CLARKE

Fire Protection Products, Inc.

CLARKE UK, LTD.

Fire Protection Products

Cincinnati, Ohio USA – Glasgow, Scotland UK

Diesel Engines for Fire Protection Applications

Based on NFPA 20 2013 Edition

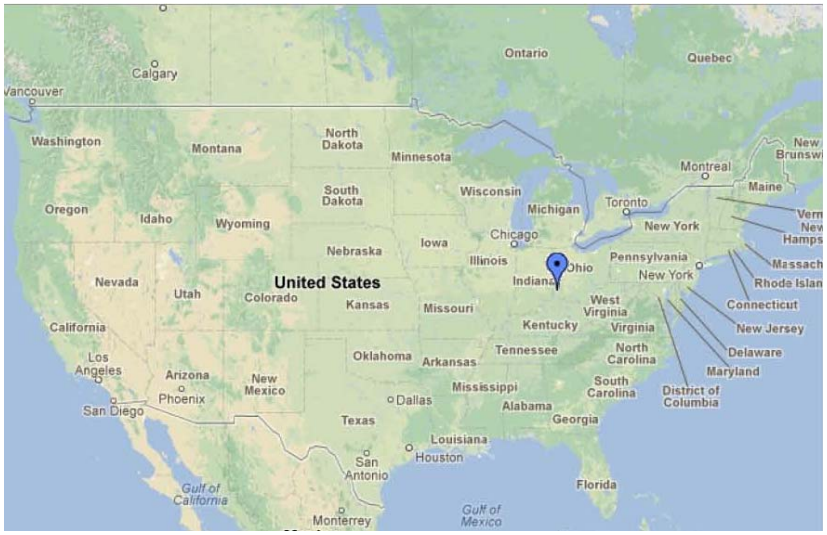
www.clarkefire.com

Clarke Summary

Clarke assembles engines in two facilities:

- Corporate Headquarters in Cincinnati, Ohio, USA
- European Operations in Coatbridge, Scotland, UK

Cincinnati, Ohio



Coatbridge, Scotland

Clarke Summary

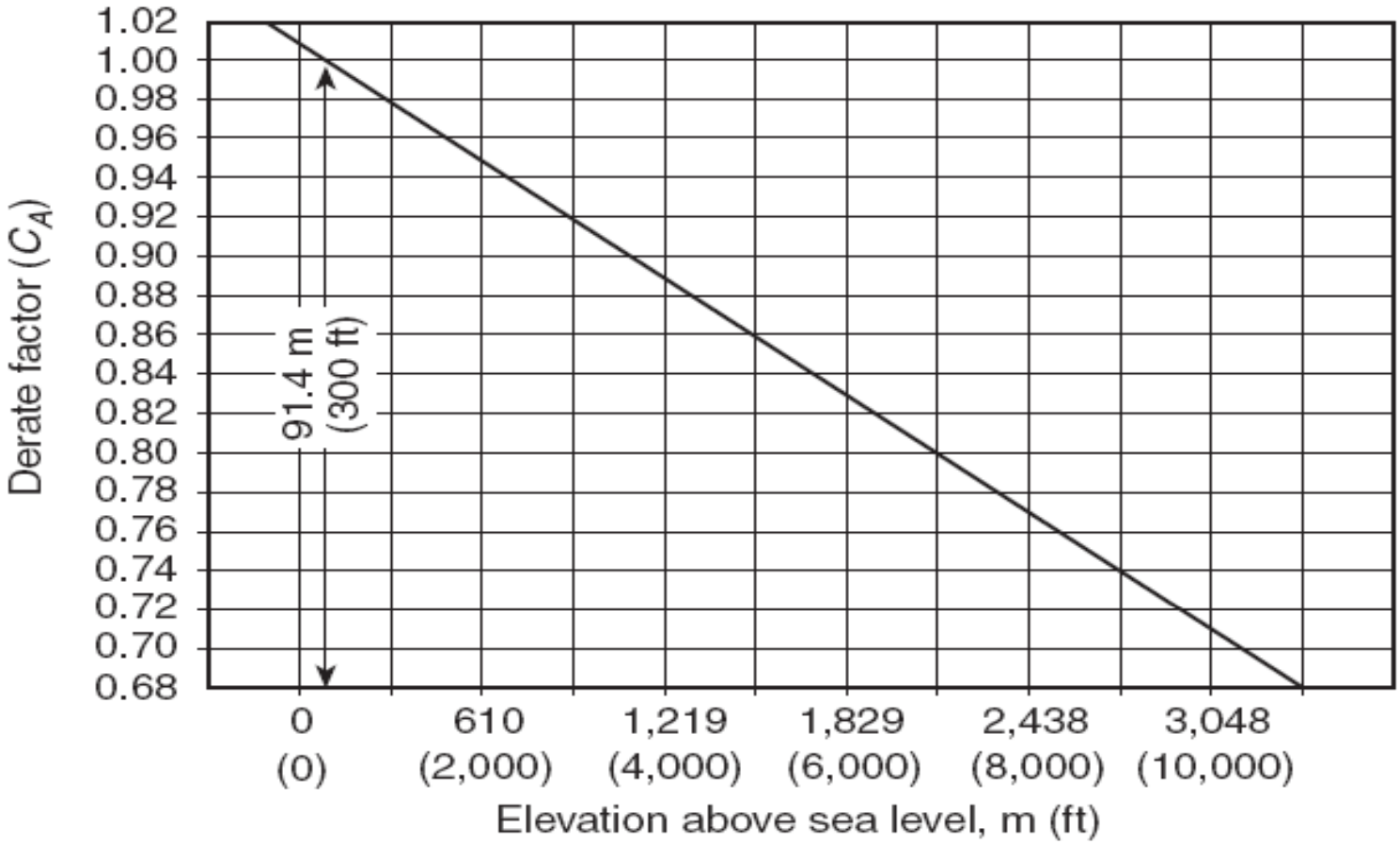
- We have been assembling UL/FM diesel fire pump drivers since 1979.
- We have over 75,000 engines installed globally.
- Largest provider of UL/FM diesel fire pump drivers with around 75% market share.
- Largest range of products available from 37 bhp to 2,376 bhp.

NFPA 20 – Engine Type

- Engines shall be listed for fire pump service.
- Diesel Engines for fire pump drive shall be of the compression ignition type.
- Spark-ignited internal combustion engines shall not be used. (i.e. natural gas, propane or gasoline)

NFPA 20 - Engine Ratings

- Rated at SAE Conditions 25°C (77°F) and 91 m (300 ft) above sea level.
- Engines must have at least a 10% reserve in horsepower and a 4 hour minimum run time. (All UL-FM engine ratings reflect this requirement).
- Engines must be derated for Altitude and Temperature.
  - 3% Derate for every 300 m (1000 ft) above 91 m (300 ft).
  - 1% Derate for every 5.6°C (10°F) above 25°C (77° F).



Note: The correction equation is as follows:

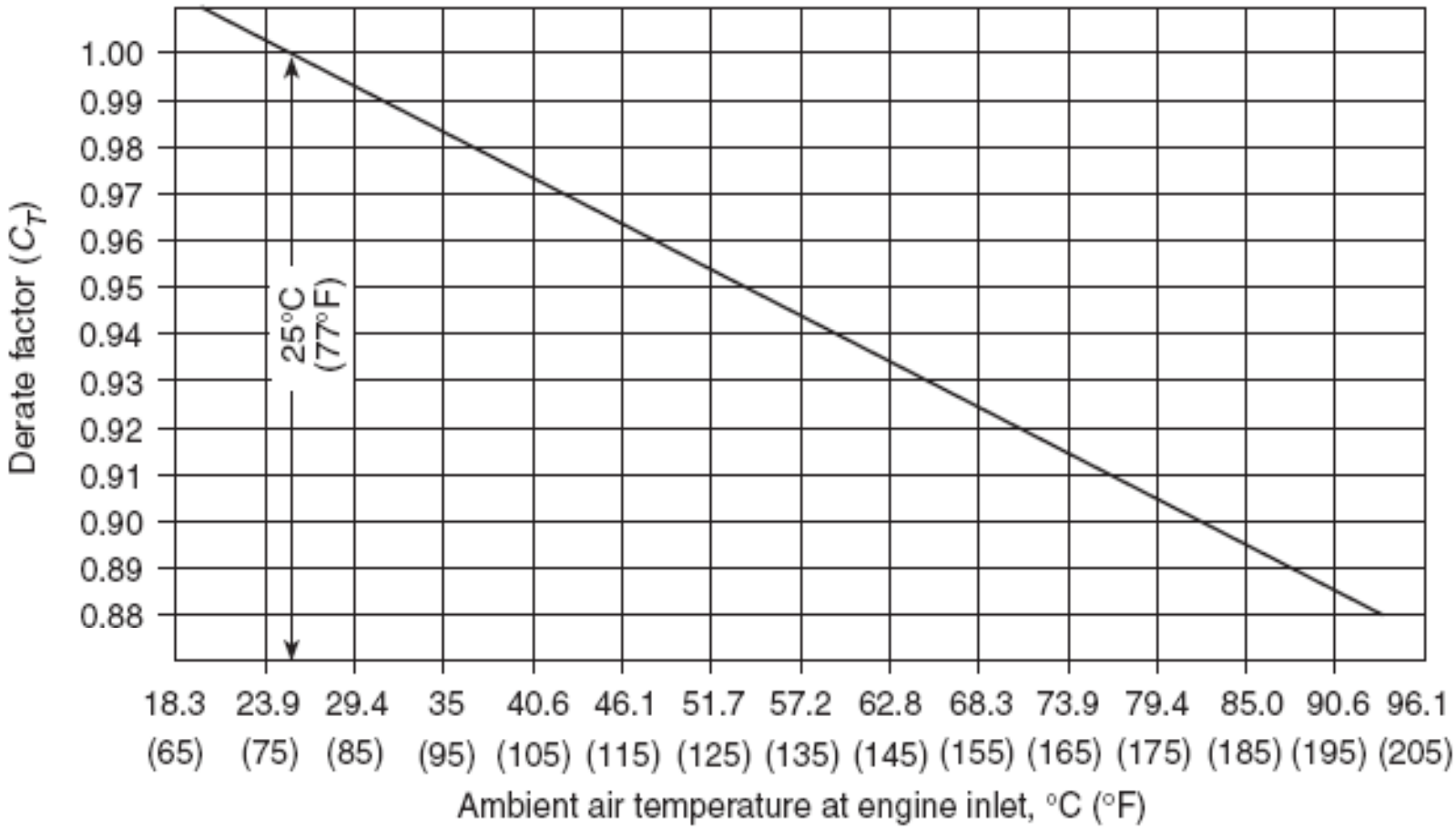
Corrected engine horsepower = $(C_A + C_T - 1) \times$ listed engine horsepower

where:

C_A = derate factor for elevation

C_T = derate factor for temperature

FIGURE A.11.2.2.4 Elevation Derate Curve.



Note: The correction equation is as follows:

Corrected engine horsepower = $(C_A + C_T - 1) \times$ listed engine horsepower

where:

C_A = derate factor for elevation

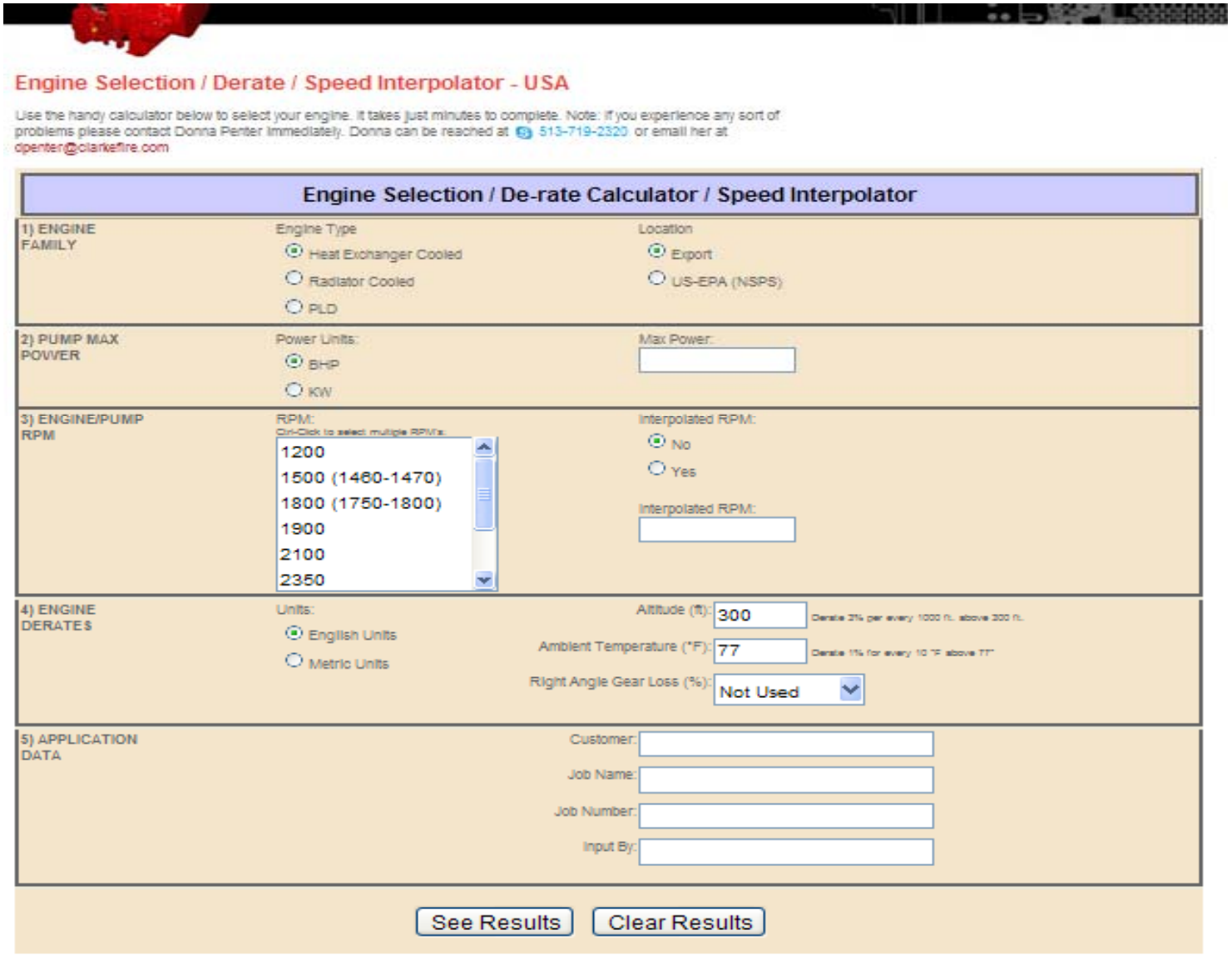
C_T = derate factor for temperature

FIGURE A.11.2.2.5 Temperature Derate Curve.

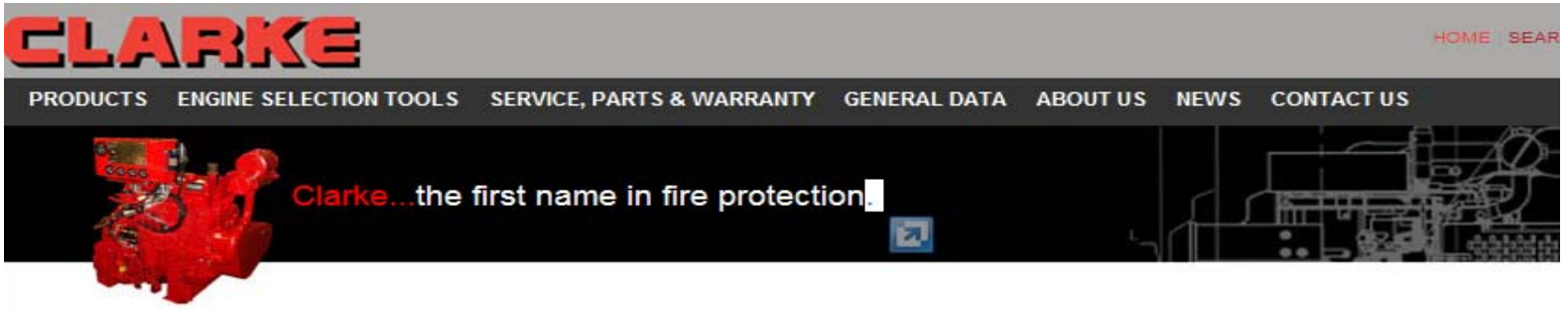
Derate Example

- 112 kW (150 hp) engine
- Altitude 1,524 m (5,000 ft): C_A=.86
- Temperature 41°C (105°F): C_T=.973
- Formula: (C_A + C_T – 1) x hp = derated hp
- (.86+ .973–1)=.833 x 150 hp = 93 kW (125 hp)
- Clarke Selection/De-rate Calculator program can calculate the exact size engine you need to use.

Engine Selection/De-rate Calculator



Engine Selection/De-rate Calculator



Engine Selection / Derate / Speed Interpolator - USA

Use the handy calculator below to select your engine. It takes just minutes to complete. Note: If you experience any sort of problems please contact Donna Penter immediately. Donna can be reached at 513-719-2320 or email her at dpenter@clarkefire.com

Engine Selection / De-rate Calculator / Speed Interpolator

USA Purchased, Export, 2010 Models, UL/FM Approved, Heat Exchanger Cooled

DATE: 8/9/2010

PUMP REQUIREMENTS:
Pump Max Power: 150 BHP
RPM(s): 1800

DERATE PARAMETERS:
Altitude: 5000 (feet)
Ambient Temperature: 105 (°F)
Right Angle Gear Loss: 0%
Derate Percent: 16.9

RESULTS:

Model	RPM	Rated HP (KW)	Derate HP (KW)	EPA Emission Tier (Reference)	Interpolation Data (RPM, HP)
JU6H-UFAAQ8	1800	227 (169)	188.6 (140.4)	N-Non-Emissionized	Not used
JU6H-UF50	1800	183 (137)	152.1 (113.8)	T1-Compliant	Not used
JU6H-UF58	1800	183 (137)	152.1 (113.8)	T1-Compliant	Not used

Alternate T3-Certified engine selections:

Model	RPM	Rated HP (KW)	Derate HP (KW)	EPA Emission Tier (Reference)	Interpolation Data (RPM, HP)
JU6H-UFAD58	1800	183 (137)	152.1 (113.8)	T3-Certified	Not used

Print | Start Over | Back

Engine Selection/De-rate Calculator

CLARKE

Fire Protection Products, Inc.

Engine Selection / De-rate Calculator / Speed Interpolator

USA Purchased, Export, 2010 Models, UL/FM Approved, Heat Exchanger Cooled

DATE: 8/9/2010

PUMP REQUIREMENTS:
Pump Max Power: 150 BHP
RPM(s): 1800

DERATE PARAMETERS:
Altitude: 5000 (feet)
Ambient Temperature: 105 (°F)
Right Angle Gear Loss: 0%
Derate Percent: 16.9

APPLICATION INFO:
Customer: Test 1
Job Name: Job 1
Job Number: 1
Run By: Justin Strousse

RESULTS:

Model	RPM	Rated HP (KW)	Derate HP (KW)	EPA Emission Tier (Reference)	Interpolation Data (RPM, HP)
JU6H-UFAAQ8	1800	227 (169)	188.6 (140.4)	N-Non-Emissionized	Not used
JU6H-UF50	1800	183 (137)	152.1 (113.8)	T1-Compliant	Not used
JU6H-UF58	1800	183 (137)	152.1 (113.8)	T1-Compliant	Not used

Alternate T3-Certified engine selections:

Model	RPM	Rated HP (KW)	Derate HP (KW)	EPA Emission Tier (Reference)	Interpolation Data (RPM, HP)
JU6H-UFAD58	1800	183 (137)	152.1 (113.8)	T3-Certified	Not used

NOTE:
Derated HP takes into account all the input derates for altitude, temperature and Right Angle Gearbox. When no derates are input, this column will be blank and engine selection(s) will be based upon Rated HP. When the Derated HP column is filled in, then the engine selection(s) are based upon this value.

DEFINITIONS:

- UL/FM - Engine that is Underwriters Laboratories Listed and Factory Mutual Approved

NFPA 20 – Instrument & Control

- Engines shall be regulated to have no more the 10% speed difference between shutoff and maximum load. (Defined as droop).
- Engines shall be provided with an over speed shutdown at 20% above rated engine speed with a manual reset. (Only over speed shutdown or a signal from the diesel controller will shut down an engine.)

Over speed Setting Verification

To verify the engine over speed setting and function without over speeding the engine, follow this procedure:

- Start engine manually from the controller while holding the over speed verification switch in the 'up' position. Observe the shutdown RPM.
- Test switch returns to normal position when released.
- Reset the over speed switch on the engine instrument panel and restart the engine from the controller to verify normal operation.
- EXAMPLE:

  Rated engine speed: 2100 rpm
  Over speed setting: 2520 rpm (120% 2100 rpm) Verification shutdown: 1688 rpm (67% of 2520 rpm)


CLARKE
MODE SELECTOR
MANUAL RUN
AUTOMATIC
OR
MANUAL STOP
WARNING
MODE SELECTOR NOT
IN AUTOMATIC
ENGINE WILL NOT STOP
FIRE PUMP ENGINE - MANUAL OPERATING INSTRUCTIONS
TO START ENGINE
1. Position MODE SELECTOR switch to MANUAL RUN.
2. Lift and hold MANUAL CRANK #1 until engine starts, or release after 15 seconds. If unit fails to start, wait for 15 seconds, use MANUAL CRANK #2 and repeat step.
3. If COOLING WATER is not flowing or engine TEMPERATURE is too HIGH, open cooling system manual by-pass valve.
TO STOP ENGINE
1. Return MODE SELECTOR switch to AUTOMATIC and MANUAL STOP position, engine will stop.
2. Close cooling system manual by-pass valve.
IMPORTANT
DO NOT leave the MODE SELECTOR switch in the MANUAL RUN postion during AUTOMATIC operation. (The controller will be unable to stop the engine and DAMAGE MAY RESULT).
OVERSPEED RESET
1. After problem has been corrected, reset the speed sensing device by lifting the OVERSPEED RESET and hold for 2 seconds.
OVERSPEED SHUTDOWN
OVERSPEED RESET
MANUAL CRANK #1
MANUAL CRANK #2
OVERSPEED 67% VERIFY
CLARKE
RPM
X1000
HOURS
WARNING
THIS EQUIPMENT STARTS AUTOMATICALLY
USE EAR PROTECTION
C13187
WARNING
This engine has an Energized to Stop Governor Solenoid and if the engine is cranked it WILL Start. Be sure to follow Manual Operations Instructions and position MODE SELECTOR switch to the MANUAL RUN position before cranking.
In an Emergency to manually override and stop engine use Stop lever on Governor Solenoid located near the instrument panel.
C134062
psi
kPa

NFPA 20 – Instrumentation & Control

- Required Gauges:
  - Tachometer – indicates RPM's
  - Oil Pressure Gauge
  - Coolant Temperature Gauge
  - Hour meter – records engine run time
- Additional Gauges:
  - Two voltmeters – one for each set of batteries

NFPA 20 – Instrumentation & Control

- The engine instrument panel shall not be used as a junction box or conduit for any AC supply.
- Interconnections between the automatic controller and engine junction box shall be made using stranded wire sized on a continuous-duty basis.
- The DC interconnections between the automatic controller and engine junction box and any AC power supply to the engine shall be routed in separate conduit.

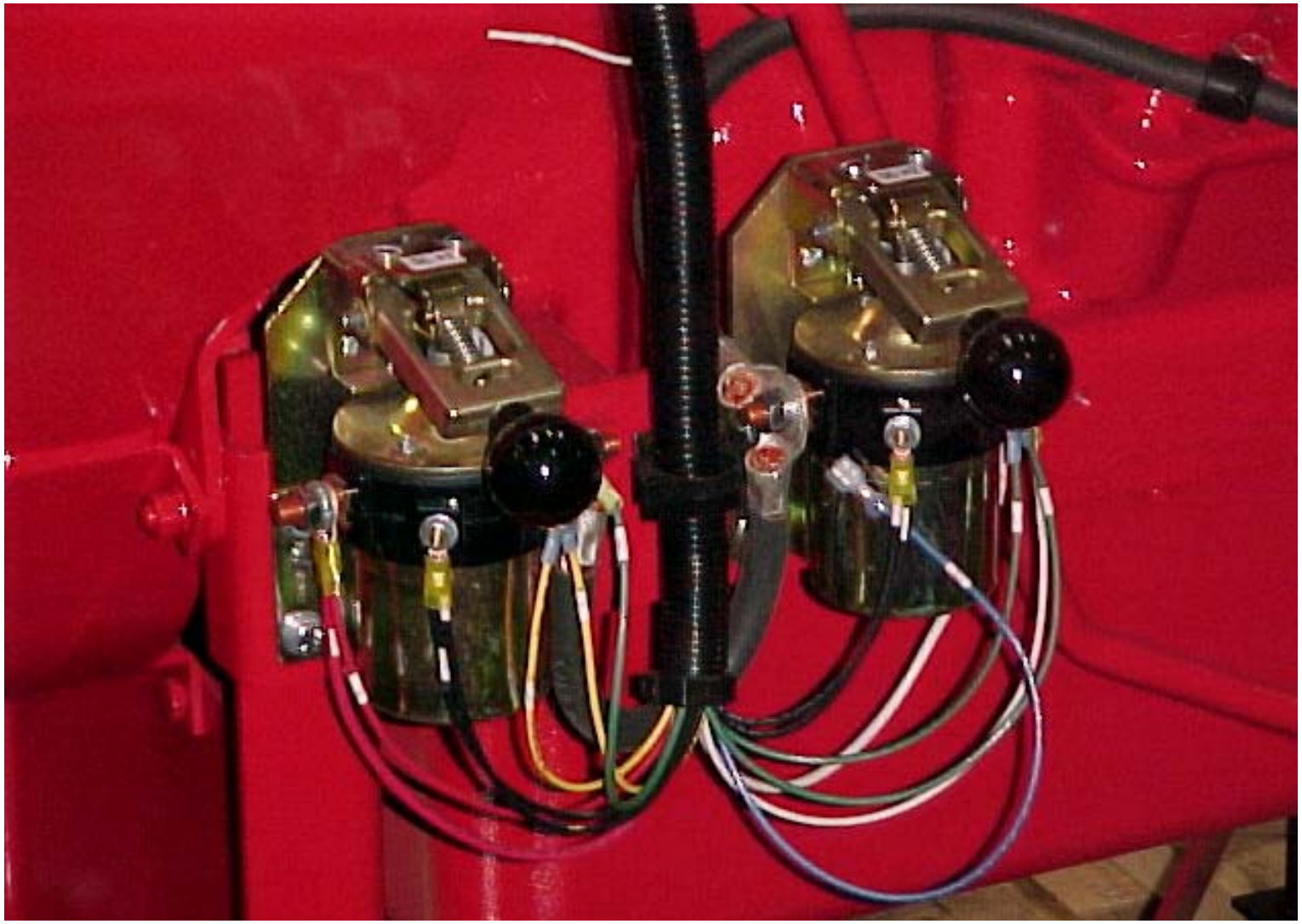
Engine-to-Controller Connections

Terminal	Interconnect Function	
1	Signal from Controller	Energize to Run
2	Signal to Controller	Engine Running
3	Signal to Controller	Over Speed Alarm
4	Signal to Controller	Low Oil Pressure Alarm
5	Signal to Controller	High Engine Coolant Temp. Alarm
6	Power Supply and Charging	Set #1
(7)	(Not used)	
8	Power Supply and Charging	Set #2
9	Cranking Signal from Controller	Start System #1
10	Cranking Signal from Controller	Start System #2
11	Common Ground	
12	Signal from Controller	Energize to Stop
301	Signal to Controller	Alternate ECM Alarm (electronic engines)
302	Signal to Controller	General Fault Alarm(electronic engines)
312	Signal to Controller	Low Engine Coolant Temp. Alarm

Typical Wire Size **	
**Refer to Controller Manufacturer's Installation Instructions for minimum size recommendations.	
1-5, 9, 10, 12, 301, 302, 312	14 Gauge (2 mm) Stranded Wire
#6, 8, 11,	10 Gauge (5 mm) Stranded Wire

NFPA 20 – Instrumentation & Control

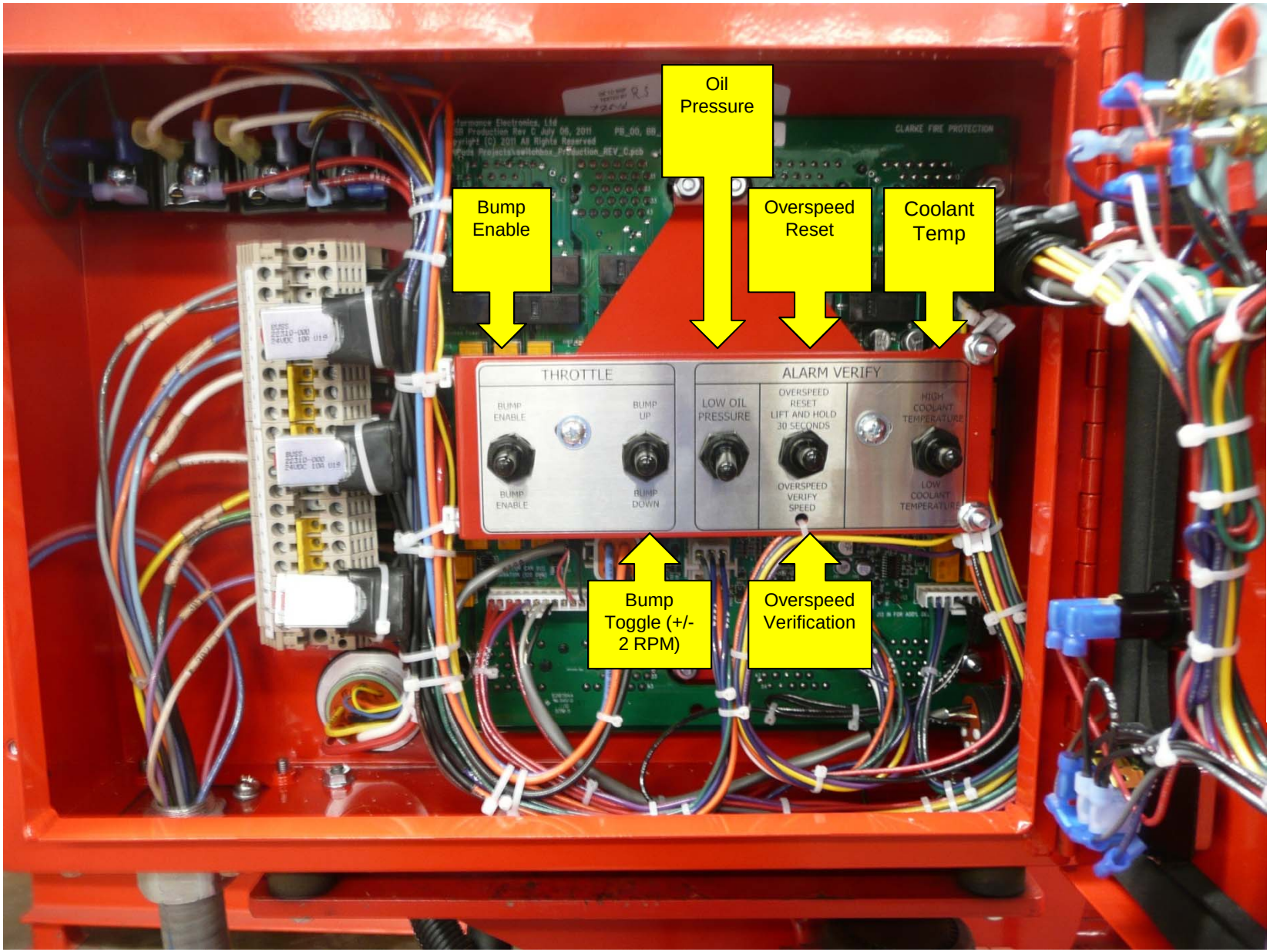
- Engines with only one starting motor shall include a main battery contactor installed between each battery and the cranking motor for battery isolation.
  - The battery contactors shall be listed for the service.
- Engines with two cranking motors shall have one cranking motor dedicated to each battery.
- Clarke electric starting standard;
  - One (1) starter with two (2) start contactors: on JW6H, JX6H, DP6H, DQ6H, DR8H, DS0H, and DT2H units.
  - Two (2) starters on JU4H, JU6H units.



NFPA 20 – Instrumentation & Control Electronic Engines

- Engines with an electronic control module (ECM) shall have an alternate ECM wired to produce full power in the event of primary ECM failure.
- There shall be a single ECM Selector Switch, with no off position, to transition from the primary ECM to the alternate ECM.
- A visual indicator shall show when the engine is running with the alternate ECM. (On both the engine panel and on the diesel controller)


MODE SELECTOR
MANUAL RUN
AUTOMATIC
WARNING
MODE SELECTOR NOT IN AUTOMATIC
CLARKE
VOLTMETER
BATTERY
BATTERY #2
BATTERY #1
FIRE PUMP ENGINE - MANUAL OPERATING INSTRUCTIONS
TO START ENGINE
1. Position MODE SELECTOR switch to MANUAL RUN.
2. Lift and hold MANUAL CRANK #1 until engine starts, or release after 15 seconds. If unit fails to start, wait for 15 seconds, use MANUAL CRANK #2 and repeat step.
3. IF COOLING WATER is not flowing or engine TEMPERATURE is too high open cooling system manual by-pass valve.
TO STOP ENGINE
1. Lift and hold MANUAL STOP until Engine Stops.
2. Return MODE SELECTOR switch to AUTOMATIC postion.
3. Close cooling system manual by-pass valve, if opened.
IMPORTANT
DO NOT leave the MODE SELECTOR switch in the MANUAL RUN postion during AUTOMATIC operation.
EMERGENCY FAILED TO START INSTRUCTIONS
SELECT ALTERNATE ECU
If a failed to start condition has occured, move the ECM selector switch to the ALTERNATE ECM position, then follow manual operating instructions above.
WARNING
OPERATING ON ALTERNATE ECM
ALTERNATE ECM WARNING:
DO NOT SWITCH WHILE THE ENGINE IS RUNNING
PRIMARY ECM
ECM SELECTOR
MANUAL STOP
MANUAL CRANK #1
MANUAL CRANK #2
C125782


Oil Pressure
Bump Enable
Overspeed Reset
Coolant Temp
THROTTLE
BUMP ENABLE
BUMP UP
BUMP ENABLE
BUMP DOWN
ALARM VERIFY
LOW OIL PRESSURE
OVERSPEED RESET LIFT AND HOLD 30 SECONDS
OVERSPEED VERIFY SPEED
HIGH COOLANT TEMPERATURE
LOW COOLANT TEMPERATURE
Bump Toggle (+/- 2 RPM)
Overspeed Verification

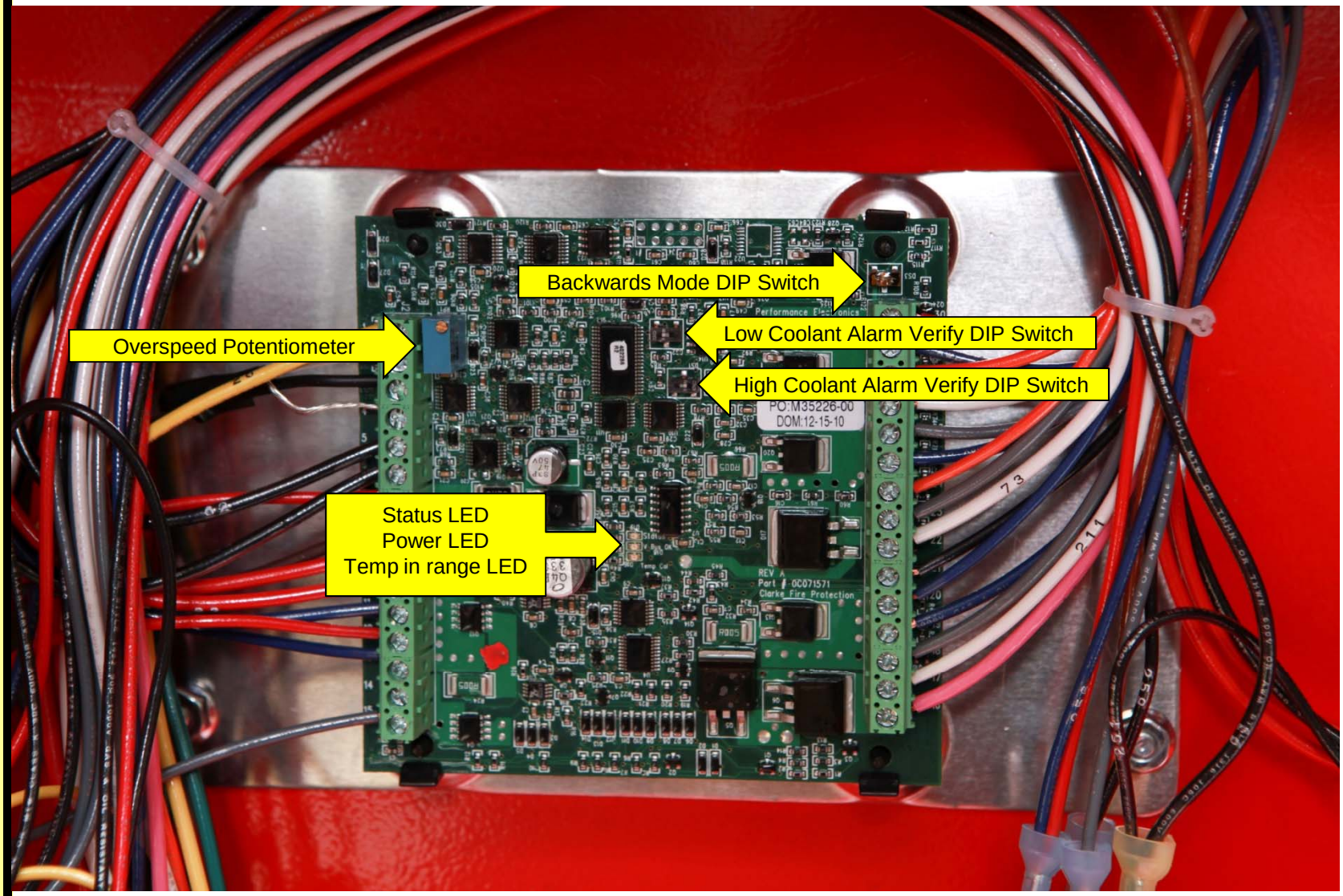
NFPA 20 – Instrumentation & Control Electronic Engines

- Any sensor necessary for the function of the ECM shall have a redundant sensor that shall operate automatically in case of failure.
- A signal shall be provided to the diesel controller for fuel injector failure, low fuel pressure and any primary sensor failure.
- The transition from the primary ECM to the alternate ECM shall be accomplished automatically upon failure of the primary ECM
- New 2013: ECM auto switching must happen in either primary or alternate ECM to the opposite.

NFPA 20 – Instrumentation & Control

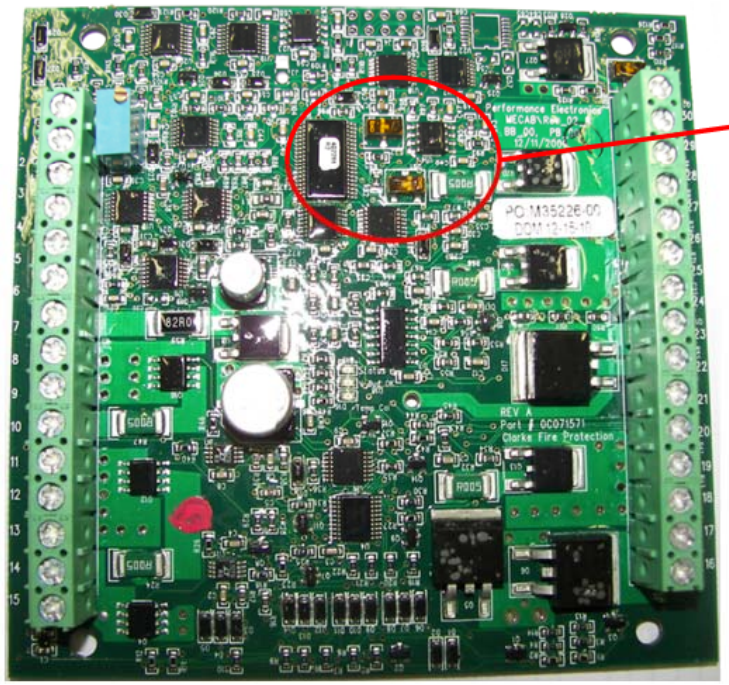
- New 2013: Means shall be provided for verifying overspeed switch & circuitry shutdown function, testing the operation of the oil pressure, testing the operation of the high engine temperature and testing the operation of the low engine temperature.
- The engine shall send a signal to the controller, resulting in a visible and common audible alarm on the controller.
- Our new “MECAB” instrument panel for our mechanical engines comply with the 2013 requirements.

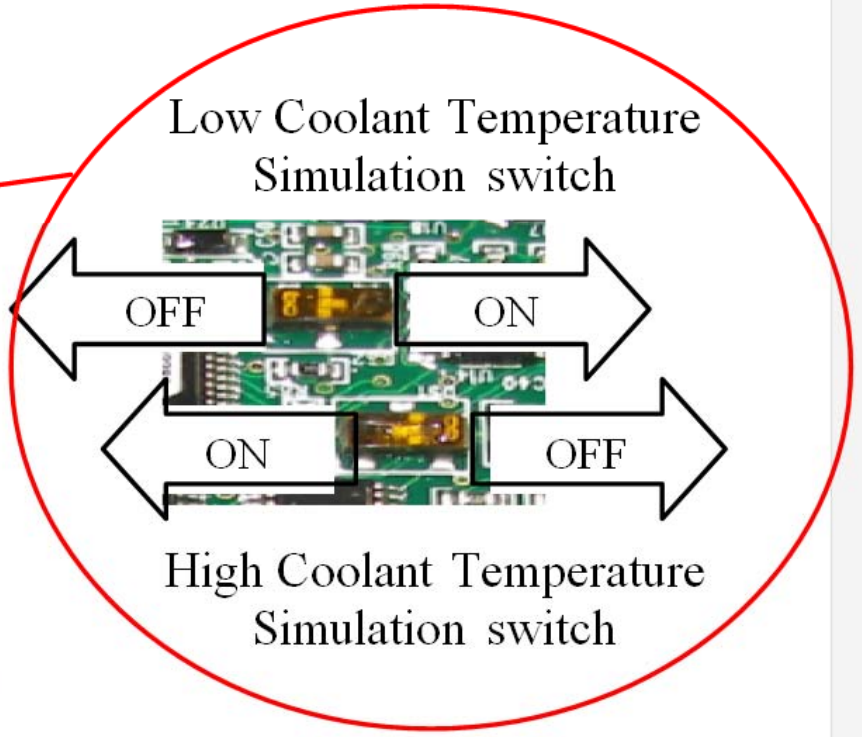
Mechanical Engine Control and Alarm Board (MECAB)



Mechanical Engine Control and Alarm Board (MECAB)

Low and High Coolant Temperature Switch Positions





NFPA 20 – Instrumentation & Control

- Each engine shall be provided with two storage battery units.
- Electrolyte shall be added a minimum of 24 hours prior to the time the engine has to be started.
- At 4.5°C (40°F) each battery shall have twice the capacity sufficient to maintain 3 minute attempt-to-start cycle (15 seconds of cranking and 15 seconds of rest in six consecutive cycles).
- Batteries shall be sized on a calculated capacity of 72 hours of stand by power without AC power being available.

NFPA 20 – Instrumentation & Control

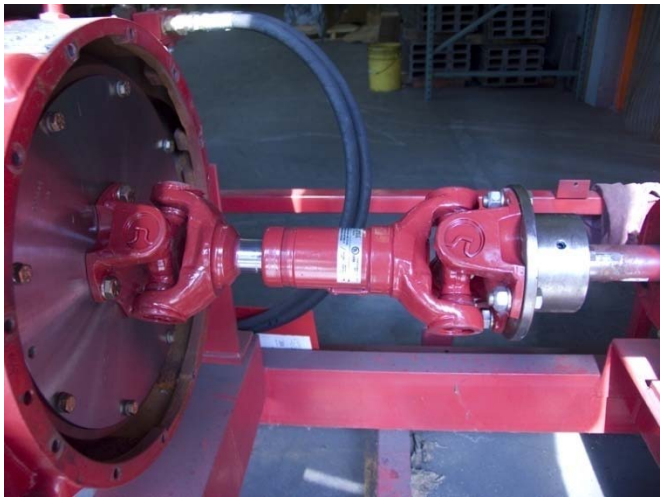
- Storage batteries shall be rack supported above the floor to prevent water damage.
- Storage batteries shall be readily accessible for servicing.
- Storage batteries shall not be located in front of the engine mounted instruments and controls.

NFPA 20 – Instrumentation & Control

- There should be two means for recharging the storage batteries.
  - The battery chargers in the diesel controller is the primary source.
  - The alternator on the engine is the secondary source.

NFPA 20 – Connecting to Pump

- Engines shall be connected to horizontal shaft pumps by means of a flexible coupling or flexible connecting shaft (drive shaft) listed for this service.
- The flexible coupling shall be directly attached to the engine flywheel adapter or stub shaft.



NFPA 20 – Torsional Coupling

- New 2013: A torsional vibration damping type coupling shall be used and mounted on the engine side of the driver shaft for all Vertical Turbine pumps unless a torsional analysis is provided and accepted by the AHJ to prove it is not necessary.
- For drive systems that include a right angle gear drive, the pump manufacturer shall provide a complete mass elastic system torsional analysis.

NFPA 20 – Engine Cooling

- The engine cooling system shall be of the closed-circuit type.
  - Heat exchanger type
  - Radiator type

NFPA 20 – Engine Cooling

- Cooling water shall be piped through a threaded rigid pipe from the discharge of the pump to the inlet of the heat exchanger.
- New 2013: Nonmetalic flexible sections shall be allowed between the pump discharge and cooling water provided they have 2 times the fire pump discharge rated pressure & 30 minute fire resistance.

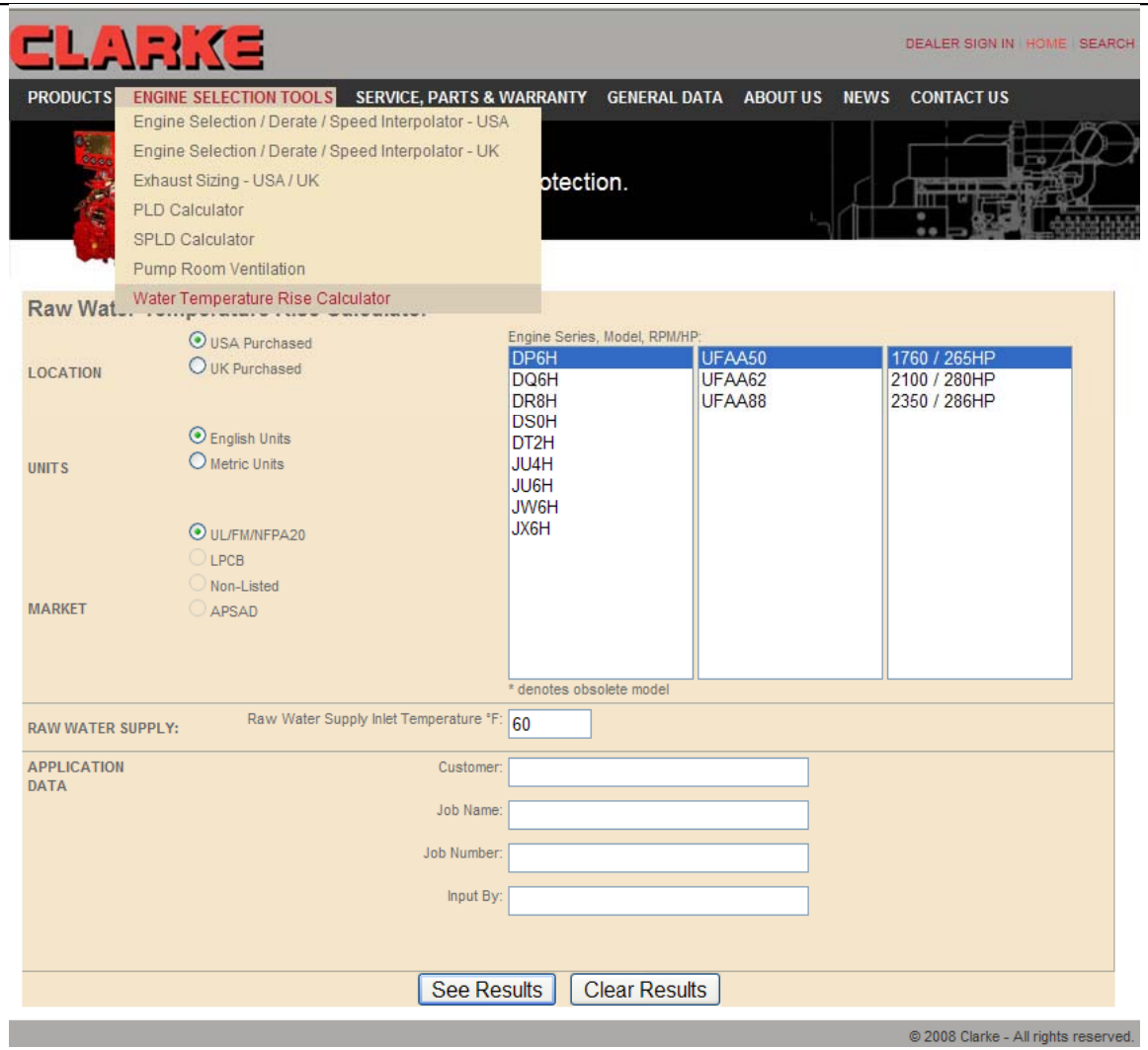
NFPA 20 – Engine Cooling

- The outlet for the wastewater coming from the heat exchanger shall be one size larger then the inlet.
- The wastewater shall be discharged into a visible open waste cone.
- New 2013 – Where pump discharge water is piped back to pump suction, a high cooling temperature signal at 104F (40C) from the inlet of the heat exchanger shall be sent to the controller. Engine will stop during test & alarm during an emergency.

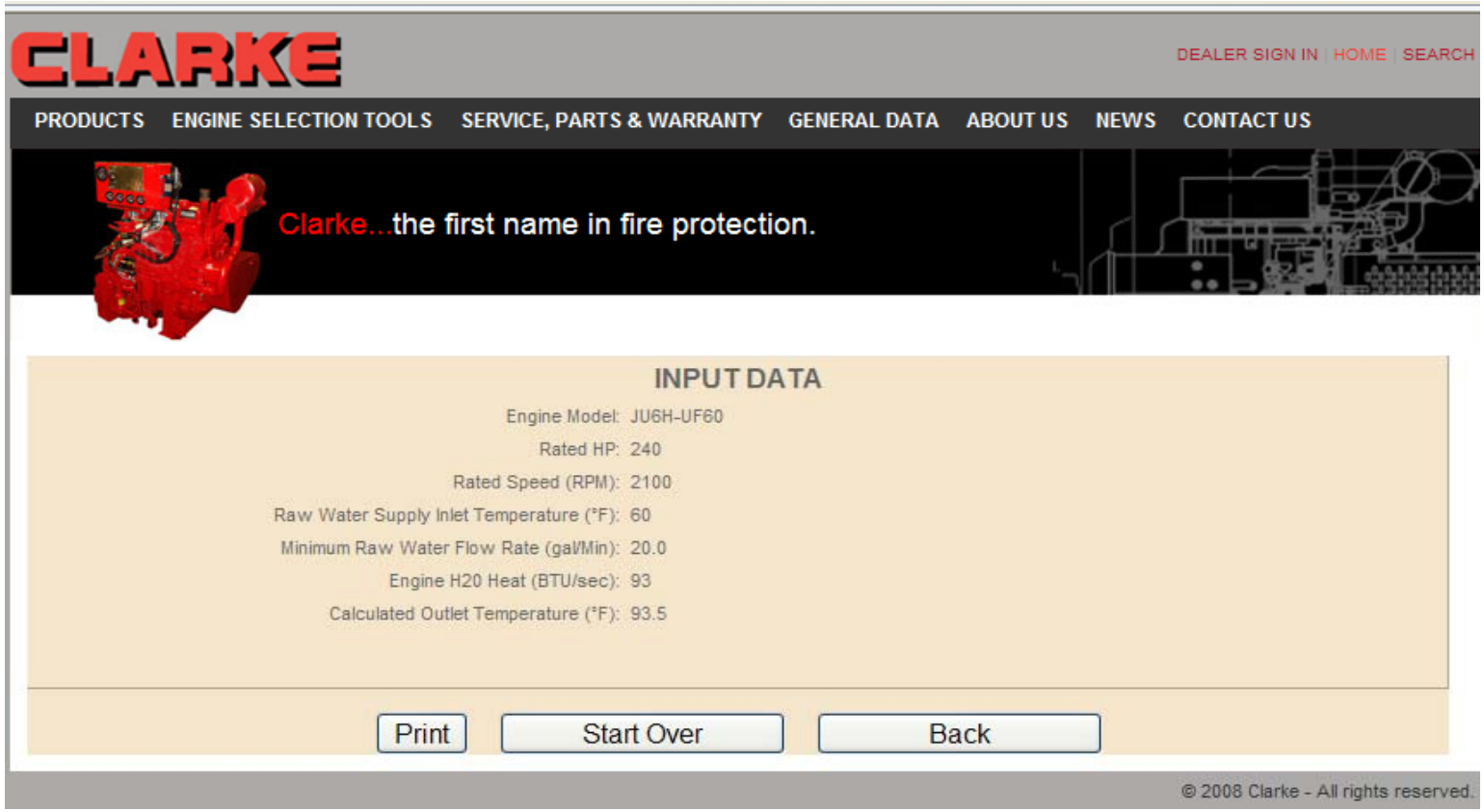
NFPA 20 – Engine Cooling

- Discharge can be piped to a suction reservoir provided a visual flow indicator and temperature indicators are installed.
- Set the temperature indicator at 10F (5.6C) above the Calculated Outlet Temperature found on the Water Temperature Rise Calculator under Engine Selection Tools on our website.
- The Calculated Outlet Temperature calculates the temperature of the water coming out of the Heat Exchanger.

NFPA 20 – Engine Cooling



NFPA 20 – Engine Cooling



NFPA 20 – Engine Cooling

CLARKE

Fire Protection Products, Inc.

Raw Water Temperature Rise Calculator - Results
Calculations made 7/16/2012

Data input by:

Application Data:

Customer:
Job Name:
Job Number:

Input Data:

Engine Model:	JU6H-UF60
Rated HP:	240
Rated Speed (RPM):	2100
Raw Water Supply Inlet Temperature (°F):	60
Minimum Raw Water Flow Rate (gal/Min):	20.0
Engine H20 Heat (BTU/sec):	93
Calculated Outlet Temperature (°F):	93.5

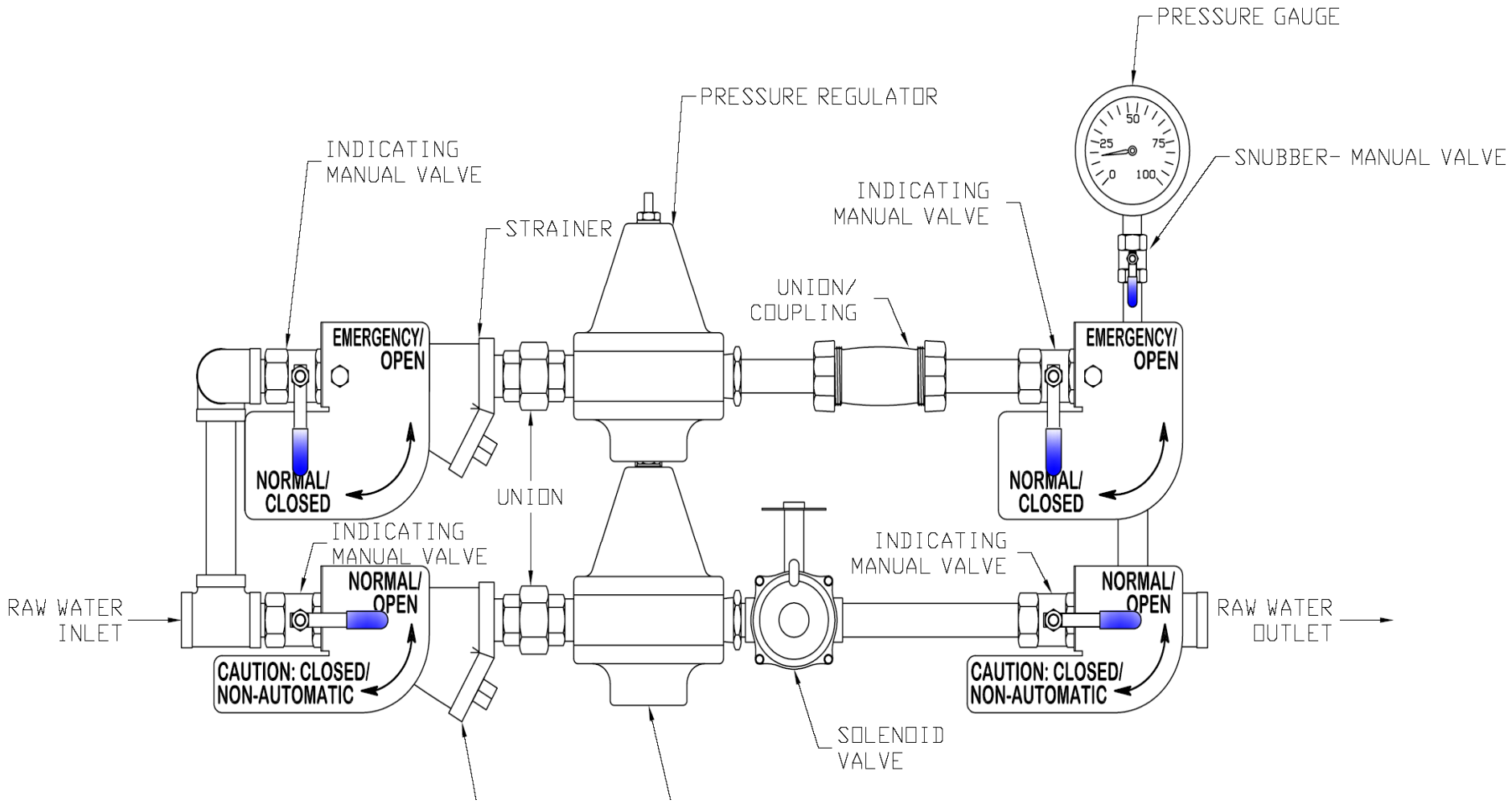
North American Offices:
3133 East Kemper Road ° Cincinnati, Ohio ° 45241 ° USA ° Tel: +1Â (513)Â 771-2200 ° Fax: +1 (513) 771-0726

European Office:
Grange Works ° Lomond Road ° Coatbridge, Scotland ° ML5 2NN ° Tel: +44Â (0)1236Â 429Â 946 ° Fax: +44 (0)1236 427 274

NFPA 20 – Engine Cooling

- Heat exchanger standard equipment.
- Sea water or fresh water; sacrificial anode
- Engines are shipped with coolant.
- Cooling water line (cooling loop) shall have a manual by-pass.
- Cooling water line and by-pass shall include:
  - indicating manual shutoff valve
  - approved flushing-type strainer
  - pressure regulator
  - automatic valve
  - second indicating manual valve or check valve
  - pressure gauge

Cooling Water Line



Engine Coolant

- Coolant is now included with the engine.
- Water, ethylene glycol, inhibitor coolant mixture. 50% water 50% coolant.
- Coolant to conform to ASTM D6210
  - Heat transfer
  - Corrosion resistance
  - Prevents cavitations
  - Prevents scale and sludge build up
  - Provides freeze and boil over protection
- Pre-mix before installing in engine to prevent premature engine heater failure.

NFPA 20 – Engine Cooling

- Coolant heater is the only AC power on engine; Separate AC junction box required. Do not use controller AC for power supply.
- Add coolant mixture *before* applying AC power.
- All heaters single voltage; Optional AC voltages available – location specific.
- Engine coolant maintained at 49°C (120°F)

NFPA 20 – Engine Protection

- The engine shall be protected against possible interruption of service through explosion, fire, flood, earthquake, rodents, insects, windstorm, freezing, vandalism and other adverse conditions.
- Application: The engine must be installed inside or protected from the weather and low temperature.

NFPA 20 – Room Requirements

- Floors shall be pitched for adequate drainage of escaping water from critical equipment.
- The pump room shall be provided with a floor drain that will discharge to a frost free location.
- Fire pump rooms enclosing a diesel engine pump driver and day tank shall be protected with an automatic sprinkler system installed in accordance with NFPA 13.
- Emergency lighting shall be provided in accordance with NFPA 101. Emergency lights shall not be connected to an engine starting battery

NFPA 20 – Room Requirements

- Access to the fire pump room shall be pre-planned with the fire department.
- Rooms containing fire pumps shall be free from storage equipment & penetrations not essential to the operation of the pump.
- Equipment related to domestic water distribution shall be permitted to be located within the same room as fire pump equipment.
- Room needs to be protected from surrounding occupancies by a minimum of 2 hour fire rated construction or physically separated from the building by 50 ft (15.3m) away from any buildings and other fire exposures exposing the building.

NFPA 20 – Room Requirements

- Fire pump rooms not directly accessible from the outside shall be accessible through an enclosed passageway from an enclosed stairway or exterior exit. The enclosed passageway shall have a minimum 2 hour fire resistance rating.
- New 2013 – Pump room shall be sized to fit all of the components necessary for the operation of the fire pump and there must be clearance between components, the wall and electrical equipment for installation and maintenance.

NFPA 20 – Air Requirements

- The minimum ambient temperature for the pump room is 4.5°C (40°F).
  - An approved or listed source of heat shall be provided for maintaining the temperature of a pump room or pump house.
- Limit the maximum temperature for the pump room to 49°C (120°F) at the air cleaner inlet with the engine running at rated load.

NFPA 20 – Air Requirements

- Inlet louver and ventilating system must:
  - Maintain 49°C (120°F) in the room
  - Supply adequate air for engine combustion
  - Supply adequate air for ventilating radiated heat; both engine & exhaust system.
- Radiator Cooled Units shall be ducted outdoors in a manner that will prevent recirculation and requires more air for combustion and radiated heat removal.

Installation and Operation Data

CLARKE
Fire Protection Products, Inc.

JU6H-UF60

INSTALLATION & OPERATION DATA (I&O Data)

USA Produced

Basic Engine Description				
Engine Manufacturer	John Deere Co.			
Ignition Type	Compression (Diesel)			
Number of Cylinders	6			
Bore and Stroke - in (mm)	4.19 (106) X 5 (127)			
Displacement - in³ (L)	415 (6.8)			
Compression Ratio	17.0:1			
Valves per cylinder				
Intake	1			
Exhaust	1			
Combustion System	Direct Injection			
Engine Type	In-Line, 4 Stroke Cycle			
Fuel Management Control	Mechanical, Rotary Pump			
Firing Order (CW Rotation)	1-5-3-6-2-4			
Aspiration	Turbocharged			
Charge Air Cooling Type	Raw Water			
Rotation, viewed from front of engine, Clockwise (CW)	Standard			
Engine Crankcase Vent System	Open			
Installation Drawing	D536			
Weight - lb (kg)	1693 (768)			

Power Rating	**1760**	**2100**	**2350**
Nameplate Power - HP (kW)	200 (149)	240 (179)	240 (179)

Cooling System - [C051127]	**1760**	**2100**	**2350**
~~Engine Coolant Heat - Btu/sec (kW)~~	~~78 (82.3)~~	~~93 (98.1)~~	~~101 (107)~~
→ Engine Radiated Heat - Btu/sec (kW)	46 (48.5)	54 (57)	54 (57)
Heat Exchanger Minimum Flow			
60°F (15°C) Raw H_20 - gal/min (L/min)	17 (64.3)	20 (75.7)	23 (87.1)
95°F (35°C) Raw H_20 - gal/min (L/min)	18 (68.1)	21 (79.5)	25 (94.6)
Heat Exchanger Maximum Cooling Raw Water			
Inlet Pressure - psi (bar)	60 (4.1)		
Flow - gal/min (L/min)	40 (151)		
Typical Engine H_20 Operating Temp - °F (°C)[1]	180 (82.2) - 195 (90.6)		
Thermostat			
Start to Open - °F (°C)	187 (86.1)		
Fully Opened - °F (°C)	196 (91.1)		
Engine Coolant Capacity - qt (L)	14.79 (14)		
Coolant Pressure Cap - lb/in² (kPa)	10 (68.9)		
Maximum Engine Coolant Temperature - °F (°C)	200 (93.3)		
Minimum Engine Coolant Temperature - °F (°C)	160 (71.1)		
High Coolant Temp Alarm Switch - °F (°C)	205 (96.1)		

Electric System - DC	**Standard**		**Optional**	
System Voltage (Nominal)	12		24	
Battery Capacity for Ambients Above 32°F (0°C)				
Voltage (Nominal)	12	[C07633]	24	[C07633]
Qty. Per Battery Bank	1		2	
SAE size per J537	8D		8D	
CCA @ 0°F (-18°C)	1400		1400	
Reserve Capacity - Minutes	430		430	
Battery Cable Circuit, Max Resistance - ohm	0.0012		0.0012	
Battery Cable Minimum Size				
0-120 in. Circuit Length[2]	00		00	
121-160 in. Circuit Length[2]	000		000	
161-200 in. Circuit Length[2]	0000		0000	
Charging Alternator Maximum Output - Amp,	40	[C07639]	40	[C071048]
Starter Cranking Amps, Rolling - @60°F (15°C)	440	[RE69704/RE70404]	250	[C07819/C07820]

Installation and Operation Data

CLARKE
Fire Protection Products, Inc.

JU6H-UF60

INSTALLATION & OPERATION DATA (I&O Data)

USA Produced

	1760	2100	2350
Exhaust System			
Exhaust Flow - ft.³/min (m³/min)	952 (27)	1227 (34.7)	1345 (38.1)
Exhaust Temperature - °F (°C)	988 (531)	909 (487)	883 (473)
Maximum Allowable Back Pressure - in H_20 (kPa)	30 (7.5)	30 (7.5)	30 (7.5)
Minimum Exhaust Pipe Dia. - in (mm)[3]	5 (127)	5 (127)	5 (127)
Fuel System	1760	2100	2350
Fuel Consumption - gal/hr (L/hr)	10 (37.8)	10.3 (39)	11.2 (42.4)
Fuel Return - gal/hr (L/hr)	5.4 (20.4)	5.8 (22)	7 (26.5)
Fuel Supply - gal/hr (L/hr)	15.4 (58.3)	16.1 (60.9)	18.2 (68.9)
Fuel Pressure - lb/in² (kPa)	4 (27.6) - 6 (41.4)		
Minimum Line Size - Supply - in.	.50 Schedule 40 Steel Pipe		
Pipe Outer Diameter - in (mm)	0.848 (21.5)		
Minimum Line Size - Return - in.	.375 Schedule 40 Steel Pipe		
Pipe Outer Diameter - in (mm)	0.675 (17.1)		
Maximum Allowable Fuel Pump Suction Lift with clean Filter - in H_20 (mH_20)	31 (0.8)		
Maximum Allowable Fuel Head above Fuel pump, Supply or Return - ft (m)	4.5 (1.4)		
Fuel Filter Micron Size	5		
Heater System	**Standard**		**Optional**
Engine Coolant Heater			
Wattage (Nominal)	1500		1500
Voltage - AC, 1 Phase	120 (+5%, -10%)		240 (+5%, -10%)
Part Number	[C124948]		[C124949]
Air System	**1760**	**2100**	**2350**
Combustion Air Flow - ft.³/min (m³/min)	354 (10)	494 (14)	538 (15.2)
Air Cleaner	**Standard**		**Optional**
Part Number	[C03396]		[C03327]
Type	Indoor Service Only, with Shield		Canister, Single-Stage
Cleaning method	Washable		Disposable
Air Intake Restriction Maximum Limit			
Dirty Air Cleaner - in H_20 (kPa)	12 (3)		10 (2.5)
Clean Air Cleaner - in H_20 (kPa)	6 (1.5)		5 (1.2)
Maximum Allowable Temperature (Air To Engine Inlet) - °F (°C)[4]	130 (54.4)		
Lubrication System			
Oil Pressure - normal - lb/in² (kPa)	40 (276) - 60 (414)		
Low Oil Pressure Alarm Switch - lb/in² (kPa)	20 (138)		
In Pan Oil Temperature - °F (°C)	220 (104) - 245 (118)		
Total Oil Capacity with Filter - qt (L)	21.1 (20)		
Lube Oil Heater	**Optional**		**Optional**
Wattage (Nominal)	150		150
Voltage	120V (+5%, -10%)		240V (+5%, -10%)
Part Number	C04430		C04431
Performance	**1760**	**2100**	**2350**
BMEP - lb/in² (kPa)	217 (1500)	218 (1500)	195 (1340)
Piston Speed - ft/min (m/min)	1467 (447)	1750 (533)	1958 (597)
Mechanical Noise - dB(A) @ 1m	C13916		
Power Curve	C13481		

[3]Based on Nominal System. Back pressure flow analysis must be done to assure maximum allowable back pressure is not exceeded. (Note: minimum exhaust Pipe diameter is based on: 15 feet of pipe, one 90° elbow, and a silencer pressure drop no greater than one half of the maximum allowable back pressure.) [4]Review for horsepower derate if ambient air entering engine exceeds 77°F (25°C). [ ] indicates component reference part number.

CLARKE

DEALER SIGN IN | HOME | SEARCH

PRODUCTS | ENGINE SELECTION TOOLS | SERVICE, PARTS & WARRANTY | GENERAL DATA | ABOUT US | NEWS | CONTACT US

- Engine Selection / Derate / Speed Interpolator - USA
- Engine Selection / Derate / Speed Interpolator - UK
- Exhaust Sizing - USA / UK
- PLD Calculator
- SPLD Calculator
- Pump Room Ventilation

otection.

Pump Room Ventilation Calculator

LOCATION
- (•) USA Purchased
- ( ) UK Purchased

UNITS
- (•) English Units
- ( ) Metric Units

MARKET
- (•) UL/FM/NFPA20
- ( ) LPCB
- ( ) Non-Listed
- ( ) APSAD

Engine Series, Model, RPM/HP:

DDFP	06FA *	1470 / 315HP
DP6H	06FH *	1760 / 368HP
DQ6H	08FA *	1900 / HP
DR8H	08FH *	2100 / 412HP
DS0H	12FH *	2350 / 443HP
DT2H	L8FA *	
IK6H	T6FA *	
IK6R		
JDFP		
JU4H		
JU4R		
JU6H		
JW6H		
JX6H		
PDFP		

* denotes obsolete model

PUMP ROOM DATA:

Max. Temp Rise (°F): 20

APPLICATION DATA :

Customer:

Job Name:

Job Number:

Input By:

See Results | Clear Results

CLARKE

DEALER SIGN IN | HOME | SEARCH

PRODUCTS | ENGINE SELECTION TOOLS | SERVICE, PARTS & WARRANTY | GENERAL DATA | ABOUT US | NEWS | CONTACT US

Clarke...the first name in fire protection.

INPUT DATA

Engine Model:	JU4H-UF10
Rated HP:	41
Rated Speed (RPM):	1760
Combustion Air Flow (CFM):	140
Temperature Rise (°F) :	20
Engine Radiated Heat (BTU/Sec):	8
Engine Radiated Heat (BTU/Min):	480

PUMP ROOM VENTILATION CALCULATIONS

	140	Combustion Air Flow (CFM)
+	1333	Flow for engine radiated heat (CFM)
	1473	Total (CFM)

You must apply the NFPA 20 BHP derate to the engine rated BHP if you are going to allow the pump room to go above an ambient temperature of 77°F.

Print | Start Over | Back

CLARKE

Fire Protection Products, Inc.

Pump Room Ventilation Calculator - Results
Calculations made 2/10/2012

Data input by:

Application Data:

Customer:
Job Name:
Job Number:

Input Data:

Engine Model:JU4H-UF10
Rated HP:41
Rated Speed (RPM):1760
Combustion Air Flow (CFM):140
Temperature Rise (°F):20
Engine Radiated Heat (BTU/Sec):8
Engine Radiated Heat (BTU/Min):480

Pump Room Ventilation Calculations:

	140	Combustion Air Flow (CFM)
+	1333	Flow for engine radiated heat (CFM)
	1473	Total (CFM)

You must apply the NFPA 20 BHP derate to the engine rated BHP if you are going to allow the pump room to go above an ambient temperature of 77°F.

North American Offices:
3133 East Kemper Road ° Cincinnati, Ohio ° 45241 ° USA ° Tel: +1 (513) 771-2200 ° Fax: +1 (513) 771-0726

European Office:
Grange Works ° Lomond Road ° Coatbridge, Scotland ° ML5 2NN ° Tel: +44 (0)1236 429 946 ° Fax: +44 (0)1236 427 274

Print

Heat Exchanger Ventilation

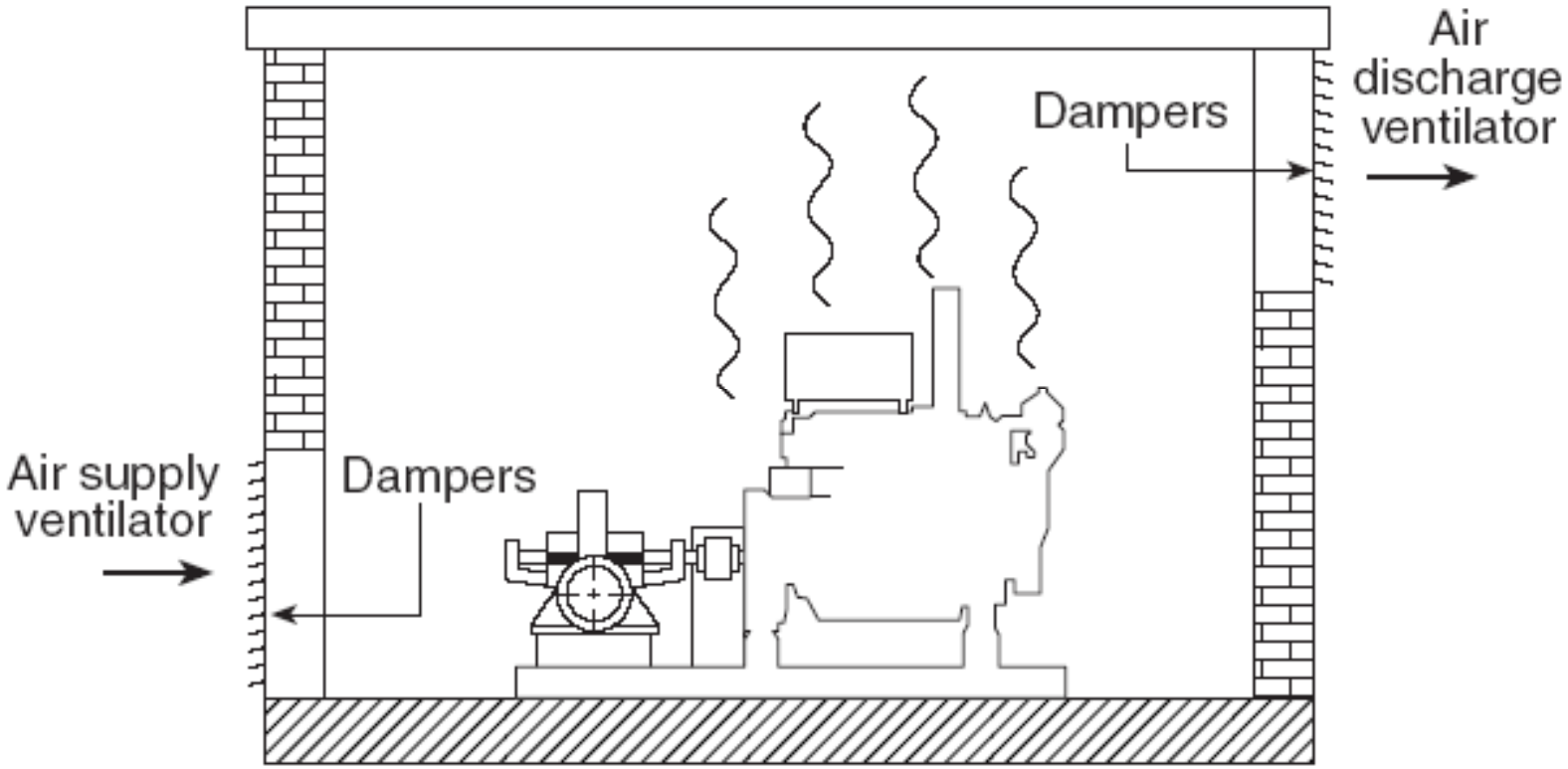


FIGURE A.11.3.2(a) Typical Ventilation System for a Heat Exchanger–Cooled Diesel-Driven Pump.

Radiator Ventilation

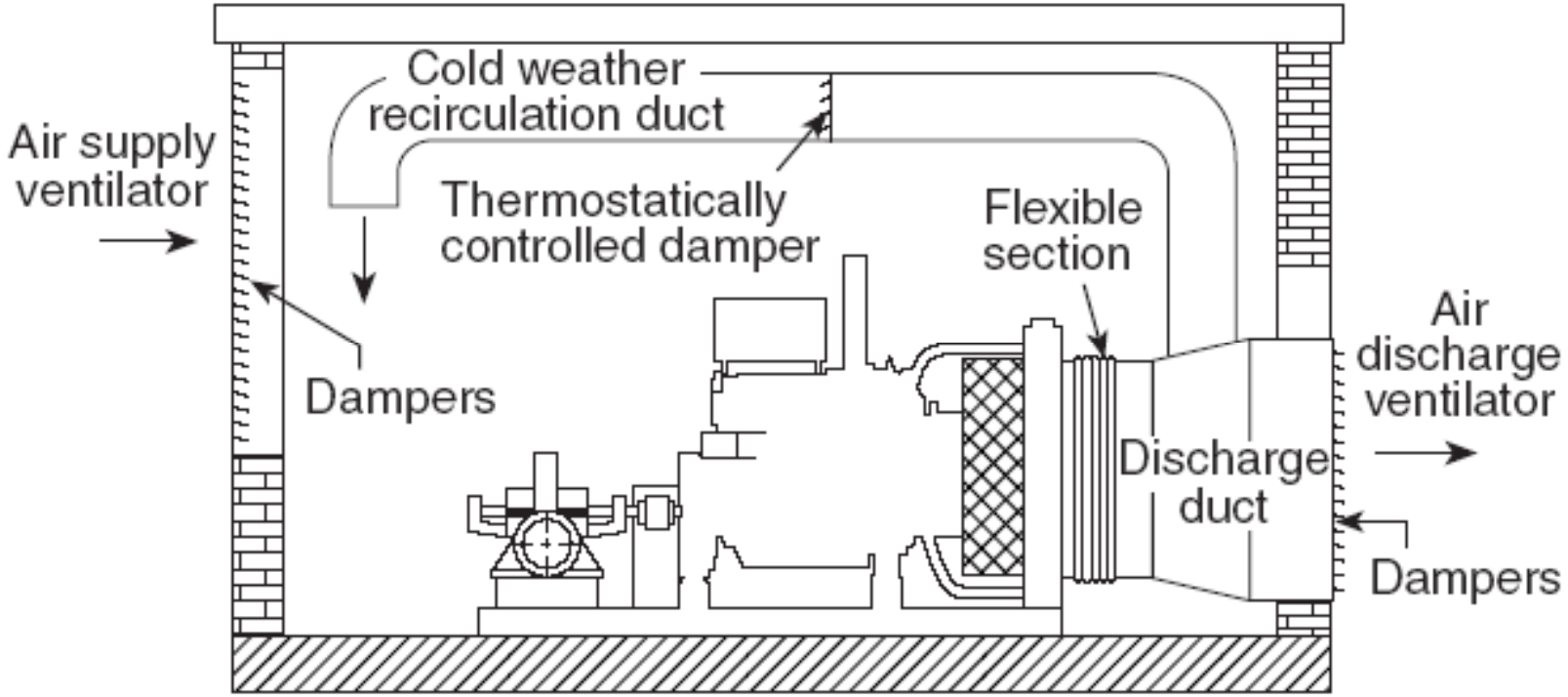
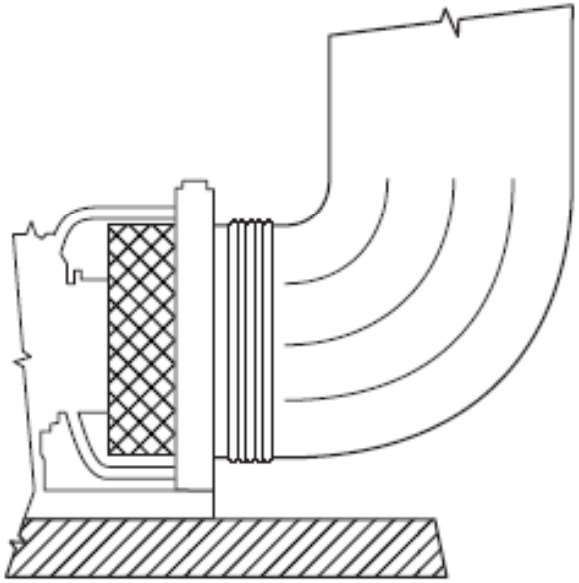


FIGURE A.11.3.2(b) Typical Ventilation System for a Radiator-Cooled Diesel-Driven Pump.

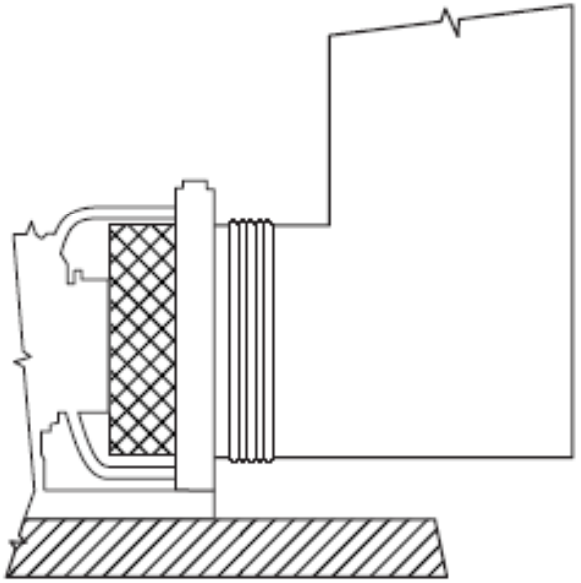
Radiator Ventilation

Right



If a bend in the ducting cannot be avoided, it should be radiused and should include turning vanes to prevent turbulence and flow restriction.

Wrong



This configuration should not be used; turbulence will not allow adequate air flow.

Radiator Ventilation

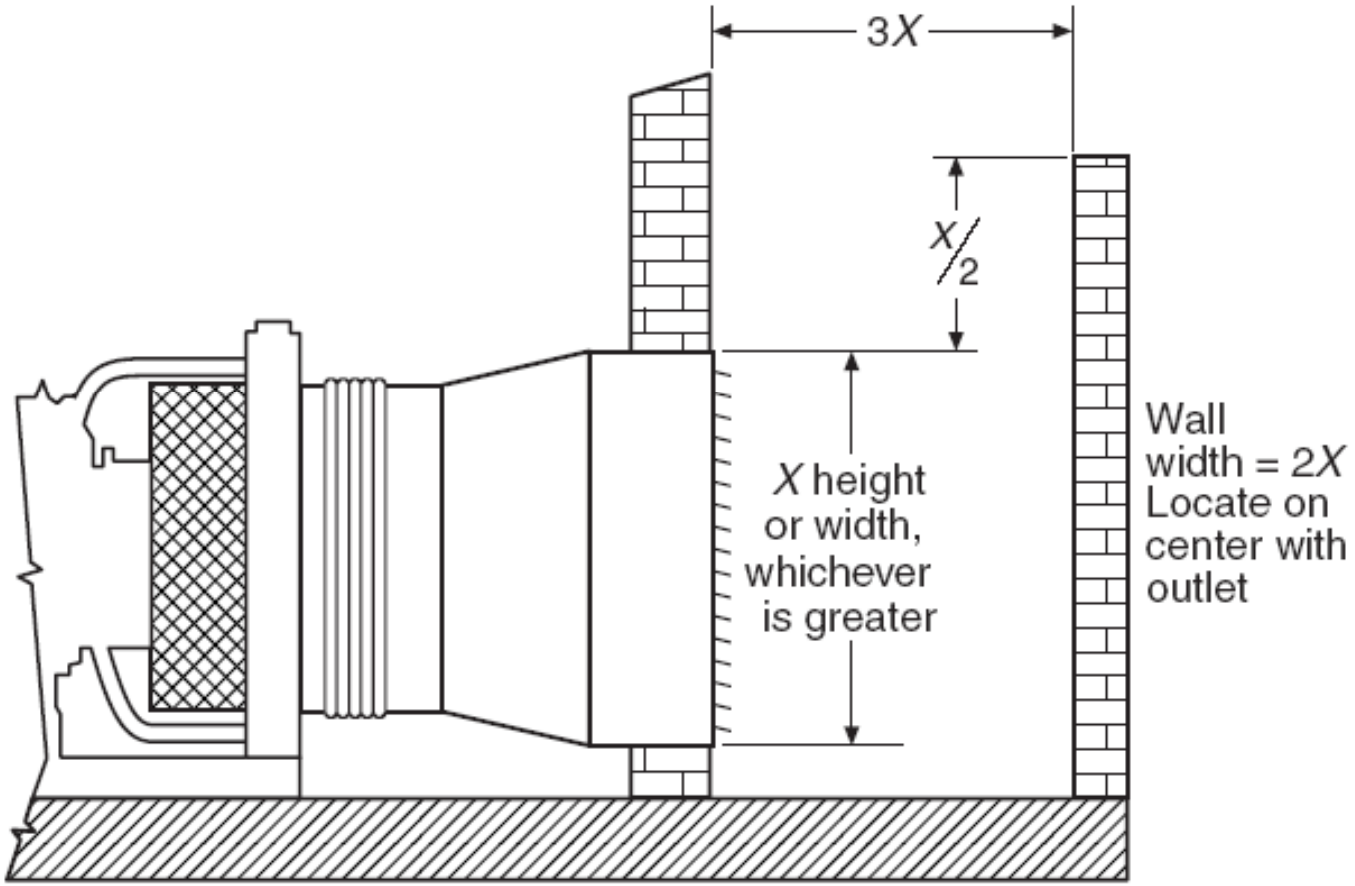


FIGURE A.11.3.2.4 Typical Wind Wall.

NFPA 20 – Fuel Tank Arrangement

- The fuel tank is sized for 5.07 liter/kW (1 gal/HP) plus 10% (5% for expansion and 5% for sump).
- The fuel tank shall be reserved exclusively for the fire pump diesel engine.
- There shall be one fuel tank per engine.
- The fuel tank shall be located above ground.
- The fuel tank outlet shall be located so that its opening is no lower than the level of the engine's fuel transfer pump.

NFPA 20 – Fuel Tank Arrangement

- The static head pressure limits shall not be exceeded when the level of fuel in the tank is at a maximum.
- New 2013: A manual shut off valve shall be provided within the tank fuel supply line locked in the open position. No valves other than the manual fuel shut off are allowed in the fuel supply.

DSC 4584.NEF

Installation and Operation Data

CLARKE
Fire Protection Products, Inc.

JU6H-UF60

INSTALLATION & OPERATION DATA (I&O Data)

USA Produced

	1760	2100	2350
Exhaust System			
Exhaust Flow - ft.³/min (m³/min)	952 (27)	1227 (34.7)	1345 (38.1)
Exhaust Temperature - °F (°C)	988 (531)	909 (487)	883 (473)
Maximum Allowable Back Pressure - in H_20 (kPa)	30 (7.5)	30 (7.5)	30 (7.5)
Minimum Exhaust Pipe Dia. - in (mm)[3]	5 (127)	5 (127)	5 (127)
Fuel System	**1760**	**2100**	**2350**
Fuel Consumption - gal/hr (L/hr)	10 (37.8)	10.3 (39)	11.2 (42.4)
Fuel Return - gal/hr (L/hr)	5.4 (20.4)	5.8 (22)	7 (26.5)
Fuel Supply - gal/hr (L/hr)	15.4 (58.3)	16.1 (60.9)	18.2 (68.9)
Fuel Pressure - lb/in² (kPa)	4 (27.6) - 6 (41.4)		
Minimum Line Size - Supply - in.	.50 Schedule 40 Steel Pipe		
Pipe Outer Diameter - in (mm)	0.848 (21.5)		
Minimum Line Size - Return - in.	.375 Schedule 40 Steel Pipe		
Pipe Outer Diameter - in (mm)	0.675 (17.1)		
Maximum Allowable Fuel Pump Suction Lift with clean Filter - in H_20 (mH_20)	31 (0.8)		
Maximum Allowable Fuel Head above Fuel pump, Supply or Return - ft (m)	4.5 (1.4)		
Fuel Filter Micron Size	5		
Heater System	**Standard**		**Optional**
Engine Coolant Heater			
Wattage (Nominal)	1500		1500
Voltage - AC, 1 Phase	120 (+5%, -10%)		240 (+5%, -10%)
Part Number	[C124948]		[C124949]
Air System	**1760**	**2100**	**2350**
Combustion Air Flow - ft.³/min (m³/min)	354 (10)	494 (14)	538 (15.2)
Air Cleaner	**Standard**		**Optional**
Part Number	[C03396]		[C03327]
Type	Indoor Service Only, with Shield		Canister, Single-Stage
Cleaning method	Washable		Disposable
Air Intake Restriction Maximum Limit			
Dirty Air Cleaner - in H_20 (kPa)	12 (3)		10 (2.5)
Clean Air Cleaner - in H_20 (kPa)	6 (1.5)		5 (1.2)
Maximum Allowable Temperature (Air To Engine Inlet) - °F (°C)[4]	130 (54.4)		
Lubrication System			
Oil Pressure - normal - lb/in² (kPa)	40 (276) - 60 (414)		
Low Oil Pressure Alarm Switch - lb/in² (kPa)	20 (138)		
In Pan Oil Temperature - °F (°C)	220 (104) - 245 (118)		
Total Oil Capacity with Filter - qt (L)	21.1 (20)		
Lube Oil Heater	**Optional**		**Optional**
Wattage (Nominal)	150		150
Voltage	120V (+5%, -10%)		240V (+5%, -10%)
Part Number	C04430		C04431
Performance	**1760**	**2100**	**2350**
BMEP - lb/in² (kPa)	217 (1500)	218 (1500)	195 (1340)
Piston Speed - ft/min (m/min)	1467 (447)	1750 (533)	1958 (597)
Mechanical Noise - dB(A) @ 1m	C13916		
Power Curve	C13481		

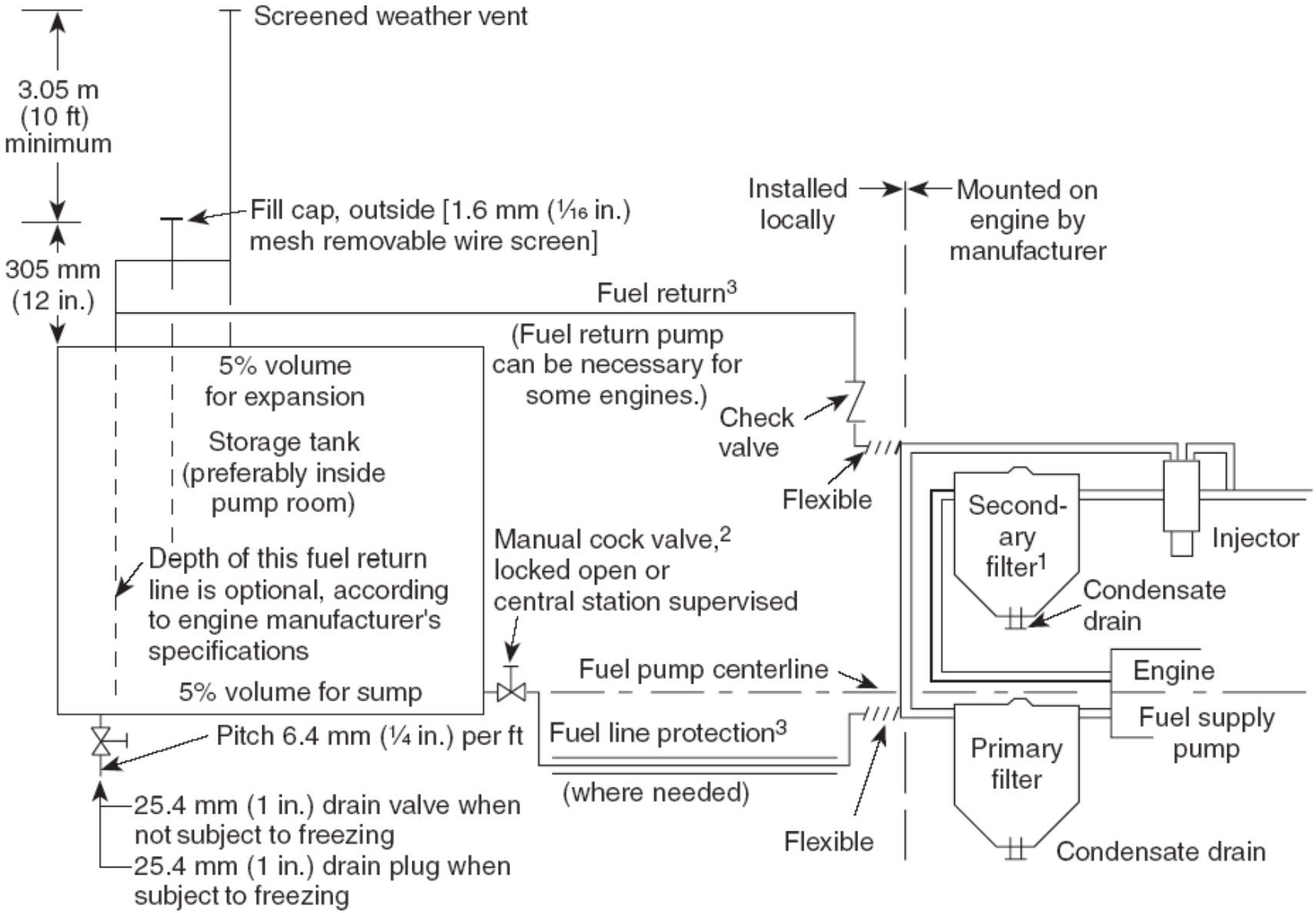
[3]Based on Nominal System. Back pressure flow analysis must be done to assure maximum allowable back pressure is not exceeded. (Note: minimum exhaust Pipe diameter is based on: 15 feet of pipe, one 90° elbow, and a silencer pressure drop no greater than one half of the maximum allowable back pressure.) [4]Review for horsepower derate if ambient air entering engine exceeds 77°F (25°C). [ ] indicates component reference part number.

NFPA 20 – Fuel Tank Arrangement

- In sites where temperatures below 0°C (32°F) could be encountered, the fuel tank shall be located in the pump room.
- The fuel storage tanks shall be kept as full as practical at all times, but never below 66% of tank capacity. A fuel level indicator shall be provided to activate at the 2/3rds tank level.
- <u>New 2013:</u> Bonding & grounding will be required on all metallic components, piping and equipment in the fuel supply to <u>prevent electrostatic ignitions.</u>

NFPA 20 – Fuel Arrangement

- The diesel engine must use clean #2 diesel.
- #1, blended fuel, or jet fuel have a lower cetane ratings, which reduces the power output by 10% of the engine compared with the listed power.
- Biodiesel and other alternative fuels are not recommended for diesel engines used for fire protection because of the unknown storage life issues.
- A guard, pipe protection, or approved double walled pipe shall be provided for all exposed fuel lines.



[1]Secondary filter behind or before engine fuel pump, according to engine manufacturer's specifications.
[2]Excess fuel can be returned to fuel supply pump suction, if recommended by engine manufacturer.
[3]Size fuel piping according to engine manufacturer's specifications.

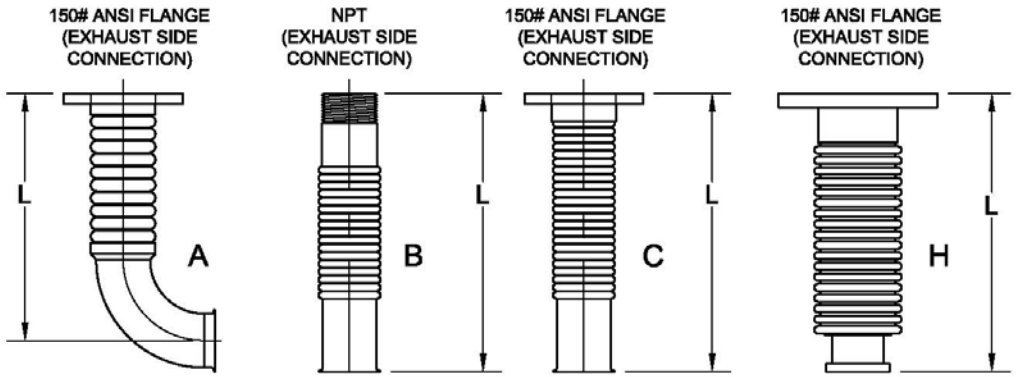
FIGURE A.11.4.6 Fuel System for Diesel Engine–Driven Fire Pump.

NFPA 20 – Fuel Arrangement

- Flame-resistant reinforced flexible hose shall be provided at the engine for connection to the fuel system piping.
- Fuel piping shall not be galvanized steel or copper. (Recommend schedule 40 or SS pipe)
- There shall be no shut-off in the fuel return line to the tank.
- The grade of fuel oil shall be indicated on the fuel tank by letters that are a minimum of 152mm (6 in) in height and in contrasting color to the tank.

NFPA 20 – Engine Exhaust

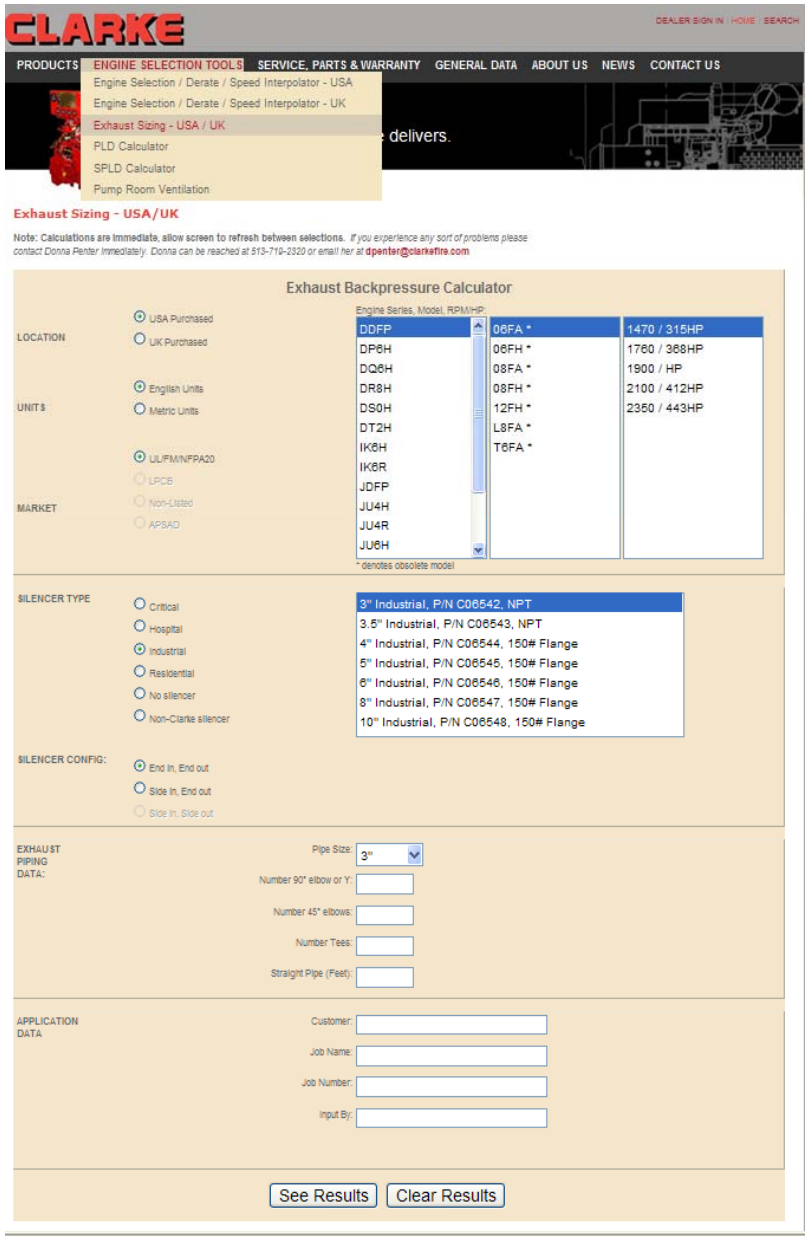
- Each engine shall have an independent exhaust system.
- A flex connector shall be used between the engine and the exhaust pipe.
- The flex connector shall not be used for misalignment. (The purpose of the flex is to allow for thermal expansion and for isolating engine vibration from the rest of the exhaust system.)



NFPA 20 – Engine Exhaust

- Back pressure in the exhaust system shall not exceed the engine's limit.
  - The exhaust sizing program on the Clarke website can calculate the back pressure)
- Building supported; *not* engine supported
- Insulation wrap the exhaust systems in-room components.
- Rain cap on outlet if necessary; tight connections.
- Exhaust system shall terminate outside where hot gases and sparks are discharged to a safe location.

Exhaust Sizing



Exhaust Sizing

CLARKE

DEALER SIGN IN | HOME | SEARCH

PRODUCTS | ENGINE SELECTION TOOLS | SERVICE, PARTS & WARRANTY | GENERAL DATA | ABOUT US | NEWS | CONTACT US

When credibility counts...Clarke delivers.

Exhaust Sizing - USA/UK

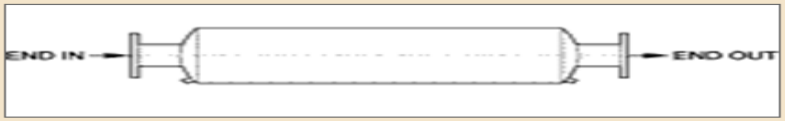
Note: Calculations are immediate, allow screen to refresh between selections. *If you experience any sort of problems please contact Donna Penter immediately. Donna can be reached at 513-719-2320 or email her at* **dpenter@clarkefire.com**

Results

ENGINE DATA:

Engine Model:	JU4H-UF10
Engine RPM:	2350
Engine HP:	55
Exh Flow (CFM):	469
Temperature (° F):	1083
Max Backpressure (inches water):	30
Min Backpressure (inches water):	0
Std. Exhaust Dia (in):	3

DRAWING:



BACKPRESSURE CALCULATIONS (inches water)

	13.2	Pipe
+	5.2	Silencer (see note 1)
	18.4	**Total**
	30.0	**Maximum Allowable Backpressure**

Result: Total Backpressure is within limits

1) CAUTION: Silencer Backpressure is based upon a Clarke USA provided Silencer. Actual Silencer Backpressure will vary depending upon the actual Silencer used (manufacturer, size, type and model). If the total Backpressure from the pipe, Silencer and orifice plate (if required) is close to the engine Maximum Allowed Backpressure, it is highly recommended you obtain the actual Backpressure (for the engine exhaust flow given above) on the Silencer being used and then confirm that the total Backpressure is still under the Maximum Allowed Backpressure.
2) Schedule 40 pipe used in calculations
3) All pipe sizes and lengths are in inches and feet.

Print | Start Over | Back

Exhaust Sizing

CLARKE

Fire Protection Products, Inc.

Exhaust Backpressure Calculator - Results

Calculations made 2/10/2012

Data input by:

Input Data:

Customer:	Job Name:	Job Number:
ENGINE DATA:	**Piping Data:**	**Silencer Data:**
Manufacturer: Clarke	Pipe Size: 3"	Manufacturer: Clarke USA
Engine Model: JU4H-UF10	#90° elbow or Y: 2	Pipe Size: 3"
Engine RPM: 2350	Number 45° elbows:	Model: C06542
Engine HP: 55	Number Tees:	Application: Industrial
	Straight Pipe (Feet): 50	Connection: NPT

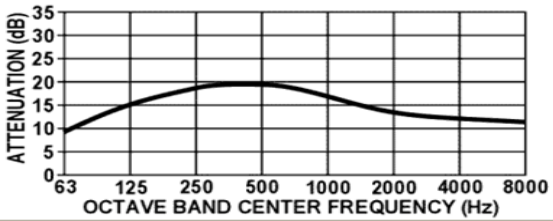
Output Data:

Exh Flow (CFM): 469

Temperature (° F): 1083

Max Backpressure (inches water): 30

Min Backpressure (inches water): 0



Exhaust Pipe Recommendation:

BACKPRESSURE CALCULATIONS (inches water)		
	13.2	Pipe
+	5.2	Silencer (see note 1)
	18.4	Total
	30.0	Maximum Allowable Backpressure

Result: Total Backpressure is within limits

1) CAUTION: Silencer Backpressure is based upon a Clarke USA provided Silencer. Actual Silencer Backpressure will vary depending upon the actual Silencer used (manufacturer, size, type and model). If the total Backpressure from the pipe, Silencer and orifice plate (if required) is close to the engine Maximum Allowed Backpressure, it is highly recommended you obtain the actual Backpressure (for the engine exhaust flow given above) on the Silencer being used and then confirm that the total Backpressure is still under the Maximum Allowed Backpressure.
2) Schedule 40 pipe used in calculations
3) All pipe sizes and lengths are in inches and feet.

North American Offices:
3133 East Kemper Road ° Cincinnati, Ohio ° 45241 ° USA ° Tel: +1 (513) 771-2200 ° Fax: +1 (513) 771-0726

European Office:
Grange Works ° Lomond Road ° Coatbridge, Scotland ° ML5 2NN ° Tel: +44 (0)1236 429 946 ° Fax: +44 (0)1236 427 274

NFPA 20 – System Operation

- Engines shall be started no less than once a week and run for no less than 30 minutes.
- The fire pump shall be started and brought up to rated speed without interruption within 20 seconds.
- In the event of fire pump operation, qualified personnel shall respond to the fire pump location to determine that the fire pump is operating in a satisfactory manner.

NFPA 20 – System Operation

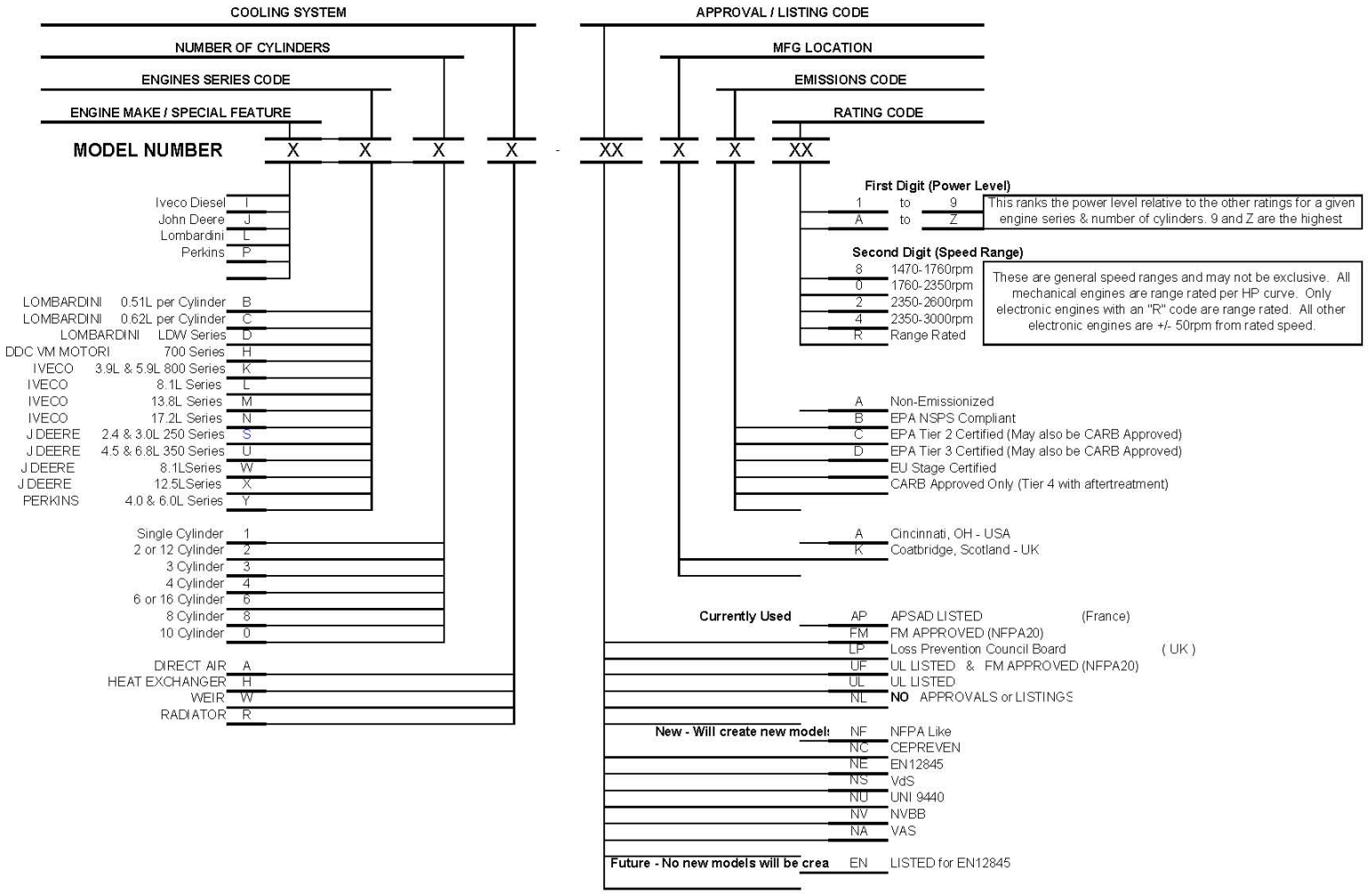
- Batteries shall be kept charged at all times and tested frequently (weekly test) to determine condition.
- Only distilled water shall be used.
- Battery plates shall be kept submerged at all times.

2012 EMISSION SUMMARY

- Beginning Jan 1, 2012
  - Diesel Fire Pump drivers with hp's between 0 bhp and 750 bhp with RPM's between 0 & 2650 and diesel fire pump drivers with hp's between 100 and 175 bhp with RPM's of 2650 and higher, must meet be certified Tier 3 engines.
  - NSPS compliant engines manufactured before Jan 1, 2012 in the above horsepower and rpm range can still be sold in 2012.

Clarke Model Nomenclature

New 10 Digit Model Number System



UL Coupling for Electric Motors

- Separately coupled-type pumps with electric motor drivers shall be connected by a flexible coupling or flexible connecting shaft.
- All coupling types shall be listed for the service.
- This requirement has actually been around since the 1996 edition of NFPA 20.
- Currently Clarke is the only company that has a UL coupling available for electric motors.

General Requirements

- Fire pumps shall be dedicated to and listed for fire protection service.
- The fire pump shall be properly anchored and grouted and set level on the foundation.
- In the event of fire pump operation, qualified personnel shall respond to the fire pump location to determine that the fire pump is operating in a satisfactory manner.

General Requirements

- (Electric Drive) Where the height of a structure is beyond the pumping capacity of the fire department apparatus or where the source of electricity is unreliable, an alternate source of power must be used.
- New 2013 – An alternate source of power for the primary fire pump shall not be required where a backup engine-driven fire pump or a back up electric motor-driven fire pump WITH independent power source is installed.

General Requirements

- Where on-site gen sets are used to supply power to fire pump motors, there shall be of sufficient capacity to allow normal starting & running of the motor while supplying all other simultaneously operated loads.
- New 2013 – The generator shall run & continue to produce rated nameplate power without shutdown or derate for alarms & warnings or failed engine sensors, except for overspeed shutdown.
- New 2013 – The generator fuel tank shall be sized for 8 hours of fire pump operation at 100% in addition to the supply required for other demands.

Clarke Website
www.clarkefire.com

- Current Models
- Installation & Operation Data
- Emission Data
- Exhaust Sizing
- Operations Manual
- Spare Parts Illustration
- Installation Checklist
- Power Curves
- Installation Drawings
- Contact List
- Wiring Diagrams
- Technical Manual
- Service Dealer Directory
- Startup and Warranty Forms