

Memorandum



THE BOUTET COMPANY

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Date: April 12, 2007

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To: Dan Southard
MOA Street Maintenance

From: Donna E. Gryder-Boutet, PE

Subject: Snow Dragon Snow Melter Demonstration

On Thursday, February 22, 2007, the Municipality of Anchorage (MOA) Street Maintenance Division of the Maintenance and Operations Department hosted a demonstration of the Snow Dragon SND900 snow melting unit, presented by Yukon Equipment and the Snow Dragon manufacturers. This memorandum summarizes the effort put into the demonstration, the results of the demonstration, and the costs associated with melting snow with the SND900.

PREPARATION AND PERMITTING

The demonstration project was originally proposed in November of 2006. Initial efforts were put into determining disposal options available for water generated by the snow melting unit.

Research revealed that the generated water would not be allowed to enter the MOA storm drain system, as melting the snow artificially creates a "point source discharge". As such, the water from the snow melter would have to meet State of Alaska water quality standards prior to discharge either into the MOA storm drain system, or any fresh water or marine water environment.

A study of stockpiled snow collected from downtown Anchorage streets was performed during the winter of 2005-2006 (June 2006, *Evaluation of Snow Disposal into near Shore Marine Environments*, CH2M Hill, prepared for Alaska Department of Environmental Conservation). The extensive data collection effort provided a general characterization of contaminants found in snow collected within urban downtown Anchorage. Extrapolating this data, it was determined that there was a reasonable likelihood that snow melt water generated during the trial would exceed State of Alaska water quality standards for at least one parameter.

Considering these restrictions, the only feasible alternative for such a short term discharge was disposal via the MOA sanitary sewer system. None of the data reported by CH2M Hill exceeded Anchorage Water and Wastewater Utility (AWWU) permit limits.

Once a specific timeframe and location were determined, an application for a Temporary Discharge Permit was submitted to AWWU; a permit was issued February 21, 2007.

SNOW MELTING DEMONSTRATION

The morning of February 22, 2007, the SND 900 snow melting unit was set up at the west end of East 20th Avenue, west of Cliffside Drive. Eight truck loads of snow, each load containing approximately 14 cubic yards, was pre-staged near the snow melter. Approximately 500 gallons of water was placed in the melting hopper; once the water was heated to the necessary temperature, operators began loading snow into the unit.

At 10:45 am, discharge into AWWU manhole SW31533065 began. Flow was routed through bales of straw and sorbent booms placed around the manhole to screen sediment and hydrocarbons from the effluent; a small percentage of the effluent did not enter the manhole, but flowed overland to the west. Operators made every effort to minimize the amount of overland flow to the extent possible.

Temperature of the discharge at the manhole entry point was measured 11:05 a.m. No evidence of either sediment or hydrocarbons was observed in the effluent at any time during the melting trial. A 5-gallon sample of the stockpiled snow, which appeared relatively clean and free of debris, was collected to determine approximate snow density.

Three additional loads of snow were hauled in between 11:15 pm and 11:23 pm. At 1:53 pm, after it had been determined that fuel for the SND 900 was running low, two loads of snow were removed from the demonstration site. The SND 900 continued to operate until 2:05 pm, at which time the burner was shut down. Photographs taken during the demonstration project attached.

DATA COLLECTED

The following summarizes the information collected during the snow melting trial:

- Snow density was calculated to be approximately 32.6lb/ft³, which is relatively dense.
- The total volume of water discharged was approximately 13,850 gallons. This estimate was based on the following data and assumptions:
 - 9 truckloads of snow melted
 - 14 cubic yards of snow per truck load
 - 32.6 lbs/ft³ snow density
 - The 500 gallons of water added to the SND 900 was balanced by the effluent that escaped overland;
- Temperature of the discharge entering the sanitary sewer system was 60.2°F.

SNOW MELTING COSTS

The following costs were associated with the snow melting trial:

Total Cost of Demonstration Project

Labor	\$2,208.00
Equipment (trucks, loader, water truck)	\$968.00
Mobilization/Demobilization	\$1,000.00
Total MOA Cost	\$4,176.00
Fuel (250 gal x \$2.80/gal) (1)	\$700.00
Total Cost	\$4,876.00

(1) Fuel provided by vendor; per gallon cost is estimate only.

These costs do not include time spent on up front planning or permitting.

The following table presents the cost breakdown per cubic yard of snow.

Cost Per Cubic Yard of Snow

Total Cost	\$4,876.00
Total Snow Volume Melted (9 loads x 14 cy/load)	126 cy
Cost per Cubic Yard (\$4,876.00/126cy)	\$38.70/cy
Cost per Cubic Yard including AWWU fee (approximately \$0.22/cy)(1)	\$38.92/cy

(1) AWWU waived the \$2.00/1,000 gallon disposal fee for this demonstration project.

SUMMARY

Approximately 126 cubic yards of snow was melted over a period of three hours and 20 minutes; the volume of snow melted was limited by the available fuel. The manufacturer's representative did state that he thought the SND 900 burners were not operating at full efficiency; a full load of fuel should have powered the unit longer, allowing for more snow to be melted.

AWWU disposal fees of approximately \$0.22 per cubic yard of snow would be a small fraction of the overall cost of melting snow. Fuel cost alone for this demonstration project was \$5.55 per cubic yard; labor and equipment constituted the largest percentage of the total cost.

To make snow melting a feasible tool for dealing with large volumes of snow in Anchorage, the cost of hauling and storing collected snow would have to approach \$40.00 per cubic yard – more if the cost of fuel continues to rise.



Photo 1: Effluent control and screening prior to discharge.



Photo 2: Snowmelter effluent discharge.



Photo 3: SND 900 in operation.



Snow Dragon SND900 Spec Sheet

SPECIFICATIONS

Melt Rating	75 Cubic Yards per Hour (Based on 30lbs/cu ft snow density)
Fuel Type	No. 2 Fuel Oil or Diesel
Burner Output	9,000,000 BTU/hr
Fuel Usage	60 US Gallons per hour (max)
Fuel Capacity	250 US Gallons
Water Discharge Rate	120 Gallons per minute (max)
Water Tank Capacity	1,900 US Gallons
Weight Empty	Approx 12,700 lbs
Weight with Fuel & Water	Approx 29,000 lbs
Measurements	25'6" long x 8'5" wide x 6'10" high
Towing Speed	Empty 65 MPH / With Fuel 60 MPH / With Fuel & Water 50 MPH*

*Based on water level of 12"

STANDARD EQUIPMENT

1. Automatic ignition diesel fired 9,000,000 BTU/hr packaged burners.
2. Patent Pending engineered heat exchanger tubes.
3. Standard carbon steel inner dual weir system for debris separation.
4. Standard heavy gauge mild steel melting tank with structural steel supports.
5. Dual snow loading access on both sides of melter, each with 9'-10" of clearance.
6. Heated and lighted operating enclosures with lockable access door protecting equipment including burners, water pump spray system, and generator.
7. Lockable main control panel located on outside door panel for easy access.
8. Generator battery set up to be able to be plugged into a 110 outlet when not in use to power the generator block heater and optional battery charger.
9. Two (2) emergency shut down buttons located on both sides of the melter.
10. NEMA 4/12 main control panel with Honeywell temperature controller, visual and audible alarm indication, Honeywell high limit controller, pilot controls, indicators, gauges, relays and terminals.
11. Self contained diesel fired 20KW generator.
12. 200 gallons/min water recirculating stainless steel pump to mix and circulate water and to spray onto loaded snow.
13. Clean out hatch for easy cleaning.
14. Heavy duty tri-axle trailer with electric brakes, turn signals, marker lights and choice of ball hitch or pintal hook for towing arrangements.
15. Wood rail guards positioned on the melter to prevent damage to loading sides.
16. Quiet operation.
17. Equipment designed and built to comply with National Electric Code (NEC) and National Fire Protection Association.

OPTIONS AVAILABLE

1. Generator battery charger.
2. Stainless steel melting hopper and weir system.
3. Two (2) vibration resistance area/work floodlights.
4. Custom painting and/or decal of company logo.
5. Fifty (50) foot Fire Hose for fast and easy water start.
6. Service Contract
7. Articulating lift gate to allow a skid loader to be driven into the melting hopper.
8. As a custom engineered and manufacturing company, we can accommodate custom requests through our engineering department.

SNOW DRAGON™ SNOWMELTERS



SNOW DRAGON OVERVIEW

The Snow Dragon™ is the beginning of a revolution in the snow removal process. This “patent pending” commercial snow melting system will eliminate accumulated snow, even in the toughest conditions.

In 2004, Snow Management Group (the largest snow contracting firm in North America) teamed up with Park-Ohio Company (NASDAQ – PHOH), the world leader in oven and heat exchanger technology, to design an affordable, highly efficient and technologically advanced product for melting snow.

From this partnership evolved Snow Dragon™, LLC. With Park Ohio’s financial might and John Allin’s background in the snow industry, the Snow Dragon™ snow melting system is quickly becoming the standard in the industry.



Using the very latest advances in heat exchanger technology this product presents an economically viable solution to the very expensive and environmentally unfriendly process of physically hauling and relocating snow. Now in full production, Snow Dragon™ snow melters provide a cost effective alternative for snow contractors, facilities managers, municipalities and airport operations alike.



How do Snow Dragon™ Snowmelters Work?

Snow and ice are deposited into a hot water bath that is integrated with heat exchanger tubes. The burner fires into the tubes creating a burner boiler type system heating the water. A spray system is incorporated in the melting hopper where warm water is sprayed over the snow to promote further melting. As snow is dumped into the melting hopper and the water level rises, standpipes from within the unit further screen out particles while water drains out from under the unit. Several screens also filter out dirt and debris so that storm water relocation systems are not clogged or impeded. Thus water leaving the melter is cleaner than the snow being dumped in. Contaminants contained in the melter can then be hauled and dumped at a designated site, if required.

For security conscious users, eliminating a parade of trucks on and off a site allows for less outsider intrusions to protected areas. And, since these units are portable, piling snow can be done in a manner most convenient to the snow moving equipment operators instead of having to move the snow great distances to where the melter is located.

For more information on how Snow Dragon™ offers you a better tool for managing your snow removal process or to tour our 145,000 sq ft manufacturing facility located in Cleveland Ohio, call Snow Dragon Sales at 216.531.1599 or visit us online at www.SnowDragonMelters.com.

SNOW DRAGON™ SNOWMELTERS



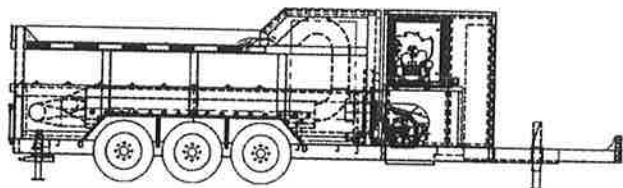
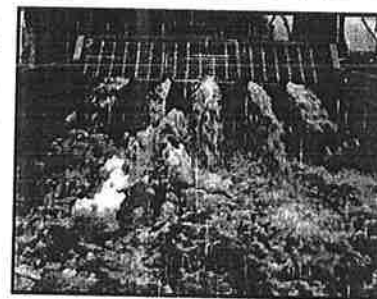
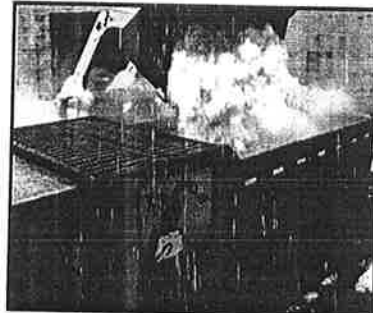
SND900 MINIPRO MODEL

The Snow Dragon™, SND900 MiniPro Model is designed for use at strip malls, schools, parking lots and is the ideal configuration for landscapers and contractors.

This model is rated at economically melting 75 cubic yards of snow per hour, based on a snow density of 30lbs per cubic foot. This model is a commercially rugged unit fabricated on a tri-axle trailer, can be towed from site to site with a one-ton truck and can carry a skid loader along inside. Measuring twenty-five feet long and eight and a half feet wide, it is capable of fitting in tight places. The SND900 also measure less than seven feet high without the skid loader inside to be able to fit into low areas such as parking garages.

The SND900 has been engineered to be a low maintenance, easy to operate, and extremely mobile unit. The heated operating enclosure has two double doors on both sides for easy access. The heated enclosure protects the burner, fuel tanks, generator, water pump system as well as other major components from the weather elements. The control panel is also fabricated on the door so it can be accessed from the outside.

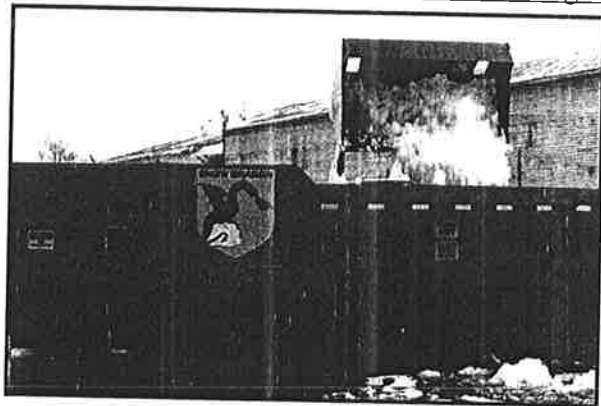
Easy access side loading, from both sides, is one feature with the MiniPro. The melting hopper tank measures a total of fifteen feet long with a ten-foot length area for dumping snow. Other features with this model include, one-man operation capabilities, plug and play components, quiet operation, built-in lighting system, and visual and audible alarm indication.



Specifications:

- 75 cubic yard rated capacity per hour
- Burner output at 9,000,000 Btu/hr
- No2 Fuel Oil or Diesel Fuel Type
- Fuel Consumption of 60 gallons/hr (max)
- Fuel Storage Capacity of 250 US Gallons
- Measures 25' long x 8'5" wide x 6'10" high

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SNOW DRAGON™ SNOWMELTERS



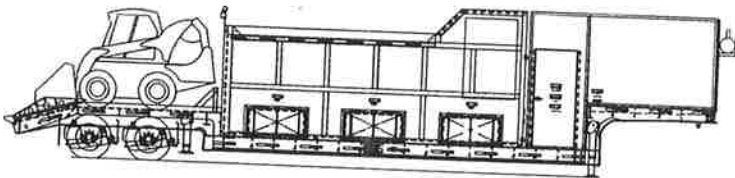
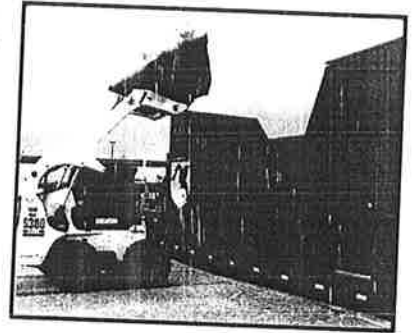
SND1800 CONTRACTOR MODEL

The Snow Dragon™, SND1800 Model is designed for companies that handle the big commercial sites, shopping centers, stadiums, hospitals, downtown parking lots, and airports. This is also the ideal model configuration for a municipal department of streets or a state department of transportation.

SND1800 is designed to efficiently melt snow at a rate of 180 cubic yards per hour, based on a snow density of 30lbs/cf. This is equivalent to a 3 cubic yard loader bucket per minute. This system is also designed so you can pull the melter to any site as needed with your skid loader riding along on the same custom trailer or is available as a stationary unit.

The SND1800 is engineered to be a low maintenance, easy to operate system. The heated operating enclosure protects the burner, fuel tanks, generator, water pump system as well as other major components from the weather elements. The packaged burner design includes two 9,000,000 btu/hr burners that operate automatically and independent of each other. If one burner goes down during operation, the melter will continue to operate even while maintenance replaces the burner in the field.

Easy access dual side loading is another feature with the SND1800. The melting hopper tank measures a total of twenty feet long with a thirteen-foot length area for dumping snow. Other features with this model include, protective guardrails, plug and play components, quiet operation, built-in lighting system, and visual and audible alarm indication.



Specifications:

- 180 cubic yard rated capacity per hour
- Burner output at 18,000,000 Btu/hr
- No2 Fuel Oil or Diesel Fuel Type
- Fuel Consumption of 120 gallons/hr (max)
- Fuel Storage Capacity of 600 US Gallons
- Measures 48'10" long x 8'6" wide x 11'11" high

For more information on how Snow Dragon™ offers you a better tool for managing your snow removal process or to tour our 145,000 sq ft manufacturing facility located in Cleveland Ohio, call Snow Dragon Sales at 216.531.1599 or visit us online at www.SnowDragonMelters.com.





Snow Dragon SND1800 Spec Sheet

SPECIFICATIONS

Melt Rating	180 Cubic Yards per Hour (Based on 30lbs/cu ft snow density)
Fuel Type	No. 2 Fuel Oil or Diesel
Burner Output	18,000,000 BTU/hr
Fuel Usage	120 US Gallons per hour (max)
Fuel Capacity	600 US Gallons (standard, see options available)
Water Discharge Rate	250 Gallons per minute (max)
Water Tank Capacity	6,074 US Gallons
Weight Empty	Approx 25 tons
Weight with Fuel & Water	Approx 50 tons
Measurements	48'10" long x 8'6" wide x 11'11" high
Towing Speed	Empty 65 MPH / With Fuel 60 MPH / With Fuel & Water 50 MPH*

*Based on water level at 12"

STANDARD EQUIPMENT

1. Two (2) Automatic ignition diesel fired 9,000,000 BTU/hr packaged burners.
2. Independent burner operation allowing the melter to continue to run if one burner fails.
3. Patent Pending engineered heat exchanger tubes.
4. Standard carbon steel inner dual weir system for debris separation.
5. Standard heavy gauge mild steel melting tank with structural steel supports.
6. Dual snow loading access on both sides of melter, each with 13'-8" of clearance.
7. Heated and lighted operating enclosure with lockable access door protecting equipment including burners, control panel, water pump spray system, and generator.
8. Generator is set up to be able to be plugged into a 110 outlet when not in use to power the generator block heater and optional battery charger.
9. Two (2) emergency shut down buttons located on both sides of the melter.
10. NEMA 12 main control panel with Honeywell temperature controller, visual and audible alarm indication, Honeywell high limit controller, pilot controls, indicators, gauges, relays and terminals.
11. Self contained diesel fired 50KW generator.
12. Two (2) 200 gallons/min water recirculating stainless steel pump to mix and circulate water and to spray onto loaded snow.
13. Four (6) clean out hatches for easy cleaning, two located on each side of the melter.
14. Heavy duty flat bed trailer with air brakes, turn signals, marker lights and can accommodate a skid loader on the back end.
15. Wood rail guards positioned on the melter to prevent damage to loading sides.
16. Fifty (50) foot Fire hose included for quick water start.
17. Quiet operation.
18. Equipment designed and built to comply with National Electric Code (NEC) and National Fire Protection Association (NFPA).

OPTIONS AVAILABLE

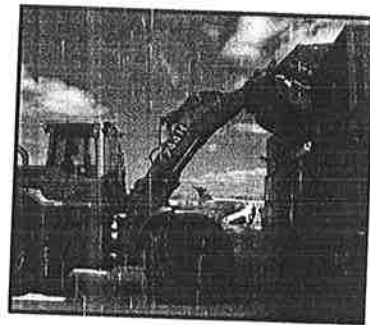
1. Generator battery charger.
2. Stainless steel melting hopper and weir system.
3. Five (5) vibration resistant area/work floodlights.
4. Custom painting and/or decal of company logo.
5. Touch screen control panel.
6. Additional fuel storage available in place of the skid loader area.
7. Service Contract
8. As a custom engineered and manufacturing company, we can accommodate custom requests through our engineering department.

SNOW DRAGON™ SNOWMELTERS

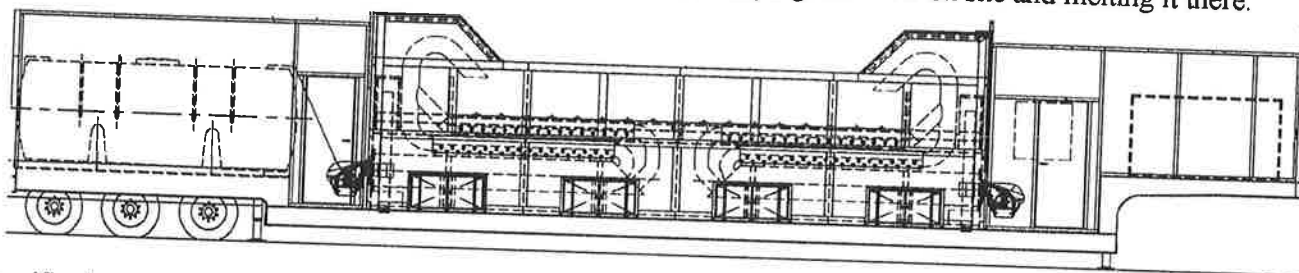


SND5400 AVIATION MODEL

The Snow Dragon™, SND5400 Model is designed for the airport market and other large-scale users. The SND5400 is capable of melting 450 cubic yards of snow in a one-hour period based on a snow density of 30lbs/cubic feet. This Model can be supplied as a mobile unit operated off of diesel fuel, or it can be supplied as a stationary unit fueled by diesel oil or natural gas.



In the post 9/11 environment, the Snow Dragon™ can eliminate the security risk of trucking snow away from the airport property. SND5400 also eliminates the concern of moving environmentally contaminated snow away from the airport by keeping the snow on site and melting it there.



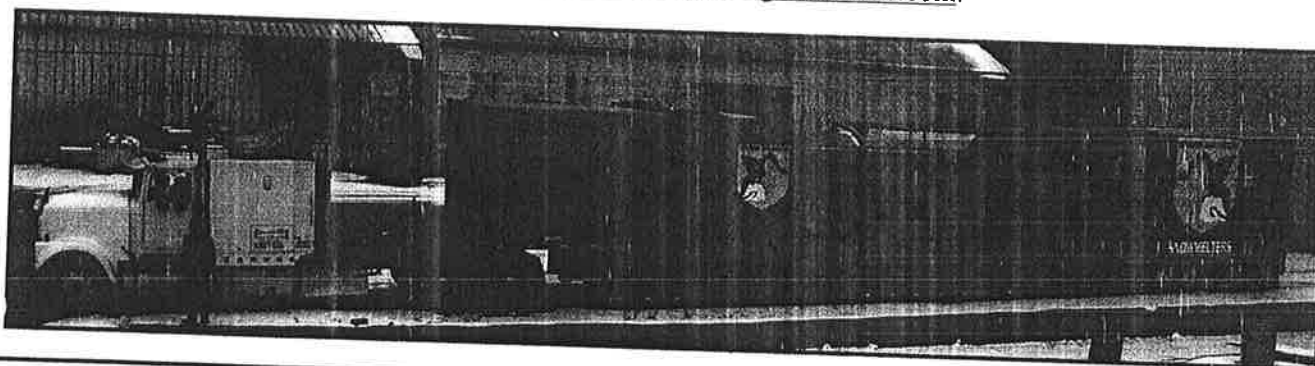
Specifications:

- 450 cubic yard rated capacity per hour
- No2 Fuel Oil or Diesel Fuel Type
- Fuel Storage Capacity of 3,000 US Gallons
- Burner output at 54,000,000 Btu/hr
- Fuel Consumption of 360 gallons/hr (max)
- Measures 68' long x 11'6" wide x 12'4" high

The SND5400 has been engineered to be an easily operated low maintenance system. The two heated operating enclosures located on each end, protect the burners, fuel tanks, generator, water pump systems as well as other major components from the weather elements. The packaged burner design includes six 9,000,000 btu/hr burners that operate automatically and independent of each other. If a burner fails during operation, the melter will continue to operate even while maintenance replaces it in the field.

Easy access dual side loading is another feature with the SND5400. The melting hopper tank measures a total of thirty-two feet long with over an eighteen foot length area for dumping snow. Other features with this model include, plug and play components, quiet operation, built-in lighting system, and visual and audible alarm indication.

Overall, the Snow Dragon™ offers you the best tool for managing your snow removal in the 21st Century. With savings between 50% to over 60%, it's no wonder why more people prefer snow melting as a part of their snow removal process. Call today or visit us online at www.SnowDragonMelters.com.





Snow Dragon

SND5400 Spec Sheet

SPECIFICATIONS

Melt Rating	450 Cubic Yards per Hour (Based on 30lbs/cu ft snow density)
Fuel Type	No. 2 Fuel Oil or Diesel
Burner Output	54,000,000 BTU/hr
Fuel Usage	360 US Gallons per hour (max)
Fuel Capacity	3,000 US Gallons
Water Discharge Rate	750 Gallons per minute (max)
Water Tank Capacity	14,500 US Gallons
Weight Empty	Approx 43 tons
Weight with Fuel & Water	Approx 100 tons
Measurements	68' long x 11'6" wide x 12'4" high
Towing Speed	Empty 55 MPH / With Fuel 50 MPH / With Fuel & Water 5 MPH*

*Based on water level at 36"

STANDARD EQUIPMENT

1. Six (6) Automatic ignition diesel fired 9,000,000 BTU/hr packaged burners.
2. Independent burner operation allowing the melter to continue to run if one or more burners fail.
3. Patent Pending designed heat exchanger tubes.
4. Standard carbon steel inner dual weir system for debris separation.
5. Standard heavy gauge mild steel melting tank with structural steel supports.
6. Dual snow loading access on both sides of melter, each with 18'-8" of clearance.
7. Two (2) heated and lighted operating enclosures protecting equipment including burners, control panel, water pump spray systems, and generator each with lockable access door.
8. Generator is set up to be able to be plugged into a 110 outlet when not in use to power the generator block heater and optional battery charger.
9. Four (4) emergency shut down buttons located on both sides of the melter.
10. NEMA 12 main control touch screen panel with Honeywell temperature controller, visual and audible alarm indication, Honeywell high limit controller, pilot controls, indicators, gauges, relays and terminals.
11. Self contained diesel fired 100KW generator.
12. Four (4) 200 gallons/min water recirculating pump to mix and circulate water and to spray onto loaded snow.
13. Eight (8) clean out hatches for easy cleaning, four located on each side of the melter.
14. Heavy duty flat bed trailer with air brakes, turn signals, and marker lights.
15. Fifty (50) foot Fire hose included for quick water start.
16. Removable filter screens for recirculating pump.
17. Quiet operation.
18. Equipment designed and built to comply with National Electric Code (NEC) and National Fire Protection Association (NFPA).

OPTIONS AVAILABLE

1. Generator battery charger.
2. Stainless steel melting hopper and weir system.
3. Ten (10) vibration resistant area/work floodlights.
4. Custom painting and/or decal of company logo.
5. As a custom engineered and manufacturing company, we can accommodate custom requests through our engineering department.