Rev.2/2017

INTRODUCTION

This instruction book has been prepared to help you obtain the best possible performance from your new Chinook wind machine. If you follow these instructions with reasonable care, a lot of unnecessary problems can be avoided.

If you have any questions on running your wind machine be sure to contact your dealer. He will assist you with start up, operation, and maintenance.

IMPORTANT: To ensure maximum machine life and complete frost protection, keep your engine tuned and running smoothly at all times. A rough running engine will greatly increase machine vibration causing undue stress and fatigue.

CAUTION: DO NOT RUN MACHINE UNDER WINDY, FOGGY OR RAINY CONDITIONS!

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SAFETY FIRST

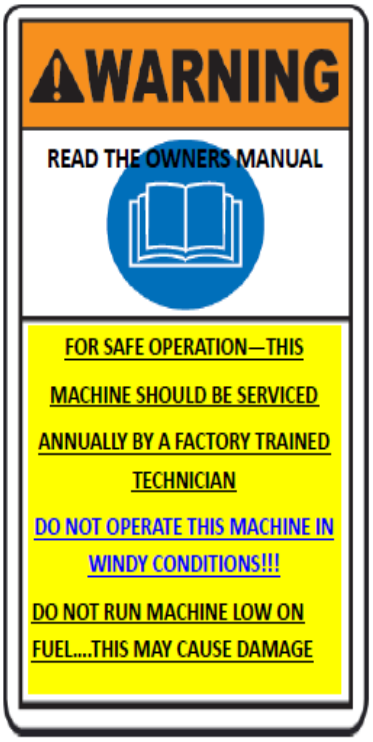
1. Never stand under or in line with the propeller blades plane of rotation when it is turning.
2. Never stand in line with the engine radiator fan's plane of rotation when running.
3. Never climb or work on the tower when the engine is running.
4. Never require or encourage any person that expresses a fear of working at heights to service or repair a wind machine tower.
5. Always wear and use a safety belt when working on the tower. Safety belts may be purchased at a safety equipment supply store or thru us.
6. Do not climb or work on the tower without disconnecting the battery ground cable to prevent a surprise start.
7. Do not climb the tower if the wind is causing the fan to rotate. Wait until the fan feathers out in the cross wind or engage the clutch.
8. Never, under any circumstances, try to stop the fan from rotating by reaching into the tower and grabbing the drive shaft.
9. Never throw any object into a rotating fan.
10. Always keep hands, feet and clothing away from moving parts.
11. Do not wear loose clothing, rings or wrist watches while working in or around your machine. Tie up or otherwise restrain long hair.
12. The cooling system is always pressurized during and after engine operation. Use extreme caution in turning the radiator cap to relieve the pressure before removing it.
13. Flammable and explosive battery gas is created when a battery is either charging or discharging. The battery may explode if short-circuited.
14. Use caution when working with fuel. Do not smoke while filling the fuel tank or while working on the fuel system.
15. The operator and/or service mechanic should be provided and required to carry an adequate fire extinguisher and first aid kit that contains an eye wash.
16. Never operate the machine without all the guard covers in place on the tower and engine.
17. Always anchor the blade if you remove any part of the drive train. Wind can start the blade turning causing damage or injury.
18. Before and while climbing the tower of any wind machine inspect the ladder and all its welded and bolted connections for cracks and breaks. A person climbing a damaged ladder could fall.
19. Always check for fuel leaks before attempting to operate your wind machine.

ADVISO/CAUTION
Sensitive Electronics Inside
Keep and Maintain Fully Charged Batteries
Keep Proper Voltage
Best to Replace the Battery
Jump starting may damage electronic circuits









OPERATING CAUTIONS

The following operating cautions must be observed when operating your wind machine. Failure to do so could result in damage to your machine and possible severe personal injury.

1. **DO NOT RUN MACHINE UNDER WINDY CONDITIONS.** Operating under windy conditions can cause the fan and tower to vibrate violently, causing possible damage or breakage to the fan, tower, drive train, and gear drives.

2. **DO NOT RUN MACHINE UNDER FOGGY CONDITIONS.** Ice may form on the blades causing severe imbalance with the resultant damage or breakage to the fan, tower, drive train, and gear drives.

3. **DO NOT ALLOW ENGINE TO BE STARTED OR SHUT DOWN WITH FAN ENGAGE**

   This places excessive stresses and vibrations on the drive train and gear drives. Over time, damage to component parts will occur. New Machines with a centrifugal clutch are free of this type of damage. Auto engage and free wheels to stop.

4. **DO NOT ALLOW PROPANE UNITS TO RUN LOW ON FUEL OR ON DIRTY FUEL.** A gas/liquid mixture is formed causing engine power surging. This creates excess stresses and vibrations on the fan, tower, drive train, and gear drives for all propane powered engines. Engine power surging will result creating excess stresses and vibrations on the fan, tower, drive train, and gear drives.

5. **ON PROPANE - SHUT FUEL TANK SUPPLY OFF AFTER EACH USE or At END OF THE SEASON.** This will help keep the propane vaporizer unit clean from building up with possible contaminated propane by-products which could block the flow of vapor to the carburetor. Compressor oil from transports is often the cause of fuel contamination.

6. **WHEN RUNNING AN ENGINE EQUIPPED WITH ELECTRONIC IGNITION, DO NOT REMOVE ANY SPARK PLUG WIRES OR BATTERY CABLES while running.** To do so will likely cause the electronic ignition system to fail. New Style engines all have computerized electronic engine controllers. All of these computers (ECM's) are sensitive to low and high voltage. It is best to change to a charged battery rather than jump start a unit. Crossing positive and negative or having an improper ground could cause damage to the ECM. Also, a battery that is low on voltage may operate the starter but not supply enough correct voltage to the ECM. Because of this, the signal to start may not occur. Your Chinook dealer/representative could explain in more detail and assist in case of faults.

Starting Instructions from Door Panel for your Chinook Ford V10 Engine

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Ford Triton V10

Chinook WIND MACHINES

IMPORTANT: DO NOT OPERATE MACHINERY IN WINDY CONDITIONS.

IMPORTANT: DO NOT OPERATE MACHINERY IN RAINY OR FOGGY CONDITIONS.

STARTING INSTRUCTIONS

Manual Start

1. Turn on fuel supply.
2. Turn A/M switch to M for manual start
3. Push Red start button—engine will crank and start.
4. Advance speed with Up/Down rocker switch-push up

Manual Stop

1. Reduce speed with Up/Down rocker switch-push down
2. When speed reduced to idle—Turn A/M switch to off

Danger/ Precautions

1. Do not run machine under windy, rainy or foggy conditions.
2. Do not allow propane fuel to run low-possible damage
3. Never climb tower without safety belt
4. Never climb tower while in operation
5. Ensure all guards and covers are in place while using
6. Stand away from Radiator and fan's plane of rotation
7. Never stand in or under direct line of propeller's plane of rotation while in operation

Auto Start "ON" Directions

1. Turn fuel on
2. Turn A/M switch to A to activate "auto operation".
3. This will activate the engine to start momentarily and shut off---if temp setting is above needed start up temp.
4. Switching on A also activates the Carel temperature unit and will display current temperature.
5. To check or set your start up temperature, HOLD down the "SET" button. In a few seconds the display will start flashing and show the temperature set for the wind machine to start.
6. To change the low temp start temperature (while still flashing) arrow up or down to the desired temp—push "Set". This will lock in your start up temperature. The display will then stop flashing and display current air temperature.

Auto Start "OFF" Directions

When Auto Start is no longer needed on the Chinook wind machine – turn A/M switch to "OFF"

See Start Up and Auto Start directions in the Carel and Murphy sections in back of booklet.

MORE STARTING INSTRUCTIONS

PROPANE:

1. Before each run check the machine and the area around the machine for any evidence of oil or coolant leaks. Check oil and coolant levels in the engine. Check alternator and fan belt tension periodically.
2. Turn on the fuel supply (valve should be turned on all the way). Make sure you have enough fuel to run a full night.
3. Your new Chinook Wind Machine is equipped with a Centrifugal Clutch System
4. If Manual operation is used, turn A/M switch to M for manual and push rocker switch to start. If engine does not start - Sixty seconds should be allowed between starting attempts.
5. AFTER THE ENGINE STARTS: Allow to fast idle to warm up to 140 degrees to continue to full throttle. The maximum RPMs are factory set. You may now run your machine until shut down.

NOTE: All ground powered Chinook wind machines are equipped with Murphy safety shut down circuits. If the engine oil pressure should drop to 20 PSI, if the engine gets hotter than 210°F, 99° C, or if the engine speed exceeds set limits, the circuits will shut the engine down automatically. Familiarize yourself with the instruments, noting the safety reset over-ride button. The full operating speed has been set by the installer and must not be changed except by a Chinook representative.

WARNING: NEVER RUN THE UNIT WITH CONTAMINATED FUEL! NEVER LET THE UNIT RUN OUT OF FUEL! IF EITHER CONDITION HAPPENS THE ENGINE WILL SURGE – CAUSING POSSIBLE DAMAGE TO THE ENGINE, GEAR BOXES, DRIVE TRAIN, AND FAN.

IF YOUR MACHINE WON'T START

If your machine will not start on a critical night, do a quick check of the machine to see if you can determine what is wrong. If you cannot find what is wrong or if you need parts be sure to call your Chinook service person right away.

1. Check to make sure you have fuel to the carburetion system. Check to make sure you have fuel in the propane tank. Make sure you have the valve open all the way.
2. Check all wiring for loose, broken or shorted wires. Possible damage from rodent's chewing wires.
3. Check the fuse on the Murphy by-pass switch to see if it is blown. If it is, check to see that the tower light is not shorted out, as well as alternator wires, starter wires, and any other wires before replacing fuse.
4. LIQUID PROPANE UNITS: Check for waxy residue build-up in the vaporizer and carburetor. Check to make sure the pop-off valve did not click shut when opening the propane tank valve. Also check for dirty propane fuel by inspecting propane filter.

WARNING: BEFORE DOING ANY WORK ON PROPANE, MAKE SURE TO TURN THE MAIN PROPANE TANK VALVE OFF AND SLOWLY LOOSEN FUEL LINES TO ALLOW PROPANE TO ESCAPE.

In any emergency situation, the best practice is to immediately call your factory authorized dealer or service organization.

FUEL OPTIONS AND REQUIREMENTS

PROPANE: GRADE HD-5

PROPANE:

1. Chinook wind machines when operated on LPG/Propane fuel **MUST BE OPERATED ON LIQUID WITHDRAWAL (NOT VAPOR).**
2. Liquid withdrawal from the top of the LPG tank is preferred with the supply tube extending into the tank not closer than two inches from the bottom of the tank.
3. If liquid withdrawal is made from the bottom of LPG tank, the supply tube should extend into the tank approximately two inches. This helps with no or less contamination into the supply line.
4. Be sure you obtain fuel that is clean and free of contaminant.

ENGINE WARM-UP

PROPANE:

Avoid racing your engine during warm-up. The greatest percentage of wear occurs when a cold engine is first started. After an engine has been shut down and allowed to cool, the majority of the lubricating oil drains off the reciprocating parts back into the oil pan. Engine oil does not flow freely or lubricate properly until it has reached normal operating temperature.

If an engine is operated at excessive speeds or under heavy loads when it is cold, wear will be accelerated. The greatest damage will be done to cylinder walls and pistons.

AFTER STARTING THE ENGINE:

1. Allow the engine to idle until around 140 degrees F.
2. Increase speed to half throttle.
3. Operate at about half throttle until engine temperature reaches 160° - 170°F, 71°- 77°C.
4. Open throttle to full operating speed.
5. New series engines use an electronic rocker switch to increase and decrease the engine speed. Engines with AUTO START have warm up and cool down settings to manage both the warm up period and the shut down period all automatically.

With proper warm-up, engine life will be increased considerably

SHUT-DOWN INSTRUCTIONS

PROPANE:

1. Slowly reduce the engine speed to a fast idling speed.
2. Run engine at a fast idle for 2 to 3 minutes to allow engine temperatures to stabilize.
3. Reduce engine speed to slow idle and turn switch to off.
4. If equipped with “auto start” turn the A/M switch to the off position between A and M if operating on manual. If on Auto Setting, the engine will shut off once the upper temperature has been reached.
5. It is a good idea to turn off the fuel supply if you are not going to use the Chinook Wind Machine again for a long period of time and at the end of the heating season. When finished for the season, be sure to turn the Auto start setting to off as prolonged periods will deplete the battery charge.
6. It is suggested to remove the battery from the machine at the end of the heating season and keep it charged. This will increase the life of the battery.

WARNING: NEVER LET THE PROPANE FUEL TANK RUN OUT OF FUEL.

BREAK-IN PROCEDURE FOR NEW ENGINE

PROPANE:

When you are handed the keys to your new Chinook wind machine it is ready to function. Certain precautions, however, should be taken during the first few hours of operation to make sure the engine will not be damaged during the break-in period. Your new V 10 engine is ready to run, however during the break-in period of 20 hours it is recommended to operate the first 5 hours at a reduced throttle around ½ and keep a close check on the engine oil and coolant levels. Check for any signs of oil and coolant leaks. Look at the gear boxes and check for leaks. Look for loose bolts and listen for any odd noises or clicks from the engine or tower. After the 20 hours of break-in, you new Chinook will be ready for years of frost protection service.

During the break-in period, the engine speed should be

1/2 throttle approx. 1500 RPM -- 5 hours.
The remaining 15 hours at full throttle

Engine instrument reading should be monitored frequently. Check the machine visually for an indication of oil leaks, loose bolts, and excessive vibration. Engine oil consumption should be checked every 5 hours. New engines may use oil. Contact your dealer at once if any evidence of trouble occurs.

After the first 20 hours of operation, drain the oil from the crankcase and change the oil filter element. Refill with new oil (see owner's manual for SAE number). The engine is now ready for frost protection.

PREVENTIVE MAINTENANCE

The length and reliability of service that you received from your Chinook wind machine depends upon thorough lubrication and preventive maintenance. Without adequate oil and grease, the working parts of your machine can be ruined in a very short time.

PLEASE CHECK ALL NUTS AND BOLTS for Tightness after the first 5 hours of break-in. The loss of a nut or bolt can result in the loss of a crop.

We recommend that you initiate a system of a "scheduled maintenance" for the care of your machine. Following are charts with minimum intervals for various maintenance and lubrication requirements for your Chinook wind machine. Additional recommendations for your engine are included in the manufacturer's operators manual.

Your Chinook wind machine dealer can provide assistance and service in maintaining your machine as well as answer your questions concerning its operation.

Do not wait for a problem to happen! Correct it before it happens.

MAINTENANCE SCHEDULE AND RECORD

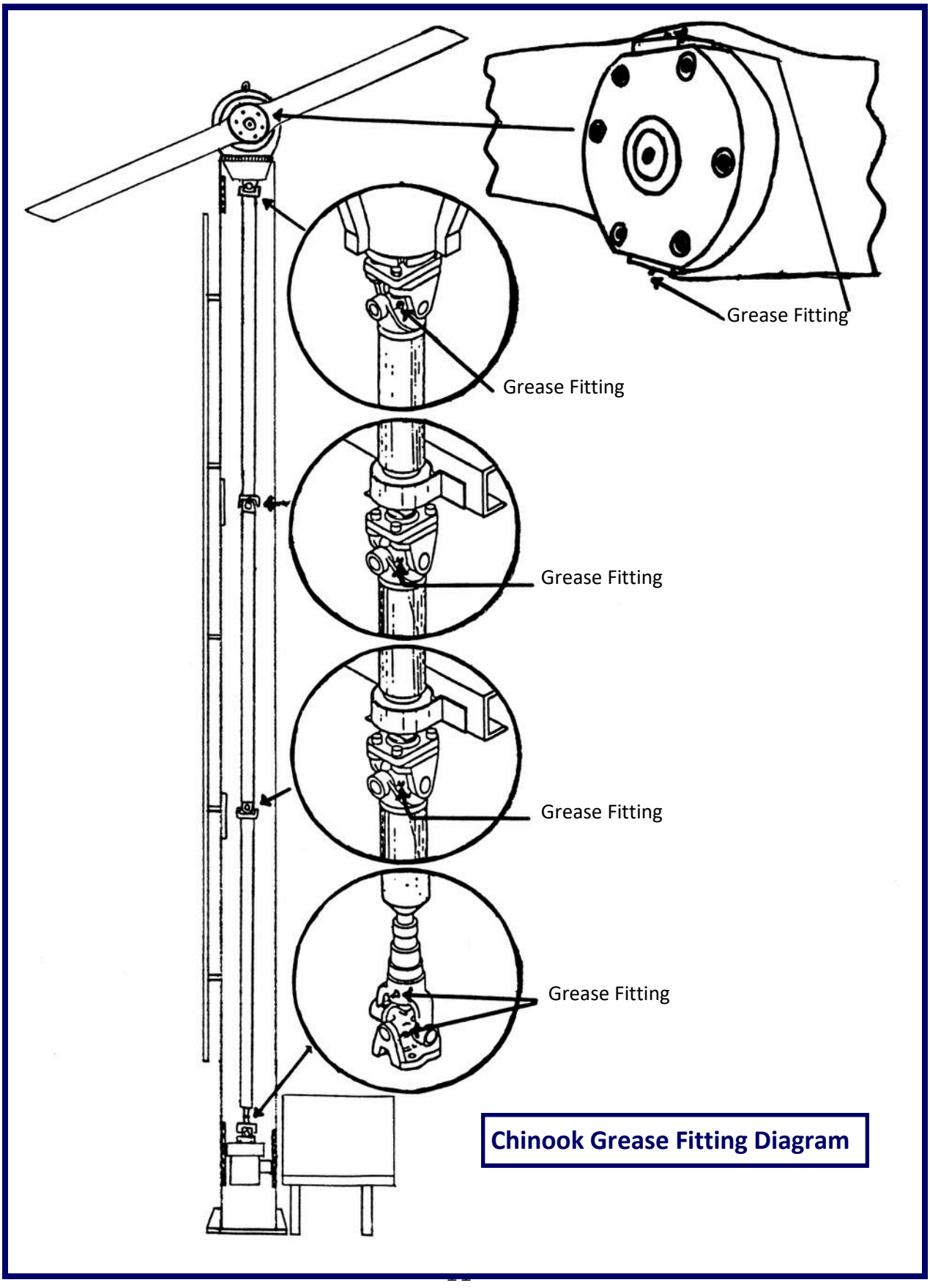
GASOLINE/PROPANE/DIESEL

Initial Start-up Sequence	Operation	100 Hrs.	200 Hrs.	300 Hrs.	400 Hrs.	500 Hrs.	600 Hrs.	700 Hrs.	800 Hrs.	900 Hrs.	1000 Hrs.
1	Oil, Check Level	DAILY									
2	Coolant, Check Level	DAILY									
3	Fuel, Oil and Coolant Leaks, Check	DAILY									
	Oil, Change [1] [2]	X	X	X	X	X	X	X	X	X	X
	Oil Filter, Change [1] [2]	X	X	X	X	X	X	X	X	X	X
4	Air Cleaner (Dry Type), Replace Element	X	X	X	X	X	X	X	X	X	X
5	Battery, Check Charge and Level	X	X	X	X	X	X	X	X	X	X
	Crankcase Vent System Breather Cap, Clean	X	X	X	X	X	X	X	X	X	X
	Battery cables, Clean [2]		X		X		X		X		X
6	Water Pump and Alternator, Belt, Check and Adjust [2]		X		X		X		X		X
	Throttle, and Choke, Linkage, Lubricate [2]	X	X	X	X	X	X	X	X	X	X
	Fuel Filter, Replace [1]		X		X		X		X		X
	Cooling System, Check or Refill [2]				X				X		
9	Idle Speed, Check and Adjust				X				X		
10	Idle Mixture, Check and Adjust				X				X		
11	Load Adjustment [2]				X				X		
	Spark Plugs, Clean, Adjust and Test or Replace		X		X		X		X		X
7	Ignition Timing, Check and Adjust (Check Centrifugal Advance) 2				X				X		
	PCV Valve Hose and Fitting, Clean				X				X		
12	Throttle Adjust				X				X		
8	All Bolts and Nuts, Check for Tightness [2]	SEASONAL									

[1] More frequent interval may be required in dusty areas.

[2] Seasonal or as required.

NOTE: SCHEDULED MAINTENANCE BEYOND 1000 HOURS SHOULD BE CONTINUED AT SAME INTERVALS AS BEFORE.



Chinook Grease Fitting Diagram

LUBRICATION SPECIFICATIONS

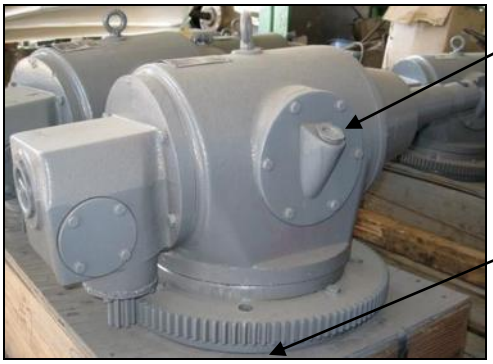
	LUBRICANT	AMOUNT	FREQUENCY
Fan Teeter Hub	Chassis Lube #2	Few Shots	Seasonal
Top Gear Box	SAE-30W, or High-Grade Turbine Oil W/ Rust & Oxidation Inhibitors	12 Quarts	Check Seasonal & Fill to Level Drain & Refill as Required or Every 500 Hours
Universal Joints & Slip Spline	Chassis Lube #2	Few Shots	Seasonal
Lower Gear Box	SAE-30W, or High-Grade Turbine Oil W/ Rust & Oxidation Inhibitors	5 Quarts	Check Seasonal & Fill to Level Drain & Refill As Required Or Every 500 Hours
Crankcase			
Ford V10 Gas & Propane	SAE 10-40W Must Meet Ford Specification ESE-M2C153-C API Classification SJ, if SJ oils are not available SH oils are acceptable	9 Quarts	Change Oil & Filter Every 100 Hours & Seasonal
IVECO NEF 67 TAA	SAE-10-40W API SAE-CE/SF	15 Quarts	Change Oil & Filter Every 100 Hours & Seasonal
Chevy 454	SAE-30W, SAE-10-40W SE-CC	6 Quarts	Change Oil & Filter Every 100 Hours & Seasonal
Choke & Throttle Cable Housings	Light Weight Oil Penetrant	As Needed	Seasonal
Throttle Cable T-Handle & Brass Insert	Thick Coating of Grease	As Needed	Seasonal

CHINOOK GEAR DRIVES

All Chinook wind machines come equipped with pressure lubricated gear drives.
With a pressure lubricated gear drive system, the oil is force-fed over the gears and bearings rather than being submerged in oil and splash lubricated. Pressure lubrication reduces the friction and heat generated. Less friction results in more available horsepower reaching the fan. This makes for a more efficient gear drive than a comparable splash lubricated gear drive.

All Chinook wind machine gear drives are installed with high grade gear oil (AGMA 4 rating) with rust and oxidation inhibitors in both the upper and lower main gear box.

The oil in the gear boxes will last for an indefinite period of time. However, gear box oil levels should be checked seasonally and filled to level if necessary. The oil should be changed in the gear boxes if it becomes discolored, water contaminated, or if foreign material becomes present. Change oil at least every 500 - 700 hours of operation and/or more frequently to eliminate water formed in the gear case due to condensation. Gear drives operated in climate with hot days and cool nights will accumulate moisture more rapidly than gear drives operated at constant temperatures.



OIL LEVEL DIP STICK AND FILL

TOP HEAD

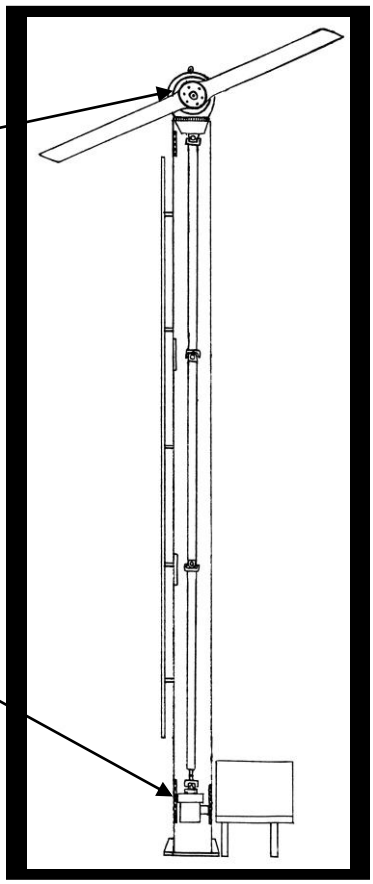
DRAIN PLUG



OIL LEVEL AND FILL

LOWER BOX

DRAIN PLUG



TROUBLE SHOOTING ENGINES

The following pages describe the most probable causes of engine malfunction applicable to a particular type of failure. Only those problems that can readily be corrected in the field are listed.

We do not list the procedures for the correction of any faults as those procedures will be obvious to person qualified to make the repair. The list is intended as a quick reference only, as any emergency repair should be done by a fully qualified mechanic.

PROPANE:

A. STARTER WILL NOT CRANK ENGINE

1. Defective battery
2. Lead disconnected or terminals corroded
3. Faulty starter switch or solenoid
4. Starter drive dirty and /or sticking
5. Defective starter motor

B. STARTER CRANKS ENGINE BUT TOO SLOW TO START

1. Low battery charge
2. Terminal(s) loose or corroded
3. Too heavy grade of engine oil for climate
4. Defective starter motor

C. ENGINE CRANKS BUT WILL NOT START - IGNITION AND ELECTRICAL SYSTEM

1. Low Battery voltage
2. Poor Ground or bad battery connections
3. Loose or unplugged wiring

D. ENGINE CRANKS BUT WILL NOT START - FUEL SYSTEM

1. NO FUEL to Propane Carburetion System
    a. Fuel valve is off at the tank
    b. Blocked fuel line between tank and carburetor
    c. Lock off filter plugged
    d. Fuel shut off valve not coming on

2. LIQUID PROPANE SYSTEMS
    a. Waxy residue builds up in converter and carburetor holes
    b. Dirty plugged up propane filter a. Air leak in the system or diaphragm
    b. Dirt and residue in system
    c. Water in fuel system

E. **ENGINE MISFIRES - IGNITION**

1. Wires to plugs or injectors bad
2. Possible bad injector or spark plug
3. Loose connections

F. **ENGINE MISFIRES - FUEL SYSTEMS**

1. Water in Fuel
2. Fuel line partly blocked
3. Low pressure fuel pressure
4. Fuel filter dirty and partially blocked
5. Low Fuel in Tank

G. **ENGINE MISFIRES - Other**

Call your Chinook Factory Representative or Dealer

H. **ENGINE STARTS AND STOPS - IGNITION**

1. Loose connection, low tension circuit, broken or shorted wire
2. Defective ignition switch
3. Defective Murphy switch

I. **ENGINE RUNS AT FAST THROTTLE ONLY**

Call your Chinook Representative or Dealer

J. **ENGINE DOES NOT PRODUCE FULL POWER**

1. Fuel valve not fully opened
2. Air leaks in intake system
3. Call your Chinook Representative or Dealer

AFTER EACH RUNNING SEASON

Wind machine engines should either be run periodically year-round or pickled after each heating season.

If the engine is not pickled, run every month for one hour at not less than 2/3 throttle with the clutch engaged. This is important to prevent internal corrosion and valves from sticking.
A proper storage and preservation program, if followed, can save you both time and money. We recommend a storage-pickling program rather than one requiring periodic operation during the non-frost season.

Before pickling your engine be sure to do the following:

1. Perform all the seasonal periodic maintenance operations as listed on the maintenance charts.
2. Check the complete tower assembly for loose nuts and bolts. Tighten or replace if required.
3. Check the fan prop assembly for damage or deterioration.
4. Check gear boxes for oil level and oil condition, change as required. Adjust drag bearing as needed.
5. Operate the engine under load until the engine temperature has stabilized. Change engine oil and oil filter. Change air filter if dirty.
6. Check out engine thoroughly including belts, carburetion, electrical, ignition and fuel systems. If major repairs are needed, they should be made prior to pickling the engine.
7. Check the engine coolant fluid. Replace if indicated by the presence of rust or low antifreeze protection.
8. Operate the engine under load for ten minutes to circulate the new clean oil. If the coolant is replaced, operate the engine for thirty minutes to insure complete mixing of the antifreeze solution.

NOTE: AT THIS POINT, POWER PLANTS SHOULD HAVE THE EXHAUST AND THE AIR CLEANER INTAKE SEALED OFF WITH TAPE AND PLASTIC BAG, AND BATTERY REMOVED FOR STORAGE.

PROCEDURE FOR PICKLING / WINTERIZING

PROPANE:

1. Shut off the fuel supply either by disconnecting fuel line or turning fuel valve off. Run engine until completely out of fuel.
2. While the engine is still running, treat upper cylinders by pouring 2 to 4 cups recommended engine oil (SAE 10 wt.) or equivalent into carburetor air intake for about ten to fifteen seconds. Open throttle for short burst of speed. Shut off ignition and allow engine to come to a stop while continuing to feed oil into air intake.
3. Tape and seal off the ends of the exhaust pipes and air cleaner.
4. Remove the battery. Store the battery in a cool dry location after bringing up to a full charge. Check battery condition monthly. Keep the top of the battery clean.

PROCEDURE FOR UN-PICKLING

PROPANE:

1. Make a visual inspection of the tower for any oil leaks, or damage to the fan or gear boxes.
2. Make a visual inspection of the engine for oil, fuel, or coolant leaks.
3. Remove the tapes and seals from all sealed openings.
4. Check oil and coolant levels in the engine.
5. Install a fully charged battery.
6. Be sure to open the fuel valve at the propane tank.
7. Start engine by using standard starting procedures.
8. Repeat steps 7 and 8 until engine is purged of pickle oil.
9. Check all instrument functions.
10. Run engine long enough to remove any excess pickle oil in the system.

PRINCIPLES OF WIND MACHINE FROST PROTECTION

Successful frost protection efforts depend in part upon the topography and general condition of the orchard. An ideal situation would consist of a smooth, moist, clean cultivated floor, with trees adequately pruned and tree rows laid out parallel to the flow of nocturnal cold air. The slope of the floor would be constant at 1 to 1½ degrees. Both the floor of the orchard and the border areas would be free from any obstruction to normal air drainage.
Cover crops, loose soil, wood mulches and dry surface soil all reduce the flow of solar heat into and out of the ground. Those orchards with any of these conditions can be expected to reach lower temperatures than those where the surface conditions are represented by moist firm soil. Water has a great capacity to absorb, retain, conduct and release heat. These advantages should be utilized.

During cold weather, improperly maintained wind breaks will add to frost problems. Wind breaks that are correctly pruned and thinned will allow the normal cold air drift to pass through.

Wind machine frost protection begins with the moving out or blowing out of the heavier cold air that settles in and around the trees in the orchard. The movement of this low-level air prevents stratification and prevents frost formation. The wind machine will replace it with the warmer air found at higher elevations near the inversion ceiling.

In frost conditions, a "skin" of extremely cold air forms around buds, fruit and foliage. This "skin" is a super conductor of heat from the warmer object it surrounds to colder air mass. The wind machine can prevent the formation of this "skin" and thereby slow the heat loss from the objects of protection.

The past fifty years has seen considerable development and technological improvement of both wind machine and application techniques. The correct location in the orchard plus the choice of options that best accommodates the topographical features of the orchard are equal in importance to adequate horsepower in obtaining economical frost protection.

PRINCIPLES OF WIND MACHINE FROST PROTECTION

The development of orchard operations in colder locations requires that a reliable system of frost protection shall be a combination system such as wind machines and water or wind machines and orchard heaters. Either combination will provide much more protection than any single system.

THE WIND MACHINE SHOULD BE REGARDED AS A TOOL FOR MAINTAINING TEMPERATURES ABOVE THE DANGER POINT, NOT FOR RAISING THEM. WITH THE LOW OPERATING COSTS OF WIND MACHINES, THE PRACTICE OF EARLY STARTING AND LATE SHUT DOWN IS RECOMMENDED.

WIND MACHINES AND WATER IN COMBINATION

As long as additional applications of water are not detrimental to trees, buds, or fruit, this can be one of the cheapest sources of heat available. There will be a transfer of heat from water to the surrounding air as long as the ambient air temperature is colder than the water. Water in motion radiates more heat than still water. The most heat is transferred at the time water freezes and forms ice. The most efficient use of the heat released by water is achieved when the movement of air from the wind machine forces the heated air back down into the orchard.

The use of under-tree sprinklers or open ditch system may be recommended as a water supplement to wind machines.
It is not recommended to use over-tree sprinklers since this system depends on the encapsulation in ice of the fruit or bud being protected. Although the formation of ice provides positive temperature control during the time of ice formation, it can act as a super conductor of heat transfer from the encapsulated object to the surrounding air if additional water for ice formation is not being supplied. This rapid cooling of buds, fruit, or foliage with ambient temperatures below the danger point, can result in the complete loss of crop if a loss of water should extend beyond twenty minutes. An additional danger in the use of overhead sprinklers is the enormous loads of ice the trees are required to carry if long periods of application are necessary.

WIND MACHINES AND HEATERS IN COMBINATION

There are two economic factors involved in the use of a wind machine-heater combination. First, on low temperature nights, even though the wind machine might not provide complete protection, it can delay the time period that heaters are required. On most nights, the wind machine alone will be sufficient. Secondly, the rule of thumb is to use 45 heaters per acre when depending on heaters alone. In combination with a wind machine this requirement is reduced to 15 heaters per acre. The savings in fuel and labor costs are significant.

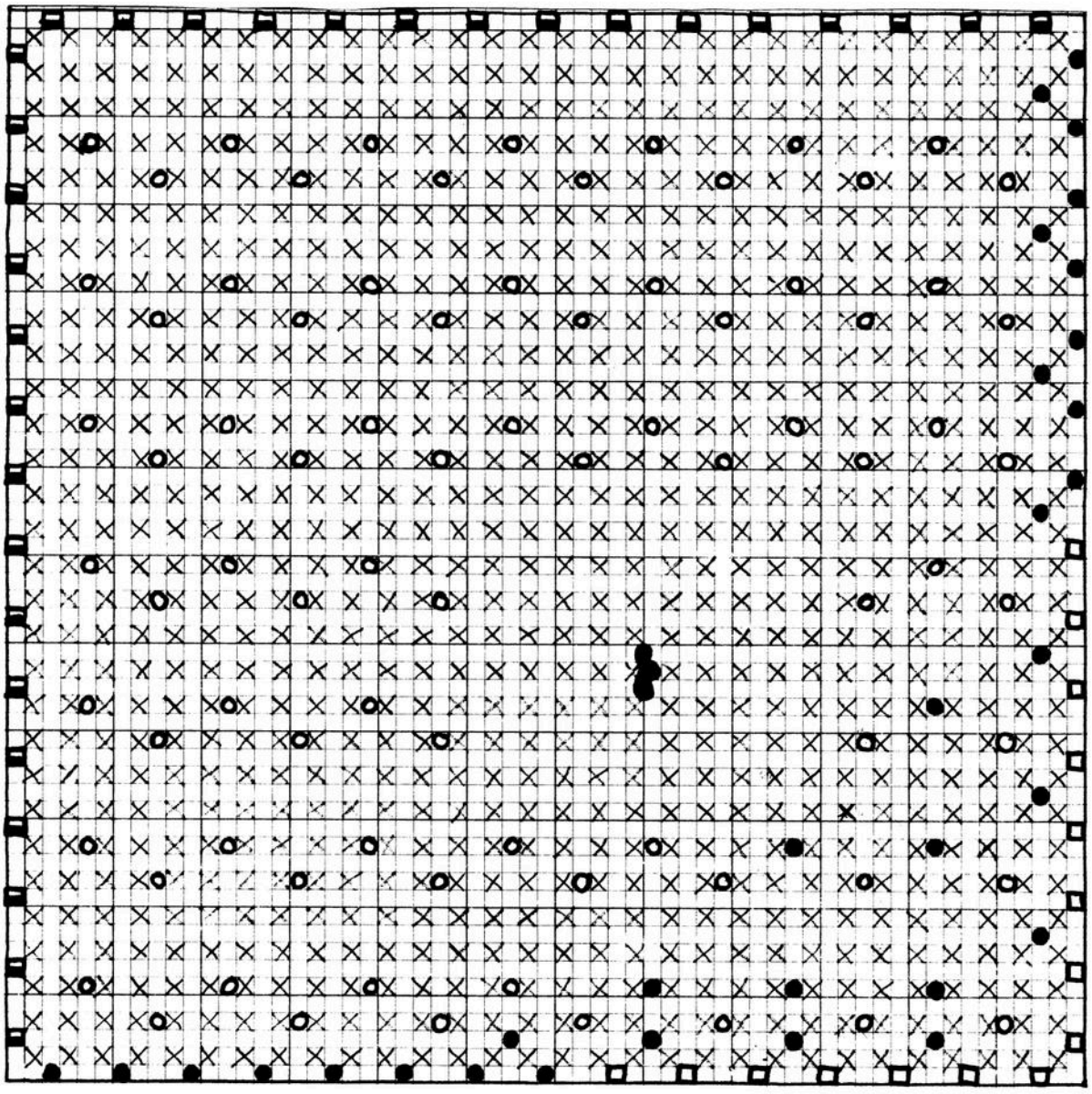
Care must be used in the distribution and lighting of heaters used in combination. No heaters should be placed within 150 to 200 feet of the wind machine. Heaters should not be lighted in double rows or concentrated in banks so dense that the heat will create a thermal updraft, turning it up and out of the orchard. Where two or more wind machines are operation together, the distribution of heaters between the machines should be very light.

A recommended charting of heater distribution in combination with a wind machine is illustrated on the following page.

ILLUSTRATION OF WIND MACHINE AND HEATER COMBINATION

The following is a lay-out of a square, 10-acre plot showing the placement of an 86-HP wind machine and auxiliary pots. For illustrative purposes, it is assumed that the frost condition will be for a 25°F, -4°C critical temperature night or lower with a prevailing south-east drift.

Wind Machine to Start At 33°F or 32°F, -.6°C or 0°C
☐ 15 Pots to Light At 29°F, -1.7°C
● 32 Pots to Light At 28°F, -2.2°C
○ 82 Pots to Light At 27°F, -2.8°C
⬓ For Reverse Drift Only: 30 Pots to Light At 29°F, -1.7°C



NOTE: THE WIND MACHINE IS LOCATED AWAY FROM THE CENTER OF THE ORCHARD TO COMPENSATE FOR A NORMAL AIR DRIFT.

ADDITIONAL INFORMATION ON THE USE OF WIND MACHINES

FOR DECIDUOUS OPERATIONS:

Bulletin No. 634

Title: Frost & Frost Control in Washington Orchards

Available From: Cooperative Extension Service
U.S. Department of Agriculture
Washington State University
Pullman, WA 99164-6230

FOR CITRUS OPERATIONS:

Leaflet No. 2372

Title: Protecting Citrus from Cold Losses

Available From: Cooperative Extension Service
U.S. Department of Agriculture
University of California
Berkley, CA 94720

A Call to our office to speak with one of our experienced persons about the operation of frost control may also be helpful. 509-248-0318

Thank you for your Chinook Wind Machine Purchase

Carel Thermostat Instructions



Setting Carel to desired temperature:

- Hold down the SET button until the screen starts flashing; the flashing number is the temperature at which the unit will turn on.
- To program (change) desired temperature, use the up or down arrow.
- After you have entered the desired temperature, hit the SET button once again and the temperature is set.
- To test accuracy, you may spray starting fluid on the Carel sensor; engine should start up when it reaches your desired set temperature or see Test Your Auto Start System below.

Auto-Start Procedures:

- Set Manual/Auto switch to AUTO to give power to the Auto Panel. You are now armed in the AUTO position. At the time this happens the engine will start and run momentarily, then shut off. You know with this action the machine is set to run on Auto Start.
- Set the digital Carel thermostat to desired temperature by holding down the SET button until the temperature flashes. The flashing temperature is the temperature at which the machine will start. Push the UP or DOWN button until your desired temperature shows. Then press the SET button to bring the display back to the temperature of the day.

TO TEST YOUR AUTO START SYSTEM

Set your Wind Machine to Auto Start.

Set the Carel Temperature unit to 45 degrees.

Put Ice in a 1 liter/quart container and then fill it with water. Stir for 2 minutes...Mixture will be close to 32 degrees F. Put temperature probe in Ice water mixture. When the temperature drops below 45 degrees F your machine will start. Has a 5-minute warm up and then will go full speed. We Program in a 5 degree differential which means the machine will stay on for 5 degrees over the start temp where ever that is set……. Remove the probe.

Warm the probe and as soon as temperature is above 45 degrees, + 5 degrees the engine will go to idle for approx. 5 minutes.

Engine will shut off. Test is Complete. Re-set your start up temperature on the Carel

Murphy Power View



1. Flip the switch to the **Manual Position (M)**. The power view wakes up. Let it go through it's "boot up" cycle.

2. Push and release the **Red Button**. The unit will start and idle. Fan will begin to spin slowly.

3. To increase engine RPM, push and hold the **UP Button** to the desired RPM.
   To decrease RPM, push and hold the **Down Button** to the desired RPM or idle.

4. To turn machine off, flip the upper right-hand Toggle Switch back to the center position.

ON THE POWER VIEW

**Note: Horizontal arrow buttons let you scroll through the different functions. **

To Run in Auto-Start, turn switch to A setting – Auto Start. The engine will start and run momentarily. This action is your verification that the machine is ready and set to operate in auto start, and will start up at your start or low temperature setting you have applied. All Carel units should have been pre-set to 33 Degrees start up temperature from the factory. You should set it to YOUR desired low start up temperature. Please check this operation of your new Chinook Wind Machine and become familiar with its operation.

H.F. HAUFF COMPANY INC.