SHEAR DIAMONDS LTD.

WASTE MANAGEMENT PLAN
JERICHO DIAMOND MINE, NUNAVUT

REPORT

FEBRUARY 2011
ISSUED FOR USE
EBA FILE: E14101118

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EBA, A Tetra Tech Company
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
p. 780.451.2121 f. 780.454.5688

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ACRONYMS & ABBREVIATIONS

AA	Atomic Absorption Spectrophotometry
ABA	Acid Base Accounting
ACM	Asbestos-containing Material
AEM	Aquatic Effects Monitoring
AIA	Aquatic Impact Assessment
AIRS	Adaptation and Impacts Research Section
ANCOVA	Analysis of Covariance
ANFO	Ammonium Nitrate Fuel Oil Explosives
ANOVA	Analysis of Variance
APEC	Areas of Potential Environmental Concern
ARD	Acid Rock Drainage
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
BACI	Before-after-control-impact
CALA	Canadian Association for Laboratory Accreditation
CCME	Canadian Council of Ministers of the Environment
CDA	Canadian Dam Association
CPK	Coarse Processed Kimberlite
DIAND	Department of Indian Affairs and Northern Development
DFO	Department of Fisheries and Oceans
DO	Dissolved Oxygen
EBA	EBA, A Tetra Tech Company
EC	Electric Conductivity
EIS	Environmental Impact Statement
EOC	Emergency Operations Centre
EPP	Emergency Preparedness Plan
ERP	Emergency Response Plan
ESA	Environmental Site Assessment
FSCF	Fuel Storage Containment Facility
FPK	Fine Processed Kimberlite
GC/FID	Gas Chromatograph - Flame Ionization Detector
GTC	Ground Temperature Cable
Hazmat	Hazardous Materials
HDPE	High Density Polyethylene
HVAS	High Volume Air Sampling
HWTA	Hazardous Waste Transfer Area
ICP-MS	Inductively Coupled Plasma – Mass Spectrometry
IDLH	Immediately Dangerous to Life and Health
INAC	Indian and Northern Affairs Canada
KIA	Kitikmeot Inuit Association
LBP	Lead-based Paint
LPRM	Long-term Post-reclamation Monitoring
MANOVA	Multivariate Analysis of Variance

MSDS	Material Safety Data Sheets
NIRB	Nunavut Impact Review Board
NP	Neutralization Potential
NWB	Nunavut Water Board
PHC	Petroleum Hydrocarbons
PKCA	Processed Kimberlite Containment Area
PPE	Personal Protection Equipment
QA	Quality Assurance
QC	Quality Control
RBC	Rotating Biological Contactor
RCM	Reclamation Construction Monitoring
ROM	Run of Mine
RPD	Relative Percent Difference
RRPK	Recovery Rejects Processed Kimberlite
SCBA	Self-contained Breathing Aparatus
Shear	Shear Diamonds (Nunavut) Corp.
SOP	Standard Operating Procedure
SPRM	Short-term Post-reclamation Monitoring
TDC	Tahera Diamonds Corporation
TDGR	Transportation of Dangerous Goods Act (RSNWT 1988) and Regulations
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
WSCC	Workers' Safety and Compensation Commission of the Northwest Territories and Nunavut
WHMIS	Workplace Hazardous Materials Information System
WWTP	Wastewater Treatment Plant

2011 Water Licence Renewal Documents

AEMP	Aquatic Effects Monitoring Plan
AQMP	Air Quality Management Plan
CAMP	Care and Maintenance Plan
CMP	Contingency Management Plan
EP-RP	Emergency Preparedness and Response Plan for Dam Emergencies
GMP	General Monitoring Plan
ICRP	Interim Closure and Reclamation Plan
LDP	Preliminary Landfill Design Plan
LMP	Landfill Management Plan
LFDP	Preliminary Landfarm Design Plan
LFMP	Landfarm Management Plan
OMS	Operations, Maintenance, and Surveillance Manual
PKMP	PKCA Management Plan
SWMP	Site Water Management Plan
WEMP	Wildlife Effects Management Plan

WMP	Waste Management Plan
WRMP	Waste Rock Management Plan
WTMP	Wastewater Treatment Management Plan

1.0 INTRODUCTION

The Jericho Waste Management Plan (WMP) has been developed to provide operating guidelines, in compliance with federal and territorial (Nunavut) legislation and guidelines, for the collection, storage, transportation, and disposal of hazardous and non-hazardous waste generated at the Jericho Diamond Mine (Jericho). It also provides information on the safe and environmentally sound manner to minimize waste products generated during site activities.

The plan is submitted in addition to the Jericho Water Licence NWB1JER0410 (issued December 21, 2004). However, this plan is being submitted to the Nunavut Water Board (NWB) in the absence of complete historical information as Shear Diamonds (Nunavut) Corp. (Shear) only assumed control of the project in August 2010. Since that time, Shear has discovered that detailed information on the present site conditions is limited. Comprehensive historical site monitoring records were not well maintained under previous ownership and management, and the available information is incomplete or lacking detail.

The WMP has been based on existing records and the best available information at the time of report preparation. The plan has been redeveloped for the current regulatory requirements and to reflect Shear's commitment to the best practices in environmental stewardship. Once Shear has had an opportunity to investigate the site and gather information in 2011, the WMP will be revised (if required). Subsequent revisions of the WMP will be submitted for review and approval prior to resuming mining operations or commencing closure and reclamation activities.

1.1 Objective of Waste Management Plan

The primary objective of the WMP is to provide Shear and their designated contractors with operational guidelines to minimize the generation of wastes at points of use, optimize the usage of materials before disposal, and facilitate the collection and processing of wastes with the least adverse effects on the physical and biological environment on site. The WMP has incorporated reduction of wildlife attraction practices and avoided practices that have been problematic at other sites, to eliminate or reduce the effect of mine wastes on wildlife.

At the time of the water licence renewal application, mining operations have been suspended and the site is under care and maintenance. This document therefore reflects an estimation of the waste volumes on site, with provision for waste generation during resumed operations. In addition to being a management tool, the WMP is developed to assist Shear and the regulatory agencies with mine closure planning and the development of the Jericho Interim Closure and Reclamation Plan (EBA 2011e).

The WMP includes the following:

- A summary of regulatory requirements;
- A discussion of waste at Jericho, and potential waste minimization, recycling, and reuse opportunities;
- A summary of collection, storage, and disposal of major hazardous and non-hazardous wastes on site; and
- A discussion on ways to minimize biological and physical impact of the site.

1.2 Background Information

The Jericho Diamond Mine is located approximately 260 km southeast of Kugluktuk, NU, and 30 km north of Lupin Mine. The Jericho Mine was constructed and operated by Tahera Diamond Corporation (TDC) between 2004 and 2008. In January 2008, mining operations were suspended by TDC, and the site was subsequently placed under care and maintenance. Shortly thereafter, Indian and Northern Affairs Canada (INAC) assumed control of the care and maintenance activities for the site. In August 2010, Shear purchased the Jericho Mine Site and its assets and assumed the responsibility for the site.

Presently, the mine remains under care and maintenance as Shear evaluates the mineral resource. Once the evaluation is complete, a mine plan and operations schedule for the project will be established.

1.3 Linkages to Other Plans

The WMP should be considered as part of the site wide management system. Other management plans that are related to or refer to the WMP include:

- Aquatic Effects Monitoring Plan (AEMP);
- Contingency Management Plan (CMP);
- General Monitoring Plan (GMP);
- Landfarm Management Plan (LMP);
- Landfill Management Plan (LFMP);
- Waste Rock Management Plan (WRMP);
- Wastewater Treatment Management Plan (WTMP);
- Interim Closure and Reclamation Plan (ICRP); and
- Care and Maintenance Plan (CAMP) during periods where mining and processing operations are suspended.

1.4 Regulatory Requirements

Waste management is regulated under the Nunavut *Public Health Act*, the Nunavut *Environmental Protection Act* and the federal *Environmental Protection Act*. In addition to mandatory requirements, a number of waste management guidelines are commonly used in NU and the NWT. One such guideline was developed for municipal solid waste, and is titled "Guidelines for the Planning, Design, Operations and Maintenance of Modified Solid Waste Sites in the NWT" (Kent et al. 2003b). While the recommendations provided in this guideline may not all necessarily be appropriate for the management of industrial waste such as that generated at Jericho, applicable principals been adopted in the design and operation of the landfill.

Both federal and territorial legislation regulates hazardous materials that will be used at Jericho. Acts, regulations, and guidelines are listed below:

Federal

- Transportation of Dangerous Goods Act and Regulations
- Explosives Act
- National Fire Code
- CCME Guidelines for Above-Ground Storage Tanks
- CCME Environmental Quality Guidelines (re. contaminated soils remediation)
- Canada –Wide Standards for Dioxins and Furans

Territorial

- Transportation of Dangerous Goods Act (RSNWT 1988) and Regulations (TDGR)
- Explosive Use Act and Regulations
- Fire Prevention Act and Regulations
- Mine Health and Safety Act and Regulations
- Work Site Hazardous Materials Information System Regulations
- Nunavut Disposal Guidelines for Fluorescent Lamp Tubes
- Nunavut Environmental Guideline for the General Management of Hazardous Wastes
- Nunavut Environmental Guideline for Industrial Waste Discharges
- Nunavut Hazardous Waste Disposal Manual
- Nunavut Environmental Guide for Waste Antifreeze
- Nunavut Environmental Guide for Waste Asbestos
- Nunavut Environmental Guide for Waste Batteries
- Nunavut Environmental Guide for Waste Paint
- Nunavut Environmental Guide for Waste Solvents

Relevant acts will be kept on file at the mine site and an overview understanding of their regulation will be given to mine site personnel as part of their training.

2.0 WASTE MANAGEMENT PROCESSES AND PRINCIPLES

2.1 Definition of Wastes

Waste at Jericho is considered to be any material that can no longer be used for its intended purpose and is destined for recycling, treatment, disposal, or storage. Solid inert-wastes include such items as cans, filters, belts, scrap metals, sewage sludge, and domestic garbage.

Hazardous wastes are defined by the Government of Nunavut guidelines for TDGR and include waste petroleum products, solvents, paints, waste chemicals, batteries, chemical based sludge from waste water treatment plants, etc.

Hazardous waste generated in the amount of less than 5 kg per month (if a solid) or 5 L per month (if a liquid), where the total quantity accumulated at any one time does not exceed 5 kg or 5 L, is considered a small hazardous waste quantity. This does not apply to mercury or in classes 2.3, 5.1, or 6.1 of TDGR where generated amount is less than 1 kg per month if a solid, or 1 L per month if a liquid, and where the total quantity accumulated at any one time does not exceed 1 kg or 1 L.

The responsibility for proper waste management rests with the waste generator and should be considered a part of the cost of doing business.

2.2 Principals of Waste Management

There is a hierarchy of preference when managing waste. To ensure a more sustainable outcome of the Jericho WMP, the focus will be on achieving the more favourable options at the top of the Waste Management Hierarchy Pyramid (Figure 4). The top two levels of the pyramid, prevention and minimization, deal with the solid waste problem at the source. Where possible, Shear intends to use prevention to eliminate the problem altogether. Materials are taken out of the waste stream either at the production or consumption stage. Minimization is similar to prevention in that it eliminates part of the problem before the production or consumption stage. This could include such measures as finding more effective ways to package materials before or when they are shipped to site, thereby reducing the amount of packaging that goes to the landfill.

Prevention and minimization require careful analysis of Jericho's operations and supply chain in order to reduce the amount of waste generated by the site.

The next three steps on the pyramid deal with the primary, secondary, and tertiary recovery of waste products. Primary recovery (reuse) involves the use of products in their original form. This may include refurbishment of a product prior to its reuse but the product must perform the same essential function for which it was originally intended.

Where prevention and minimization are not possible, Shear will look for opportunities for primary recovery of products, particularly those which can be refurbished on site to save energy and avoid significant transportation costs.

Secondary recovery (recycling) involves recovering materials that can be processed into new products. With secondary recovery, a further distinction must be made on whether the recovered product can be used to reproduce the original item or whether it must be "downcycled" into a lower grade product. Downcycling is not a sustainable practice although it does prolong the useful life of a material. Wherever possible, Shear will take measures to prevent contamination of recyclable materials, which will reduce the risk of downcycling.

Secondary recovery will be the most difficult to achieve because significant handling and backhaul costs would be incurred for materials of relatively low value. It is not practicable to recycle such materials on site.

In some situations, site waste can be downcycled and used for alternative purposes. An example is using waste tires as traffic structures as discussed in Section 3.2.

Tertiary recovery (energy recovery) is the lowest form of recovery. Materials are combusted to generate energy, which can be used to heat building or processes as well as to generate electricity. Tertiary recovery is a better option than simply incinerating the material because a useful product (heat) is being generated, but the process is not nearly as effective as primary and secondary recovery.

Tertiary recovery will be used for substances such as waste oil that is not economical to backhaul but can be easily turned into energy.

The lowest level of the hierarchy is disposal. Disposal represents a double cost as materials and energy are lost while landfill costs are incurred. Incineration (without energy recovery) can reduce these landfill costs but the materials and energy are still not recovered.

Disposal should only be used as a last resort when all other forms of recovery are not possible.

Due to the limited options for waste recovery, Shear has even greater incentive to focus their waste management efforts on the top two levels of the pyramid.

2.3 Waste Sources

Tables 1 through 3 provide a summary of the expected types of inert, hazardous, and polluting waste to be generated at Jericho for disposal.

Table 1: Inert Waste Type and Source

Waste Type	Examples
Scrap metal	Structural steel, equipment guards, plate steel, steel pilings, tanks (decommissioned), bins, cladding, doors, rebar, filing cabinets, cable tray, metal furniture, wheels
Rubble	Broken concrete, masonry
Wood products	Timber dunnage, plywood and lumber from formwork and camp modules or burned in open burn pit
Rubber products	conveyor belting, floor mats
Construction	Construction and demolition debris
Glass	Cleaned bottles, jars, plate glass and mirrors
Piping	Steel and plastic piping (fuel and glycol piping clean), including insulation, heat trace cable and support brackets
Fabrics and liners	HDPE liner, woven geo-textile, insulation (liners cut into strips for burial to prevent water containment)
Electrical	Cabling, cable support systems, switchgear, and transformers (without oil-filled units)
Equipment (non-recyclable)	Non-hydrocarbon-contaminated and cleaned equipment: electric motors, boilers, fans, heaters, bearings, gearboxes, pumps, screens, truck parts, conveyor idlers and pulleys, truck shop equipment, appliances
Incinerator ash	Ash from the incinerator

Table 2: Hazardous Waste Type and Source

Waste Type	Examples
Petrochemicals	Diesel, Aviation Fuels, Gasoline,
Solvents	To be determined
Acids	Sulphuric acid, nitric acid, and hydrochloric acid
Contaminated soil	Petrochemical Contaminated Soil/ Snow/Water
Batteries	Lead-acid based batteries

Table 3: Pollutant Type and Source

Waste Type	Examples
Petrochemicals	Lubricant oil, Hydraulic oil, transmission fluid, Ethylene glycol
Solvents	Varsol
Electronics	Computers parts, office electronics, circuit boards, transformers (oil-filled units)
Fluorescent tubes	Regular and compact fluorescent lamp
Batteries	Dry cell batteries including 6 or 9 volt consumer batteries, and button batteries

2.4 Waste Management Activities

The waste management operations consist of a number of activities that include source separation of organic (food wastes), separation of materials for incineration, separation of materials for burning, separation of recyclables, separation of inert non-combustible materials, hazardous recyclables, and hazardous material. The materials that are not sent to the landfill are consolidated and stored until they can be returned for treatment and/or disposal via backhaul from site. Further discussion of the type and handling practices for specific hazardous and non-hazardous materials on site are addressed in Section 3.0.

2.5 Recovery Opportunities

As discussed previously, recovery opportunities for non-hazardous wastes are limited at Jericho due to the site's remote location. However, Shear will investigate and take advantage of any recovery opportunities when possible. Opportunities will be largely determined by the recovery technology that is, or can be made available, at site and what is practical to backhaul. During care and maintenance activities, Shear will review the waste recovery options of the site.

Table 4 presents selected examples of waste recovery currently being undertaken on site:

Table 4: Recycling Opportunities

Waste Type	Recovery Type	
Used Oil	Tertiary	Collected, filtered and used in waste oil burner
Used Tires	Secondary (downcycled)	Used as haul road safety berms. Potential for use as bunks for laydown of stock materials
Hydraulic Oils	Primary	Filtered and cleaned for reuse
Metal	Primary	Pieces suitable for other projects is re-stocked
Wood	Primary	Pieces suitable for other projects is re-stocked

Materials to be recovered will be organized, protected from deterioration, and stored in a site laydown for assessment and eventual processing or shipment off site.

3.0 IDENTIFICATION, DESCRIPTION, CLASSIFICATION AND DISPOSAL PLAN

3.1 Hazardous Recyclable And Non-Recyclable Wastes

3.1.1 Petroleum Hydrocarbon Waste Stream

3.1.1.1 Used Oil

Waste lubricating oils, from service vehicles and mobile or stationary equipment, including generators and pumps, will be collected and stored in empty bulk lubricant cubes. The cubes will then be placed in the designated petroleum hydrocarbon waste area of the Hazardous Waste Transfer Area (HWTA). Used lubricating oil can be combusted in specially designed burners for heat generation in various facilities around site (tertiary recovery). Excess waste oil, or waste oil not fit for combustion, will be backhauled to the product supplier or to a registered hazardous waste receiver.

3.1.1.2 Hydraulic Fluid

Where possible, Shear will filter and reprocess hydraulic fluid for reuse in site equipment (primary recovery). Hydraulic fluid that can not be reprocessed can be combusted in the waste oil burner or should be transferred to clearly labelled, tightly sealed, sound containers, such as steel drums, for storage in the HWTA. Excess hydraulic fluid, or hydraulic fluid not fit for combustion, will be backhauled to the product supplier or to a registered hazardous waste receiver.

3.1.1.3 Used Oil and Fuel Filters

Waste oil and fuel filters must be drained at temperatures above 15°C for a minimum 48 hours prior to disposal. The filters will then be crushed to release additional oil and reducing disposal volume. A well-ventilated waste oil and fuel filter drainage area will be established at the Truck Shop prior to resuming mining operations. The area will have secondary containment (such as a liner or tray) to collect any spilled or splashed petroleum hydrocarbon product. Once drained and crushed, the waste filters will be placed in clearly labelled, tightly sealed, sound containers, such as steel drums, located near the drainage area. Full drums will be transported to the HWTA and will await backhaul to a petroleum hydrocarbon (PHC) products supplier or registered hazardous waste receiver.

3.1.1.4 Used Rags and Sorbents

Used rags and sorbents will be stored in a well-ventilated area in clearly labelled, tightly sealed, sound containers, such as steel drums. Drums will be located as close as practicable to the waste generating source such as the Truck Shop and other maintenance facilities. Rags and sorbent pads will be incinerated on site. Granular sorbent will be collected in drums and taken to the HWTA to await backhaul to a PHC products supplier or registered hazardous waste receiver.

3.1.1.5 Contaminated or Out of Date Fuels

Contaminated or expired fuels, such as Jet B aviation fuel, should remain in clearly labelled, tightly sealed, sound original containers in the fuel storage area. The fuel may be combusted in a waste oil burner or transported to the HWTA for backhaul to a registered hazardous waste receiver.

3.1.1.6 Empty Petroleum Hydrocarbon Containers and Drums

Empty PCH containers will be stored in a designated area and returned to the supplier during the winter road backhaul. Alternatively, when directed by the Environment Manager or designate, empty PHC drums can be drained and air dried. The drums will then be inspected by a member of the Jericho Environment Department before being crushed and placed in the landfill for disposal or, if cost effective, backhauled to a recycling facility.

3.1.1.7 Petroleum Hydrocarbon Contamination

Shear will minimize the potential for PHC-impacted soils, snow and ice, and rock by lining storage facilities, proactively maintaining and inspecting mobile and stationary equipment, using refuelling drip trays, and e lining fuel loading and unloading zones. In spite of these measures, spills, leaks, or pipe ruptures can occur resulting in PHC contamination.

In the event of a spill, the contaminating materials will be cleaned up immediately in accordance with the Jericho Contingency Management Plan (CMP, EBA 2011c).

- PHC-impacted **sediments and soils** should be isolated and handled as outlined in the CMP. Impacted sediments and soils that meet landfarm acceptance criteria, as outlined in the Jericho Landfarm Management Plan (LFMP), should be transported directly to the landfarm for placement in one of two graded areas as directed by the Site Manager. Contaminated soils exceeding landfarm acceptance criteria, or those not approved for landfarm treatment, should be considered hazardous waste and packaged for off-site transport to a registered treatment facility. Packaged PHC-impacted sediments and soils can be stored at the HWTA until inventoried for backhaul.
- Small volumes of PHC-impacted **snow and ice** should be collected immediately and transferred into designated drums, as discussed in the CMP. Drums should be transported directly to the landfarm for placement in one of two sump areas, as directed by the Environment Manager or designate. Larger volumes may require trucking of the snow to the facility and decontamination of the truck box and tires. Snow and ice can be dumped on a soilless portion of the upstream landfarm area and pushed into the sump with a bulldozer, or other equipment. Meltwater, generated from the contaminated snow and ice, will be accommodated using the water management procedures outlined in the LFMP.

3.1.2 Chemicals

3.1.2.1 Glycol

Ethylene glycol is used as a coolant and antifreeze in mobile and stationary equipment. Waste glycol is stored in clearly labelled, tightly sealed drums and placed in a secondary containment structure (such as a tray or lined area) within a designated area of the HWTA.

Glycol has a sweet odour and taste that can attract and harm wildlife. As discussed in the Jericho CMP, glycol spills are to be cleaned up without delay. Additionally, Shear will store unused and waste glycol in an enclosed or fenced area capable of deterring wildlife.

Waste glycol will be backhauled to a registered hazardous waste receiver or management facility.

3.1.2.2 Solvents

Solvents are used as degreasing agents in maintenance shops, in other service buildings and in small quantities around the site on mobile equipment. Where possible, Shear will use of non-toxic, citrus-based alternatives as substitutes as well as detergent and steam jets to minimize the use of toxic, petroleum-based solvents. Where non-toxic substitutes are not suitable, the use of petroleum-based solvents will be controlled to prevent harm to the user and release into the environment.

Excess or waste solvents will be packaged in clearly labelled, original, tightly sealed, sound containers, or manufactured containers designed for solvent transport, and stored in the HWTA until backhauled to a registered hazardous waste receiver or management facility.

3.1.2.3 Waste Batteries

Shear reduces or eliminates the generation of waste batteries through:

- Maintaining and protecting batteries to prevent damage and charge loss,
- Testing batteries prior to disposal to confirm the battery is spent,
- Replacing non-rechargeable batteries with rechargeable batteries where possible, and
- Servicing batteries to extend life.

All batteries will eventually deteriorate and reach the end of their useful life. Where applicable, waste batteries must be properly handled and disposed of to minimize, if not eliminate, spillage of corrosive materials and release of metals.

- Dry cell batteries are used in equipment such as hand-held radios and flashlights. General dry cell batteries include, but are not limited to, AAA to D cells, 6 or 9 volt consumer batteries, and button batteries. Specific containers are set up in offices and common rooms on site to collect dry cell batteries. These batteries will be brought to the HWTA and shipped off-site to a recycling facility.
- Waste lead acid batteries and rechargeable batteries should be deposited, sealed, and temporarily stored in a 16 gauge (or lower) metal container or 205 L plastic drum in a designated area of the HWTA. Temporary storage of waste batteries is only acceptable as an interim measure for battery quantities totalling less than 1,000 kg, and then only for periods less than 180 days, unless in a registered hazardous waste designated facility.

3.1.2.4 Aerosol Cans

Shear discourages the use of aerosol cans on site due to high energy costs associated with transport and because they are not suitable for any of the three types of recovery. Wherever possible, aerosol cans will be substituted with refillable type pump or spray bottles.

Waste aerosol cans are collected in specific containers places around the site and in the accommodation complex. The cans may be stored in the HWTA for shipment to an off-site disposal facility; however, Shear is investigating the feasibility of puncturing and draining the cans to allow on site disposal.

3.1.2.5 Paints

Shear will reduce the quantity of waste paint generated by:

- Purchasing the correct paint volume for the job,
- Training staff in proper paint techniques to improve the efficiency of paint use.
- Using water-based paints instead of oil-based paints and specialty coatings whenever possible,
- Using excess paint for touch-ups or as primer on future jobs.
- Choosing ecologo certified products whenever possible, and
- Specifying durable coatings such as powder coatings when purchasing products as to reduce the need for on-site painting.

Excess and waste paint should be packaged in clearly labelled original tightly sealed sound containers, or 16 gauge (or lower) or plastic drums. Containers should be labelled in accordance with WHMIS and the transport authority.

Unopened paint containers and waste paints should be stored in a designated area of the HWTA for return to the supplier or backhaul to a paint recycler, registered hazardous waste receiver or management facility. Small quantities of unwanted paint up to, but not exceeding, 5 L can be disposed of in the landfill after it has been allowed to dry thoroughly.

3.1.2.6 Fluorescent Lamp Tubes

Shear will reduce the generation of fluorescent lamp tube waste through efficient lighting usage and installation of motion sensors. Lights are only engaged when Jericho personnel are in the vicinity, or if a matter of safety.

Fluorescent lamp tubes will be packaged in their original shipping box (or equivalent), stored in a watertight enclosure at the HWTA for shipment to an approved hazardous waste recycling or disposal company.

Fluorescent lamp tubes are considered hazardous waste if broken and should be handled accordingly.

3.1.2.7 Waste Chemical Containers

Many chemical containers are not safe to dispose of directly and must be recycled, or require handling precautions identical to full containers. This information is supplemental to training given to chemical handlers through the *Workplace Hazardous Materials Information System* (WHMIS). Chemical users must be familiar with safe handling and storage procedures provided by manufacturers in Material Safety Data Sheets (MSDS).

3.1.3 Laboratory Chemical Wastes

Any laboratory wastes that cannot be safely incinerated or placed in the landfill on site should be stored in appropriate containers at the HWTA and backhauled by the winter road to a registered laboratory chemical waste receiver. Laboratory waste disposal information is supplemental to training given to chemical waste handlers through WHIMIS. Chemical users must be familiar with safe handling and storage procedures provided by manufacturers in MSDS.

3.1.4 Blasting Waste

3.1.4.1 Waste ANFO

Sine no production blasting will be occurring during care and maintenance activities, Shear does not expect to find waste ANFO on site. If waste ANFO is discovered, Shear will consult the supplier to determine the correct protocols for disposal as per the Jericho Explosives Management Plan (TDC 2005)

3.1.4.2 Spilt Ammonium Nitrate

Since production blasting will be minimal (if at all) during care and maintenance activities, Shear expects that Ammonium Nitrate spills will be rare.

3.2 Hazardous Biological Waste

To reduce the transmission of communicable diseases, small amounts of hazardous biological waste and other medical materials, such as needles, syringes, scalpels, and blood and tissue contaminated items are properly contained, labelled as “BioHazard”, and stored in a secure area of the first aid centre. Hazardous biological waste should remain under the direct supervision of medical staff until backhauled for disposal at a registered hazardous biological waste receiver. Biological waste generated on site should not be incinerated, as there is an increased risk of injury to the incinerator operator from needles or other sharp objects.

3.3 Inert Non-Combustible Solid Waste

3.3.1 Conveyor Belts and Tires

Shear recycles tires where possible for haul road berms and for turning area road protection (secondary recovery). In addition, Shear is examining the potential to reuse tires as bunks for laydown of stock material. Waste conveyor belts and tires are disposed of in the landfill.

3.3.2 Vehicles

Vehicles and equipment that are no longer useable at Jericho, will be driven or backhauled on the winter road for refurbishment or recycling (primary or secondary recovery). Vehicles awaiting transport will be stored in a designated area of the laydown area.

3.3.3 Plastics

Waste plastic containers that originally contained non-hazardous materials, not including food products, should be disposed in the landfill. Shear discourages the use of disposable dishes and beverage bottles in an effort to minimize plastic waste generation.

3.3.4 Scrap Metal

Shear promotes restocking and reusing scrap metal pieces for other projects where possible. The economic feasibility of recycling or resale of scrap metal (secondary recovery) will be investigated. If scrap metal is to be recycled, it will be stored in a designated area of the laydown or landfill for backhaul on the winter roads. However, backhaul priority will always be for hazardous waste. Alternatively, waste metal can be disposed of in the landfill.

3.3.5 Sandblasting Residues

Sandblasting residue will be collected in steel drums and may be disposed in the landfill or shipped off site for disposal depending on the type of blasting media used. Silica-sand-based media will be disposed in the Jericho landfill. Shear will cover sandblasting residue with intermittent fill as soon as practicable to reduce wind redistribution of sandblast waste.

Blasting media derived from metal slags or the like that have potential to form leachate will be shipped to a registered disposal facility. During care and maintenance, Shear will investigate the types of blasting media present on site and determine if less harmful alternatives (such as soda blasting) could be substituted.

3.3.6 Electronic and Electrical Equipment

Electronic and electrical equipment that may contain polluting substances, such as heavy metals, will not be disposed in the Jericho landfill. All electronics waste is to be collected and stored in watertight containers and placed in dry storage at the HWTA for eventual shipment to a registered disposal facility. Where practicable, inert parts, such as computer enclosures, will be stripped from the devices and disposed of as inert non-combustible solid waste. Electrical waste and devices may or may not contain polluting substances and will be assessed by a qualified member of the Jericho Environment Department to determine if the waste should be placed in the landfill or sent to the HWTA for off-site disposal.

3.4 Inert Combustible Solid Waste

3.4.1 Corrugated Cardboard

Shear promotes corrugated cardboard waste prevention and minimization through the active monitoring of materials packaging shipped to Jericho. If the packaging is deemed excessive, Shear will request that suppliers reduce the volume of packaging where practicable. Shear will also give preference to products shipped in bulk in order to reduce packaging volumes. Waste corrugated cardboard may be recycled as packaging for backhauled materials when required. Excess waste corrugated cardboard is placed in the appropriate collection bin and incinerated or burned in the burn pit, located in the landfill. Proper storage and transport for burning only when burns are scheduled will prevent scattering by wind.

3.4.2 Paper

Shear promotes waste paper prevention by using email, voicemail, telephone, or verbal communication over written communication whenever possible. Shear will default to using both sides of paper when printing, photocopying, or any other tasks similar in nature (minimization). Specific containers are set up in offices and common rooms on site to collect waste paper. Waste paper is collected and incinerated or burned in the burn pit.

3.4.3 Waste Lumber

Shear promotes restocking and reusing lumber products for future projects or as backhaul packaging (primary and secondary recovery). Waste lumber is placed in the appropriate collection bin and sent to the landfill burn pit on regular basis.

3.5 Solid Domestic Wastes

3.5.1 Food Waste and Packaging

Shear will provide regular awareness programs on the negative effects of feeding wildlife to all personnel on site. Shear has a zero-tolerance attitude and policy towards the feeding of wildlife, and anyone who is caught feeding wildlife will be removed from site. Dedicated steel bins and dumpsters for the collection of food waste and packaging are provided where people eat, including at the camp kitchen and in remote offices and lunchroom trailers. Bag lunches and kitchen food waste and packaging will be stored in plastic bags within the sealed container, and collected and incinerated daily to minimize the attraction of wildlife. Ash is deposited in the landfill and promptly covered with intermittent fill to reduce wind redistribution.

Oil and grease collected from the kitchen is to remain stored in the kitchen until transferred to the incinerator for immediate disposal.

3.5.2 General Camp Wastes

General camp wastes are defined as those collected from offices, camp rooms, and leisure and recreation areas. Mine site personnel are oriented to sort general waste into specific containers provided for recyclables or for substances requiring additional processing prior to incineration. Shear will provide regular awareness programs on the effects of disposing hazardous or polluting personal waste items. The use of clear trash bags will allow cleaning staff to perform cursory inspections of camp waste regularly and confirm sorting. Additional audits may be performed from time to time by the Jericho Environment Department to ensure compliance with waste sorting procedures. General camp waste will be incinerated and the ash deposited in the landfill; ash will be promptly covered with intermittent fill to reduce wind redistribution.

3.6 Sewage Sludge

Sewage sludge is the thickened biodegradable organic components removed by settling in the waste water treatment plant. Shear plans to limit the use of commercially produced fertilizers during the reclamation process and plans to use sewage sludge as a soil amendment instead. Sewage sludge will be transported

and stored within a designated containment area of the landfill facility as described in the Jericho Landfill Management Plan (LMP, EBA 2011g) and the Jericho Landfill Design Plan (LDP, EBA 2011p)

3.7 Miscellaneous Wastes

The collection, sorting, and disposal of miscellaneous waste not listed here should be done at the discretion of qualified Environment Department personnel.

4.0 SITE FACILITIES

4.1 Hazardous Waste Transfer Area

The HWTA will be used for the handling, tracking, and temporary storage of hazardous wastes and pollutants prior to backhauling to registered hazardous waste facilities. Liquid or spillable wastes are to be stored within one of the two bermed enclosures located at the HTWA. Dry or non-spillable wastes, or those packed in secondary containment packaging (such as wet cell batteries in drums), are to be stored in a dry storage area. At present, Shear has not been able to confirm if a dry storage area was constructed under the previous ownership, but a dry storage area will be established during care and maintenance.

The dry storage area will consist of a steel cargo container or similar structure that is watertight and lockable. Additional containers may be added if required. The dry storage area will be used to store items such as punctured and drained aerosol cans, batteries, electronics and fluorescent lamp tubes.

The existing HWTA has a secondary containment structure in place for the storage of liquid hazardous wastes. The two separate cells of the enclosure are lined with a high density polyethylene liner with berms on four sides. The condition of the structure is unknown as it was not designed by a qualified engineer and no as-built or construction records exist. In 2011, Shear will assess the condition and suitability of the facility with the geotechnical engineer during the inspection.

Toxic materials and petroleum products will be stored in sealed steel or plastic drums or larger 1000 L bulk containers. Chemicals, such as glycols, solvents, paints, are to be stored in marked steel or plastic drums.

No food-based products or wastes are to be stored in the HWTA.

4.2 Landfill

In 2011, Shear will review the location of the landfill to determine the most suitable placement for future disposal with the intent to relocate to Waste Dump as originally described in Appendix H of the Environmental Impact Statement (EIS, TDC 2003). The landfill will receive inert wastes such as conveyor belts and tires, plastics, scrap metal, sandblasting residue, incinerator ash, and cleaned crushed drums from Jericho mining and maintenance operations. Landfill waste will be promptly covered with intermittent fill to limit exposure to wind and make inert wastes inaccessible to wildlife. Combustible non-hazardous wastes will be stored in the burn pit for scheduled burning. Further information on landfill management can be found in the Jericho LMP.

The incinerator and temporary waste storage area are housed in a watertight, animal-proof enclosure. Incineration will only be conducted on very light wind or no wind days. Incinerator ash will be collected and transported to the landfill. The operation and maintenance manual for the forced air incineration system is included in Appendix A.

4.3 Wastewater Treatment Plant

The wastewater treatment plant (WWTP) was installed in 2005 by the mine's previous owners. It is housed in an insulated metal clad building adjacent to the accommodations complex within the Processing Plant Area. The WWTP was designed to treat the domestic wastewater from a camp serving 200 occupants, and was previously operated by site maintenance personnel.

The treatment system enhances the biological degradation of the organic substance wastewater by supplying sufficient oxygen and microorganisms under a controlled environment. The treated wastewater will be discharged into the PKCA. The treated sludge from the WWTP will be stored in a dedicated cell in the Jericho landfill facility for possible use as soil amendment during reclamation activities.

4.4 Landfarm

Landfarming is an ex situ bioremediation treatment that uses naturally-occurring microorganisms (predominantly aerobic) to metabolize or breakdown PHC in impacted sediments or soils. Remediation is achieved by spreading impacted soils in a thin layer across the landfarm area. Stimulation of microbial growth and activity for PHC removal is accomplished primarily through the addition of air and nutrients. End products of bioremediation are microorganism protein, carbon dioxide, and water.

PHC-impacted sediments and soils will be placed in the landfarm area, with the potential addition of sewage sludge, for soil treatment. PHC impacted snow, ice, and subsequent meltwater, along with PHC-impacted rock wash water will collect in the landfarm sump areas and treated to meet discharge criteria to the PKCA. A description and design of the landfarm and its operation can be found in the Jericho Landfarm Management Plan (LFMP, EBA 2011f) and the Jericho Landfarm Design Plan (LFDP, 2011o)

4.5 Identification and Signage

All waste storage areas will be clearly marked and labelled with appropriate signage. Within the storage areas, wastes will be segregated and labelled to ensure safety for handlers and appropriate waste disposal.

5.0 HAZARDOUS WASTE TRANSFER AREA OPERATING PLAN

5.1.1 Objective

The Jericho HWTA Operating Plan has been developed to provide operating guidelines, in compliance with federal and territorial legislation, for collecting, sorting, packaging, and storing hazardous and non-hazardous waste at the HWTA for transport and off-site disposal. The HWTA is a short-term waste management area and should not be used for long-term waste storage.

The primary objective of the plan is to provide Shear and their designated contractors with operational guidelines to minimize physical and biological impacts at Jericho through:

- Appropriate inventory control, storage, handling, and transport procedures of hazardous waste within the HWTA; and
- Winter backhaul prioritization of hazardous waste to a registered hazardous waste receiver or management facility.

The HWTA is described in Section 4.0 and is presently located north of Carat Lake on Airstrip Road as shown in Figure 1.

Shear will review the functionality of the current facility during care and maintenance and develop a sorting system to aid in waste segregation, inventory and access. The dry storage facility will be secured at all times to prevent wildlife access and improper placement of materials within the waste facility. Access to the HWTA will be controlled to prevent improper handling and placement of hazardous wastes by unqualified personnel. This will minimize the risk of potential damage to the liner within the facility.

The HWTA Operating Plan includes:

- A summary of safety procedures;
- Identification of management responsibility;
- A summary of HWTA personnel general duties; and
- Itemization of inspection and monitoring.

5.2 Safety Procedures

In addition to adherence to the Jericho Health and Safety Plan, personnel in charge of operating the HWTA must have valid WHMIS and *Transportation of Dangerous Goods* (TDG) training. They must also be trained in the procedures associated with waste management, including the use of safety equipment (first aid supplies, eyewash station, fire extinguisher, spill response materials, etc.), emergency response procedures, safe waste storage and handling procedures, safe solid and liquid waste sampling and characterization procedures, and record-keeping. It is recommended that activities involving hazardous waste be conducted under the supervision of site personal having a 40-hour *Hazardous Waste Operations and Emergency Response Standard* (HAZWOPER) or *Canadian Hazardous Waste Workers Program* certificate.

Prior to handling wastes, personnel will be provided with a clear explanation as to the nature of the contamination at the facility and the site-specific personal protective equipment (PPE) required to complete the assigned tasks. If the nature or degree of contamination is such that respiratory equipment is required, personnel must be provided with task-appropriate respiratory protection and properly fit-tested prior to starting work at the landfarm facility. The selection of PPE is the responsibility of the site Occupational Hygienist, Corporate Safety Officer, or equivalent.

Personnel will also be trained in how to decontaminate equipment and PPE. Washing hands prior to eating, smoking, etc., and showering at the end of the work day is mandatory after handling any type of waste.

Personnel are encouraged to watch for and immediately report any unsafe conditions or damages to the HWTA, especially tears in secondary containment structures and leaking storage containers.

Annually, Jericho emergency response staff should carry out spill response drills at the HWTA. Results of emergency response drills are recorded and forwarded to the mine and plant managers, and the Health and Safety Committee. Drill results may indicate additional, or refresher, training is required. Safety Committee recommendations will be enacted expeditiously.

5.3 Management Responsibility

The Environment Manager, who reports to the VP Operations, will be responsible for managing the HWTA, adhering the Jericho Health and Safety Plan, and following the Safety Procedures outlined in Section 5.2. Any changes in HWTA procedures or operation must be approved by the Environment Manager. When the Environment Manager is not on site, responsibility will fall on the camp services manager or designate.

The Site Manager or equivalent is responsible for selecting respiratory PPE.

5.4 Hazardous Waste Transfer Area Monitoring and Reporting

As part of Shear's due diligence program, an internal monitoring and reporting process is to be put in place at the Jericho. The program actively promotes the interrelationship between HWTA personnel and management so that information, resources and finances can be directed effectively.

Records of daily waste inventory and inspection should be filed in the Environment Department office. Any accidental damage to containment structures and/or waste packaging will be inspected immediately and appropriate repairs undertaken. The extent of damage will be reported in writing to the Environment Manager, or alternate, along with the remedial repairs affected together with the date of repairs and any follow up inspection.

The hazardous waste manifest for tracking the hazardous waste will be developed. The records of handling and shipping hazardous waste will be kept on site for mine inspections, and will be included in the annual report. A standard operating procedure (SOP) for hazardous waste handling, storage, and shipment will also be developed.

5.4.1 General Duties

The general duties of the HWTA personnel are identified in Table 5.

Table 5 General Duties for Waste Transfer Personnel

Item	Inspection
HWTA	Ensure access to the HWTA is controlled.
Waste Collection	Collect and transport waste storage containers from site to HTWA.
Inventory Waste	Identify, inventory, and log all incoming waste, including volume or weight
Sort Incoming Waste	Sort and package waste for storage in segregated HWTA.
Label and Prepare Waste	Label and prepare waste for backhaul to approved disposal facilities.
Housekeeping	Ensure housekeeping of the HWTA is maintained.

5.4.2 Inspection

The daily inspection duties of the HWTA personnel are identified in Table 6.

Table 6 Daily Inspection Schedule for Waste Transfer Personnel

Item	Inspection
HWTA	Inspect for evidence of unauthorized access by personnel.
Storage	Ensure waste collected is stored within appropriate segregated areas.
Waste Packaging	Ensure no leaks or damage of waste packaged within the HWTA.

In addition, HWTA personnel should conduct a thorough weekly inspection, including adjustments to any inventory and an assessment of all safety and environmental impacts, and submit the minutes to the site services manager and safety concerns to the health and safety committee.

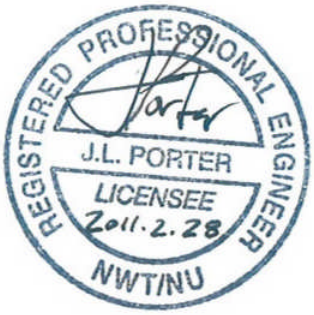
The site services manager, environmental services manager, and environmental health and safety manager should inspect the following items in Table 7.

Table 7 Inspection Schedule for Management

Item	Inspection
HWTA including Secondary Containment	Monthly by the site services manager; weekly by the environmental services manager to ensure compliance.
Spill Kits	Monthly by the site services manager; weekly by the environmental health and safety manager.
Hazardous Materials Storage	Monthly by the site services manager; weekly by the environmental services manager.

6.0 CLOSURE

EBA, A Tetra Tech Company



Michelle K. Blade, B.Sc., Geol.I.T.
Environmental Scientist
Environment Practice
Direct Line: 780.451.2130 x307
mblade@eba.ca

Jason Porter, MPhil, P.Eng.
Senior Project Engineer
Direct Line: 780.451.2130 x556
jporter@eba.ca

Ken E. Armstrong, P.Eng.
Senior Environmental Consultant
Environment Practice
Direct Line: 780.451.2130 x250
karmstrong@eba.ca

Reviewed by Shear Diamonds Ltd.

Michelle Tanguay
Environment Manager
Shear Diamonds Ltd.

Allison Rippin Armstrong
Director of Environment and Permitting
Shear Diamonds Ltd.

2011 WATER LICENCE RENEWAL DOCUMENTS

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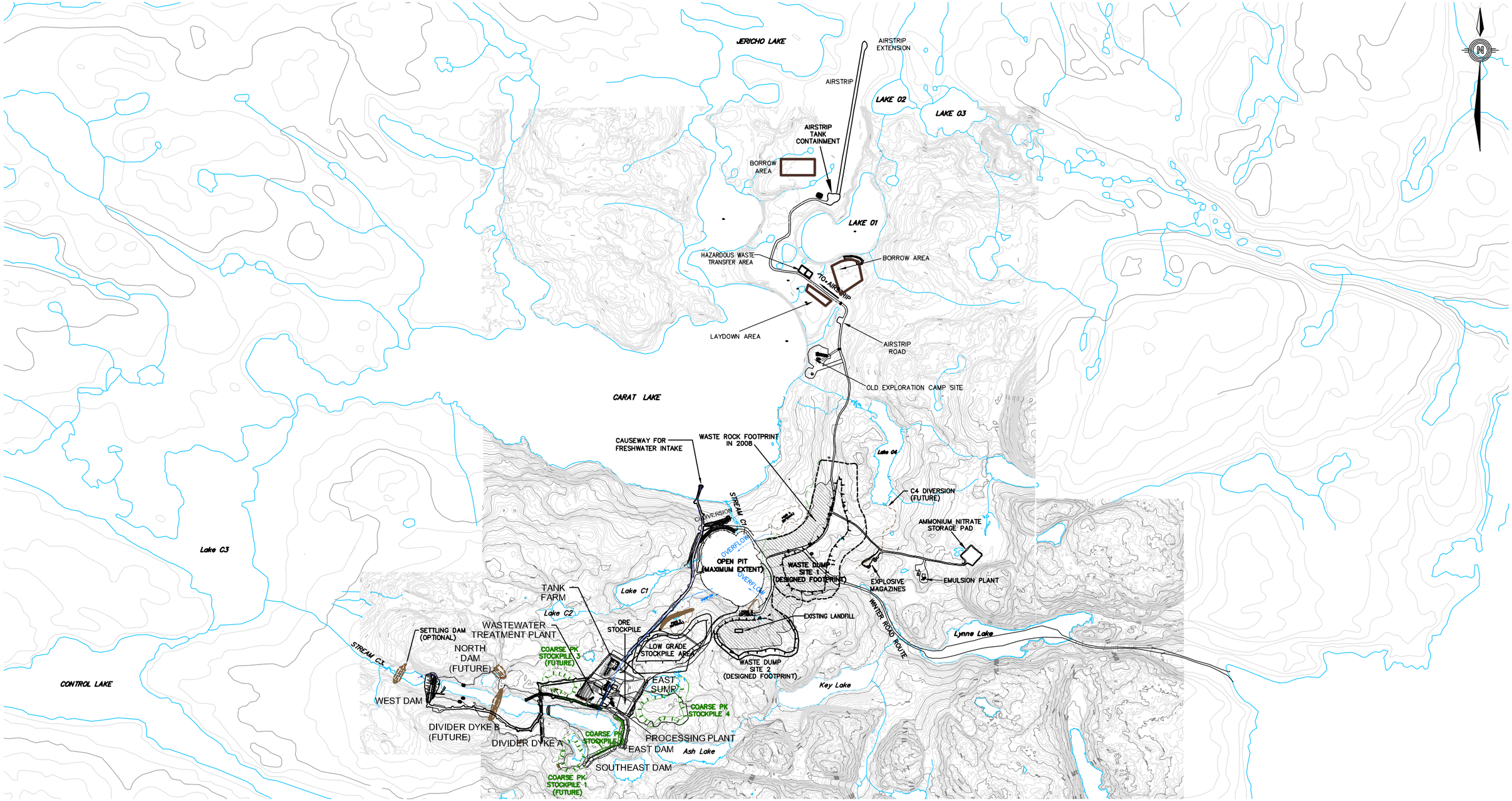
FIGURES



NOTES:

1. LAYOUTS ARE APPROXIMATE, AND MAY NOT REFLECT ACTUAL SIZE AND LOCATIONS
2. FOOTPRINTS OF WASTE ROCK PILES, COARSE PK STOCKPILES, AND ORE STOCKPILES ARE SHOWN IN MAXIMUM LIMITS, ACTUAL FOOTPRINTS MAY VARY

0 1 000
Scale: 1: 25 000 (metres)

STATUS
ISSUED FOR USE

CLIENT
SHEAR DIAMONDS LTD.

WASTE MANAGEMENT PLAN
JERICHO DIAMOND MINE, NUNAVUT

GENERAL SITE PLAN

eba
A TETRA TECH COMPANY

PROJECT NO.	DWN	CKD	REV
E14101118	TK	JS	0
OFFICE: EBA-EDM	DATE: February 25, 2011		

Figure 1

Hazardous Waste

Are you transporting a hazardous waste?

Manifesting & Registration

Environmental Protection Service

Road

NU Department of Community Government & Transportation

Air, Rail, Marine

Transport Canada

Is it a Class 1: Explosives under TDGR?

Natural Resources Canada

Is it a Class 7: Radioactive under TDGR?

Licencing

Canadian Nuclear Safety Commission

Handling & Disposal

Canadian Nuclear Safety Commission

Is it associated with drilling, production, or transmission of oil and gas?

National Energy Board

Is it Polychlorinated Biphenlys (PCBs) or from a Federal facility or land?

Environment Canada

Is it associated with a water licence or a land lease/permit/ development proposal outside municipal lands?

Federal

Department of Indian and Northern Affairs Canada

Claimant Lands

Claimant Groups & Board

Is it associated on Commissioner's Land (GN), lands administered by municipal governments or a GN facility?

Environmental Protection Service

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
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WASTE MANAGEMENT PLAN
JERICHO DIAMOND MINE, NUNAVUT

Primary Regulatory Contact for Hazardous Waste Management

PROJECT NO.	DWN	CKD	APVD	REV
E14101118	CLS	JP		0

OFFICE	DATE
EBA-EDM	February 2011

Figure 2

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START

Do you generate a waste dangerous goods under TDGR? Section 1.1

NO

YES

Is the waste:
i) household in origin
ii) returned directly to the manufacturer/supplier for reprocessing, repacking or resale
iii) include in class 1, Explosives, or class 7, Radiocative materials under TDGR Section 1.1

YES

NO

Do you generate less than 5kg or L/mth & total quantity accumulated <5kg or L at any one time? If the waste is mercury or is in class 2, 3, 5.1, 6.1 under TDGR -
Do you generate less than 1kg or L/mth & total quantity accumulated <1kg/L at any one time?

YES

NO

Is the waste intended for disposal in a sewage system or landfill and is below the applicable standards set ou in Schedules I, III, or IV of the Guidelines for Industrial Waste Discharges in Nunavut? Section 1.1

YES

NO

Not subject to Guidelines for the General Management of Hazardous Waste

Subject to Guidelines for General Management of Hazardous Waste

Storage
Section 3.2/3.3

Facilities used other than storage Section 3.4

Consult EPS Section 3.4

Register with EPS
Section 3.4

Long term storage conditions
>180 days & exceeds schedule II volumes Section 3.4

Short Term Storage conditions
<180 days & does not exceed schedule II volumes

Inform
Local Fire Chief

Container & Storage requirements
Section 3.2/3.3

Management Options including pollution prevention
Section 4

On Site

Off Site

Treat waste generated on-site - acceptable management method
Section 4.1/4.2

Transport
- acceptable management method
- registered Hazardous Waste Mgmt. facility or receiver Section 4.2/4.3

Register
- generator/carrier/receiver
- obtain & fill out manifest
Section 3.5/3.6

Shipment

Nunavut
- approved facility
- approved method
Section 4.2/4.4

Out of Nunavut
- registered facility in receiving province
Section 4.3

LEGEND

NOTES

STATUS
FOR INTERNAL USE ONLY

CLIENT
SHEAR DIAMONDS LTD.

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WASTE MANAGEMENT PLAN
JERICHO DIAMOND MINE, NUNAVUT

Decision Flow Chart for Managing a Hazardous Waste

PROJECT NO.	DWN	CKD	APVD	REV
E14101118	CLS	JP		0

OFFICE	DATE
EBA-EDM	February 2011

Figure 3

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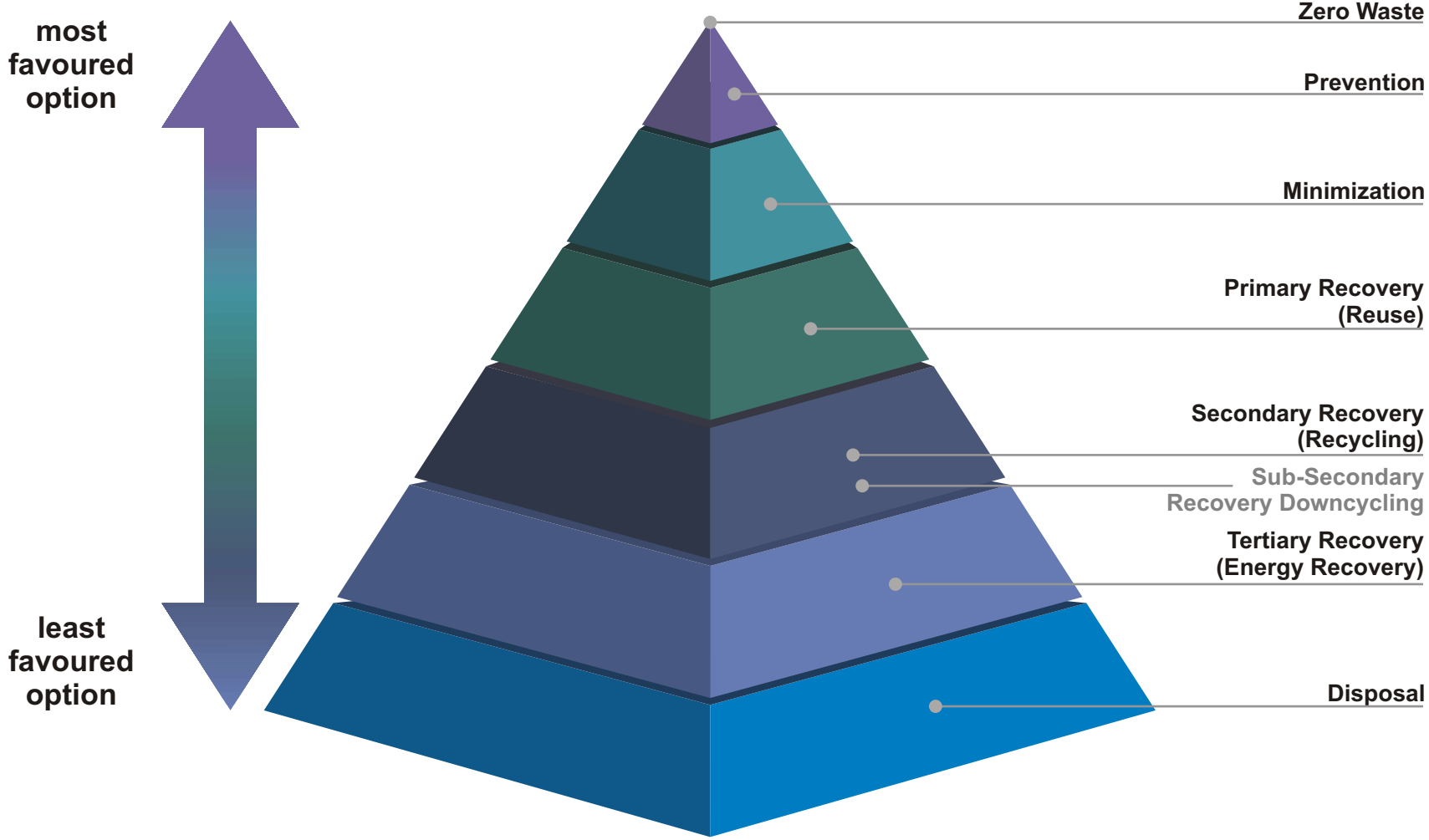

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WASTE MANAGEMENT PLAN
JERICHO DIAMOND MINE, NUNAVUT

Waste Management Hierarchy

PROJECT NO.	DWN	CKD	APVD	REV
E14101118	CLS	JP		0

OFFICE	DATE
EBA-EDM	February 2011

Figure 4

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APPENDIX A

APPENDIX A FORCED AIR INCINERATION SYSTEM OPERATING AND MAINTENANCE MANUAL

Forced Air Incineration Systems


SINGLE-CHAMBER


DUAL-CHAMBER

Operating and Maintenance Manual

Westland Environmental Services Inc.
20204 110 Ave. NW
Edmonton, Alberta
Canada T5S 1X8
780 447 5052
info@westlandenvironmental.com

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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.

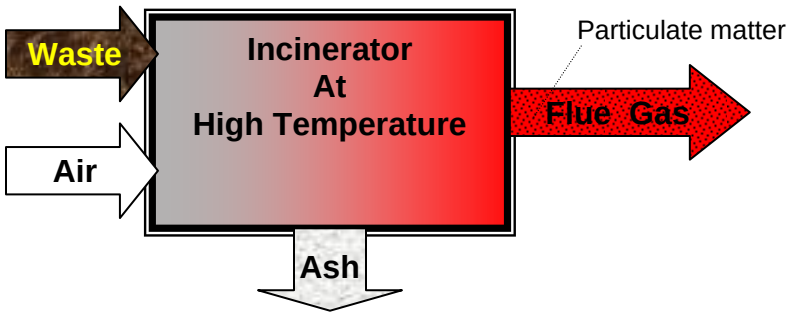

Figure 1 Schematic Diagram of Incineration Process

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.

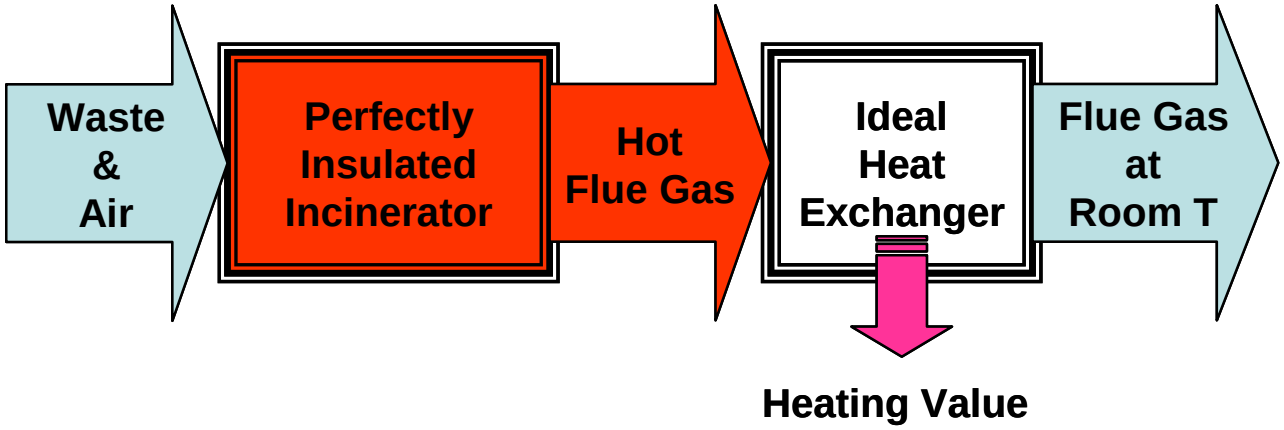

Figure 2 The Concept of Heating Value

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".

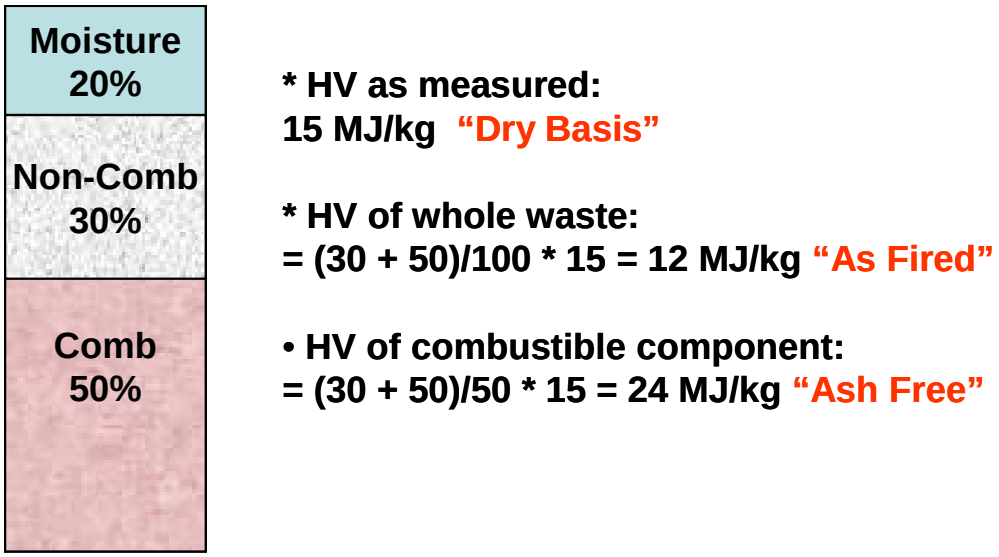

Figure 3 Different Bases for Expressing Heating Value (HV)

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.

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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										

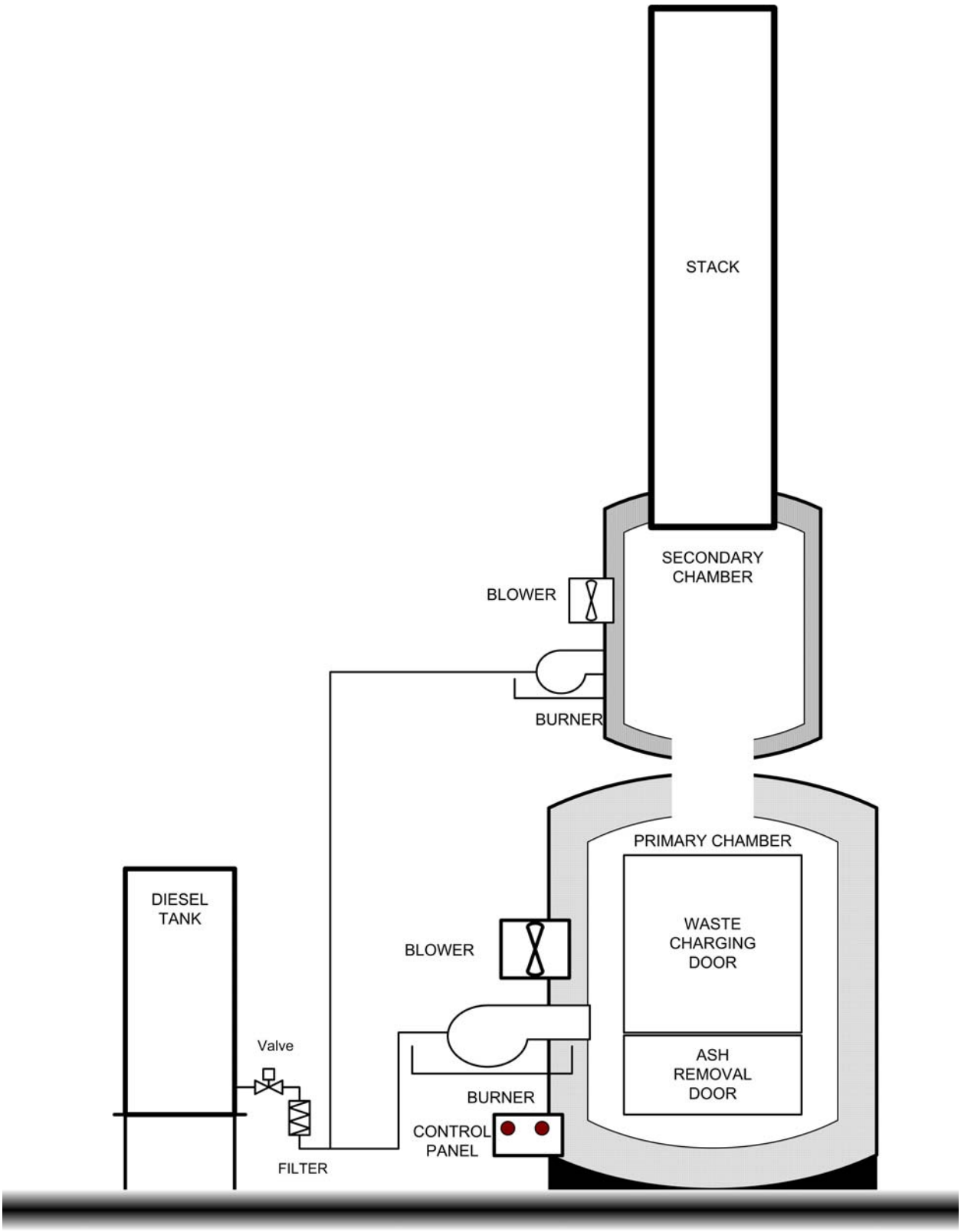


Figure 4 Schematic Diagram of Forced Air Dual-Chamber Design

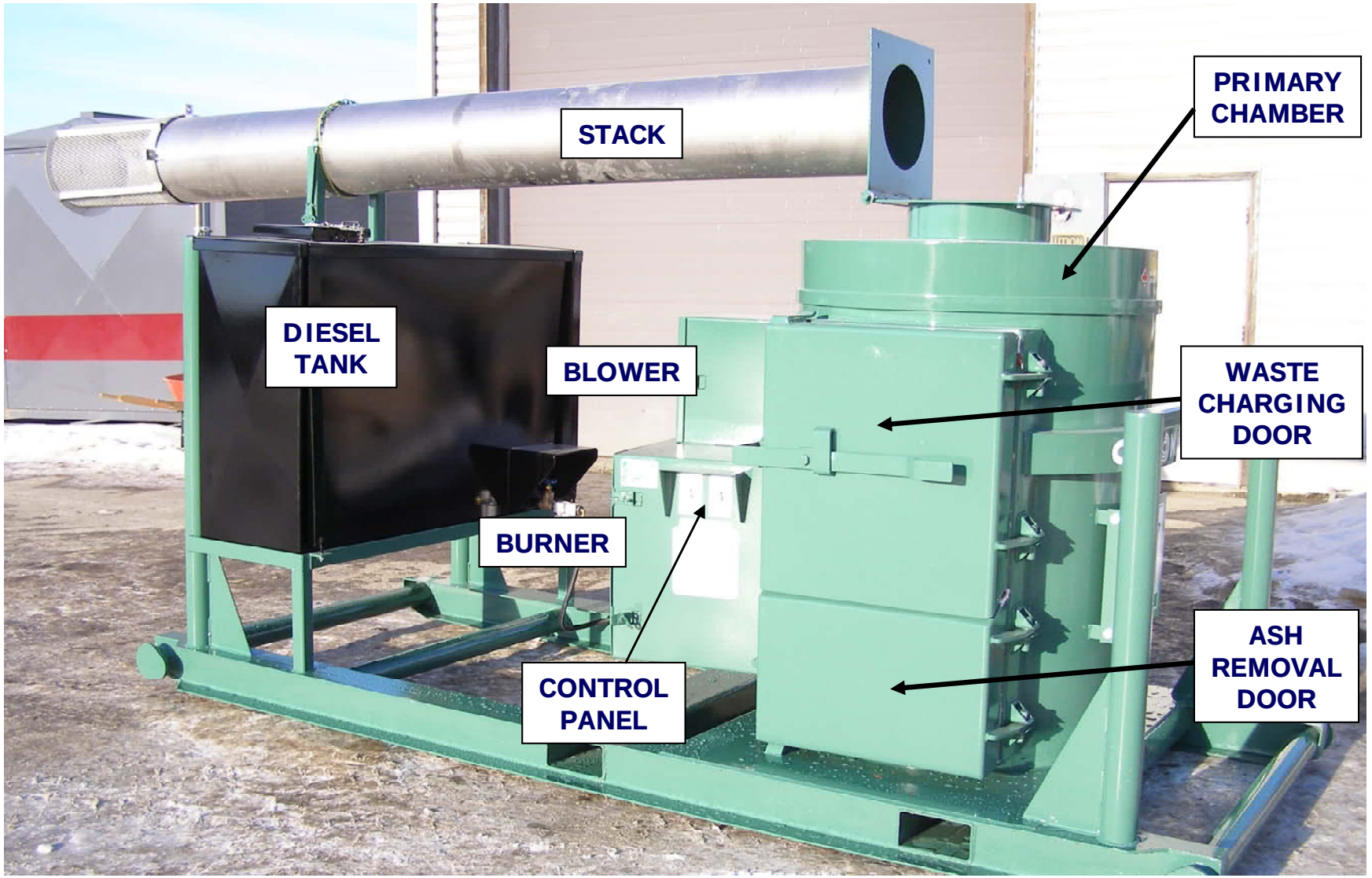


Figure 5 Photograph of the Single-Chamber Design

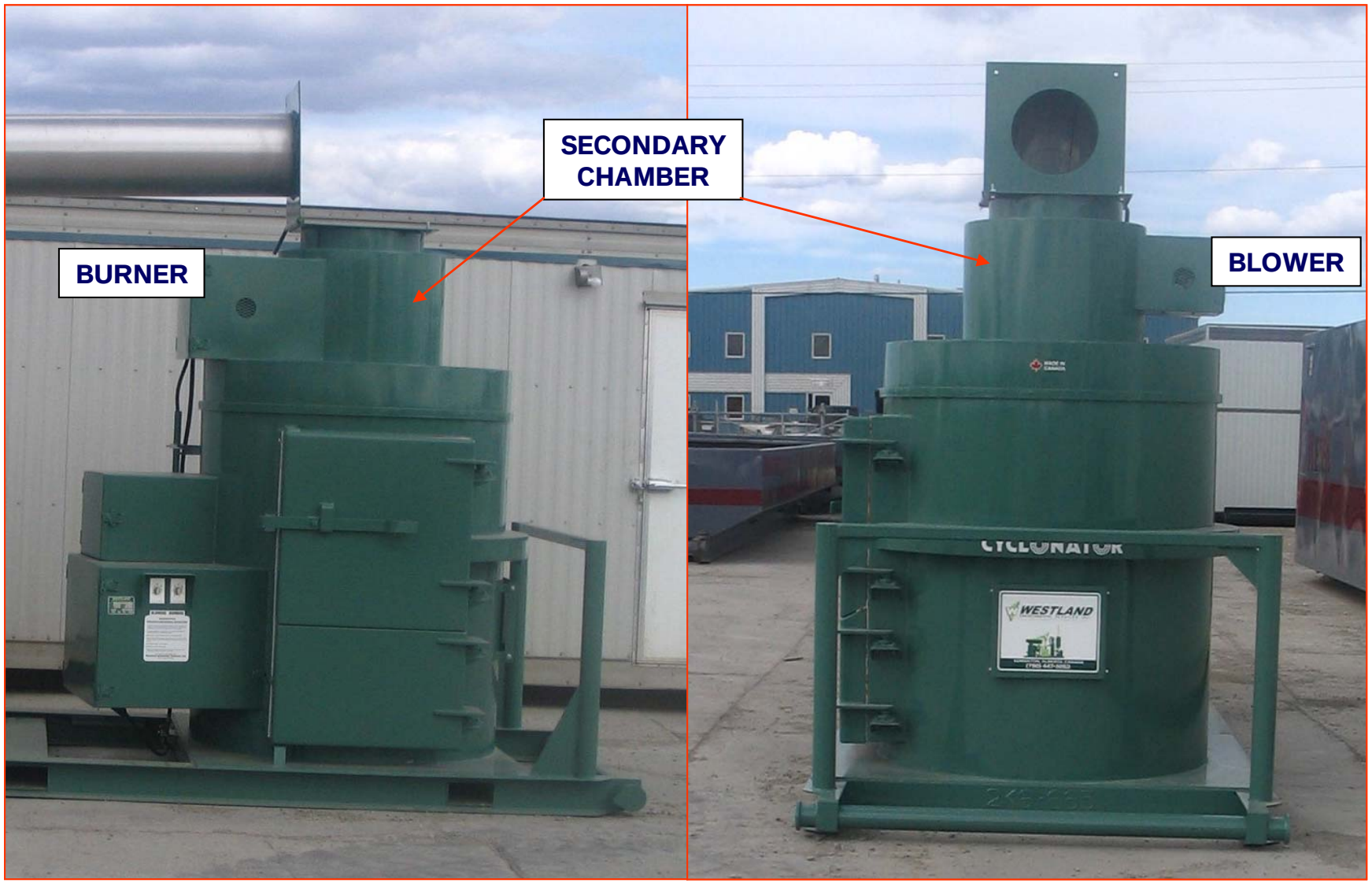


Figure 6 Photographs of the Dual-Chamber Design

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.

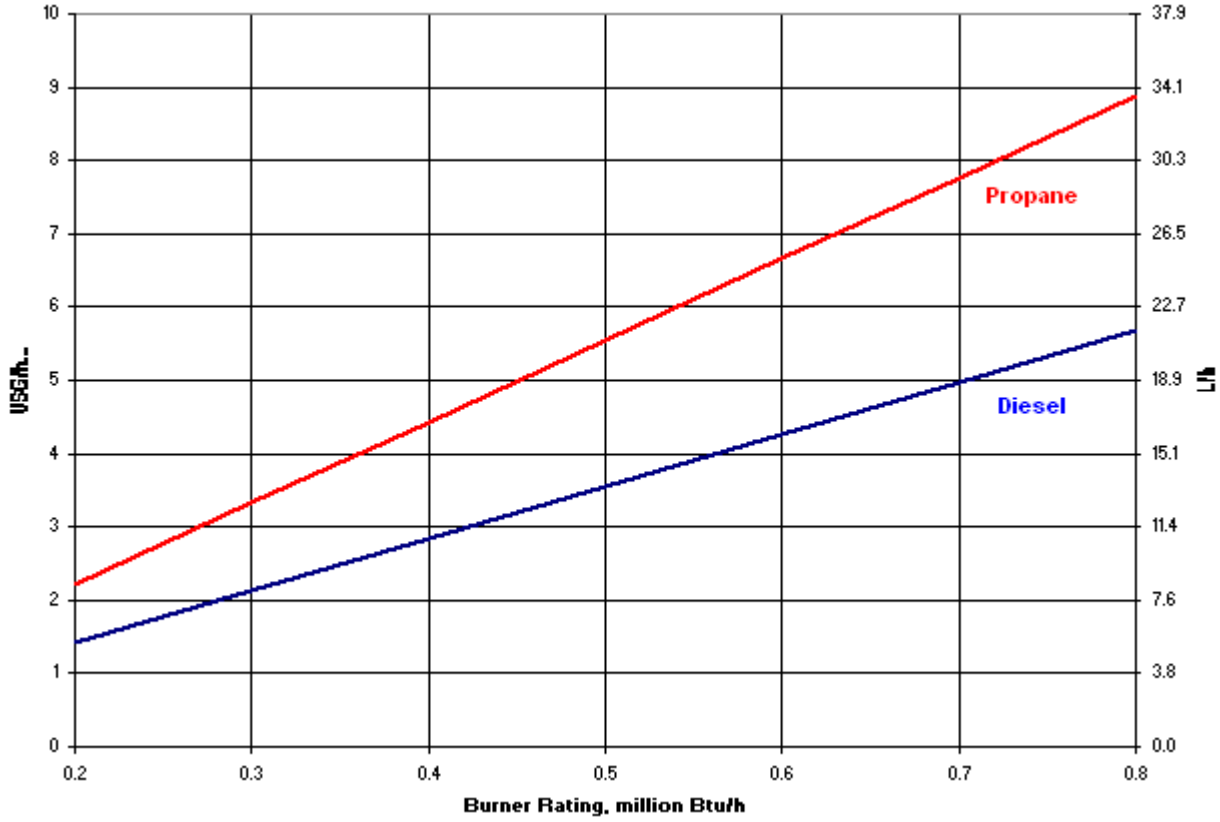


Figure 7 Consumption Rates of Propane and Diesel

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

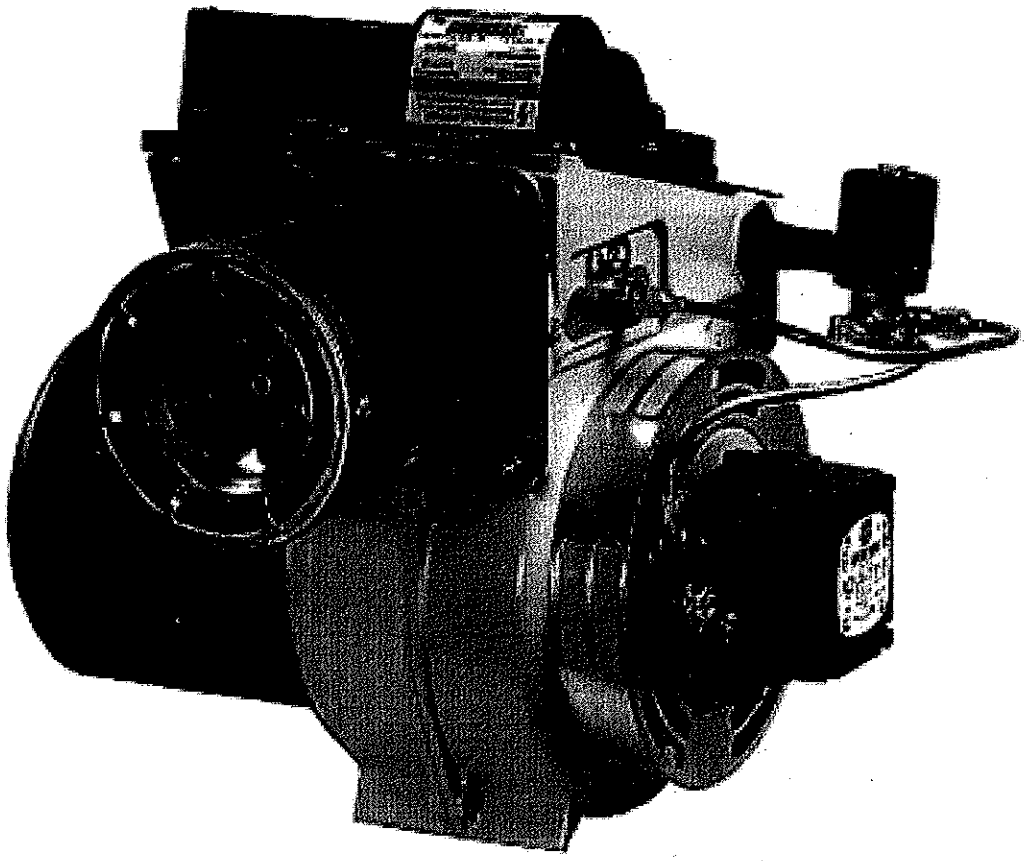
Forced Air Incinerator PARTS LIST
(CY 1013/1020/2020/1050/2050 FA "D")

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

20204 - 110 Ave, Edmonton, Alberta, T5S 1X8, Canada. Tel: (780) 447-5052, Fax: (780) 447-4912.
Visit us at: www.westlandenvironmental.com

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.

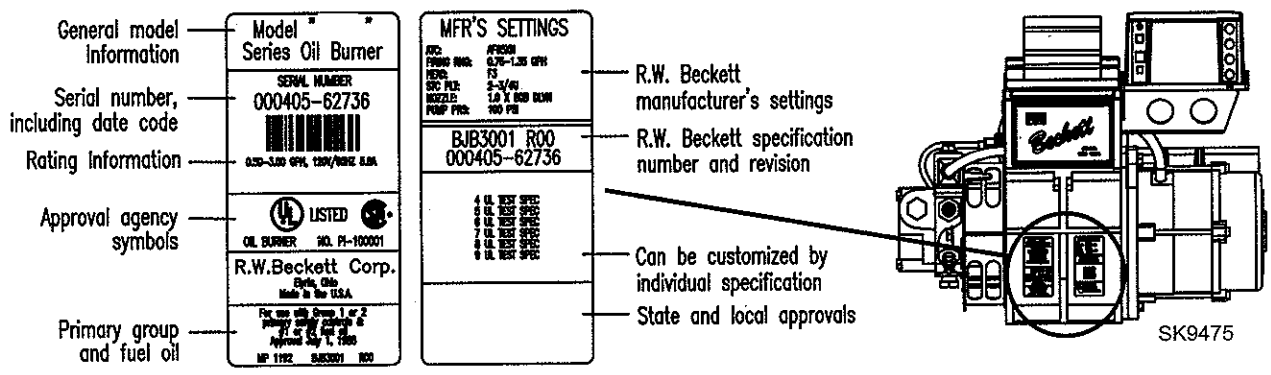
• Attach air tube (if not already installed)

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

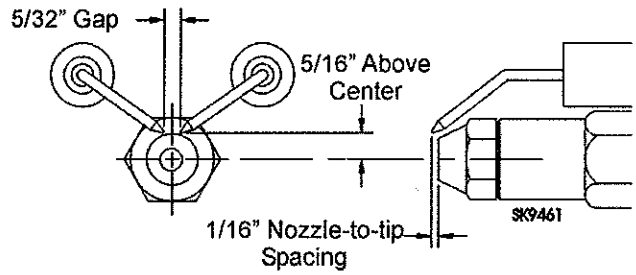
Recommended nozzle spray angles	
"F" head	70°, 80° or 90° nozzle

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.

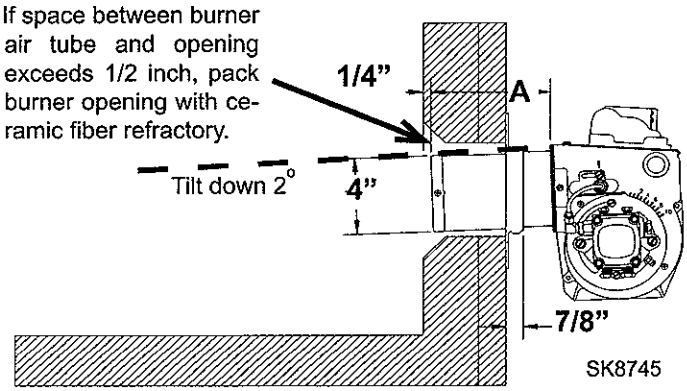
• Mounting options

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 anti-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

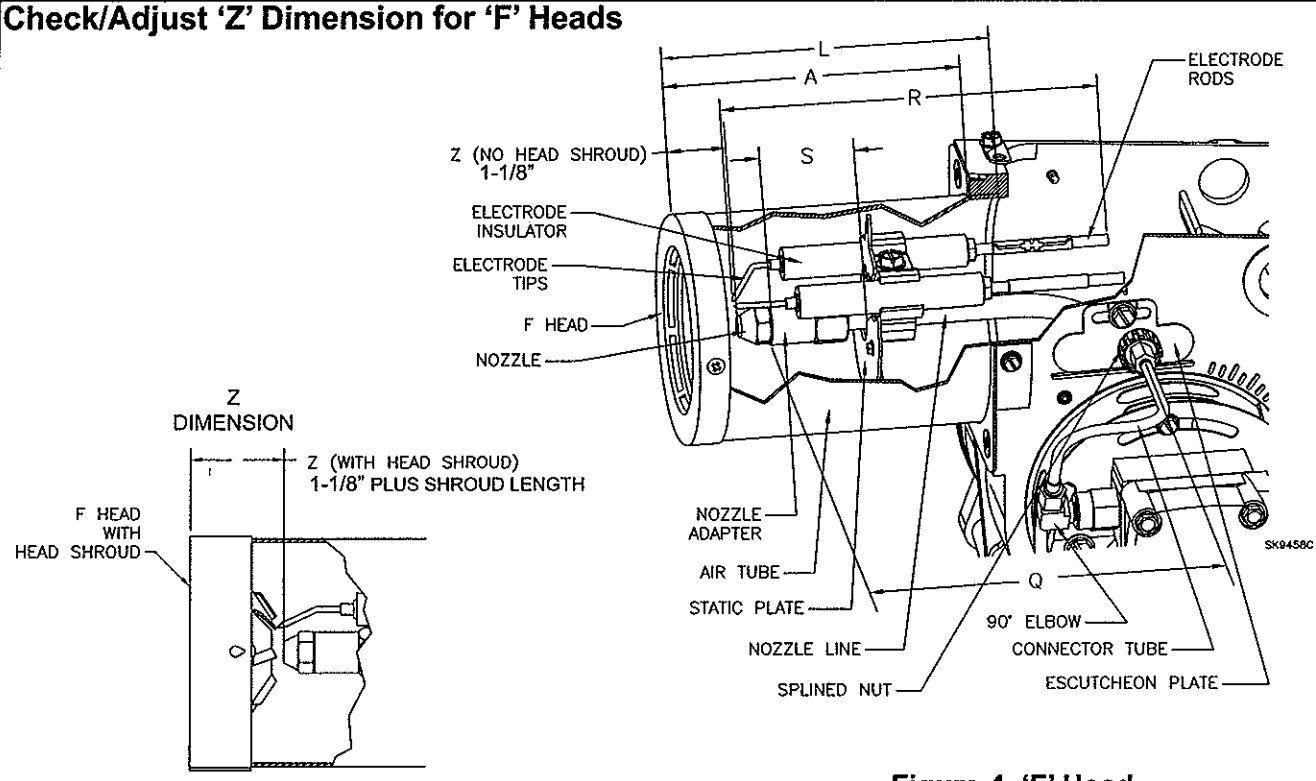


Figure 4. 'F' Head

• 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 shutoff 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.

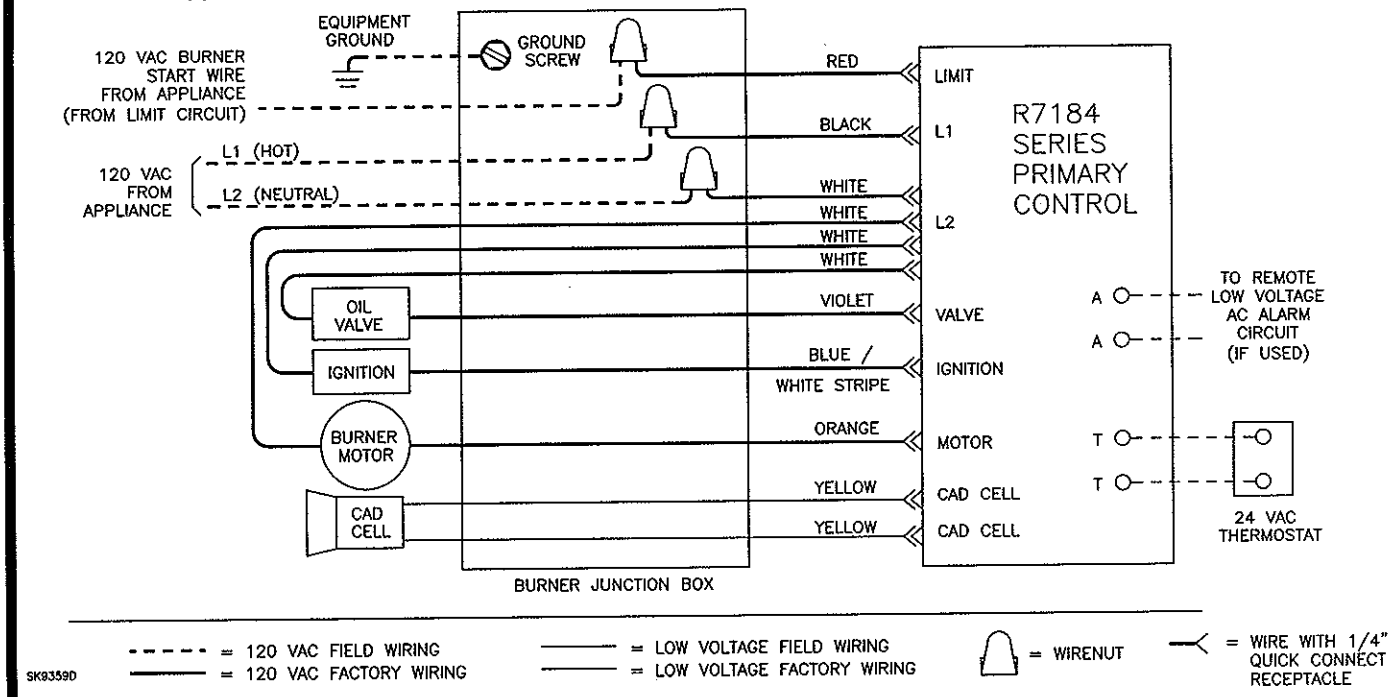
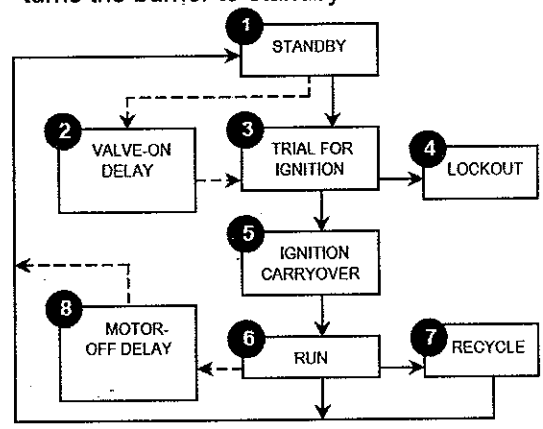


Figure 5. – Typical Burner Wiring

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.

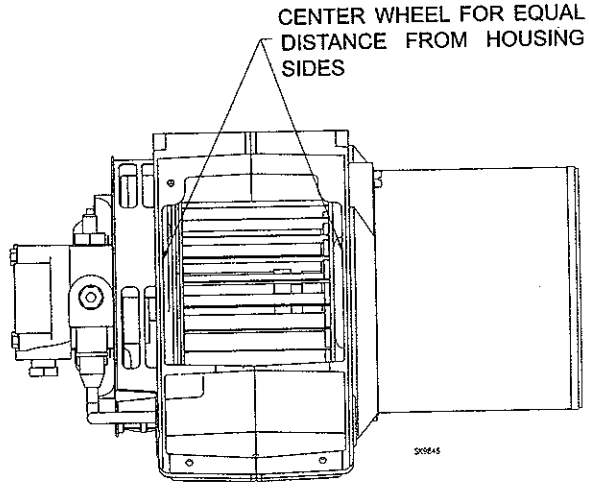
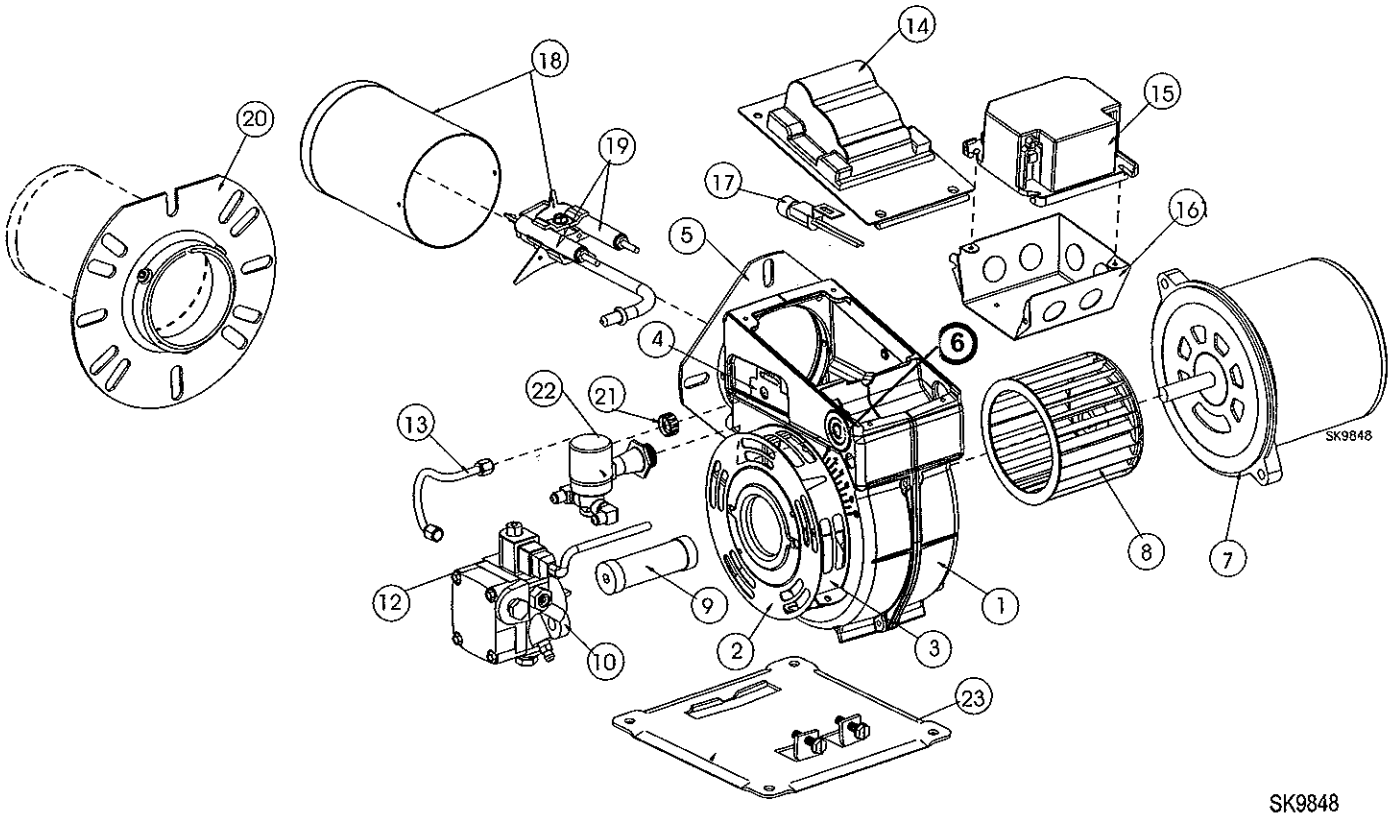


Figure 6. Blower Wheel Assembly

Burner Parts Diagram



For best performance specify genuine *Beckett* replacement parts

#	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	B60	700	-	-

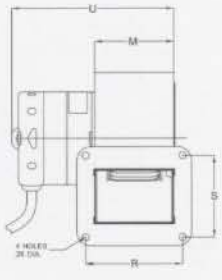
Tested by The Nozzle Chamber Method as directed in A.M.C.A. Bulletin #210. Figure #4.

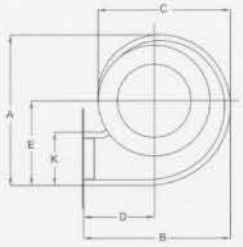
Features

115 Volt, 60 Hz

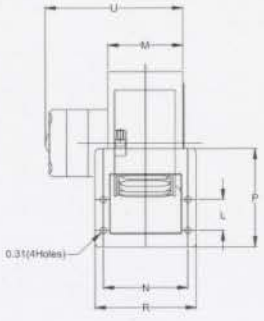
- Thermal overload protection
- Conduit wiring box
- Permanently lubricated bearings
- Horizontal or vertical operation
- Counter clockwise rotation drive side
- AMU 245, 400, 525, 625, 845 and 1100 supplied with inlet collars.
- Sleeve bearings with oilers
- 4 discharge positions

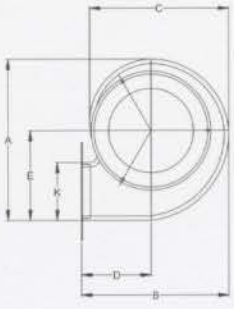
Specification Charts



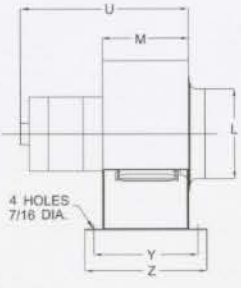


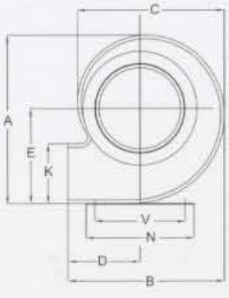
Description	A	B	C	D	E	K	M	R	S	U	Weight (lbs)
AMU 75	5.34	5.17	4.68	2.50	3.02	1.92	2.75	3.38	2.88	5.35	3.4
AMU 130	7.59	7.09	6.58	3.31	4.30	2.72	3.75	4.69	3.75	6.75	4





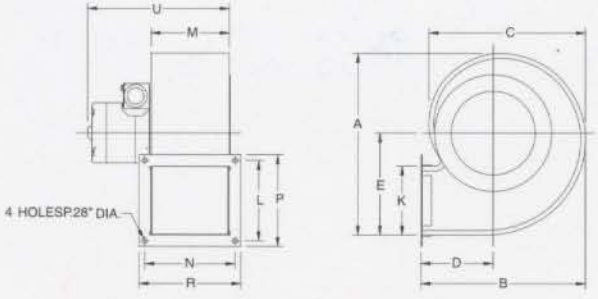
Description	A	B	C	D	E	K	L	M	N	P	R	U	Weight (lbs)
AMU 160	7.80	7.08	6.69	3.34	4.34	2.80	1.50	3.60	4.05	4.75	4.85	6.40	5.4



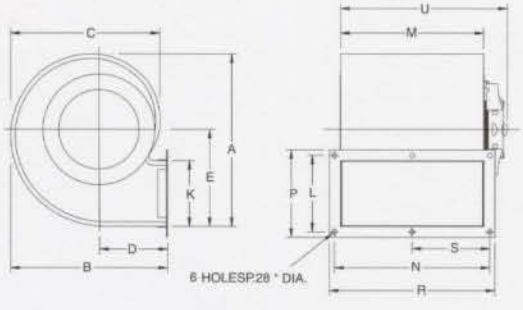


Description	A	B	C	D	E	K	L	M	N	U	V	Y	Z	Weight (lbs)
AMU 245	9.41	8.73	8.17	4.0	5.33	3.36	5.0	4.75	6.0	9.0	5.0	5.75	6.75	8
AMU 400	10.61	9.76	9.24	4.44	6.01	3.79	6.0	5.25	6.0	10.75	5.0	6.25	7.25	13

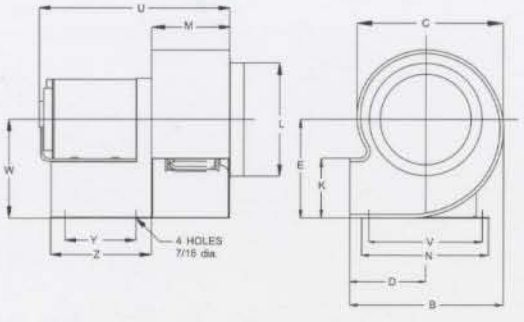
Specification Charts



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

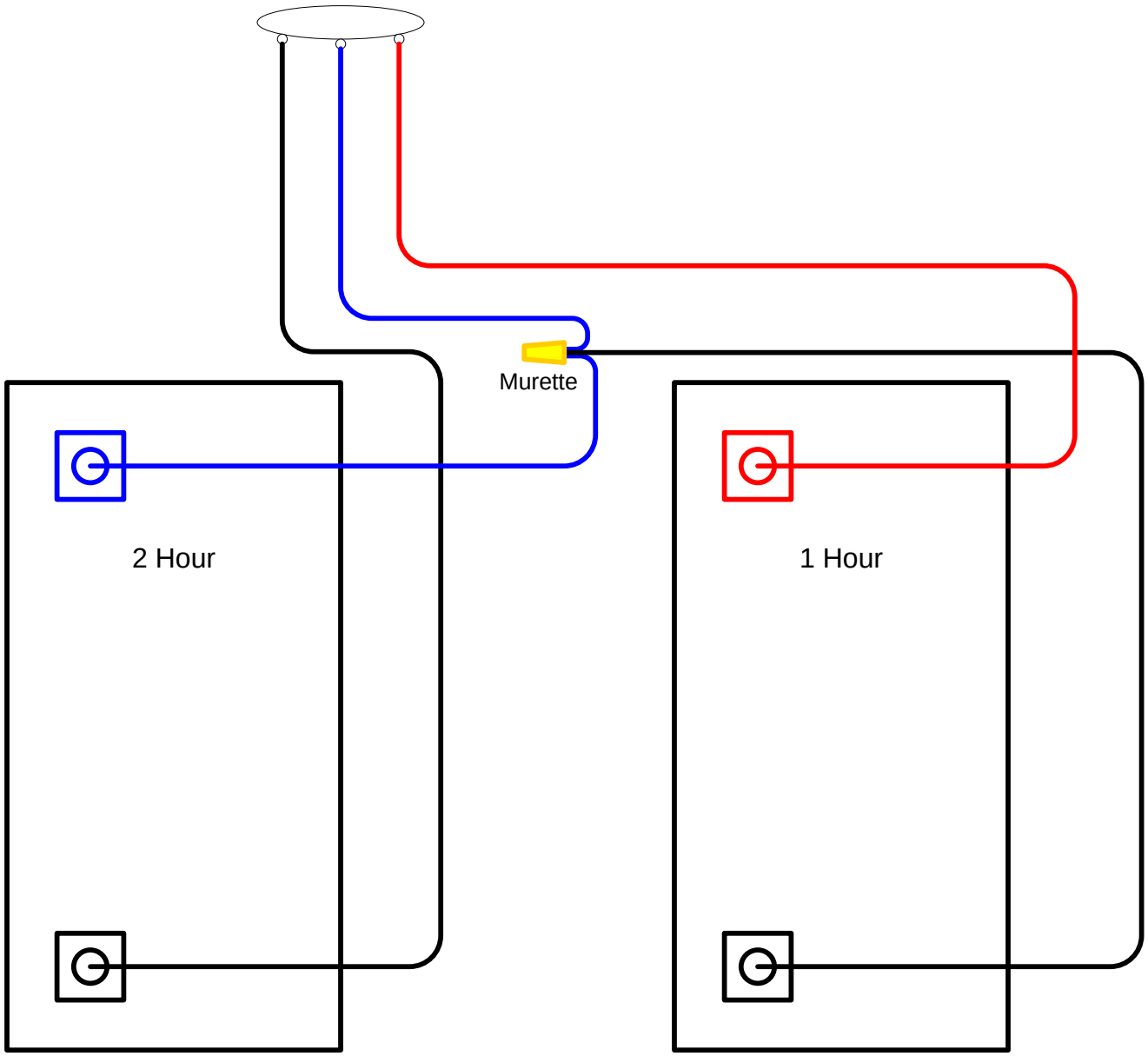


Description	A	B	C	D	E	K	L	M	N	P	R	S	U	Weight (lbs)
AMU 465	9.93	9.0	8.46	3.9	5.55	3.75	4.37	8.12	8.82	5.0	9.4	4.41	9.46	11.0



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”



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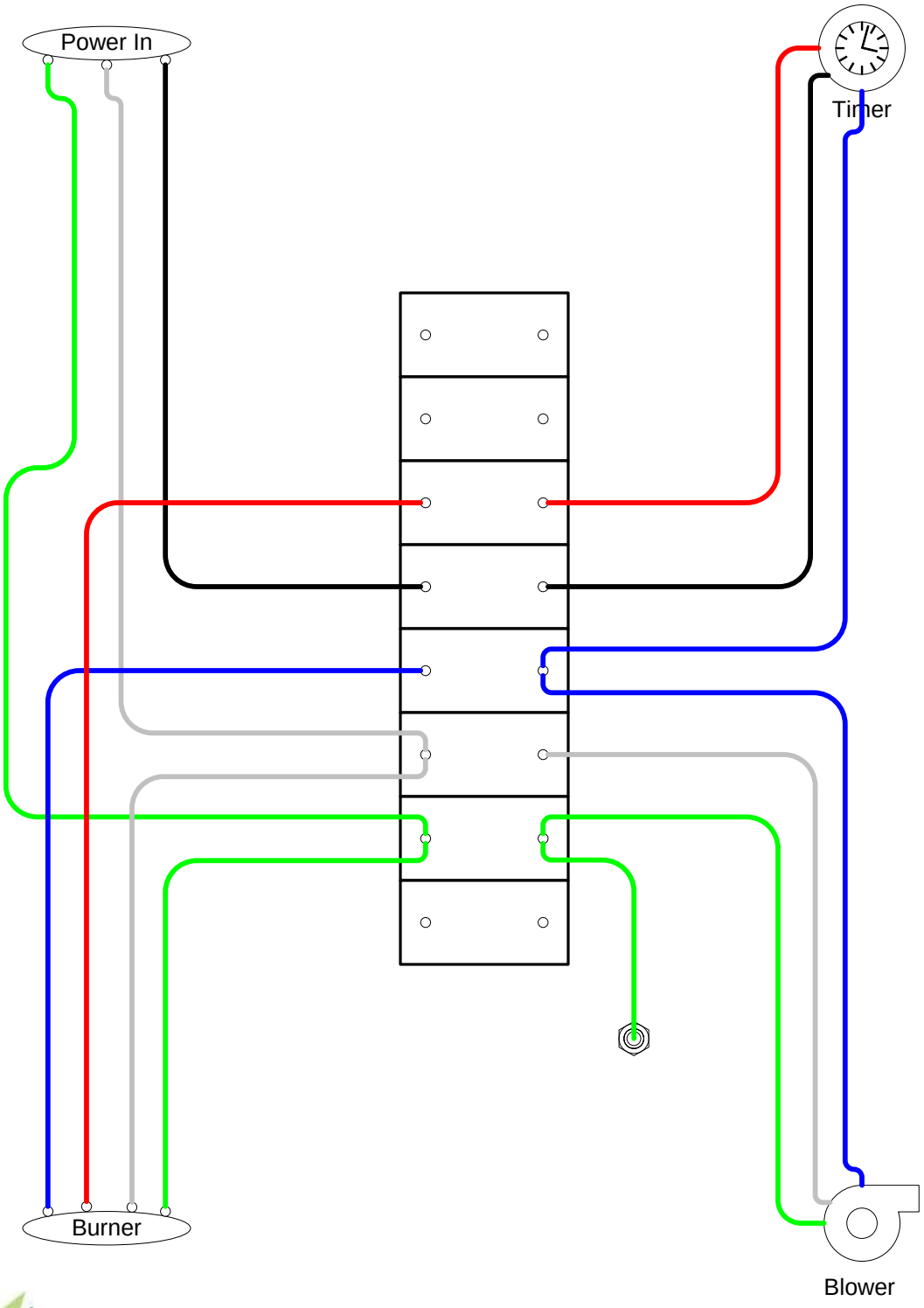
Burner Wiring (Beckett)
CY-1020/1050 FA”D”



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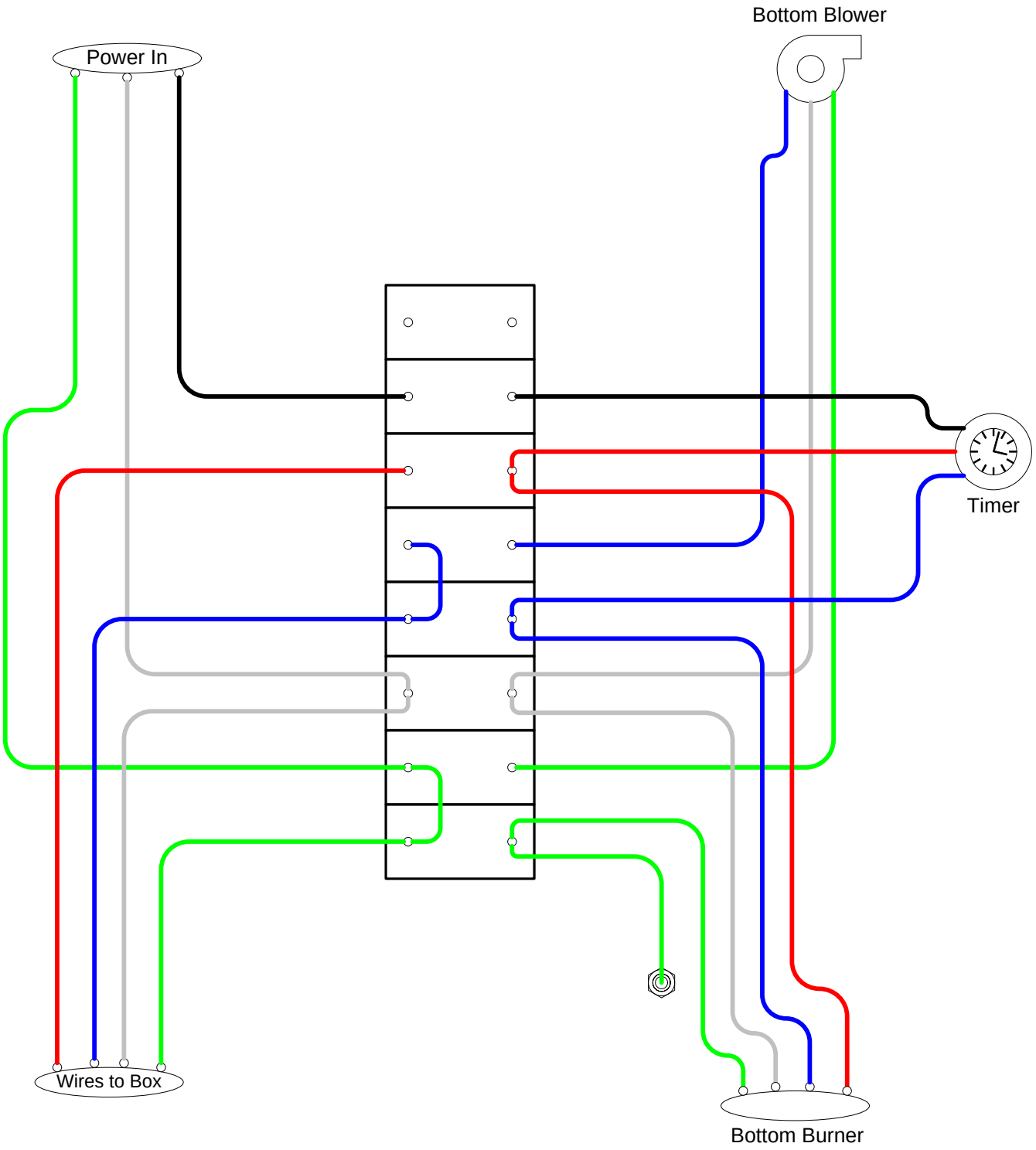
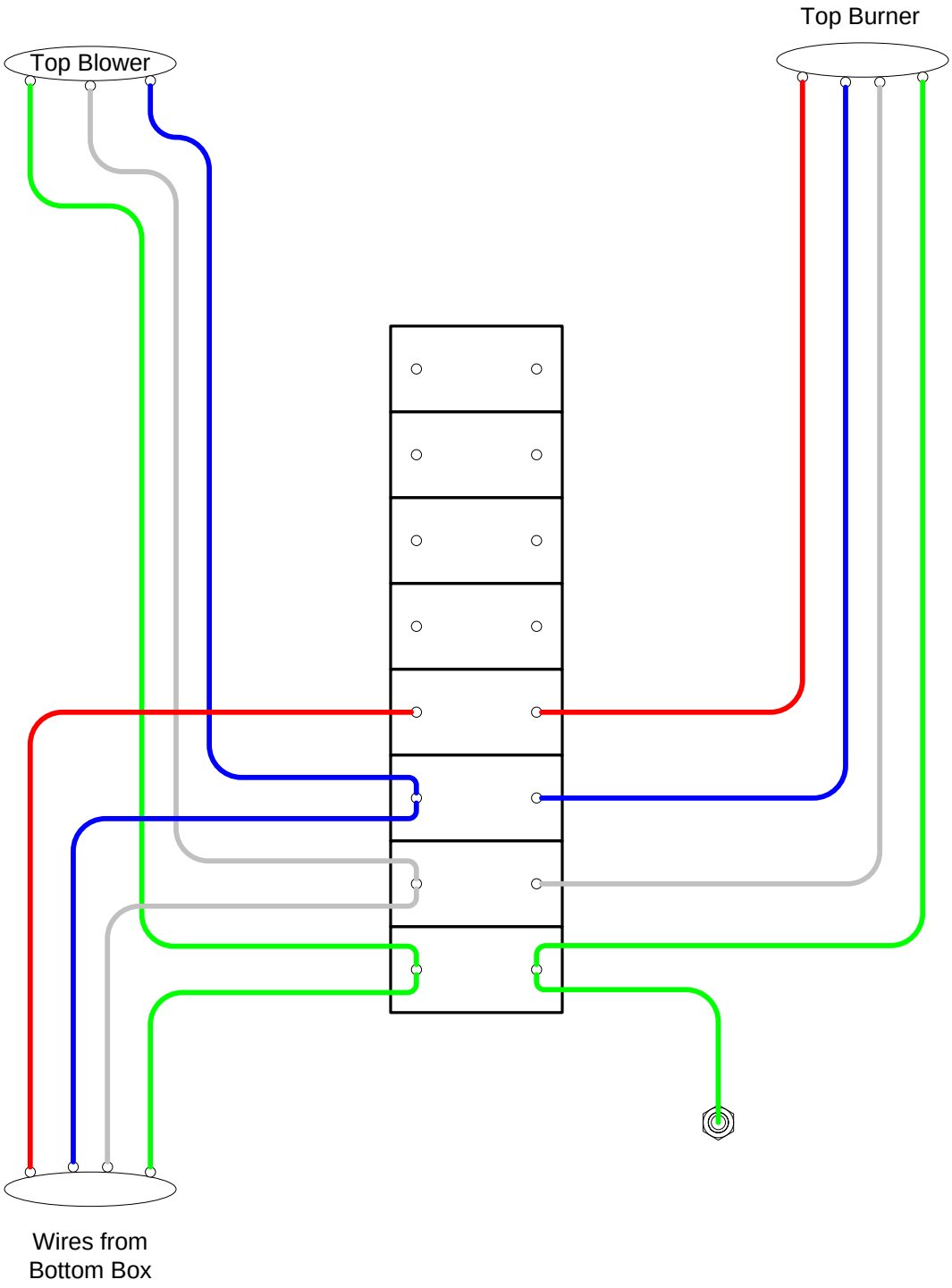
Wiring (Beckett)
CY-2020/2050 FA”D”
Bottom Box



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



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