

Winterisation Systems

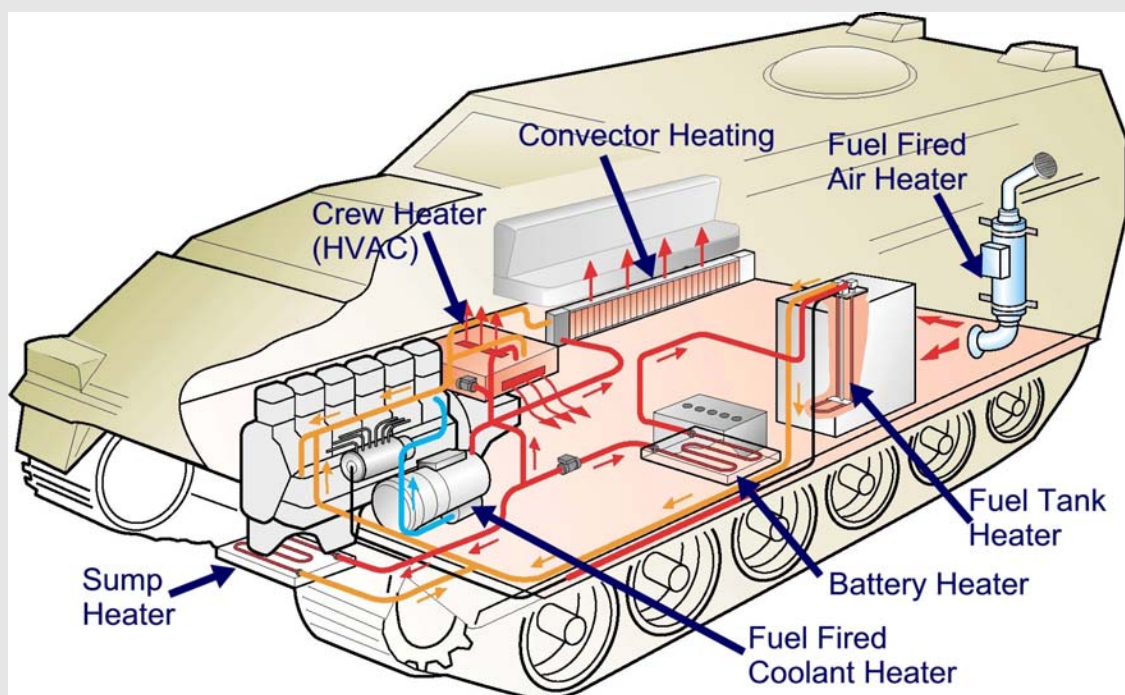
Introduction

The task of preparing a military vehicle for operation in extremely cold environments is considerably more complex than providing good crew heater performance and adequate vehicle insulation.

At the extremes of temperature, many of the vehicle systems designed for normal operation may perform more slowly, or fail to work altogether. The consequences of this can range from a minor inconvenience to a mission failure.

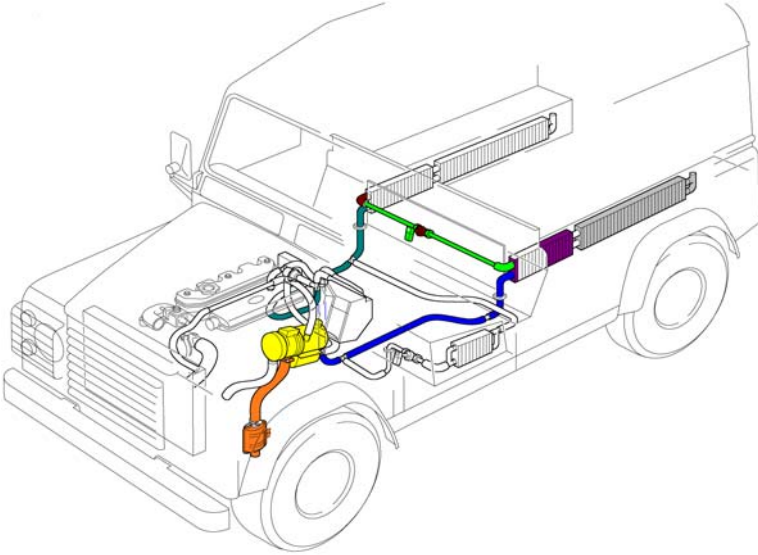
Webasto, with its long history of providing 'stand alone' heating systems on vehicles has developed products, systems and know-how to assist manufacturers in this important aspect of military vehicle design.

This document provides an overview of the Webasto equipment available for winterisation of military vehicles, to enable compliance with the temperature related requirements of DefStan 23-8, Winterisation of Military Logistics Vehicles.



Engine Pre-Heating

The engine is usually regarded as an adequate source of heat for maintaining the temperature of the vehicle equipment and crew. However, in extreme cold, an engine start may be impossible to achieve without the assistance of an additional heat source. Even then, following a successful cold start, the heat-up characteristics of a modern diesel engine are such that sufficient heat energy may never become available to provide effective heating for the crew or equipment.



Webasto can provide the solution to this problem with a range of coolant heaters, from 5kW to 35kW output, that can be installed within the vehicles cooling system and generate heat prior to attempting an engine start, as well as supplementing the engine in performing crew and equipment heating tasks.

The selection of a suitable heater is dependent upon a number of factors, the main ones being the mass of the engine, desired pre-heat duration and other heating duties on the vehicle. Packaging space is also a major consideration and often, instead of installing a heater to cover all duties simultaneously, temperature management is employed to divert the heat to the most appropriate area at different phases in the duty cycle.

The following table indicates how the correct heater for engine pre-heating can be selected.

ENGINE PRE-HEATING REQUIREMENT

$$1/2 \times (W + (SHC \times \% \times M)) \times (t_e - t_a) \times f$$

z	Heat-up Time in Seconds	3600.00
W	Water Quantity in kg	100.00
M	Mass of Engine in kg	600.00
SHC	SHC for Engine Block	0.63
%	Water/Engine Contact Ratio	0.36
f	Radiated Heat Factor	1.00
ta	Ambient Temperature	-56.00
te	Desired Temperature	70.00

1.2 if radiator is in heated circuit

HEAT REQUIREMENT 8.26 kW

This information, along with knowledge of the heat demand from other systems, forms the basis of the combustion heater selection.

The temperature that the engine coolant is allowed to achieve, prior to diverting the heat to other systems will depend upon the engine manufacturers minimum cold start temperature and the ability of the engine temperature to increase following being started.

Some engines, when operating at sub-zero temperatures, do not have the surplus energy to raise the coolant temperature sufficiently to meet the legal requirements for screen demist, and a 9kW energy input is often necessary to maintain satisfactory coolant temperatures when the full heating demand is placed on the system.

Radio Suppression

Webasto heaters employ sophisticated electronic control systems in order to provide flexibility of control, as well as providing numerous safety features and integrated diagnostics.

Webasto have undertaken a significant amount of development to ensure that suppression and immunity of these systems can be achieved in line with the requirements of DefStan 59-41.

Crew Heater

The crew heater is regarded as the primary source of heat for the crew, and also has the important duty of meeting the legal/vehicle specific requirements for defrosting and demisting.

An additional requirement, as detailed in DefStan 23-8, is to ensure that the crew benefits from specific temperatures at their fingers and toes (15° and 12°), within one hour of occupation, during operation in cold climates. To perform effectively the coolant temperature must be maintained at a high level.

A Webasto coolant heater, operated simultaneously with the engine will ensure that the crew heater can operate at maximum efficiency. For vehicles where silent watch is an operational requirement, a Webasto coolant heater connected into the crew heater feed will enable normal operation of the crew heater, without running the engine.

Hot Air Combustion Heater

Webasto Hot Air Heaters provide heat into crew or cargo areas extremely quickly after being switched on, ensuring the crew conditions demanded by DefStan 23-8 can be met prior to occupation. Used in parallel with a Webasto coolant heater, operational capability of the entire vehicle can be achieved in the shortest possible time.

This type of heater is also suitable if there is an operational requirement for avoiding coolant pipes within the crew area. Webasto are able to offer a range of air heaters with power outputs of between 2kW and 9kW, all with the possibility of radio suppression for military usage.

Waterproofing

Modern military operations are increasingly demanding the ability to undertake fording and wading operations with the minimum of preparation.

Rather than remove the heater from the vehicle as with other heaters, the Webasto Thermo 90 has been specially prepared to remain on the vehicle, and is submersible to 1m depth, simply by sealing the exhaust outlet and combustion air inlet points.

Fuel System

The problems of moisture in diesel fuel and wax formation in cold climate operation are well documented. In addition to employing best practice to avoid placing fuel system components in exposed positions; devices such as heated fuel lines, electrically heated water separators and heated fuel filters, will help prevent engine failures.

The energy that is provided by the Webasto coolant heater may also be used to heat the fuel at the point it is taken from the tank, by inserting a serpentine pipe carrying heated coolant, into the fuel tank.

Heated Fuel Line

DefStan 23-8 calls for fuel lines to be routed away from exposed areas to prevent waxing, however, should this be impractical, electric trace heating can be added to the fuel pipes or they could be bundled loosely with the coolant pipes feeding the fuel tank heater.

Battery Heating

As the ambient temperature falls, the efficiency of the battery decrease and it also becomes increasingly difficult to re-charge. An insulated battery compartment can be supported by a heating element, fed by the Webasto coolant heater, located beneath or adjacent to the battery.

Coolant Circuits

The system diagram and the foregoing text illustrate a number of heating possibilities, all supported by the Webasto coolant heater until the engine is rejecting sufficient heat to sustain the heater system demand, (assuming such a state can exist with a modern, efficient diesel engine in extreme climates).

The size of the engine, the mass of the vehicle and the desired heat up duration will all determine the size of the combustion heater required.

Often, however, the task of carrying out these duties simultaneously will require such a large heater that sufficient packaging space does not exist in the vehicle.

Even if installed, such a large heater may also be oversized in instances where only partial heating is desired, such as silent watch, or standby heating.

To overcome this, Webasto will work in partnership with the vehicle manufacturer and crew heater supplier to determine the optimum strategy for heating the vehicle. This can be achieved by using thermostatically controlled valves to divert the heated coolant when 'key' conditions have been met.

One possible strategy for a large system, for example, is to heat the engine to a temperature at which the engine manufacturer will guarantee a cold start, when this temperature is achieved, the flow is diverted to the crew heater.

A constant bleed is also fed to the battery and fuel system heating. This allows a smaller combustion heater to raise the engine temperature quickly, before providing the maximum possible heat to the crew area in order to rapidly meet the habitability conditions.

Convactor Heating

Convactor heaters provide a robust, simple solution to bring additional heat into crew areas within personnel carriers, which may not be directly served by the crew heater.

Having minimal resistance to coolant flow, they provide a useful way of bringing heat into the crew area at low temperatures, when a conventional heat exchanger may not be achieving an adequate coolant flow.

An approximate rating for convactor heaters is 750W per metre.

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