3.4
AMU 130	7.59	7.09	6.58	3.31	4.30	2.72	3.75	4.69	3.75	6.75	4

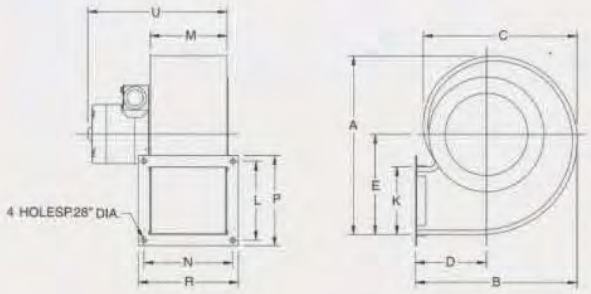


Description	A	B	C	D	E	K	L	M	N	P	R	U	Weight (lbs)
AMU 160	7.80	7.08	6.69	3.34	4.34	2.80	1.50	3.60	4.05	4.75	4.85	6.40	5.4

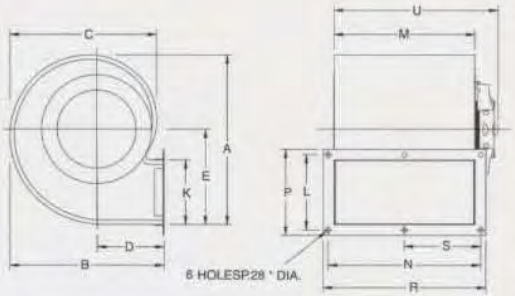


Description	A	B	C	D	E	K	L	M	N	U	V	Y	Z	Weight (lbs)
AMU 245	9.41	8.73	8.17	4.0	5.33	3.36	5.0	4.75	6.0	9.0	5.0	5.75	6.75	8
AMU 400	10.61	9.76	9.24	4.44	6.01	3.79	6.0	5.25	6.0	10.75	5.0	6.25	7.25	13

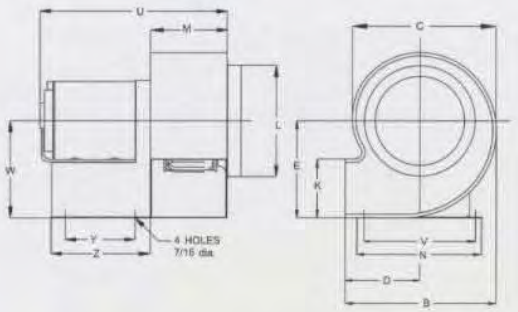
Specification Charts



Description	A	B	C	D	E	K	L	M	N	P	R	S	U	Weight (lbs)
AMU 265	9.93	9.0	8.46	3.9	5.55	3.75	4.37	4.22	4.87	5.0	5.5	-	7.65	8.05

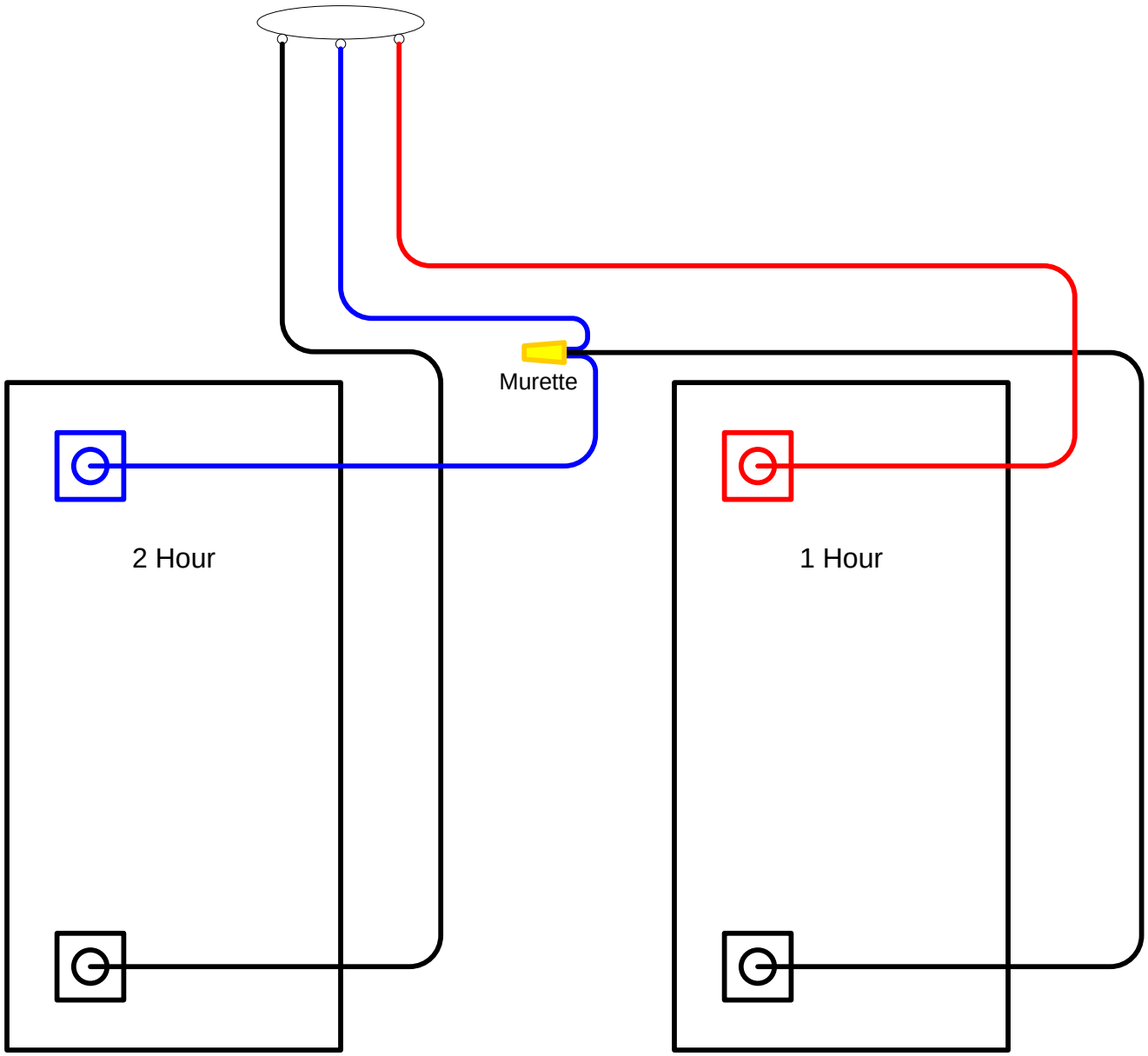


Description	A	B	C	D	E	K	L	M	N	P	R	S	U	Weight (lbs)
AMU 465	9.93	9.0	8.46	3.9	5.55	3.75	4.37	8.12	8.82	5.0	9.4	4.41	9.46	11.0



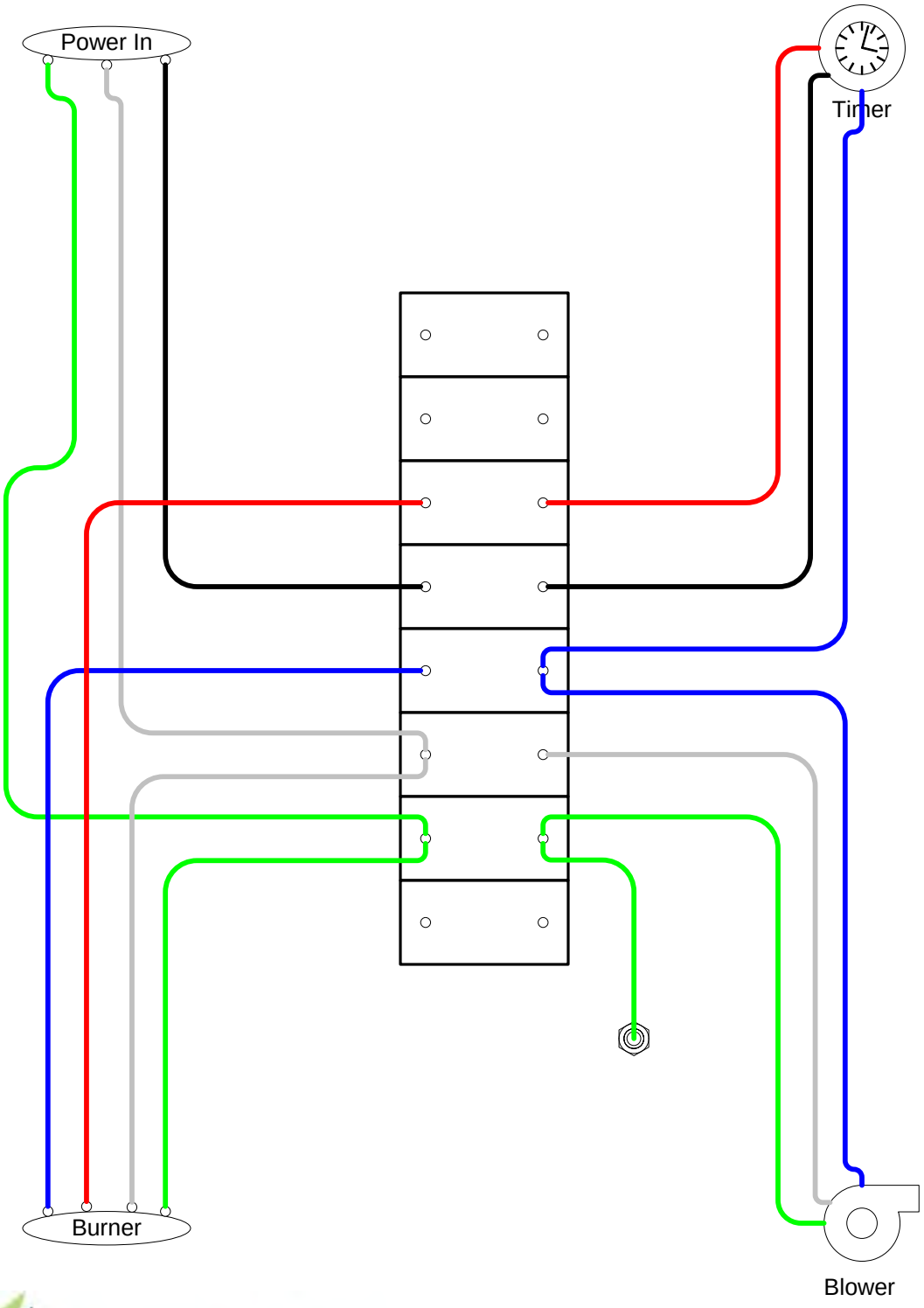
Description	A	B	C	D	E	K	L	M	N	U	V	W	Y	Z	Weight (lbs)
AMU 525	11.91	10.85	10.36	4.88	6.98	4.24	8.0	5.5	9.0	13.6	8.0	7. 23	5.0	7.02	24
AMU 625	11.91	10.85	10.36	4.88	6.98	4.24	8.0	6.0	9.0	14.1	8.0	7.23	5.0	7.02	24
AMU 845	13.43	12.19	11.66	5.44	7.60	4.76	8.0	6.0	9.0	14.8	8.0	7.85	5.0	7.02	30
AMU 1100	16.58	14.62	14.06	6.34	9.51	6.28	9.0	7.0	9.0	16.6	8.0	9.81	5.0	7.02	53

Cyclonator Timers
Wiring
CY-1020/1050 FA”D”
CY-2020/2050 FA”D”



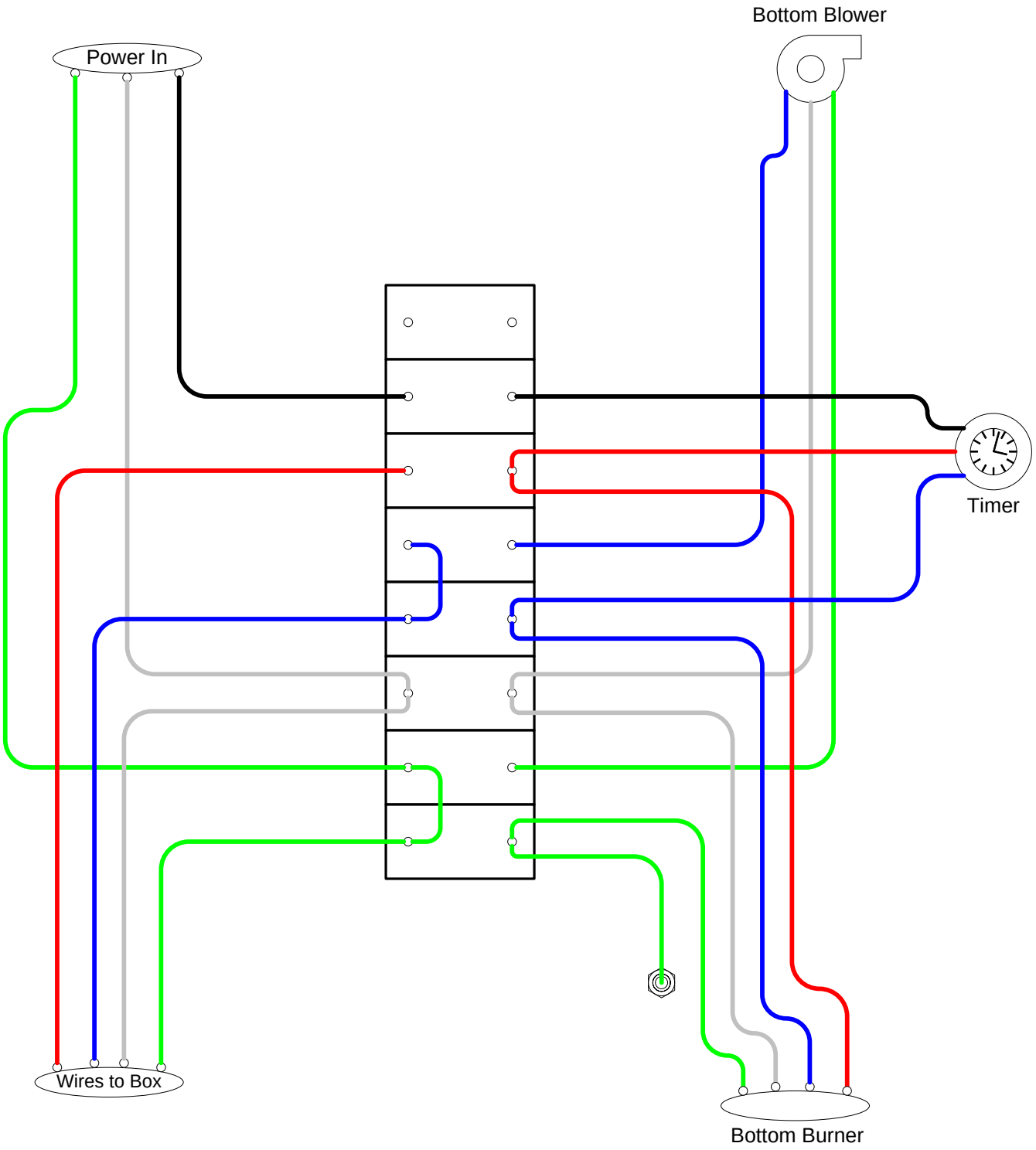
WESTLAND
ENVIRONMENTAL
SERVICES INC.

Burner Wiring (Beckett)
CY-1020/1050 FA”D”

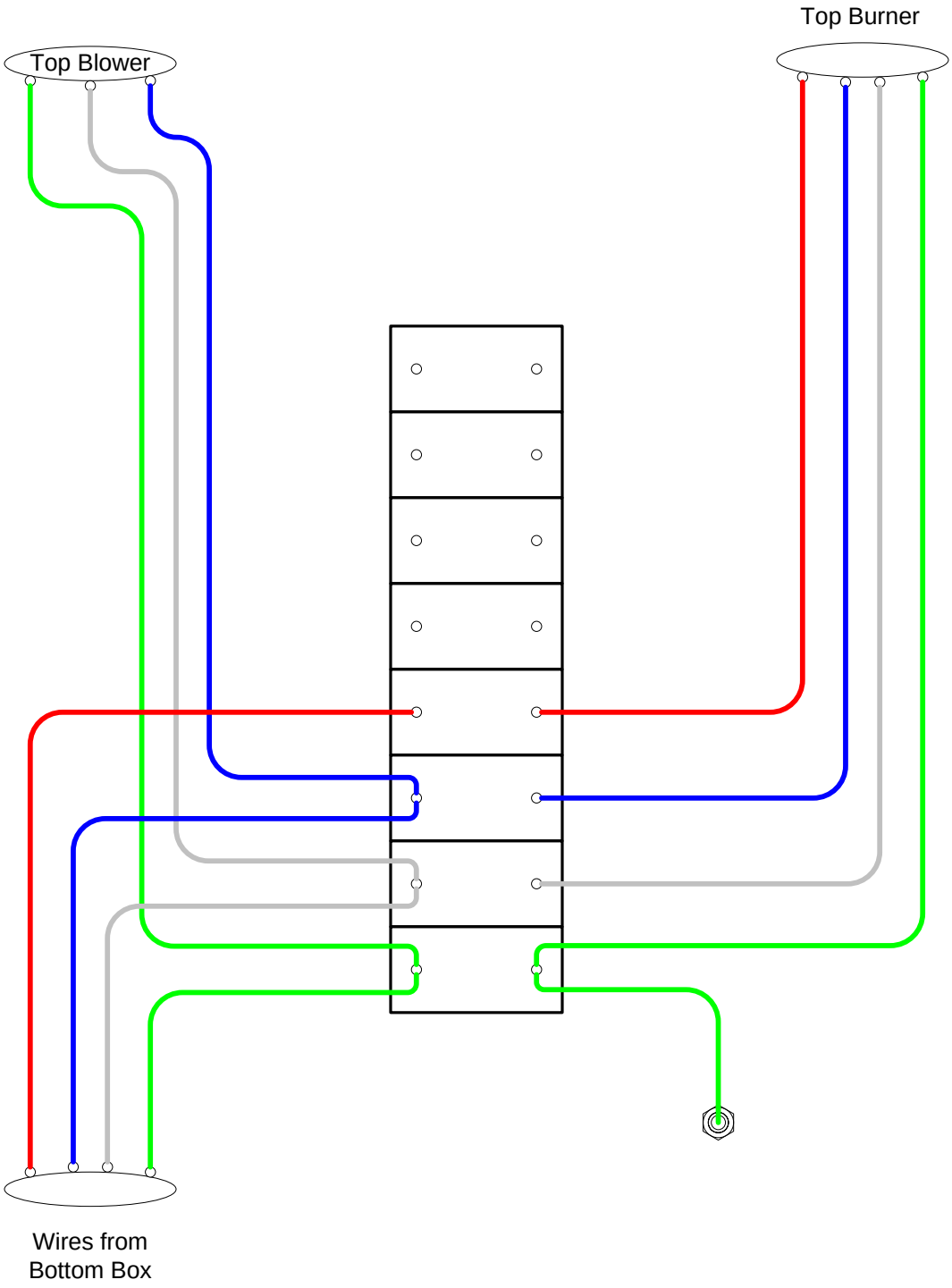


WESTLAND
ENVIRONMENTAL
SERVICES INC.

Wiring (Beckett)
CY-2020/2050 FA”D”
Bottom Box



Burner Wiring (Beckett)
CY-2020/2050 FA”D”
Top Box



WESTLAND
ENVIRONMENTAL
SERVICES INC.

HOPE BAY PROJECT INCINERATOR MANAGEMENT PLAN

HOPE BAY, NUNAVUT

Module A – Appendix B:
Operating and Maintenance Manual
CY-100-CA-D

KETEK GROUP

Results Driven.

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Edmonton, AB, Canada, T5S 1X8
Phone: 1-855-447-5050
Fax: (780) 447-4912
Email: info@ketek.ca
www.ketek.ca

CY-100-CA

MANUAL

OPERATION & MAINTENANCE

LIST OF TABLES

LIST OF FIGURES

Thank you for selecting Ketek Group to provide you with a reliable, proven and cost-effective system to manage your waste in an environmentally sound manner. This manual has been prepared to allow you to operate and maintain the system safely and efficiently, ensuring its proper operation and continued use for a long time.

It also contains information on the combustion process. We think a good understanding of the basic principles make a knowledgeable, and hence a better, operator.

Table 1 outlines the contents of this manual. We encourage you to read Chapter 2. Chapters 4 and 5 contain the most important information.

TABLE 1 ORGANIZATION OF MANUAL

Chapter	Title / Description
2	Waste Incineration and General Guidelines for Waste Management
3	Roles and Responsibilities
4	Principles of waste incineration What incineration is, how it is affected by waste properties, including incinerator capacity and the design and operational features of the system.
5	System Description List of photographs of the components of the system and their functions
6	Operation and Maintenance How to operate and maintain the system, including discussion of safety

Incineration of waste is recognized as an effective and environmentally sound disposal method for a wide range of wastes, provided the incinerator is properly operated and maintained. However, waste segregation, recycling and reuse should be considered before waste is sent for incineration. Examine the waste to determine the opportunities that exist for:

- reducing the overall quantity of waste generated
- reusing materials, and
- recycling as much as possible before disposal

Incineration of waste can lead to the emission of pollutants. Polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDDF), commonly known as dioxins and furans, can be generated if the incinerator is operated inefficiently and combustion is incomplete. Dioxins and furans are toxic, persistent, and bio-accumulative and therefore must be controlled. Mercury is another high priority potential contaminant released from incinerators. It is toxic and bioaccumulates in the environment. Mercury is not emitted unless the waste items incinerated contain mercury. The best method to control mercury is therefore waste segregation to eliminate mercury from the waste fed into the incinerator.

Waste management and segregation before incineration will help reduce waste and provide cleaner emissions, maintaining an environmentally sound way of disposing waste products.

3.1 Waste management in charge/site services

- Ensure that relevant waste handling training is provided to all waste management personnel at site and only properly trained individuals (Incinerator Operators) operate the incinerator.
- Ensure that the operator follows the requirements of the Incinerator Operational Plan, Equipment Operation Manual and other relevant guidelines.
- Ensure that all checklists and data logs are maintained and the records required by this guidance document are collected.
- Ensure adequate re-training is provided to the operators at regular interval.
- Ensure the safety of all personnel and the site.
- Carry out periodic inspections and record observations in supervision checklist appended in this document.

3.2 Incinerator Operator

- Ensure the safe operation of the incinerator and the associated work and storage area.
- Ensure the operation and maintenance of the incinerator is carried out in accordance with the Equipment Operation Manual.
- Ensure that only appropriate wastes are incinerated, and all inappropriate wastes, including plastics, aerosol cans, metallic containers or cans filled with waste oil, are removed and handled accordingly.
- Document and maintain the required logs and records as appended in the document (pre-operational checklist, operational checklist and waste incineration log).
- Notify the supervisor or waste management in charge of any incinerator upsets, malfunctions or required repairs.
- Wear proper Personal Protective Equipment at all times while working with the incinerator or waste.

3.3 Maintenance Personnel

- Carry out timely Inspections and maintain the records
- Carry out preventive maintenance at scheduled intervals; record and report any unusual observations on the equipment.
- Do not alter the electrical wiring or incinerator components.
- Consult Ketek for any clarifications or guidance related to maintenance of the equipment.
- Fill and record the inspection and maintenance checklist and follow the checklist for weekly, monthly and annual inspection and maintenance
- Make sure to lock out/tag out the unit as per the company's existing procedures if there is a problem.

4.1 Combustion

Combustion, burning, incineration, and thermal oxidation all denote the same process, which is the reaction of a combustible materials with oxygen at temperatures higher than the ignition temperature[1] of that matter. The reaction is exothermic, meaning it generates heat in the form of hot gas.
In the case of waste, it may also contain non-combustible matter which does not react with oxygen. In waste incineration, the non-combustible component ends up as ash and a small portion of it is also present in the hot gas in the form of particulate matter or dust.

Figure 1 shows the process of waste incineration. The oxygen used comes from air, which contains 21% oxygen by volume, and the hot gas is typically referred to as flue gas.

4.2 Why incinerate waste?

The main purpose is to reduce the mass and volume for final disposal. Another important reason, since the waste may contain pathogenic, infectious or toxic materials, is to detoxify it. In remote areas, where wildlife is present, scavenging and spreading of diseases can be prevented by incineration.

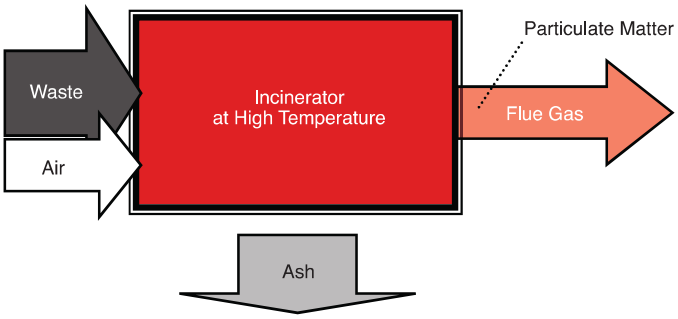


FIGURE 1 SCHEMATIC DIAGRAM OF INCINERATION PROCESS

In some cases, incineration is used to recover the energy contained in the waste in the form of electricity, steam, hot fluids or hot air. In other cases, valuable materials can be recovered from the ash, or the ash as a whole can be used for soil amendment or as a construction material.

4.3 Waste components

There are different ways of characterizing waste, depending on the purpose for doing it. Here, it is sufficient to characterize the components as follows: [2]

A. WATER is an important component because in incineration it has to be evaporated, which requires a lot of energy.[3] That, in turn, lowers the temperature of the flue gas.

B. COMBUSTIBLES are those components that react with oxygen and release heat.[4] The higher the combustible content in the waste, the more air per kilogram of waste is needed for incineration.

This component can be further classified as:

(i) Volatile, which is released to the gas phase when the combustible matter is heated without the presence of oxygen, and
(ii) Fixed carbon which remains in the solid waste after the volatile has been released. This is often referred to as charcoal.

C. NON-COMBUSTIBLE OR ASH is the component that does not react with oxygen.[5] As previously mentioned, this forms ash, and some of it is in the flue gas in the form of particulate matter or dust. If the waste has a high ash content, less waste can be incinerated before ash must be removed from the combustion chamber. Note also if the waste contains metals, such as lead and cadmium, these metals will be present in the ash.

4.4 Heating Value

Heating value, calorific value and heat of combustion are synonyms that quantify the heat released by the combustible component in the waste. An understanding of the concept can be gained from the hypothetical processes shown in Figure 2.

A measured mass of dry waste and a sufficient amount of oxygen, at room temperature, are ignited, and the resulting hot flue gas is passed through a heat exchanger, where heat is extracted until the flue gas is brought back to room temperature. Let M be the mass (kg) of the dry waste, and H (MJ) is the heat extracted from the heat exchanger. The heating value of the dry waste is H/M (MJ/kg).

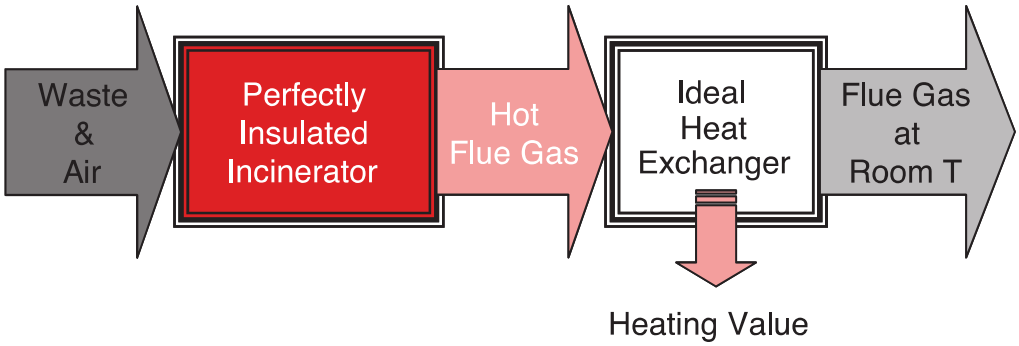


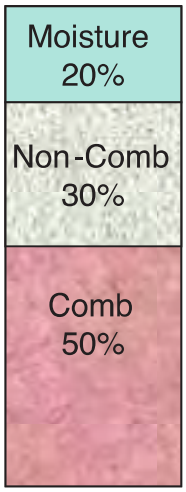
FIGURE 2 THE CONCEPT OF HEATING VALUE

1. Below the ignition temperature, combustion does not take place. Consider, for example, gasoline or wood: it has to be ignited for combustion to take place. That is, the temperature in some portion of the matter must be brought up to the ignition temperature for combustion to start.
2. This is referred to as proximate analysis. Another method is elemental analysis, which produces the elemental composition (C, H, O , N, S, Cl ...) of the waste.
3. It takes ~ 2.3 MJ (2200 BTU or 90 cc of propane or 60 cc of diesel) to evaporate 1 L or 1 kg of water. This is referred to as the latent heat of evaporation.
4. The term "organic" is also used, which is strictly incorrect in that some "inorganic" elements or compounds are combustible, such as carbon, sulphur and carbon monoxide.
5. The terms "ash" and "inorganic" are also used. Note that the latter is inaccurate as explained previously.

4.5 Different Expressions for Heating Value

Two different values are reported in the literature (a) "high" or "gross", and (b) "low" or "net". The former corresponds to the case where the moisture in the flue gas is condensed, and hence the high or gross heating value includes the latent heat of evaporation of the water formed in combustion (see Footnote 3). The latter excludes the latent heat evaporation. The low or net heating value thus represents the maximum available energy that can be recovered from the flue gas without condensation.

To be noted also is the basis on which the heating value is expressed, which can be (a) as fired, (b) dry basis or (c) ash free. The distinction is illustrated in Figure 3. An understanding of the different bases can be gained by noting that heating value is a property of the combustible component in the waste. Water and the non-combustible component simply "dilute" the heating value. In terms of incinerator operation, the relevant basis is "as fired".



* HV as measured:
15 MJ/kg "Dry Basis"

* HV of whole waste:
= (30 + 50)/100 * 15 = 12 MJ/kg "As Fired"

* HV of combustible component:
= (30 + 50)/50 * 15 = 24 MJ/kg "Ash Free"

FIGURE 3 DIFFERENT BASES FOR EXPRESSING HEATING VALUE (HV)

4.6 Examples of waste characteristics

Proximate compositions and heating values of commonly found wastes are given in Table 2.

FIGURE 3 DIFFERENT BASES FOR EXPRESSING HEATING VALUE (HV)

Type*	Description	Componets	Weight %			MJ/kg
			Moist	Comb	Non-C	HHV (A/F)
0	Trash	Paper, cardboard, cartons, wood boxes and combustible floor sweepings from commercial and industrial activities. Up to 10% by weight of plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags and plastic or rubber scraps.	10%	85%	5%	19.7
1	Rubbish	Trash + Type 3 (up to 20%)	25%	65%	10%	15
2	Refuse	Rubbish and Garbage	50%	43%	7%	10
3	Garbage	Animal and vegetable waste, restaurants, hotels, markets, institutional, commercial and club sources	70%	25%	5%	5.8
4	Animal/ Pathological	Carcasses, organs, hospital and laboratory, abattoir, animal pound, veterinary sources	85%	10%	5%	2.3

Notes:
Moist= moisture, Comb= Combustible; Non-C = Non-combustible; HHV = High Heating Value; A/F = As Fired
* In some cases, Roman numerals are used. That is Types 0, I, II, III and IV

4.7 Incinerator Capacity and Load Size

Incinerator capacity is dependent on waste composition. In general, the higher the heating value, the lower is the capacity in terms of kg/h that can be incinerated. This can be explained by noting that waste that has a higher heating value requires more air per unit mass than that required to incinerate a waste with a lower heating value. To put it another way, for the same amount of air, more mass of a waste with a lower heating value can be incinerated.

Another important consideration is the size of the batch loaded to the incinerator. The higher the heating value, the smaller (lighter) the load should be. Otherwise, insufficient amount of the air would generate black smoke.

Unfortunately, waste composition is not always known. Nevertheless, there may be indications of the components present. To assist in getting a qualitative estimate of the heating value of a batch of waste, the heating values of common generic waste components are shown in Table 3.

TABLE 3 HIGH HEATING VALUES (APPROXIMATE) OF COMMON WASTE COMPONENTS

Component	MJ/kg A/F *	Component	MJ/kg A/F *
Kerosene, diesel ...	44	Leather	16
Plastics	46	Wax paraffin	44
Rubber, latex	23	Rags (linen, cotton)	17
Wood	18	Animal fats	39
Paper	17	Citrus rinds	4
Agricultural waste	17	Linoleum	25

* A/F: As Fired

Another important waste component is the volatile content in the waste. Table 4 shows the proximate components of various materials and wastes.

In general, this component is responsible for smoke generation. Therefore, as in the case with heating value, the higher the volatile content, the smaller the load that should be charged to the incinerator.

TABLE 4 PROXIMATE COMPOSITION OF VARIOUS MATERIALS

Material	Volatile	Moisture	FC	Ash	FC/V
	%wt	%wt	%wt	%wt	-
Coal (bituminous)	30	5	45	20	1.5
Peat	65	7	20	8	0.3
Wood	85	6	8	1	0.1
Paper	75	4	11	10	0.15
Sewage sludge	30	5	20	45	0.66
MSW	33	40	7	20	0.21
RDF	60	20	8	12	0.13
PDF	73	1	3	13	0.04
TDF	65	2	30	3	0.46
PE, PP, PS	100	0	0	0	0
Plastic + Colour	98	0	0	2	0
PVC	93	0	7	0	0.08

Notes:

FC = Fixed Carbon
FCN = Ratio of Fixed Carbon to Volatile
RDF = Refuse Derived Fuel
PDF= Paper Derived Fuel
TDF = Tire Derived Fuel
PE= Polyethylene
PP= Polypropylene
PS = Polystyrene
PVC = Polyvinylchloride

5.1 Overview

Regardless of the model of your incinerator, the main components are similar. Figure 4 shows a schematic diagram of the incineration system. It consists of a Primary Chamber and a Secondary Chamber, which are connected by a flame-port. Combustion air to the Secondary Chamber is delivered via the flame-port by the flame-port blower. Auxiliary burners are provided for start-up and to maintain the minimum temperatures set in the two chambers.

Thermocouples are used to measure the temperatures in the chambers, the outputs of which are used by on-off Omron controllers, which regulate the operation of the auxiliary burners.

The Secondary Chamber combined with high temperatures maintained by the auxiliary burner, and the turbulence created from the delivery of air (oxygen) by the flame-port air blower, ensures that black smoke is not generated (provided the size of the waste load is not too large).

Waste is charged manually and intermittently via the waste charging door (1), and ash is removed manually and batch-wise after operation. The waste charging door is also used to rake the waste in the primary chamber after several loads have been charged, which is necessary to expose the fixed carbon component in the waste to the oxygen.

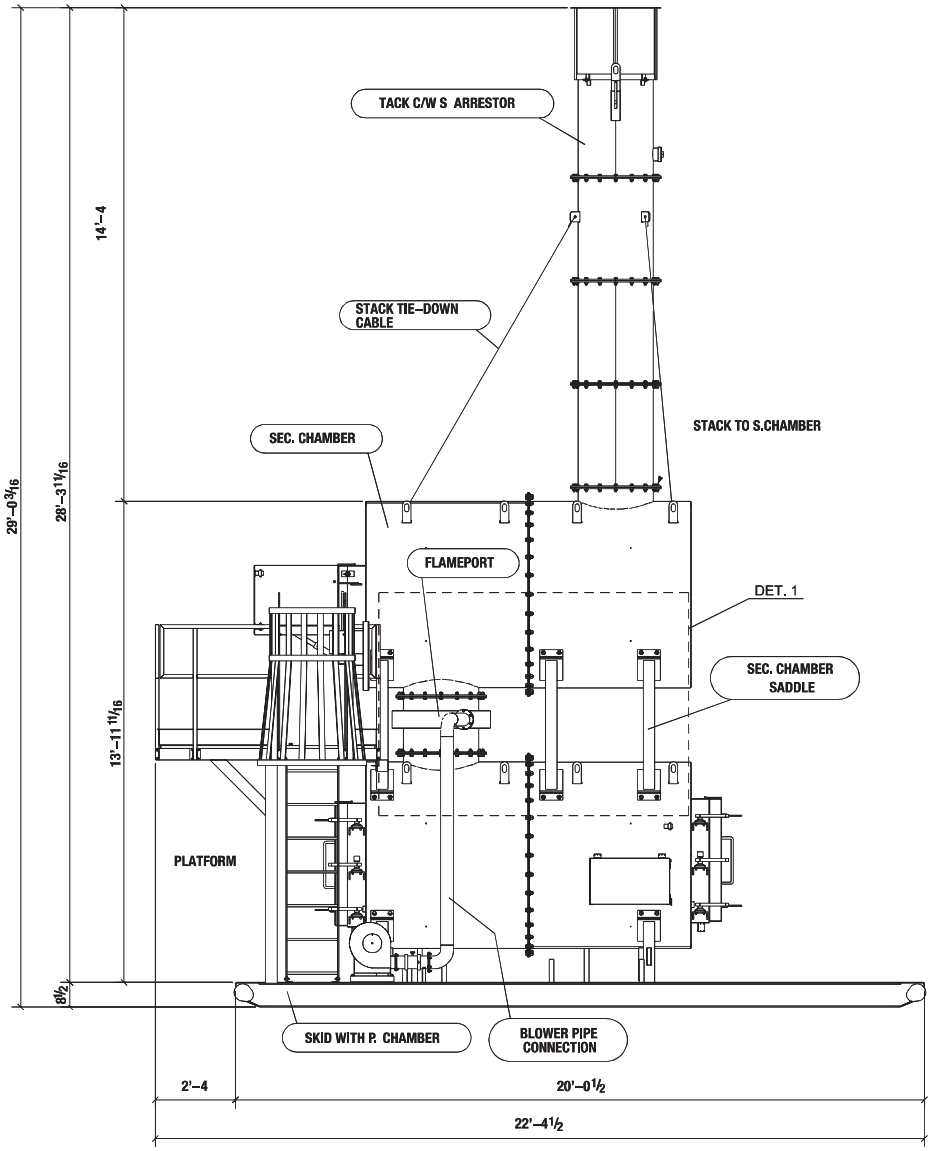


FIGURE 4 SCHEMATIC OF THE INCINERATION SYSTEM

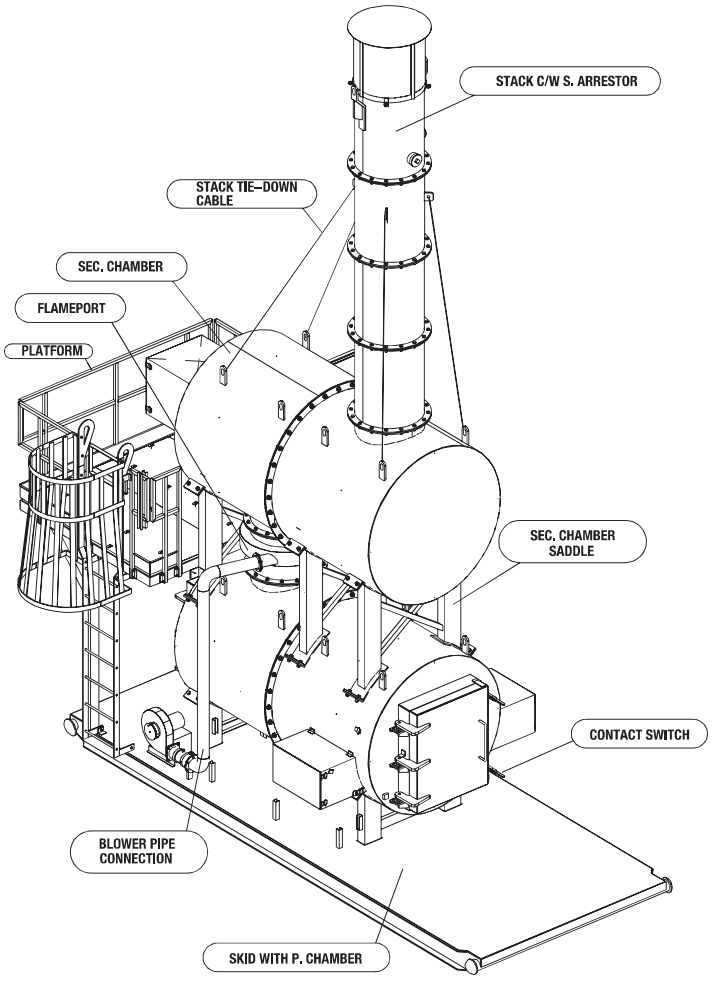


FIGURE 5 OVERALL VIEW SHOWING THE SECTIONS

5.3 Primary Chamber Section

TABLE 5 COMPONENTS IN THE PRIMARY CHAMBER SECTION {FIGURE 6 & FIGURE 7)

Code	Component	Description	Function
PC	Primary Chamber	Built in-house. Inside Vol: 2.74 m3 Refractory + Insulation	Pyrolysis and gasification Combustion of fixed carbon
PC_B	Auxiliary Burner	Becket2 x WIC-201; 770,000 BTU/h (Each); 5.5 USG/h (Each)	Start-up and maintains a minimum temperature
PC_T	Thermocouple	Stainless Steel	Used by PC Temp. Controller to regulate burner
PC_D	Charging Door & Ash Door	Built in-house. Feed Door: 90cm (Height) x 70 cm (Width) Ash Door: 86 cm (Height) x 70 cm (Width)	Load waste and ash removal
PC_S	Contact Switch	Square D ZCKJ1H7 (2)	Turn off PC burner when Feed door/Ash door is opened

5.4 Secondary Chamber Section

TABLE 6 COMPONENTS IN THE SECONDARY CHAMBER SECTION {FIGURE 6 & FIGURE 7)

Code	Component	Description	Function
SC	Secondary Chamber	Built in-house. Inside Vol: 2.87m3 Refractory Insulation	Complete combustion of gases and soot generated in Primary Chamber
SC_B	Auxiliary Burner	Becket WIC-301; 1,600,000 BTU/h; 13.0 USG/h	Start-up and maintain minimum set temperature
SC_T	Thermocouple	Ceramic	Measure temperature in Secondary Chamber
FP_P	Flame-port Plenum	Turbulent vortex flow built inhouse.	Mixing of combustible gases and flame-port air
FP_B	Flame-port Blower	4C 108 Dayton; 1 HP; 3600 rpm	Combustion air supply to flame-port plenum
FP_T	Flame-port Throttle	Butterfly valve	Controls flame-port airflow
ST	Stack	Refractory+ Insulation, built in-house.	Dispersal of flue gas

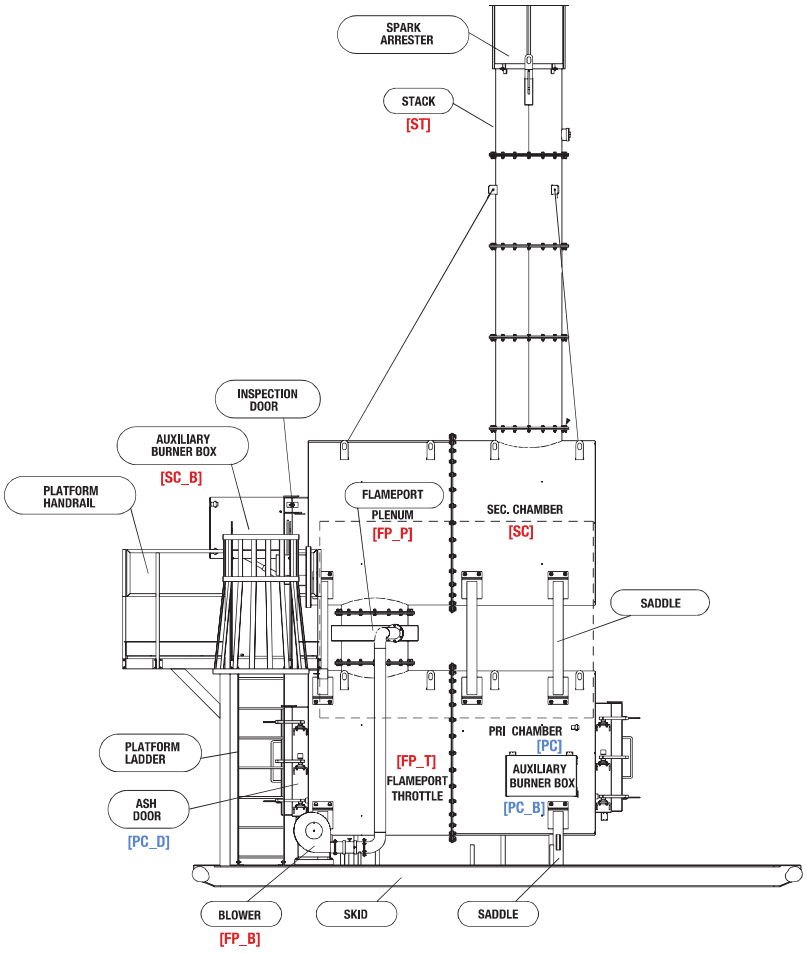


FIGURE 6 COMPONENTS IN THE PRIMARY AND SECONDARY CHAMBER SECTIONS (1)

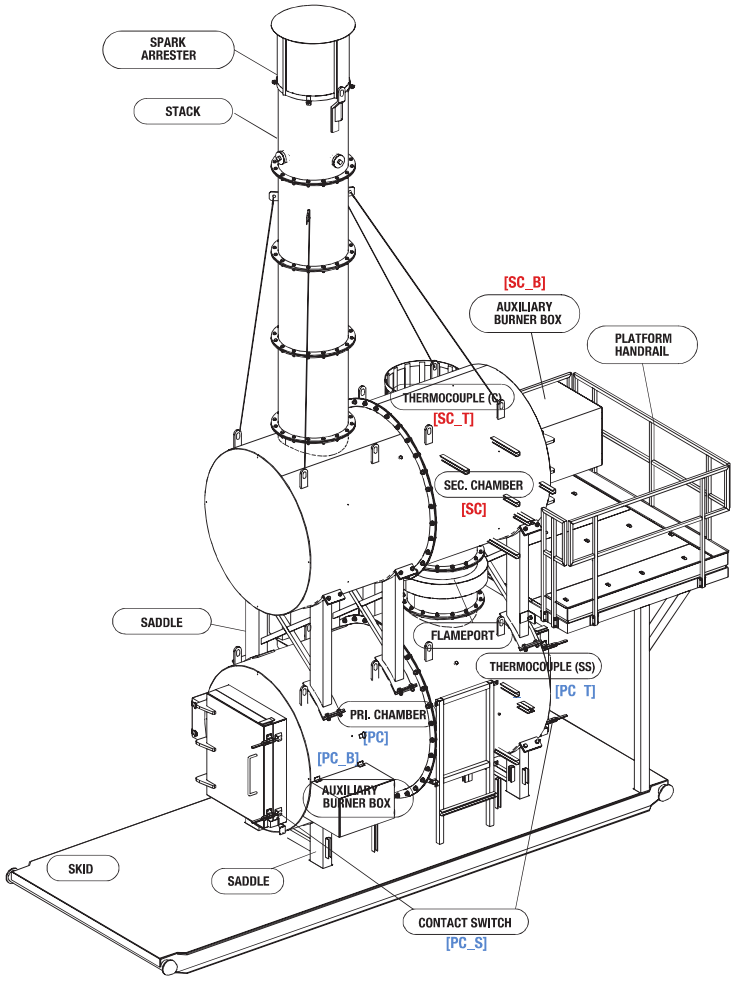


FIGURE 7 COMPONENTS IN THE PRIMARY AND SECONDARY CHAMBER SECTIONS (2)

5.5 Control Panel Section

The components are listed in Table 7.
Figure 8 Overview of Control Panel, Showing the Main Sections shows a photograph of the whole control panel, which has been divided into sub-sections marked A, B, C, and D.

TABLE 7 COMPONENTS IN THE CONTROL PANEL SECTION

Code	Label	Function
Sub-Section A: Indicator LEDs (ON-OFF)		
C3, C5 C8	Primary Blower Secondary Blower	GREEN PC_BL GREEN SC_BL
C6	Flameport Blower	GREEN FP_B
C2, C4 C7	Primary Burner Secondary Burner	RED PC_B RED SC_B
Sub-Section B: Burn Timer		
T1	Burn Timer	Set burn-cycle duration to the specified time. (Start switch restarts timer)
Sub-Section B and C: Main Controller and Controllers for Burners and Blowers		
PB1 PB2 R1	Start Switch Energy Stop Contact Switch	Initiate Pre-Purge, Burn, Burn-Down, Cool-Down Automatic Cycles. Emergency Use Only. For Normal Stop, Set Burn Time to 0. Safety Apparatus, Will Turn ON/OFF Primary Chamber Burner When Feed Door is OPEN/CLOSED.
Sub-Section D: Omron Temperature Controllers and Indicators		
TC1 TC2 TC3	Primary Chamber T.C. Secondary T.C. Secondary Trigger T.C.	Temperature Displays and Control of Minimum Temperatures in Primary and Secondary Chambers by Setting Adjustable Set Points (OMRON E5CN). Primary Burner Enabled When Secondary Trigger Reaches its Specific Temperature Set Point.
Sub-Section E: Touchscreen Digital Display		
	Primary Blower Secondary Blower Flameport Blower	Blower symbol - GREEN "OFF" Blower symbol - BLUE "ON"
	Primary Burner Secondary Burner	Burner Symbol - NO FLAME "OFF" Burner Symbol - FLAME SYMBOL "ON"
	Digital Magnetic Guage	Displays pressure of Primary Chamber Should be Negative Pressure between 0 and -0.5 inches
	Feed Door / Ash Door	Displays if door is open or closed.

Notes:
This panel has been configured with Burner Protection which ensures that if the primary and/or secondary chamber is hot, the corresponding burner-blower will run even if the cool-down period has elapsed, or if there has been a power disruption.

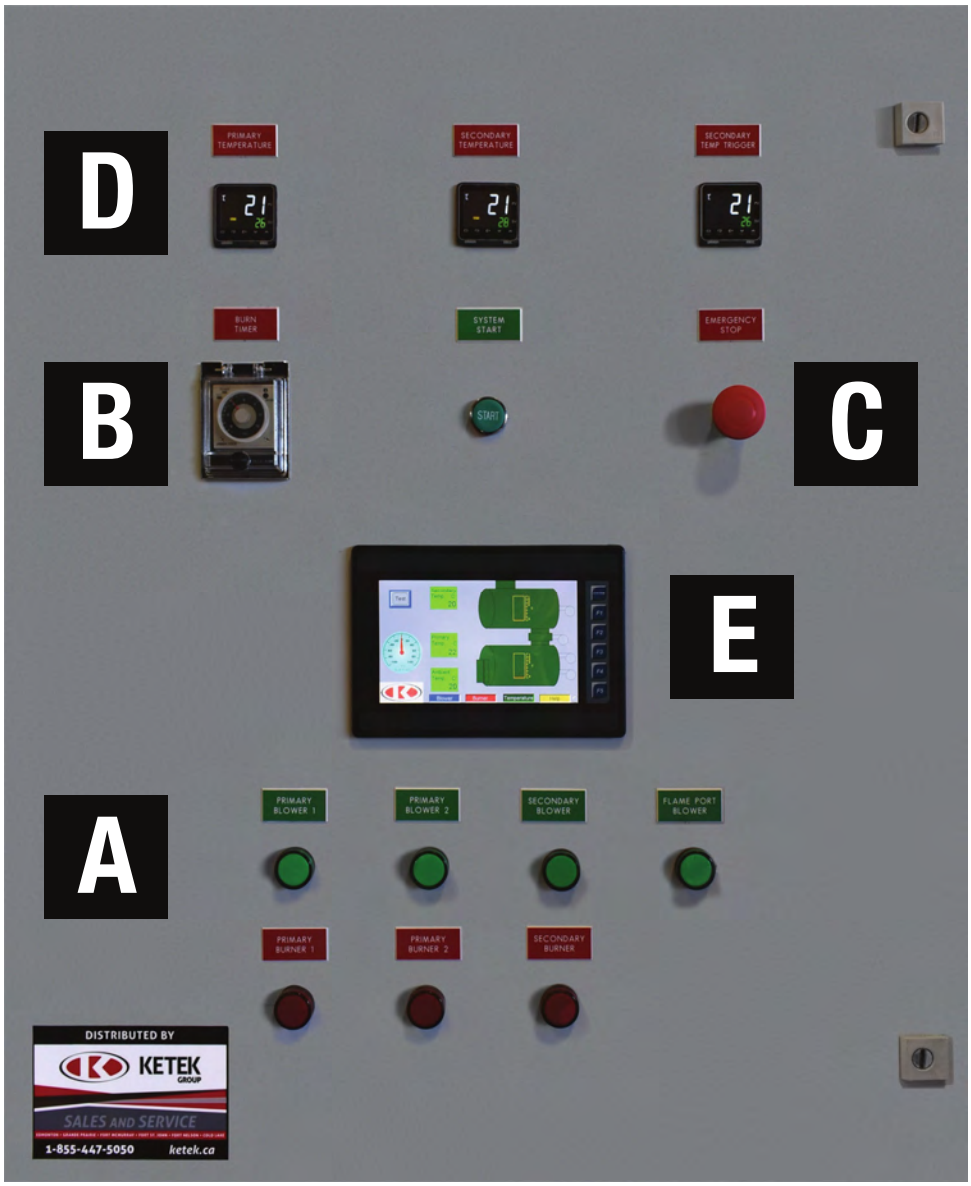


FIGURE 8 OVERVIEW OF CONTROL PANEL, SHOWING THE MAIN SECTIONS

The operation of the incinerator can be described by distinct sequential steps as shown in Figure 9. There are additional necessary steps which involve safety, routine inspection and waste batch preparation, which will be first described.

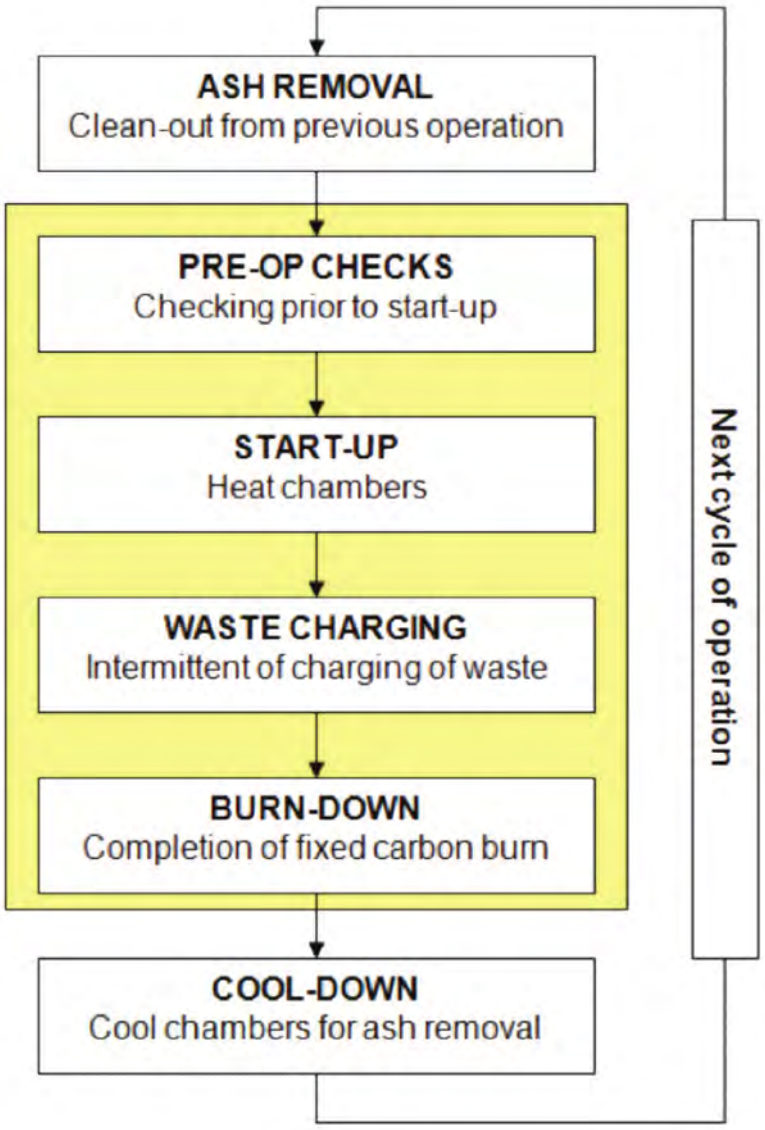


FIGURE 9 STEPS IN THE OPERATION OF THE INCINERATOR

6.1 Safety equipment

The following Personal Protective Equipment should be used while operating the incinerator system:

- Long-sleeved shirt and long pants;
- Long-cuffed, puncture resistant gloves;
- CSA approved, Grade 1 safety footwear;
- CSA/ANSI approved safety glasses.

The personal protective equipment related to specific tasks are listed below:

- Ash removal and handling: NIOSH N95 respirator
- Waste charging: (i) heat protective clothing and gloves, and (2) CSA/ANSI approved full face shield.

The hazards that could be encountered arise from the following (not in any order of importance):

- Contact with waste (infectious or toxic components, or sharps);
- Exposure to heat, from contact with hot surface or radiation from the primary combustion chamber when the waste charging door or ash removal door is opened.

Therefore, the general precautionary actions include: Not opening waste batches

- Not touching hot surfaces, and minimum exposure to heat radiation through open doors (charging / ash doors while combustion is taking place).
- Wearing appropriate PPE for charging waste and raking the primary chamber, AND minimizing the time for those tasks.

6.2 Routine inspection and maintenance

- Check fuel lines for leak and check connections Check spark arrestor to ensure no plugging
- During ash removal (see next section):
  - Inspect refractory for large cracks (not expansion cracks)
  - Inspect door gaskets for damages

6.3 Waste batch preparation

The following cautionary notes should be followed:

- NO explosives, aerosol cans or containers containing combustible liquids
- Make sure that every batch can go through the waste charging door easily, regardless of its weight.
  If others prepare the batches, the operator should tell them about the maximum batch size.
- DO NOT open batches and "rearrange" the contents for health/safety reasons.

6.4 Ash removal

Typically, ash from previous operation is left to cool, and ash removal is done prior to current operation.

- Make sure combustion chamber is sufficiently cool (DO NOT spray water into the combustion chamber) While removing ash, avoid damaging the burner tip Use non-combustible container
- Minimize dust generation
- Light water spraying on ash in the container is OK to minimize dust generation Ash to be removed daily (after sufficient cool down period)
- Dispose of ash as specified in the guidelines or regulations

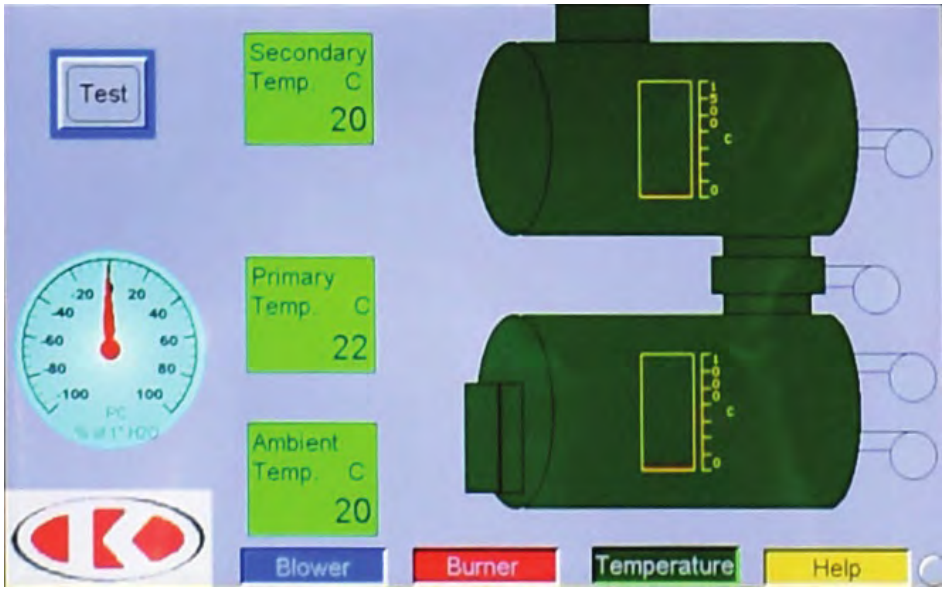
6.5 Pre-operational checks

- When diesel or propane is used, check fuel tank to make sure there is enough fuel (see Figure 14 for estimates of fuel consumption, depending on burner size and length of operation). Conduct inspection around incinerator, make sure there is no debris or fire hazards; area should be clean
- Open fuel valve
- Check fuel lines for leaks and check all connections
- Check for any physical damage on incinerator including stack and spark arrestor Inspect thermocouples, feed door/ash door seals, and blower inlets
- Re-check that the combustion chamber is empty Check power connection
- When diesel is used, bleed the diesel lines to the burners if necessary

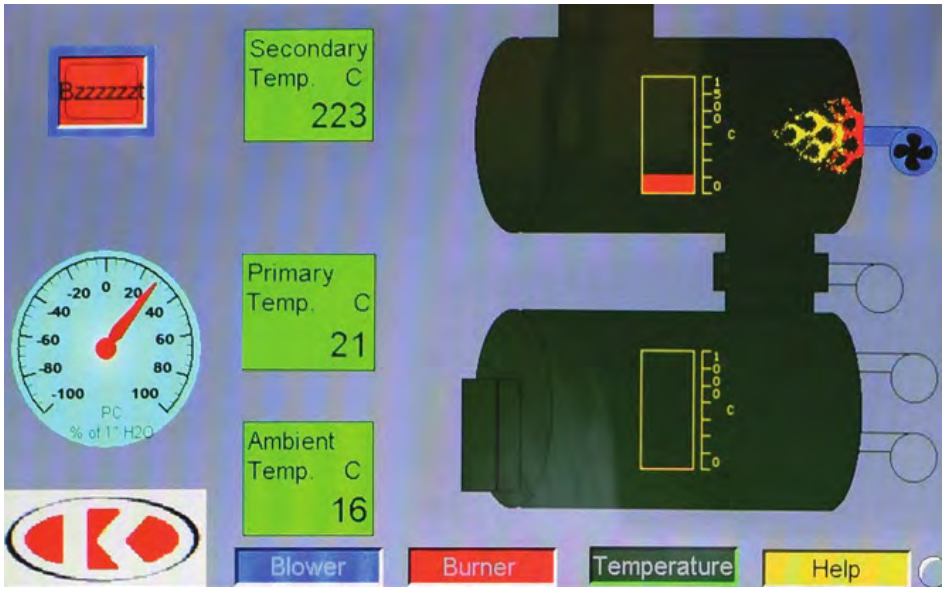
6.6 Operational Procedure

1. The first step in managing waste is to understand the quantity and composition of the waste that is generated. A waste audit should be completed. (Ketek Group can provide a waste audit, which can provide the following:
- Determine the quantity of waste from each type of operation
- Characterize the waste stream to determine what opportunities exist for:
- Reducing the quantity of waste generated,
- Reusing materials and recycling as much as possible before considering disposal.
2. Before operation of an incinerator, the area surrounding the incinerator shall be free of any debris and tripping hazards. Maintaining proper housekeeping for the incinerator is important and will reduce safety hazards such as slips, trips and falls.
3. A pre-operational checklist should be completed prior to operation of the incinerator. (Ketek can prepare a pre-operational checklist for you). Make sure all ash is removed from the previous burn. Record the weight of ash on checklist.
4. The operational checklist should be continually filled out with the required information throughout the day and during operation of the incinerator.
5. The incinerator should be loaded to the limited charging capacity (both in terms of waste quantity and the calorific value of waste charge). The incinerator should be charged with the appropriate mix and quantity of waste, the operator should close the door, ensure all interlocks are engaged, and start the burn cycle.

6. Turn the timer to 12 hours and press the green "Start" button.



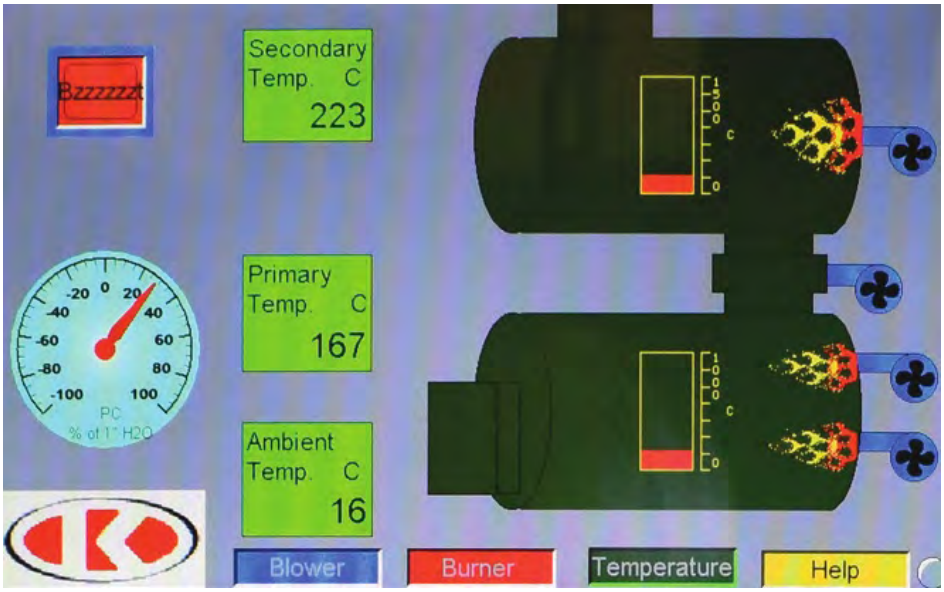
7. Proceed with inspecting of the incinerator and make certain that all burner blowers (two burners in Primary Chamber and one in Secondary Chamber) are functioning correctly.
8. After five minutes, primary burner motor will shut off and the secondary burner (flame) should be running. You will see the temperature increase on the temperature display "Secondary Chamber T.C."



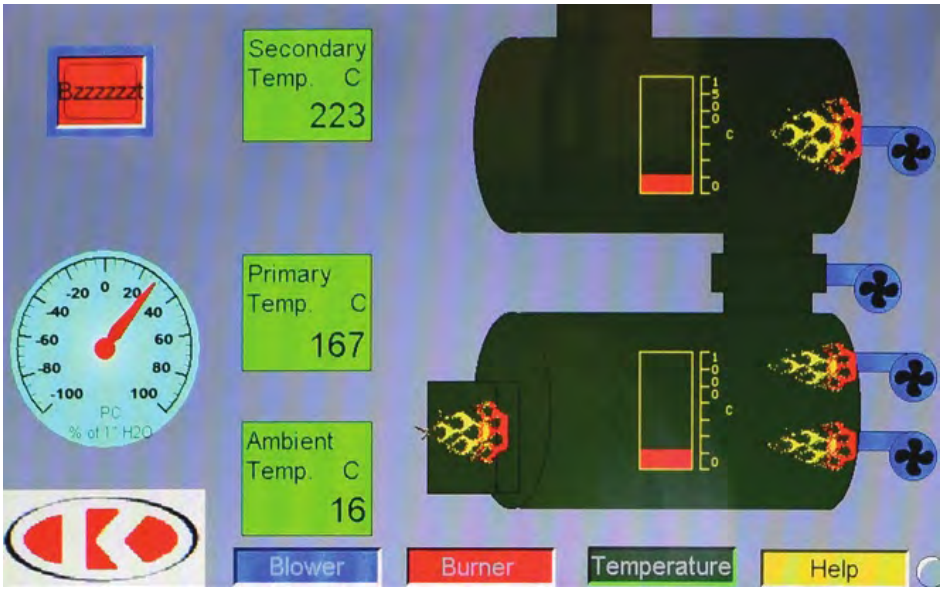
9. The secondary burner heats up to the specified temperature in "Secondary Temperature

Trigger."

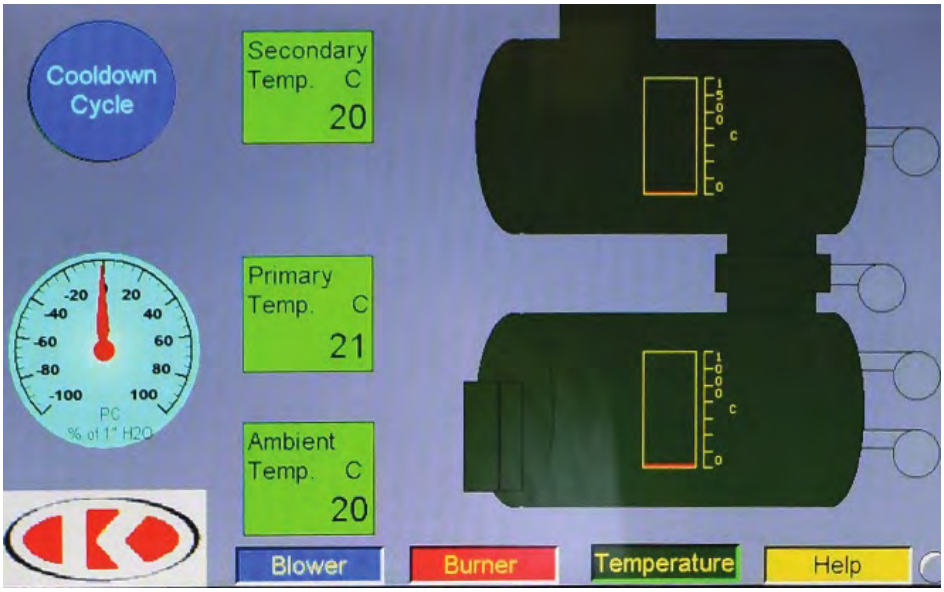
10. At this point, primary burners (flame and blowers) and flame port blower will come on and you will see the temperature increasing on the temperature display "Primary Chamber T.C."



11. The temperature will keep increasing until it goes up to the set point and after that burners will continually function on/off to maintain the specified temperature set on the incinerator control system.
12. After about 2-3 hours into the burning process, open the door and check the status of the waste and rake if necessary. Always rake from the ash door side.



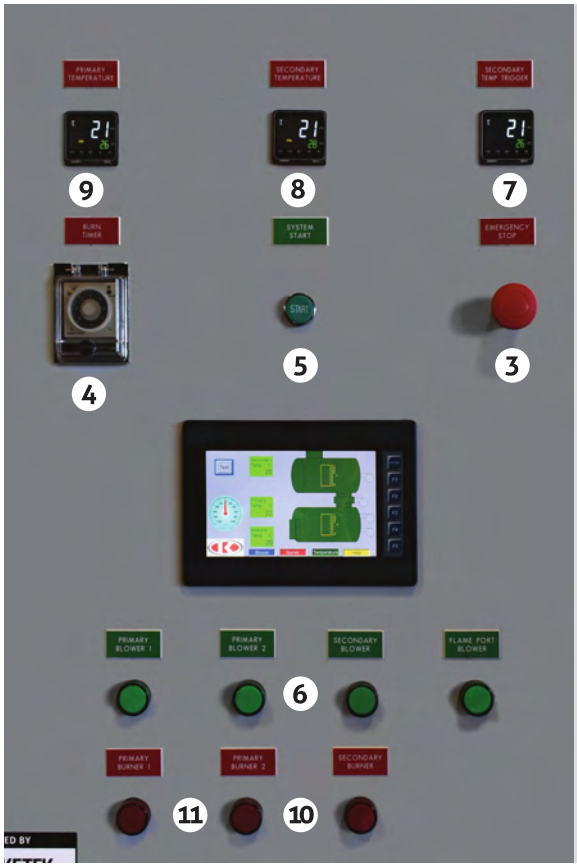
13. Approximately one hour after the rake, check the waste status again. If not burned, rake it and close the door. If waste seems burned and you do not need to burn another batch, then manually run the burn timer to zero. If you need to burn more batches, lower the set point on "Burn Timer" to 0 by pressing the "▲" down arrow. Give about 30-60 minutes for the Primary Chamber to cool down.
14. Load the next batch in the Primary Chamber and turn the timer to 12 hours.
15. Repeat steps 11 to 13 for other batches of the day.
16. For the final batch of the day turn the timer to about 5-6 hours. Rake in between if required.
17. After the timer runs out, the primary burners will no longer produce flames, but the blowers will continue to run. At this time the secondary chamber burner will still keep running for another half hour.



18. After secondary burners shut down, all the blowers will keep running for another 5-6 hours to give enough time for the incinerator to cool down and prevent any damage to the burners. If after the cool down process the temperature in the chambers is still above 250°C, the blowers will continue to run until the temperature drops below the 250°C value.
19. The pre-operational checklist should be given to the supervisor for documentation and any further procedures. Pre-Operational Checklist should be filed and kept for record.
20. The touchscreen digital display records the incineration operations. It comes standard with 32 Gb of memory. The PLC records operations such as blower operation, burner and door feed, and incinerator chamber temperature. To go back to the home screen please push the Ketek symbol, located bottom left of screen.

Note:

a. Do not operate the incinerator if something is not functioning properly. Immediately tell your supervisors.
b. Do not overload the incinerator
c. It is important that waste should neither be open-burned nor burned in a barrel
d. Wear all required PPE (gloves, face-shield, dust mask, flame retardant coveralls, etc.)
e. If flame detection control locks out, try resetting it by pressing red button on the burner control. If it keeps resetting, let your supervisor know immediately.
f. Always ask if unsure about something.



1. Perform Pre-Op Checks
2. Load first waste charge
3. Ensure Emergency Stop is pulled out
4. Set burner timer
5. Press "Start"
6. Observe blowers in pre-purge.
   Can be seen as Touchscreen display.
7. Set Trigger TC to 650°C
8. Set Secondary TC to - 1100°C
9. Set Primary TC to - 600°C
10. Observe secondary burner.
    Can be seen as Touchscreen display.
11. Once Trig Temp is reached, observe all blowers and Primary Chamber.
12. Automatic operation until burn timer expires. Burn Down and Cool-Down cycles follow automatically.

FIGURE 10 OPERATING SEQUENCE

Note: Temperatures in Steps 8 and 9 may be governed by regulations:
If so, SET TEMPERATURE TO THE REGULATORY VALUES

6.7 Waste charging:

For Batch feeding (recommended) see Figure 11.

1. After de-ashing the cooled-down incinerator, load waste on the hearth. Refer to training notes and operating experience.
2. Ensure Burn Timer is set to 4-5 hours, depending on load size. Pressing "Start" button begins a new cycle.
3. Primary burners will start once Secondary Chamber is at trigger temperature (TC3 set-point typically at 650°G)
4. After three hours, open door, check state of ash, rake if needed.

FIGURE 11. PROCEDURE FOR BATCH WASTE CHARGING

Additional Notes to Figure 11:
** The main danger is from exposure to heat radiation, and from waste catching fire before it is inside the Primary Chamber. Precautionary steps include:
(a) Wear proper PPE,
(b) Make sure waste batch can go through the charge door easily,
(c) Open door, charge waste and close door as quickly as possible.
*** The time for complete combustion varies, depending on batch size, weight and composition. Check burning conditions from charge door. Rake if necessary.

6.8 Waste Incineration Records

To demonstrate appropriate operation and maintenance of the incinerator, we recommend that the facility maintain records containing at least the following information (or as per permits/regulations):

- A list of all staff who have been trained to operate the incinerator; type of training conducted and by whom; dates of training; dates of refresher courses.
- All preventative maintenance activities undertaken on the equipment.
- Records of operation of the incinerator.
- Records of quantities of waste incinerated.
- Summarized annual auxiliary fuel usage.
- A list of all shipments/disposal of incinerator residues, including the weight transported and disposed of by type if necessary, and the location of the disposal site.
- Results of any stack emission monitoring and ash sampling information.

All raw data records from the operation of the incinerator will be retained for inspection by the appropriate authorities for a period of three years (or any other time period as deemed necessary).

6.9 Burn-Down and Cool-Down: see Figure 12

For Batch feeding (recommended) see Figure 11.

1. Automatic Burn-Down cycle begins after burner timer expires. Primary burners shut down immediately.
2. Automatic Cool-Down cycle follows. Secondary burner shuts down.
3. Blowers automatically shut down once chambers have cooled to 250°C. Cycle is complete.

FIGURE 12. PROCEDURE FOR BURN DOWN.

6.10 Maintenance and Inspection

In addition to the routine inspection and maintenance previously mentioned, only the burner(s) and the blower(s) require maintenance, which is quite minimal; see manuals in the binder. The following inspection steps are recommended:

TABLE 8 RECOMMENDED INSPECTIONS

How Often	Component	Inspection and checking
Daily	Thermocouples PC_T and SC_T	Check that the readings of temperature controllers are close to the estimated temperatures of the Primary and Secondary Chambers
	Contact switches PC S	Free movement, no obstruction
	Gasket/seal waste feed door PC_D	Wear and tear; proper sealing
	Refractory in primary chamber PC	No large (not expansion) cracks; pieces falling out. Repair if necessary.
Weekly	Blowers PC_B, SC_B, FP_B	Inspect clean in-takes, clean if necessary
Monthly	External surfaces of PC and secondary chamber SC	"Spotty" discoloration may indicate damage to refractory and/or insulation
Annual	Refractory in SC	No large (not expansion) cracks; repair if necessary

6.1.1 Trouble Shooting

Table 9 shows a list of operational problems that may be encountered, the possible causes and corrective measures. No list can cover all potential problems. Please report problems or unusual observations, even if you have corrected them yourself.

TABLE 9 TROUBLESHOOTING GUIDELINES

Phase	Observation	Points/Items to look at.
Start UP	Incinerator won't start	□ Make sure there is power. □ Check emergency stop is not engaged. □ Timer is set to an actual value and mode. □ Make sure there is power on all phases/legs coming into the incinerator.
Pre-Purge Phase	Skipping or not starting the Pre-purge.	□ Check that pre-purge timer works correctly. □ Check emergency stop is not engaged. □ Make sure there is power on all phases/legs coming into the incinerator.
	Auxilia burner blower(s) won't run in pre-purge cycle.	□ Check Breakers. □ Check burner blower contacts are energized. □ Check that overload switch on the motor is not tripped. □ Check there is power at the burner on the wire supplying power to the motor (Use Multi meter) □ Check for a seized motor by manually spinning the blower wheel. (Make sure power is off and locked out)
Pre-heat Phase	Secondary burner wont ignite	□ Check Breakers. □ Check there is power at the Genisys Control. □ Check that Genisys control is not locked out.
	Burner keeps Locking out after manual reset.	□ Check all fuel valves are on. □ Check Burner contacts are energized. □ Check there is sufficient fuel in the tank. □ Bleed the pump at the 3/8" bleed screw and make sure there is fuel flow and no air bubbles are present. If diesel is gelled (due to cold weather) it will not let the burner operate efficiently. □ If there is no fuel coming out of the pump and the motor is running then it could be a damaged coupling or seized pump. □ If bubbles do not disappear after a while then there is a possible minute leak in the supply line. Make sure all the fittings and joints are tight. □ Check that CAD cell is clean. □ Try and hear the spark at the electrodes.
Burn Phase	Primary burner(s) won't ignite.	□ Check Door Switch(s) are engaged. □ Check Fuses. □ Check there is power at the Genisys Control. □ Check that Genisys control is not locked out.

	Burner keeps Locking out after manual reset.	□ Check all fuel valves are on. □ Check Burner contacts are energized. □ Check there is sufficient fuel in the tank. □ Bleed the pump at the 3/8" bleed screw and make sure there is fuel flow and no air bubbles are present. If diesel is gelled it will not let the burner operate efficiently. □ If there is no feel coming out of the pump and the motor is running then it could be damaged coupling or seized pump. □ If bubbles do not dissapear after a while then there is a possible minute leak in the supply line. Make sure all the fittings and joints are tight. □ Check that CAD cell is clean. □ Try and hear the spark at the electrodes.
	Flame port Blower won't start	□ Check Breakers. □ Check blower contacts are energized. □ Check there is power at the electrical box on the wire supplying power to the motor (Use Multimeter) □ Check for a seized motor by manually spinning the blower wheel. (Make sure power is off and locked out)
General	Auxiliary burner(s) ignite for a while and then stop while system is still calling for them to be on.	□ Bleed the pump at the 3/8" bleed screw and make sure there is fuel flow and no air bubbles are present. □ If bubbles do not disappear after a while then there is a possible minute leak in the supply line. Make sure all the fittings and joints are tight.
	Omron Temperature controller showing "S.err"	□ Make sure wire connections are tight at the thermocouple and on the controller inside the panel. □ Check thermocouple is not damaged. To do this follow steps below: □ If you connect red and yellow wire together at the thermocouple and the error goes away, then go ahead change the thermocouple. □ If error does not go away after connecting the wires together then most probably the wire is damaged or a small chance of a faulty controller.
	Liquid dripping from the door.	□ Check that the door seals are not damaged. □ Check there are no depesits on the door or the door frame. Scrape off any deposits. It is a good practice to do it once a week.

For further troubleshooting of burners or blowers please refer to equipment specific manuals (attached at the end of this manual).

Before conducting any work, make sure all power is locked/tagged out and that any site specific safety procedures are followed before any maintenance occurs.

6.12 Auxiliary Fuel Consumption Rate

Figure 13 shows the volumetric flow rates of propane and diesel as a function of burner rating. If the TOTAL burner rating is X million Btu/h, and the operating time from start-up to the end of burn-down is t hours, the maximum fuel needed is:

V = Y * t USG where Y is the fuel consumption rate for X million Btu/h rating, as shown in the graph.

FIGURE 13 CONSUMPTION RATES OF PROPANE AND DIESEL

APPENDIX A

1. SUGGESTED SPARE PARTS LIST
2. BURNER WIC 201
3. BURNER WIC 301
4. BLOWER DAYTON 4C 108
5. INSPECTION CHECKLIST
6. WIRING DIAGRAM

7.1 Suggested Spare Parts List

CY-100-CA-D RECOMMENDED SPARE PARTS LIST

Description	Qty	KETEK Part No.
Gun Burner Beckett, WIC 201 16" (5.5GPH)	2	129230
Gun Burner Beckett, WIC 301 10-1/4" (7.0GPH)	1	129240
Dayton 4C-108 Flameport Blower	1	129305
Air Tube Combination for WIC 201 6 5/8	2	129420
Air Tube Combination for WIC 301 10-1/4"	1	129455
Motor for WIC 201	2	129480
Motor for WIC 301	1	129520
Coupling, Flex for WIC 201	4	129400
Coupling, Flex for WIC 301	2	129510
Fuel Pump A2YA-7916 Suntec	2	129320
Fuel Pump B2TA-8851 Suntec	1	129321
Blower Wheel for WIC 201	2	129410
Blower Wheel for WIC 301	1	129411
Transformer, Ignition "S" for WIC 201	2	129360
Transformer, Ignition "S" for WIC 301	1	129530
Nozzle (5.5 GPH 60° B)	2	144700
Cad Detector Call (If Applicable)	4	120730
Beckett Genysis Control (If Applicable)	2	177800
Timer, H3CR-A 11pin	1	152760
Omron Temperature Controller	1	131850
Panel Fuse Package	8	No item #
Thermocouple Ceramic (Secondary Chamber) – 12.75"	2	130140
Thermocouple Ceramic (Primary Chamber) – 12.75"	2	163670
Proximity Switch Door	1	132600
Limit Switch Assembly	1	130090
Gasket, Ceramic Fibre ¼" x 2" (price per foot)	100 ft.	132610
Gasket Cement, HT Silicone Tube	4	132620
Spark Arrester, Stainless Steel (Crating Not Included in Price)	1	130341
Filter Adapter (For Fuel Tank)	1	147840
Filter, Fuel LFF2 (For Fuel Tank)	2	133460

HOPE BAY PROJECT INCINERATOR MANAGEMENT PLAN

HOPE BAY, NUNAVUT

Module B: Windy

Conformity Table

Licence	Part	Item	Topic	Report Section
2BE-HOP1222	D	3	The Licensee is authorized to dispose of all acceptable food waste, paper waste and untreated wood products in an incinerator.	Main Document and this Module

Contents: Module B

B1 Introduction

The Type B Water Licence No. 2BE-HOP1222 issued to TMAC by the Nunavut Water Board (NWB) allows the incineration of approved waste streams.

Old Windy Camp was closed for operations in 2008 and is undergoing closure and reclamation. A New Windy Camp is permitted under the current water licence, but has not yet been constructed. No domestic wastes are produced at Windy Camp and there is no incinerator operated under this Licence. Waste produced in support of the Regional Exploration surface drilling program or generated during water management and licence compliance activities executed under this licence is transported to Doris Camp and managed as part of the Doris Camp waste stream. This waste undergoes the same comprehensive sort-at-source and segregation processes as domestic wastes generated at the Doris Camp. Waste is collected and transferred to the centralized waste management area at Robert Bay for timely incineration.

The Incinerator Management Plan has been prepared and is being submitted by TMAC to address the requirement specified in Part F, Item 6 of the 2AM-DOH1335 Water Licence, and also includes the plan for incineration throughout the Hope Bay belt. The plan addresses all relevant aspects of waste stream management, and the operation, maintenance and monitoring of incinerator units used to burn permitted wastes. The plan includes the management and disposal of all residual ash waste generated by the operation of the incinerator.

B1.1 Background

B1.1.1 Overview of Windy Incineration Compliance

Domestic waste is not produced at Windy Camp and is managed as part of the Doris Camp waste stream. Incineration at Doris North, under the prior project owner, was demonstrated to comply with the relevant Canada-wide Standards for incinerator emissions, through effective waste segregation and efficient burn practices. It is the aim of TMAC to continue implementing the practices that reduce the probability of formation of pollutant compounds during waste incineration.

B2 Incinerator Management at Windy

There is no incinerator operated at Windy Camp at this time.

B3 Monitoring and Evaluation

TMAC is required to report a summary of waste disposal activities in the 2BE-HOP1222 Licence Annual Report by March 31 of each year. No wastes are currently deposited under the 2BE-HOP1222 Licence. All incinerator monitoring is reported under the 2AM-DOH1335 Licence Annual Report.

Records of materials deposited to the landfill (when constructed), including qualifying incinerator ash, will be reported annually to the NWB per the relevant requirements of the Licence.

HOPE BAY PROJECT INCINERATOR MANAGEMENT PLAN

HOPE BAY, NUNAVUT

Module C: Madrid (Exploration and Operation)

Conformity Table

Licence	Part	Item	Topic	Report Section
2BB-MAE1727 (Exploration)	E	17	The Licensee is authorized to dispose of all acceptable food waste, paper waste and untreated wood products in an incinerator.	Main Document and this Module
2AM-DOH1335 (Operations)	F	1	The Licensee shall implement the following waste management plans as approved by the Board: Hope Bay Project Incinerator Management Plan.	Full Document
	F	6	The Licensee shall dispose of all food Waste in an incinerator designed for this purpose and meets the requirements of the Canada-Wide Standards for Dioxins and Furans and Canada Wide Standards for Mercury emissions or other standards as they become available.	Section 1.1, 2.2, 2.3

Contents: Module C

C1 Introduction

Both the Type B Water Licence No. 2BB-MAE1727 and the Type A Water Licence No. 2AM-DOH1335 issued to TMAC by the Nunavut Water Board (NWB) allows the incineration of approved waste streams.

The Incinerator Management Plan has been prepared and is being submitted by TMAC to address the requirement specified in Part F, Item 6 of the 2AM-DOH1335 Water Licence, and also includes the plan for incineration throughout the Hope Bay belt. The plan addresses all relevant aspects of waste stream management, and the operation, maintenance and monitoring of incinerator units used to burn permitted wastes. The plan includes the management and disposal of all residual ash waste generated by the operation of the incinerator.

C1.1 Background

C1.1.1 Overview of Madrid Incineration Compliance

Domestic waste will not be incinerated Madrid North or Madrid South sites. Any domestic waste produced at Madrid North or Madrid South will be transported to Doris for treatment.

C2 Incinerator Management at Madrid

There is no incinerator operated at Madrid North or Madrid South at this time.

C3 Monitoring and Evaluation

TMAC is required to report a summary of waste disposal activities in the 2BB-MAE1727 Licence Annual Report by March 31 of each year. No wastes are currently deposited under the 2BB-MAE1727 Licence. All incinerator monitoring is reported under the 2AM-DOH1335 Licence Annual Report.

Records of materials deposited to the landfill (when constructed), including qualifying incinerator ash, will be reported to the NWB per the relevant requirements of the Licence.

HOPE BAY PROJECT INCINERATOR MANAGEMENT PLAN

HOPE BAY, NUNAVUT

Module D: Boston (Exploration and Operation)

Conformity Table

Licence	Part	Item	Topic	Report Section
2BB-BOS1727	D	3	The Licensee is authorized to dispose of all acceptable food waste, paper waste and untreated wood products in an incinerator.	Main Document and this Module
2AM-DOH1335	F	1	The Licensee shall implement the following waste management plans as approved by the Board: Hope Bay Project Incinerator Management Plan.	Full Document
	F	7	The Licensee shall dispose of all food Waste in an incinerator designed for this purpose and meets the requirements of the Canada-Wide Standards for Dioxins and Furans and Canada Wide Standards for Mercury emissions or other standards as they become available	Section 1.1, 2.2, 2.3

Contents: Module D

D1 Exploration

D1.1 Introduction

The Type B Water Licence No. 2BB-BOS1727 issued to TMAC by the Nunavut Water Board (NWB) allows the incineration of approved waste streams.

Boston Camp was closed in 2011 and remained in a state of Care and Maintenance until June 2017. The camp was reopened in June 2017 to support seasonal exploration activities surrounding the Boston Camp.

The Incinerator Management Plan has been prepared and is being submitted by TMAC to address the requirement specified in Part F, Item 7 of the 2AM-BOS1835 Water Licence, and also includes the plan for incineration throughout the Hope Bay belt. The plan addresses all relevant aspects of waste stream management, and the operation, maintenance and monitoring of incinerator units used to burn permitted wastes. The plan includes the management and disposal of all residual ash waste generated by the operation of the incinerator.

D1.1.1 Background: Overview of Boston Incineration Compliance

Incineration at Boston Camp, under the prior project owner, was demonstrated to comply with the relevant Canada-wide Standards for incinerator emissions and waste ash disposal, through effective waste segregation and efficient burn practices. It is the aim of TMAC to continue implementing the practices that reduce the probability of formation of pollutant compounds during waste incineration.

D1.2 Incinerator Management at Boston

One incinerator is located at Boston Camp and is a CY-20-20-FA-D model with a capacity of burning 50 kg of waste per hour. This unit was recommissioned in June 2017, and is used to support seasonal exploration activities. Waste management at Boston involves comprehensive sort-at-source and segregation of domestic wastes generated at the Boston Camp, return of all food waste attractants from remote worksites to the Boston Camp domestic waste stream, and collection of wastes for transfer to the designated waste incineration area.

All residual ash generated waste generated by the operation of the incinerator is transported to Doris Camp for disposal.

D1.3 Monitoring and Evaluation

TMAC is required to report a summary of waste disposal activities in the 2BB-BOS1217 Licence Annual Report by March 31 of each year. No wastes are currently deposited under the 2BB-BOS1217 Licence. All incinerator monitoring is reported under the 2AM-BOS1835 Licence Annual Report.

D2 Operations

D2.1 Introduction

The Incinerator Management Plan has been prepared to addresses all relevant aspects of waste stream management, and the operation, maintenance and monitoring of incinerator units used to burn permitted wastes. The plan includes the management and disposal of all residual ash waste generated by the operation of the incinerator for the Hope Bay Belt. TMAC 's vision is to continue to utilize existing plans for all developments on the Hope Bay belt, and modify the plans as required and at the appropriate stage of permitting or development of the Project. This includes updates related to the proposed Madrid-Boston Phase 2 Development.

D2.2 Incinerator Management at Boston

Subject to permitting, when the proposed Phase 2 Boston Camp has been constructed and it enters into the operational phase of the project, the same point source waste segregation and efficient burning practices achieved at Doris Camp and Madrid will be applied.

D2.3 Monitoring and Evaluation

As per 2AM-BOS1835 requirements, TMAC report a summary of waste disposal activities in their Annual Reports to the NWB by March 31 of each year.

HOPE BAY PROJECT INCINERATOR MANAGEMENT PLAN

HOPE BAY, NUNAVUT

Module D – Appendix A:
Operating and Maintenance Manual
CY-2020-FA-D

MAINTENANCE
OPERATING SPECIFICATION
&
TECHNICAL DATA
For
CY 2020 FA

CYCLONATOR INCINERATORS

GENERAL COMMENTS

With regulations by the Federal and Local authorities placing strong emphasis on improving our environment and controlling the quality of our air, incineration seems to be the most promising, quick method of waste disposal presently available to us today. The importance of incineration lies in its ability to reduce waste to an absolute minimum ultimate residue as ash, thereby, reducing the cost of labor, handling equipment and hauling of such residue. In addition to lowering of cost, inert residue with a minimum of organic matter can be disposed over unlimited areas.

Generally, incinerators are required to perform satisfactorily over a wide range of operating conditions. They are expected to burn the refuse to ashes without the emission of smoke, bad odors, fumes, ash, charred materials, sparks and the release of toxic pollutants. Air pollution by incinerators has been a major concern to air pollution agencies. The two major causes being: (1) Poor and improperly designed incinerators. (2) Improper operation. The latter has been the primary source of most incinerator complaints.

INCINERATOR DESIGN

Westland (forced air) units are designed to consume type O through type III waste and are built for heavy industrial use. These units meet limited Environmental Standards.

Westland C.A. (controlled air) units are designed to consume type O through type III waste and are developed with more complex control capability in order to meet the more demanding Environmental Standards of the nineteen nineties.

These units are constructed of material that has been tested and proven satisfactory before they are shipped from the factory. They are simple to operate and require very little maintenance. If a reasonable amount of care is taken in the operation of these units, repair costs should be minimal.

TYPES OF WASTE

Type O - Trash - A mixture of highly combustible waste such as paper, cardboard, cartons, wood boxes and combustible floor sweepings from commercial and industrial activities. The mixtures contain up to 10% by weight of plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags and plastic or rubber scraps.

This type of waste contains 10% moisture, 5% incombustible solids and has a heating value of 8500 btu/lb. of refuse as fired.

Type I Rubbish - A mixture of combustible wastes such as paper, cartons, rags wood scraps, floor sweepings from commercial and industrial sources. The mixture contains up to 20% by weight of garbage. This type of waste contains 25% moisture, 10% incombustible solids and has a heating value of 6500 btu/lb. of refuse as fired.

Type II - Refuse - A mixture of rubbish and garbage, mostly residential sources. This mixture has 35 - 80% in composition by weight of rubbish and 65 - 20% of garbage. This type of waste contains 50% moisture, 7% incombustible solids and a heating value of 4300 btu/lb. of refuse as fired.

Type III - Garbage - A mixture of animal and vegetable wastes, restaurants, hotels markets and wastes from institutional, commercial and club sources. This mixture has a compositional by weight of 100% garbage and rubbish of up to 35%. This type of waste contains 70% moisture, 5% of incombustible solids and a heating value of 2500 btu/lb. of refuse as fired.

CY 2000 FA
MODEL 2020 "D" (Diesel Fired)

PRIMARY BURNER 455,000 Btu/Hr.
SECONDARY BURNER 600,000 Btu/Hr.

1. **Fuel Consumption**
   for type # 2 and # 3 Waste - 29.5 Litres per Hour

   Capacity of Fuel Tank for Dual Burner is 682 Litres
   Total running Time - 20 Hours of Operation per tank maximum

2. **Capacity of Incinerator**
   #2 Waste - 68 kg.
   #3 Waste - 45 kg.

3. **Emission Standards**:
   Each unit has to be individually approved for every type of waste to be incinerated and has to be tested to meet the environmental standards of each province. The model TMF 2020 "D" has been designed to meet the Air Pollution Guidelines of Alberta Environment.

4. **Maintenance & Operational Cost**:
   The interior lining of the incinerator is made to stand rugged use. Although it deteriorates over a period of time, we supply material to reline the inside compartment of the incinerator. As far as the exterior is concerned, the only regular maintenance required is the painting of the exterior steel casing.

   Operating Cost: Fuel Consumption - Varies With Usage Per Day.

CYCLONATOR FORCED AIR INCINERATOR
OPERATING INSTRUCTIONS
DIESEL FIRED – WIC - 201

Initial Start Up for CY Incinerators

* Set-up smoke stack and bolt in place
* Load fuel in tank.
* Bleed burner
* Plug in 110 volt power supply to receptacle below the timer
* Set the Air Timer for 20 Minutes
* Set the Timer 10 minutes and allow burner to operate for full 10 minutes without any refuse in the combustion chamber. Check if air induction fan is operating, timers functioning and burner operating properly.

Operation

* Set the timer in off position
* Open the charging door and load incinerator with refuse up to 60% of full capacity. **DO NOT OVERLOAD**.
* Close charging door.
* Set Air Timer for 120 minutes
* Set Timer for 30 minutes - 1 hour, depending on the amount of refuse left after each burn
* Clean out ash with a shovel or rake taking care not to damage the refractory. (Note: The ash must be removed after each burn to prevent clogging of the air jets.)
* Allow the incinerator to cool down for 10 minutes before reloading

Note: Under No Circumstances should the burner be wired direct to the power supply as the air induction system will not function, thus causing the incinerator to overheat.

Failure to comply with the above instructions could result in loss of warranty.

Maintenance

The incinerator requires less maintenance as long as care is taken in its operation. But once in a while, one of its two major components can burn out or overheat. They are the forced air fan and the oil gun burner.

The Forced Air Fan

The blower is manufactured as one complete unit and the only thing that can go wrong with it is the motor. If the motor overheats the whole fan has to be replaced. To replace a blower, first disconnect the power supply.
Open the burner-blower casing, detach the electrical connections from the blower to the timer, unbolt the blower base, pull the whole fan out and install a new one.

The Burner

The burner has a few components that a malfunction on either one can result to a non-operational burner. Introduction to these different components is essential. To avoid costly repairs, the following are instructions for removal and replacing burner parts:

1. **ELECTRODE ASSEMBLY**
   Remove screw B, Fig. 3 and rotate transformer on its hinge. After opening the tubing connection at the side of the blower housing, remove clamp nut, E, and disengage the oil line. Remove the firing assembly by rotating it 1/4 turn in a clockwise direction and then pulling it outward and upward. Refer to Figure 11 for firing assembly adjustments. To reinstall

the firing assembly, insert it with the bend of the tubing in the vertical plane and rotate it 1/4 turn counter clockwise so the bend coincides with the outlet in the housing. Make sure the bus bars are positioned so that they will contact the transformer terminal nuts when the transformer is in its normal position.

2. **NOZZLE**

For removal and installation of the nozzle follow the steps for removal of the electrode assembly, change nozzle. Check to see that the electrode gap is 1/8" and that the tips of the electrode are 1/16" in front of the nozzle and 7/16" above the center of the nozzle (See Figure II). Reinstall the electrode assembly. Tighten the clamp nut and also the flare nut.

* Look at blast tube from front end and check nozzle for being in center on end cone opening. If it is not, adjust knurled nut and inside nut on oil pipe.

3. **BLEEDING THE FUEL LINE**

To purge the air from the fuel line and oil pump, loosen the bleeder valve on side of the pump. Close the burner switch and allow the burner to run until there is no air bubbles in the oil issuing from the valve. Then tighten the bleeder valve.

4. **AIR BAND**

If the burner is firing with a lot of smoke, the air band might have moved in transit or altitude has changed. To ensure proper combustion air into the burner, the air band has to be adjusted by loosening the air band locking screw and turning the band to the direction desired for proper combustion. Then retighten the screw.

5. **MOTOR, FAN, FLEXIBLE COUPLING**

Loosen set screw F. Remove the two screws A1 and A2. The motor may now be removed from the housing with the fan and coupling attached to its shaft. To remove the coupling, loosen the set screw and pull rubber coupling away from shaft. To remove the fan from the motor shaft, loosen set screw C. For installation reverse the above procedure.

6. **PUMP**

Loosen screws D1 & D2. Open pipe and tubing connections, loosen set screw F and remove pump.

7. **TRANSFORMER**

Remove Screw B and rotate transformer on its hinge.

For Parts and Service call:
WESTLAND Environmental Services Inc
www.westlandenvironmental.com.
Phone No. (780) 447-5052 Fax No. (780) 447-4912
When Ordering Parts Always Give the Following:

1. Model
2. Part Name
3. Part Number
4. Size
5. Quantity

1 - BTU = 1.055 KJ

TABLE NO. 1
CLASSIFICATION AND DESIGN DATA OF WASTES TO BE INCINERATED

Type of Waste	Description	Principal Components	Approximate Composition % by Weight	Moisture Content % (Design Maximum)	(Average) Incombustible Solids %	KJ Value Per Kg. of Refuse as Fired (Design Minimum)	Required Minimum Burner Input (kw per Kg Waste)
I*	Rubbish	Combustible waste, paper, cartons, rags, wood scraps, floor sweepings; domestic, commercial industrial sources.	Rubbish 100% (garbage up to 20%)	25%	10%	15000	0
II*	Refuse	Rubbish and garbage; residential sources.	Rubbish 35-80% Garbage 65-20%	50%	7%	10000	1.3
III*	Garbage	Animal & vegetable wastes, restaurants, hotels, markets; institutional, commercial & club sources.	Garbage 100% (rubbish up to 35%)	70%	5%	5815	1.9
IV**	Animal solids & organic wastes.	Carcasses, organs, solid organic wastes; hospital, laboratory abbattoir, animal pound, and similar sources.	100% Animal & human tissue	62%	9%	2300	7.5
V	Gaseous liquid or semi-liquid wastes.	Industrial process wastes (tars, paints, solvents, fumes).	Variable	Dependent on predominant components.	Must be determined by wastes survey.		Must be determined by wastes survey.
VI	Semi-solid & solid.	Combustibles requiring hearth, retort, or grate burning ecuipment (rubbish, plastics, wood wastes).	Variable	Dependent on predominant components.	Must be determined by wastes survey.		Must be determined by wastes survey.

*The above figures are recommended for use in computing heat release, burning rate, velocity and other details of incinerator design.
**Type IV wastes require a "heated hearth" type of incinerator.

INCINERATOR SIZE GUIDE

1. Approximate Usage Guide:

   a) Each man produces approximately 1.4 kg (3 lbs) of Garbage per day when living in a camp.

   b) Each 20 Cu. Ft. Incinerator consumes approximately 45 kg of garbage per hour.

   c) Each 50 Cu. Ft. Incinerator consumes approximately 91 kg of garbage per hour.

   d) Average maximum burn time per incinerator is six (6) hours.

   e) Fuel consumption: (Approximate)

INCINERATOR MODEL	DIESEL LITRE/HOUR		PROPANE LITRE/HOUR	NATURAL GAS CU. METER/HOUR
CY1020FA	16	19		13
CY2020FA	30	35		24
CY1050FA	28	33		22
CY2050FA	41	49		33

2. Fuel Specifications:

   a) Diesel – 1,000 Litres per Cu. Meter (6.25 Gal. Per Cu. Ft.)

   b) Diesel Weights – 1.2 Kg. Per Litre (10 Lbs. per Gal.)

   c) Heating Value (BTU/GAL.) of Diesel Fuel
      - Winter 129,700
      - Summer 132,700

   d) Propane Weights - .6 kg. Per Litre (5 Lbs. per Gal.)

   e) Heating Value of Propane
      110,000 BTU/GAL.

   f) Heating Value of Natural Gas
      35,000 BTU/CU. Meter

NOTE: Imperial Measure in Brackets

CYCLONATOR FORCED AIR INCINERATOR
OPERATING INSTRUCTIONS
DIESEL FIRED - HF AFC

Initial Start Up for CY Incinerators

* Set-up smoke stack and bolt in place
* Load fuel in tank.
* Bleed burner
* Plug in 110 volt power supply to receptacle below the timer
* Set the Air Timer for 20 Minutes
* Set the Timer 10 minutes and allow burner to operate for full 10 minutes without any refuse in the combustion chamber. Check if air induction fan is operating, timers functioning and burner operating properly.

Operation

* Set the timer in off position
* Open the charging door and load incinerator with refuse up to 60% of full capacity. **DO NOT OVERLOAD.**
* Close charging door.
* Set Air Timer for 120 minutes
* Set Fuel Timer for 30 minutes - 1 hour, depending on the amount of refuse left after each burn
* Clean out ash with a shovel or rake taking care not to damage the refractory. (Note: The ash must be removed after each burn to prevent clogging of the air jets.)
* Allow the incinerator to cool down for 10 minutes before reloading

Note: Under No Circumstances should the burner be wired direct to the power supply as the air induction system will not function, thus causing the incinerator to overheat.

Failure to comply with the above instructions could result in loss of warranty.

Maintenance

The incinerator requires less maintenance as long as care is taken in its operation. But once in a while, one of its two major components can burn out or overheat. They are the forced air fan and the oil gun burner.

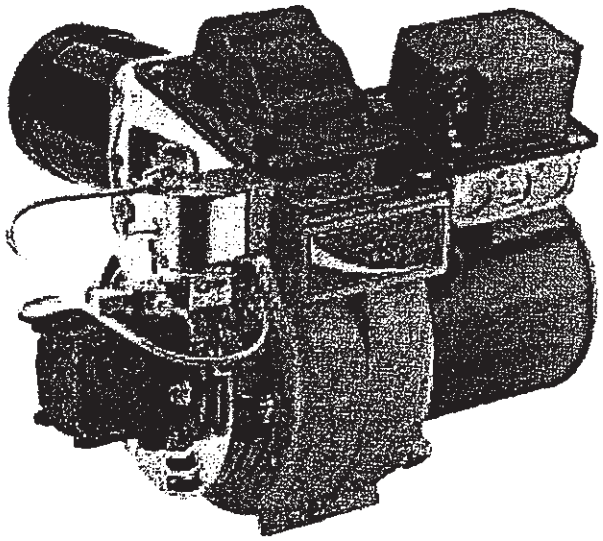
The Forced Air Fan

The blower is manufactured as one complete unit and the only thing that can go wrong with it is the motor. If the motor overheats the whole fan has to be replaced. To replace a blower, first disconnect the power supply.

MODEL
CF500/ CF800
Oil Burner

Instruction Manual

ON/OFF Operation
Firing rate: **CF500: 1.75 - 5.50 GPH**
CF800: 3.00 - 8.00 GPH
Motor voltage: **120 / 60 Hz** std.



Thank you *for purchasing a Beckett burner. With proper care and regular maintenance, it will provide years of trouble-free service. Please take a few minutes to read the section entitled "To the owner" inside this manual. Then, keep the manual in a safe place where it can be easily located if needed by your professional service technician.*

Beckett

Please . . . read this page first

Hazard definitions

The following will be used throughout this manual to bring attention to hazards and their risk factors, or to special information.

DANGER Denotes presence of a hazard which, if ignored, will result in severe personal injury, death or substantial property damage.

CAUTION Denotes presence of a hazard which, if ignored, could result in minor personal injury or property damage.

WARNING Denotes presence of a hazard which, if ignored, could result in severe personal injury, death or substantial property damage.

NOTICE Intended to bring special attention to information, but not related to personal injury or property damage.

To the owner —

WARNING Installation and adjustment of the burner requires technical knowledge and the use of combustion test instruments. Do not tamper with the unit or controls. Call your qualified service technician. Incorrect operation of the burner could result in severe personal injury, death or substantial property damage.

Have your equipment inspected and adjusted at least annually by your qualified service technician to assure continued proper operation.

Never attempt to use gasoline in your heating appliance or to store gasoline or combustible materials near the heating equipment. This could result in an explosion or fire, causing severe personal injury, death or substantial property damage.

To the installer —

WARNING Read all instructions before proceeding. Follow all instructions completely. Failure to follow these instructions could result in equipment malfunction, causing severe personal injury, death or substantial property damage.

This equipment must be installed, adjusted and started only by a qualified service technician—an individual or agency, licensed and experienced with all codes and ordinances, who is responsible for the installation and adjustment of the equipment. The installation must comply with all local codes and ordinances and with the National Fire Protection Standard for Oil-Burning Equipment, NFPA 31 (or CSA B139-M91).

To the owner —

WARNING Never burn garbage or refuse in your heating appliance or try to light the burner by tossing burning material into the appliance. This could result in severe personal injury, death or substantial property damage.

Never attempt to use crankcase or waste oil in your heating appliance. This could damage the fuel unit or heating equipment, resulting in risk of severe personal injury, death or substantial property damage.

Never restrict air openings on the burner or to the room in which the appliance is located. This could result in fire hazard or flue gas leakage, causing severe personal injury, death or substantial property damage.

To the installer —

NOTICE Concealed damage - If you discover damage to the burner or controls during unpacking, notify the carrier at once and file the appropriate claim.

Contacting Beckett for service information or parts - Please record the burner serial number (and have available when calling or writing). You will find the serial number on the Underwriters Laboratories label, located on the left rear of the burner.

NOTICE **High altitude installations** — Accepted industry practice requires no derate of burner capacity up to 2,000 feet above sea level. For altitudes higher than 2,000 feet, derate burner capacity 4% for each 1000 feet above sea level.

Warranty

Beckett warrants its equipment to those who have purchased it for resale, including your dealer. If you have any problems with your equipment or its installation, you should contact your dealer for assistance.

Refer to warranty sheet in literature packet included with burner for details.

Specifications

Fuels	#1 or #2 Fuel Oil
Firing range	CF500: 1.75 – 5.50 GPH
	CF800: 3.00 – 8.00 GPH
Motor	⅓ HP 3450 RPM
	120/60 hz standard
	4.8 amps @ 120 VAC
Ignition Trans.	120V/10,000V
Housing	Cast aluminum
Fuel unit	100 - 200 PSIG
Oil nozzle	45° - 70° solid
Shipping wt.	55 lbs.

Agency approvals

- Underwriters Laboratories has certified this burner to comply with ANSI Standard 296 and has listed it for use with No. 1 or No. 2 fuel oil as specified in ASTM D396. State and local approvals appear on the burner rating label.
- Certified by ULC.
- Approved by Commonwealth of Massachusetts - State Fire Marshall.
- Accepted by N.Y.C. M.E.A.
- Other approvals may be available and must be specified at time of order.

Contents

Before you begin . . .

The following resources will give you additional information for your installation. We suggest that you consult these resources whenever possible. Pay particular attention to the appliance manufacturer's instructions.

Appliance manufacturer's instructions — Always follow the appliance manufacturer's instructions for burner installation, equipment and set-up.

1-800-OIL-BURN — Beckett's technical services hot-line.

www.beckettcorp.com — Beckett's website.

Pre-installation checklist

❑ Combustion air supply

- The burner requires combustion air and ventilation air for reliable operation. Assure that the building and/or combustion air openings comply with National Fire Protection Standard for Oil-Burning Equipment, NFPA 31. For appliance/burner units in confined spaces, the room must have an air opening near the top of the room plus one near the floor, each with a free area at least one square inch per 1,000 Btu/hr input of all fuel burning equipment in the room. For other conditions, refer to NFPA 31 (CSA B139-M91 in Canada).
- If there is a risk of the space being under negative pressure or of exhaust fans or other devices depleting available air for combustion and ventilation, the appliance/burner should be installed in an isolated room provided with outside combustion air.

❑ Clearances

- With the burner installed in the appliance, there must be adequate space in front of and on the sides of the burner to allow access and operation. Verify that the clearance dimensions comply with all local codes and with the appliance manufacturer's recommendations.

❑ Fuel supply

- The fuel supply piping and tank must provide #1 or #2 fuel oil at pressure or vacuum conditions suitable for the fuel unit (oil pump) on the burner. Refer to fuel unit literature in the literature envelope in the burner carton to verify allowable suction pressure.

WARNING The fuel unit is shipped without the by-pass plug installed for CF500/CF800 ON/OFF burners. You must install this plug on two-pipe systems. DO NOT install the by-pass plug in the fuel unit if connected to a one-pipe oil system. Failure to comply could cause fuel unit seal failure, oil leakage and potential fire and injury hazard.

If fuel supply is *level with or higher than* fuel unit —

- When the fuel unit is not required to lift the oil, the installation is usually suitable for either a one-pipe or two-pipe oil system. The oil pressure at the inlet of the fuel unit must not exceed 3 psig.
- See ***Figure 7*** for one-pipe fuel supply installations. See ***Figure 8*** for two-pipe fuel supply installations.

If fuel supply is *below* the fuel unit —

- Use a two-pipe oil system when the fuel unit must lift the oil more than 8 feet if burner is equipped with a **B** fuel unit. The return line provided by the two-pipe system is needed to purge the air from the fuel lines and minimize the likelihood of air-related problems during operation.

❑ Vent system

- The flue gas venting system must be in good condition and must comply with all applicable codes.

❑ Electrical supply

- Verify that the power connections available are correct for the burner. All power must be supplied through fused disconnect switches.

❑ Verify burner components —

- **Burner box**, Model CF500 and CF800
- **Air tube assembly** (selected per following)
- **Mounting flange kit**
- **Pedestal mounting assembly kit** (recommended)
- **Oil nozzle**, per ***Table 1*** — Use only 45° to 70° solid pattern nozzles unless otherwise shown by appliance manufacturer.
  Find the required firing rate in the 150 psig column (factory-set fuel unit pressure).
  Select the corresponding nozzle from column 1 (*Rated gph @ 100 psig*).

Table 1 - Nozzle capacities

Rated gph @ 100 psig	Pressure - pounds per square inch	
	140	150
1.75	2.07	2.14
2.00	2.37	2.45
2.25	2.66	2.74
2.50	2.96	3.06
2.75	3.24	3.37
3.00	3.55	3.68
3.50	4.13	4.29
4.00	4.70	4.90
4.50	5.30	5.51
5.00	5.90	6.13
5.50	6.50	6.74
6.00	7.10	7.33
6.50	7.65	7.96

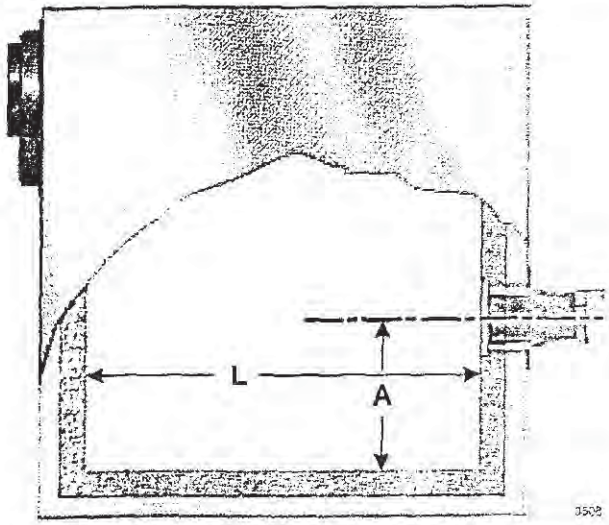
❑ Verify firing rate

- Refer to appliance manufacturer's instructions (if available) for firing rate and nozzle selection. Otherwise, the maximum recommended firing rate for the burner depends on the length of the firing chamber and the distance from the burner center to the chamber floor. Verify that the chamber dimensions are at least as large as the minimum values given in ***Figure 1***. If the appliance dimensions are smaller than recommended, reduce the firing rate accordingly.

❑ Verify air tube

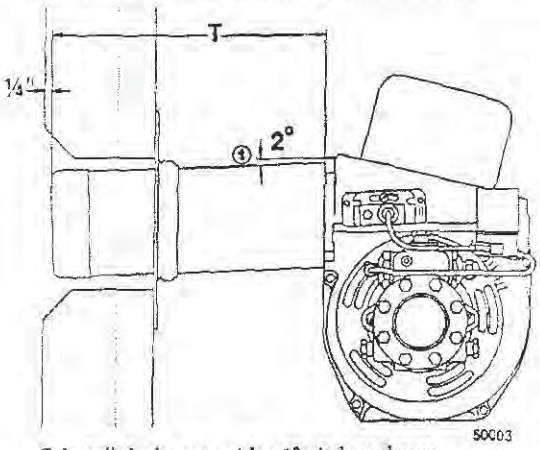
- The information in this section may be disregarded if the air tube is supplied by the appliance manufacturer.
- Tube arrangements available:
  CF500: 1.75 to 5.50 GPH
  CF800: **A** Tube — 3.00 to 7.00 GPH
  B Tube — 5.00 to 8.00 GPH
- Maximum firing capacity depends on the firebox pressure. Use ***Table 2*** to verify the correct air tube for the firing rate required.
- See ***Figure 2*** to verify the correct air tube length and air tube combination code.

Figure 1 - Min. Combustion chamber dimensions



Firing rate GPH	Minimum dimensions (inches)			
	With damper		Without damper	
	A	L	A	L
1.75 to 3.00	7.5	18.0	8.0	19.0
4.00	8.0	21.0	9.5	23.0
5.00	9.0	23.0	10.5	30.0
6.00	10.0	28.0	11.5	40.0
7.00	11.0	34.0	12.0	46.0
8.00	14.0	38.0	14.0	51.0

Figure 2 - Air tube mounting dimensions



① Install the burner with a 2° pitch as shown.

Air tube length (Dimension T)	A.T.C. Codes (A.T.C. = Air Tube Combination)		
	CF500	CF800	
		Tube A	Tube B
3.00"	CF 60 KK	CF 60 KH	CF 60 KJ
8.00"	CF 80 KK	CF 80 KH	CF 80 KJ
10.00"	CF 100 KK	CF 100 KH	CF 100 KJ
14.00"	CF 140 KK	CF 140 KH	CF 140 KJ
16.00"	CF 160 KK	--	--
17.00"	--	CF 170 KH	CF 170 KJ

Table 2 - Air tube capacity vs. firebox pressure

Firebox pressure (In. w.c.)	CF500	CF800	
	Tube KK (GPH)	Tube KH (GPH)	Tube KJ (GPH)
	No reserve air		
0.0	5.50	7.00	8.00
0.1	4.75	6.25	7.50
0.2	4.00	5.50	6.75
0.3	3.50	4.50	6.25
0.4	2.75	3.75	5.50
0.5	2.00	3.00	5.00

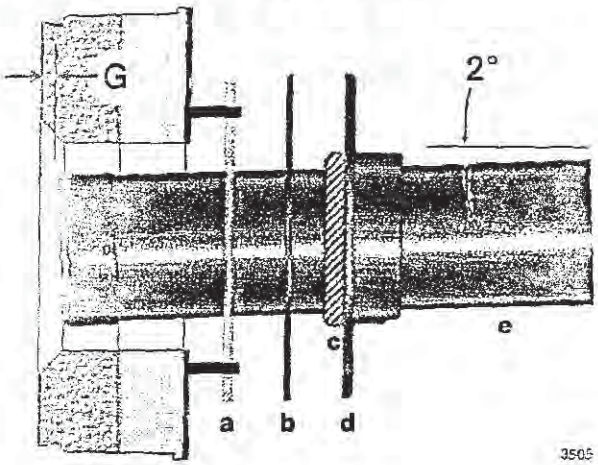
Note: The above ratings may vary 5% due to variations in actual job conditions.

Mount the burner

❑ Mount flange(s) on air tube

- This section does not apply to burners with welded flanges.
- Do not install air tube on burner.
- For ***non-pressure firing flange***, refer to ***Figure 3***: Install gasket (item **a**) and flange (item **d**). Ignore the next paragraph.
- For ***pressure-firing flange***, refer to ***Figure 3***: Slide gasket (item **a**) onto the air tube, making sure the top of the air tube is up. Pre-drill holes in the pressure firing plate (item **b**) to match the appliance studs. Slide the pressure firing plate (item **b**) and flange (item **d**) onto the air tube as shown. Wrap ceramic fiber rope (item **c**) around the air tube and press tightly into the inside diameter of the flange (item **d**).
- Slide the air tube (item **e**) into position in the appliance front. Tighten the flange-mounting-stud nuts. Set the insertion of the air tube so dimension **G** is ¼" nominal.
- Pitch the air tube at 2° from horizontal as shown and secure the flange to the air tube.

Figure 3 - Mount flange(s) on air tube



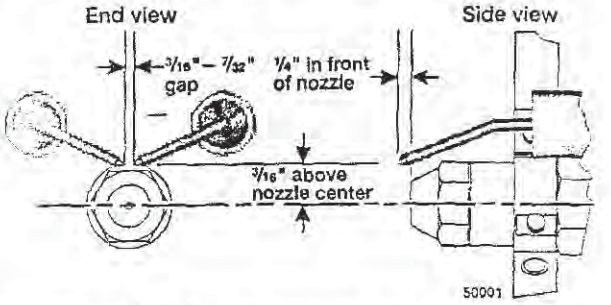
❑ Mount air tube to burner

- Attach the air tube to the burner with the screws provided.

❑ Install nozzle

- See ***Figure 4***. Install the oil nozzle in the nozzle adapter. Use a ¾" open-end wrench to steady the nozzle adapter and a ⅝" open-end wrench to turn the nozzle. Tighten securely but do not over-tighten.
- Check, and adjust if necessary, the critical dimensions shown in the drawing. Verify that the oil tube assembly and electrodes are in good condition, with no cracks or damage.

Figure 4 - Nozzle and nozzle line assembly



WARNING Failure to properly set and maintain the electrode and nozzle spacing dimensions can cause incorrect burner ignition or poor combustion. This could result in severe personal injury, death or substantial property damage.

❑ Install nozzle line assembly

- Insert the nozzle line assembly into the burner air tube.
- Slide the secondary adjusting plate (***Figure 6***, item **f**) completely to the left on the indicator adjusting plate (item **e**). Finger-tighten acorn nut **c** to secure the two plates together. Slide both plates completely to the right (Indicator plate will read **0**). Tighten fastener **d**.
- Install the spline nut on the end of the nozzle line, leaving the nut loosely placed so the plates can be moved.

❑ Set dimension Z

- Loosen fastener **c** in ***Figure 6***. Slide the nozzle line and plate assembly until dimension **Z** in ***Figure 5*** is:

  CF500 — **1 9/16" ± 1/16"**

  CF800 — **1 3/4" ± 1/16"**

  When dimension **Z** (from end of air tube to flat area of front face of head) is correctly set, tighten acorn nut **c**.
- Attach the oil line from the oil valve to the nozzle line end. Tighten securely.
- Before proceeding, check dimension **Z** once again. Loosen acorn nut **c** if necessary to reposition the nozzle line. Once dimension **Z** is set, ***do not loosen acorn nut again.*** For the setting of fastener **d**, refer to page 12.

❑ Insert burner

- Position the burner in the front of the appliance and loosely tighten the nuts on the mounting studs. The burner should be pitched downward 2° as shown in ***Figure 3***.

Figure 5 - Nozzle line assembly in burner

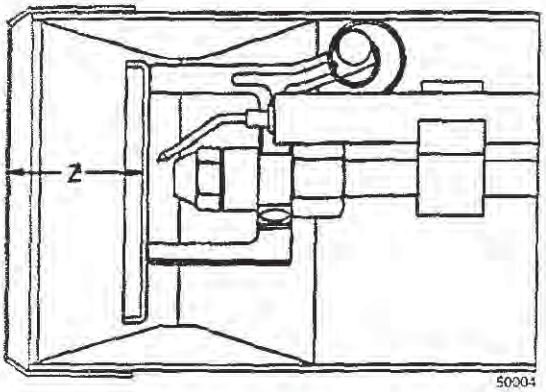
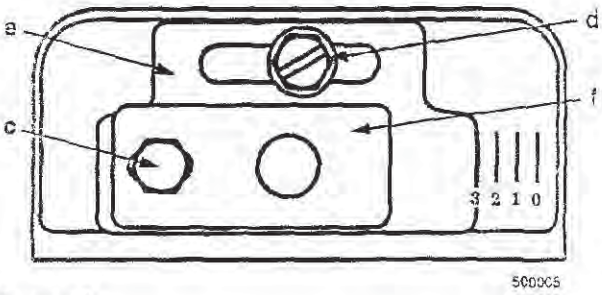


Figure 6 - Adjusting plate assembly



Legend

- **c** acorn nut
- **d** fastener
- **e** indicator adjusting plate
- **f** Secondary adjusting plate

Connect fuel line(s)

WARNING: Install the oil lines using the following guidelines. Failure to comply could lead to equipment damage and present a risk of severe personal injury, death or substantial property damage due to leakage of oil and potential fire hazard.

Use only flare fittings at joints and connections. Never use compression fittings.

Install fittings only in accessible locations to assure any leak will be detected.

Where joint sealing is needed, use only pipe dope. Never use Teflon tape. Tape strands can break free and damage the fuel unit.

Never use a one-pipe oil system with a lift in excess of 8 feet with **B** fuel unit. On two-pipe oil systems, verify that the suction line vacuum does not exceed the fuel unit manufacturer's recommendation.

WARNING: The fuel unit is shipped without the by-pass plug installed for CF500/CF800 ON/OFF burners. You must install this plug on two-pipe systems. DO NOT install the by-pass plug in the fuel unit if connected to a one-pipe oil system. Failure to comply could cause fuel unit seal failure, oil leakage and potential fire and injury hazard.

❑ Fuel unit by-pass plug

- The CF500/CF800 burner is shipped ***without*** the by-pass plug installed in the fuel unit.
- The by-pass plug ***must not*** be installed in the fuel unit for one-pipe oil systems.
- You ***must*** install the by-pass plug if using on a two-pipe oil system.

❑ Oil supply/return lines

- Install the oil tank and oil lines in accordance with all applicable codes.
- Size the oil supply and return lines using the guidelines given in the fuel unit literature included in the literature envelope. Oil line flow rate will equal the burner rate for one-pipe systems. For two-pipe systems, refer to ***Table 3*** for the fuel unit gearset capacity - the rate at which fuel is recirculated when connected to a two-pipe system. Size two-pipe oil lines based on this flow rate.
- Use continuous lengths of heavy-wall copper tubing, routed under the floor where possible. Do not attach fuel lines to the appliance or to floor joists if possible. This will reduce vibration and noise transmission problems.
- Install an oil filter sized to handle the fuel unit gearset flow capacity (***Table 3***) for ***two-pipe systems***. Size the filter for the firing rate for ***one-pipe systems***. Locate the filter immediately adjacent to the burner fuel unit.
- Install two high-quality shut-off valves in accessible locations on the oil supply line. Locate one valve close to the tank. Locate the other valve close to the burner, upstream of the fuel filter.

❑ Burner fuel flow

- **One-pipe systems** – See ***Figure 7*** for the fuel flow path.
  - Oil supply connects to one of the fuel unit inlet ports.
- **Two-pipe systems** – See ***Figure 8*** for the fuel flow paths for two-pipe oil systems.
  - Oil supply connects to one of the fuel unit inlet ports. Oil return connects to the fuel unit return port. (***Install the by-pass plug in the fuel unit for two-pipe systems.***)
- **Nozzle pressure** – The fuel unit nozzle port pressure is factory set at 140 psig. Some original equipment manufacturer burner applications may call for a lower pressure to obtain a required firing rate. Do not change this pressure unless directed to do so by the appliance manufacturer.

Table 3 – Fuel unit gearset capacities

Fuel unit model number	Gearset capacity (GPH)
A2VA-7116	17
A2YA-7916	20
B2VA-8216	21
B2YA-8916	25
B2TA-8248	21

Figure 7 – One-pipe oil flow with "B" pump

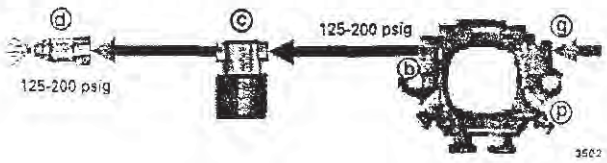
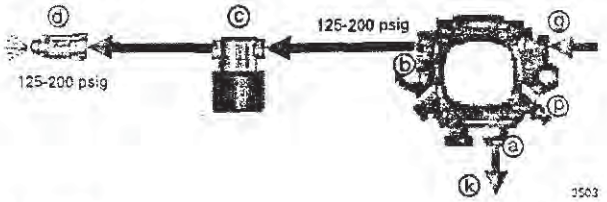


Figure 8 – Two-pipe oil flow with "B" pump



Legend

a Return port	**g** Inlet port
b Nozzle port	**k** Return line to oil tank
c Oil valve	**p** Air bleed valve
d Nozzle & adapter	

Wire the burner — R7184

Install the burner and all wiring in accordance with the National Electrical Code and all applicable local codes or requirements.

Wire the burner in compliance with all instructions provided by the appliance manufacturer. Verify operation of all controls in accordance with the appliance manufacturer's guidelines.

See ***Figure 9a*** for a typical wiring diagram, with **R7184** oil primary, for reference purposes only.

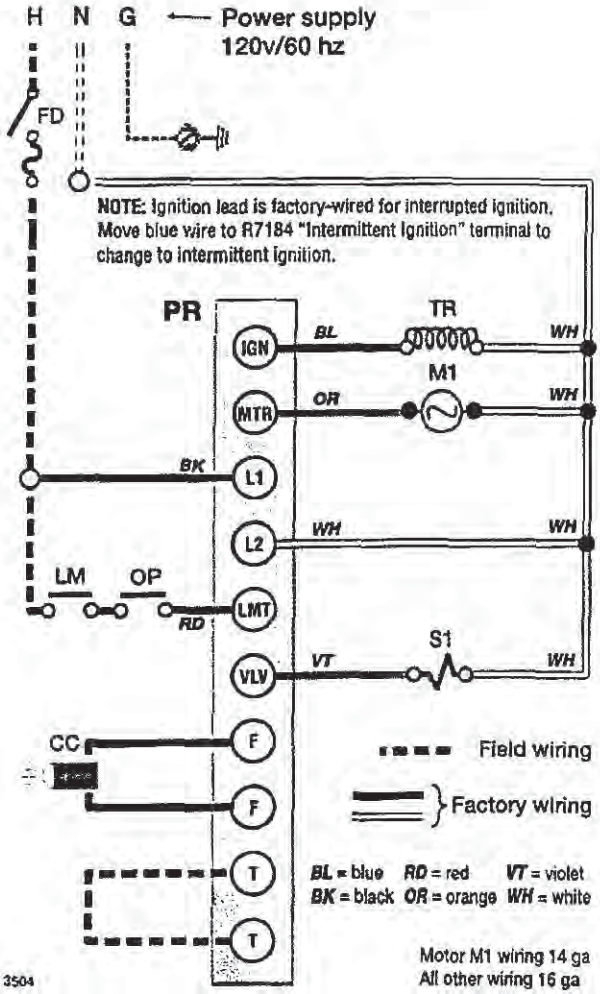
Sequence of operation — typical

1. Standby — The burner is idle, waiting for a call for heat. When a call for heat is initiated, there is a 2- to 6-second delay while the control performs a safe start check.
2. Valve-on delay — As applicable, the ignition and motor are turned on for a 15-second prepurge.
3. Trial for ignition (TFI) — The fuel valve is opened, as applicable. A flame should be established within the 15-second lockout time (30-second lockout time is available).
4. Lockout — If flame is not sensed by the end of the TFI, the control shuts down on safety lockout and must be manually reset. If the control locks out three times in a row, the control enters restricted lockout. Call a qualified service technician.
5. Ignition carryover — Once flame is established, the ignition remains on for 10 seconds to ensure flame stability. It then turns off.
6. Run — The burner runs until the call for heat is satisfied. The burner is then sent to burner motor-off delay, as applicable, or it is shut down and sent to standby.
7. Recycle — If the flame is lost while the burner is firing, the control shuts down the burner, enters a 60-second recycle delay, and then repeats the ignition steps outlined above. If the flame is lost three times in a row, the control locks out to prevent continuous cycling with repetitious flame loss caused by poor combustion.
8. Burner motor-off delay — If applicable, the fuel valve is closed and the burner motor is kept on for the selected postpurge time before the control returns the burner to standby.

WARNING Do not by-pass any safety control. By-passing a safety control could result in severe personal injury, death or substantial property damage.

WARNING **Electrical shock hazard** - can cause injury or death. Disconnect power before installing or servicing. Provide ground wiring to the burner in accordance with the National Electrical Code.

Figure 9a - Typical wiring



Legend

FD	Fused disconnect, by others	**TR**	Ignition transformer
LM	Limit controls, by others	**M1**	Burner motor
OP	Operating controls, by others	**S1**	Oil valve
PR	Oil primary control, R7184 typical	**T-T**	24-volt thermostat/limit terminals
CC	Flame sensor, cad cell typical	**F-F**	Cad cell flame sensor terminals

Wire the burner — R8184 (alternate)

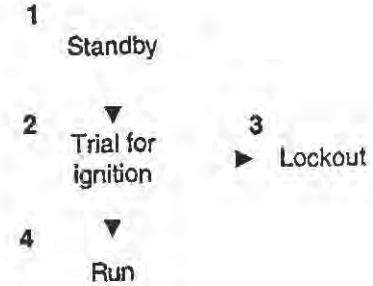
Install the burner and all wiring in accordance with the National Electrical Code and all applicable local codes or requirements.

Wire the burner in compliance with all instructions provided by the appliance manufacturer. Verify operation of all controls in accordance with the appliance manufacturer's guidelines.

See ***Figure 9b*** for an alternate wiring diagram, with **R8184** oil primary, for reference purposes only.

Sequence of operation — typical

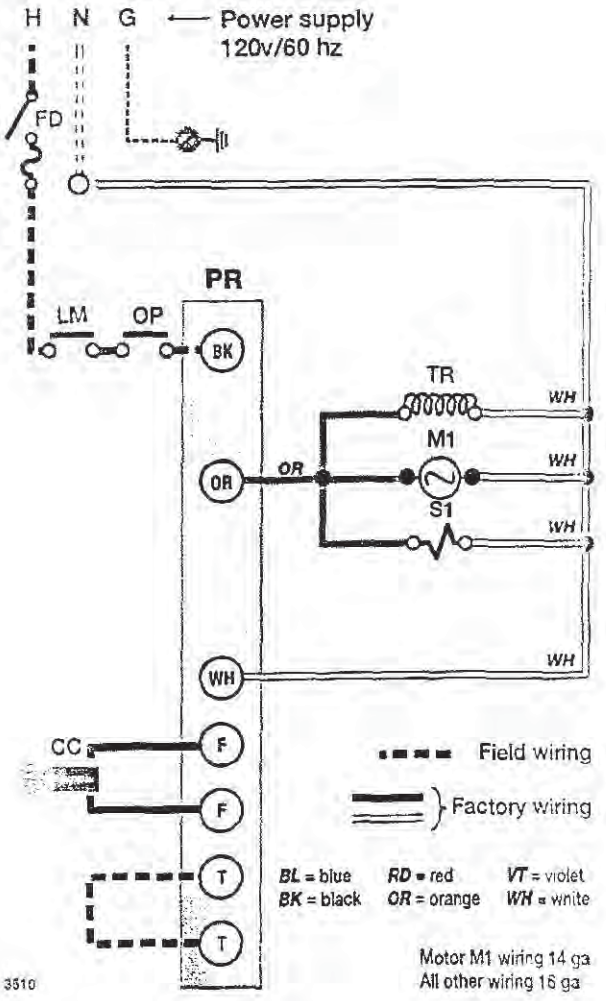
1. Standby — The burner is idle, waiting for a call for heat.
2. Trial for ignition (TFI) — The fuel valve is opened, as applicable. A flame should be established within the 15-second lockout time (30-second lockout time is available).
3. Lockout — If flame is not sensed by the end of the TFI, the control shuts down on safety lockout and must be manually reset.
   - To reset the control after lockout, wait 2 to 3 minutes after lockout to give the internal switch time to cool.
   - Then push the reset button on the primary control, allowing the burner to operate in normal sequence.
   - Troubleshoot the reason for the flame sense failure.
4. Run — The burner runs until the call for heat is satisfied.



WARNING Do not by-pass any safety control. By-passing a safety control could result in severe personal injury, death or substantial property damage.

WARNING **Electrical shock hazard** - can cause injury or death. Disconnect power before installing or servicing. Provide ground wiring to the burner in accordance with the National Electrical Code.

Figure 9b - Alternate wiring R8184



Legend

FD	Fused disconnect, by others	**TR**	Ignition transformer
LM	Limit controls, by others	**M1**	Burner motor
OP	Operating controls, by others	**S1**	Oil valve
PR	Oil primary control, R8184 typical	**T-T**	24-volt thermostat/limit terminals
CC	Flame sensor, cad cell typical	**F-F**	Cad cell flame sensor terminals

Prepare the burner for start-up

Start-up checklist - *Verify the following before attempting to start burner.*

- ❑ Combustion air supply and venting have been inspected and verified to be free of obstructions and installed in accordance with all applicable codes.
- ❑ Oil nozzle has been selected correctly and securely installed in the nozzle adapter.
- ❑ Fuel unit by-pass plug ***has not*** been installed for one-pipe oil system.

  By-pass plug ***has been*** installed for two-pipe oil system.
- ❑ Fuel connection to nozzle line assembly is secure.
- ❑ Dimension **Z** has been set per this instruction manual.
- ❑ Fuel supply line is correctly installed, the oil tank is sufficiently filled, and shut-off valves are open.
- ❑ Burner is securely mounted in appliance, with pressure firing plate and gasket installed for pressurized chamber application.
- ❑ Appliance has been filled with water (boilers) and controls have been operationally checked.
- ❑ Burner has been installed in accordance with appliance manufacturer's instructions (when available).
- ❑ Also refer to appliance manufacturer's instructions (when available) for start-up procedures.

❑ Z dimension

- Should be set per these instructions (see page 7). The acorn nut (***Figure 6***, item **c**, page 7) should never be loosened once the **Z** dimension is initially set.

❑ Initial head position

- The indicator plate assembly markings correspond to head position settings.
- Loosen the fastener (***Figure 6***, item **d**, page 7) and slide the indicator plate until the number on the plate corresponds to the initial head setting given in ***Table 4*** for the desired firing rate.
- When the head position has been set, tighten the fastener and spline nut.

❑ Initial air settings

- Loosen the air band and shutter, and adjust to the settings for the applicable firing rate shown in ***Table 5***.
- These initial settings should be adequate for starting the burner. Once the burner is in operation, the air settings will be adjusted for best performance as discussed later in this manual.
- Follow the procedures given later in this manual for fine-tuning the air settings.

❑ Set appliance limit controls

- Set the appliance limit controls in accordance with the appliance manufacturer's recommendations.

❑ Prepare the fuel unit for air venting

- To vent air from one-pipe oil systems, attach a clear hose to the vent plug on the fuel unit. Provide a container to catch the oil. Loosen the vent plug.
- Vent the air as described under ***Start the burner***, page 13, when using the R7184 control.

Table 4 - Initial indicator adjustment plate settings (head position)

Rate GPH	Approximate head settings		
	CF500	CF800	
		Tube A	Tube B
1.75	0	--	--
2.25	0		
3.00	4	0	--
3.50	5	1	--
4.00	5	2	--
5.00	6	4	3
5.50	6	4	4
6.00	--	4	4
7.00	--	6	5
8.00	--	--	6

Table 5 - Initial air settings

Rate GPH	Approximate air settings					
	CF500		CF800			
			Tube A		Tube B	
	Shutter	Band	Shutter	Band	Shutter	Band
1.75	1	0	--	--	--	--
2.25	2	0	--	--	--	--
3.00	10	1	1	0	--	--
3.50	10	2	3	0	--	--
4.00	10	3	4	0	--	--
5.00	10	5	9	0	8	2
5.50	10	10	9	5	9	4
6.00	--	--	10	3	10	3
7.00	--	--	10	8	10	5
8.00	--	--	--	--	10	10

Start the burner

WARNING Do not proceed unless all prior steps in this manual have been completed. Failure to comply could result in severe personal injury, death or substantial property damage.

WARNING Do not attempt to start the burner when excess oil has accumulated, when the appliance is full of vapor or when the combustion chamber is very hot. Do not attempt to re-establish flame with the burner running if the flame should be extinguished during start-up, venting or adjustment. Allow the unit to cool off and all vapors to dissipate before attempting another start. Failure to comply with these guidelines could cause an explosion or fire, resulting in severe personal injury, death or substantial property damage.

NOTICE **If control is not an R7184 refer to manufacturer's literature for specific control.**

❑ Starting the burner and venting air

Priming the pump

1. Initiate a call for heat.
2. While the ignition is on, press and release the reset button (hold ½-second or less). If the control has not locked out since its most recent complete heat cycle, the lockout time will be extended to 4 minutes (45 seconds in earlier units), and the ignition will remain on the entire heat cycle.
3. Bleed the pump until all froth and bubbles are purged. If prime is not established within the extended lockout time, the control will lock out. Press the reset button to reset the control and return to step 2.

NOTICE The reset button can be held for 30 seconds at any time to reset the control's lockout counter to zero and send the control to standby.

4. Repeat steps 2 and 3, if needed, until the pump is fully primed and the oil is free of bubbles. Then terminate the call for heat, and the control will resume normal operation.

Resetting from restricted lockout

- If the control locks out three times in a row without a complete heat cycle between attempts, the lockout becomes restricted. A qualified service technician should be called to inspect the burner.

Disable function

- Any time the motor is running, press and hold the reset button to disable the burner. The burner will remain off as long as the button is held and will return to standby when released.

Cad cell resistance check

- While the burner is firing, and after the ignition has been turned off, press and release the reset button (hold ½-second or less) to check the cad cell resistance. The LED will flash 1 to 4 times, depending on the cad cell resistance (see the table below). For proper operation, it is important that the cad cell resistance is below 1600 Ohms.

LED flashes	Cad cell resistance
1	0-400 Ohms
2	400-800 Ohms
3	800-1600 Ohms
4	more than 1600 Ohms

LED Indicator key

LED	Status
On	Flame sensed
Off	Flame not sensed
Flashing (½-second on, ½-second off)	Lockout/ Restricted lockout
Flashing (2 seconds on, 2 seconds off)	Recycle

Start the burner *continued*

❑ Set air adjusting plate

1. Allow the burner to run until the appliance has warmed sufficiently.

2. Visually check the flame. The flame should not be dark orange or smoky.
   If the flame appears to be smoking, increase the amount of air by re-adjusting the air band to a higher number.

3. Once the appliance has warmed, the air setting can be checked and adjusted.

4. Use combustion test instruments to adjust the burner.

   a. Adjust the air until a trace of smoke is achieved with CO_2 level as high as possible (lowest possible O_2).
   Example: 13.5% CO_2 (2.5% O_2) with a trace of smoke.

   b. Increase the air to reduce CO_2 by 2 percentage points at a zero smoke level. (Increase O_2 by 3 percentage points at a zero smoke level.)
   Example: Reduce CO_2 from 13.5% to 11.5%, with zero smoke (or increase O_2 from 2.5% to 5.5%).

   c. This procedure provides a margin of reserve air to accommodate variable conditions.

5. Check the breech draft pressure against the appliance manufacturer's recommended setting (typically + 0.1" W.C.).

6. If the breech pressure is higher or lower than recommended level, adjust the appliance breech damper to achieve the specified setting. Recheck the smoke and CO_2 levels. Adjust burner air if necessary.

Maintenance and service

WARNING The burner must be serviced at least annually by a qualified service technician to assure continued reliable operation. Operation and adjustment of the burner requires technical knowledge and the use of combustion test instruments. Do not tamper with the burner or controls. Failure to comply could result in failure of the burner or system, resulting in severe personal injury, death or substantial property damage.

Annual service
– by qualified service technician

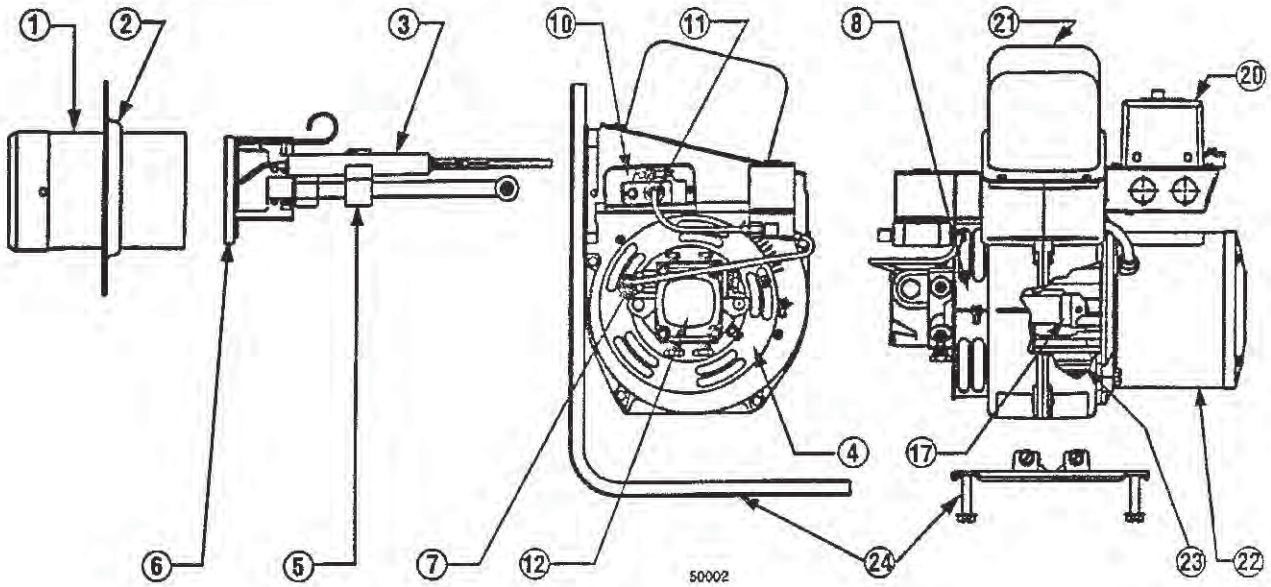
Have the burner inspected, tested and started at least annually by a qualified service technician. This annual test/inspection should include at least the following:

- ❑ Replace oil nozzle.
- ❑ Clean burner and blower wheel (if needed to remove lint or debris).
- ❑ Test ignition and combustion and verify air settings.
- ❑ Test oil supply line vacuum - verify that it is within allowable range indicated in fuel unit literature.
- ❑ Check pump pressure to nozzle.
- ❑ Inspect fuel system (including tank, lines and all connections).
- ❑ Inspect combustion air and vent systems.
- ❑ Replace oil filter.
- ❑ Oil motor (if not permanently lubricated).

Monthly maintenance
– by owner

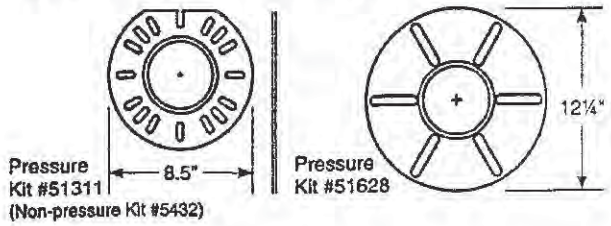
- ❑ Observe combustion air openings and vent system for integrity. Openings must be clean and free of obstructions.
- ❑ Check oil lines and fittings to verify there are no leaks.
- ❑ Observe burner ignition and performance to verify smooth operation.
- ❑ Shut the system down if you observe abnormal or questionable operation. Call a qualified service agency for professional inspection and service.

Replacement parts



Item	Part name	Description	Part number
1	Air tube	Refer to Figure 2, page 5	
2	Flange kit	Refer to Figure 10, below	
3	Electrode assembly		Specify
4	Air shutter		3215
5	Nozzle line assembly	Refer to Figure 2, page 5	
6	Head assembly	CF500 — KK CF800 — KH (Tube A) CF800 — KJ (Tube B)	51401U 51252P 51302P
7	Fuel lines	Specify lengths	
8	Air band		3819
10	Adjusting plate assembly		51286
11	Spline nut		3666
12	Fuel pump	Refer to Table 3, page 9	
17	Coupling		2433
20	Control	Specify	
21	Ignitor	14,000 volt France 14,000 volt Allanson	7440 7438
--	Transformer		2289
22	Motor	⅓ HP	21341U
23	Blower wheel	CF500 — 5 19/32" x 2 13/32" CF800 — 6 5/16" x 2 3/8"	21448U 21339U
24	Pedestal kits	Extended Standard	5606 5685

Figure 10 – Adjustable mounting plates for CF500/CF800



Instruction Manual – **Model CF500/CF800 Oil Burner**

Beckett

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