

ARMSTRONG



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FIRE PUMP

OPERATION & TECHNICAL DATA MANUAL

FIRE PUMPS DIESEL ENGINE DRIVEN |

EU DECLARATION OF CONFORMITY

We Armstrong Integrated Ltd, Wolverton Street, Manchester, M11 2ET, UK, hereby declare that the following products:

7030 - End suction, Long Coupled Fire Pump.

7600 - Horizontal Split Case Fire Pump.

Serial Number: As shown on the pump nameplate.

Are in conformity with:

- 2006/42/EC The machinery directive
- 2014/35/EU Low voltage directive
- 2009/125/EC Ecodesign directive
- 2014/30/EU Electromagnetic compatibility (EMC) directive

When the Installation, operation and maintenance instructions are adhered to.

Standards applied:

BS EN 60204-1:2006	Safety of machinery - Electrical equipment of machines.
BS EN 61010-1	Safety requirements for Electrical equipment for measurement - Control and Laboratory use.
BS EN 60439-1	Low voltage - Switchgear and Control assemblies.
BS EN ISO 12100-1:2010	Safety of machinery - Basic concepts, general principles for design.
BS EN 600034-9:2005	Rotating electrical machines - Noise limits.
BS EN 809:1998+A1:2009	Pumps and pump units for liquids.
Commission regulation no 547/2012	Water pumps (applies only to water pumps with MEI).
BS EN 61000-6-1:2007	Generic Immunity standard - Residential, Commercial and Light Industrial environment
BS EN 61000-6-3:2007	Generic Emission standard - Residential, Commercial and Light Industrial environment

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Signed :



Date : 01 / 06 / 17

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Kathryn Poke
Engineering Director

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A copy of the technical file for this equipment is available from:
The EU address above

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ARMSTRONG FLUID TECHNOLOGY
ESTABLISHED 1934

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Essential Fire Pump Safety Instructions



Noise levels can be 80dB (A) or above and ear protection should be worn.



This equipment is designed for automatic starting and the engine battery negative / earth (ground) cables and electric supplies must be isolated before removing guards or any components.



Ensure all guards are correctly fitted before operating the equipment.



All lifting must be carried out in accordance with local health and safety regulations by competent personnel. Complete packages must not be lifted by component eye bolts or lifting lugs.



The equipment contains hazardous liquids and the correct safety equipment must be worn when handling them.



The area around the equipment must be kept clean and free of trip hazards.



Surfaces can be hot and care should be taken. Engines with radiators or heat exchangers contain super heated water. Pressure / filler cap must not be removed until the engine has cooled down.



As a precaution it is not recommended that personnel stand next to the coupling assembly during operation or test.



Engines omit harmful fumes and must be installed and maintained to prevent leakage. The pump house must be adequately ventilated according to engine size. The exhaust outlet must be positioned to prevent fumes entering the air intake.



Adequate lighting must be installed in and around the location of the pumps. The use of florescent lights is not recommended around rotating machinery.



All Diesel Fire Pump Drivers manufactured by Clarke are for use with #2 Diesel Fuel (ASTM D-975, No. 2-D). This includes LPCB, FM Approved, UL Listed, and engines for specific country codes, and non-Listed engines. Note, in European Countries the alternative acceptable fuel is "Red" Diesel Fuel (BS2869, Class A2).

RECOMMENDATIONS FOR THE EXERCISING OF DIESEL DRIVEN FIRE PUMPS MANUFACTURED IN ACCORDANCE WITH BS EN12845, BS5306 Pt 2 & NFPA 20

WARNING – The equipment is designed to start automatically. NO WORK should be carried out on the set or guarding removed unless isolated and the battery negative earth lead(s) removed with the terminal ends made safe by covering with insulation tape.

- 1) A visual inspection should be carried out prior to starting the diesel set to make sure that:
 - a) all guarding is in place
 - b) nothing is disconnected
 - c) the control panel door is closed
 - d) the area around the set is clean and free from clutter and trip hazards.
- 2) As recommended in the diesel engine manufacturers hand book, the water level in the heat exchanger should be checked (water cooled engine only) and topped up if necessary with a 50/50 mix of water and antifreeze.
- 3) Prior to starting the set Ear Defenders, Safety Glasses and Gloves are recommended to be worn as the noise level of the diesel engine in the pump room will exceed 82dba. In addition you should check the COSHH sheets provided in the O&M instructions to be aware of the safe handling of the liquids and gases that could be discharged.
- 4) Once the diesel set is running for the 30 minute exercise required in BS EN12845, BS5306 Pt 2 & NFPA 20, a visual inspection should be carried out of the set to ensure that there are no leaks and the water is flowing to drain from the raw water side of the heat exchanger.
- 5) It is advisable once the diesel set is running and all the checks are completed that the engine is put under load by opening the test return line back to the suction water tank to half the design flow. This exercise will help guard against the engine suffering from glazed bores which is a direct result of light running the engine. Always close the test return line down before stopping the diesel set.
- 6) It is advisable that the operator stands clear of any guarding while the set is running unless necessary for short periods to inspect or shut the equipment down.
- 7) After shutting the diesel set down beware that many areas of the engine will stay hot for a considerable length of time.

Please note that in the same way an automobile requires regular servicing, even though the mileage may not have been achieved, a static diesel engine will require the same attention every 6 months no matter how few hours it has run in that period.

TECHNICAL BULLETIN

FIRE PUMP MAINTENANCE **DIESEL ENGINE COOLING SYSTEMS**

This applies to Diesel Engines fitted with Heat Exchangers that have a secondary sealed cooling system filled with 50 / 50 water and antifreeze mix.

It is extremely important to ensure that adequate coolant levels are being maintained. Please refer to the engine manufacturers O&M manual to ensure that the correct Routine Maintenance Regime is being adhered to.

Armstrong Integrated Systems Limited *strongly* recommends that the cooling water outlet from the Diesel Engine is piped away to drain. Piping this water back to the supply tank may result in back-pressure in the coolant line, invalidating the engine warranty.

Piping hot or warm water back to a static body of water, such as the supply tank, has inherent Legionella risks and is inadvisable at any time.

SERVICES & MAINTENANCE

PUTTING THE CUSTOMER FIRST

It is Armstrong's policy to look after the people that count.... 'You, the user'. We want you to feel confident, not only in our equipment but also in our after sales service. Armstrong Engineers are trained to carryout commissioning and service of our equipment on site to the very highest standards.

RESPONSE

With a service team throughout the UK we can offer short response times resulting in quick and efficient completion of service work. Armstrong Engineers carry a comprehensive stock of spare parts, which reduces lead times and enables work to be completed in one visit. Our networks of agents throughout the world are all fully trained to provide service support of Armstrong equipment.

INFORMATION

Keeping a history of your installation is of great importance. On completion of work a report will be issued detailing the Engineer's findings and the action taken. In addition to this, the Engineers carry a stock of literature, which can be left with you at site if required.

COMMISSIONING

The commissioning of your equipment is the first step towards ensuring high quality and prolonged performance standards.

Armstrong trained Engineers will commission your unit to suit the individual requirements of the system. Also, Armstrong can train your staff in routine maintenance and fault finding procedures, reducing the risk of plant shutdown.

MAINTENANCE

As with everything prevention is better than cure. Armstrong offers maintenance agreements, which will mean regular site visits by our trained Engineers, thus reducing the risk of failure. You specify your requirements, we do the rest!

As with all equipment regular servicing is essential in maintaining prolonged performance standards. It is a proven method of reducing plant failure and breakdown.

Prevention is preferable to cure!!!

WHAT CAN ARMSTRONG DO?

As a company that believes in taking care of the customers after the sale, Armstrong offers a scheduled maintenance service tailored to meet your individual requirements. We will arrange for a trained Engineer to attend site, service your equipment and produce a detailed report on the work carried out, together with any advice or comments regarding your installation.

You decide when and how often, we do the rest!

WHAT ARE THE ADVANTAGES?

- Reduced long term service costs
- Regular visits by a trained Engineer
- Detailed reports to enable you to keep a full service history
- Reduce risk of plant failure or breakdown
- Prolonged life expectancy of equipment

For further information and a full quotation please contact our service department:

LET US TAKE CARE OF IT!

HEALTH, SAFETY AND ENVIRONMENTAL DATA SHEET

BP OIL

Emergency Action:	Skin contact: Wash skin with soap and water as soon as practicable after contact. Remove contaminated clothing and wash underlying skin. Dry clean and preferably launder and starch contaminated clothing before re-use.
	Eye Contact: Immediately wash out eye thoroughly with water. If pain or redness develops and persists, obtain medical advice
	Ingestion: If oral contamination occurs wash the mouth out with water. If large amounts are swallowed obtain medical advice.
	Inhalation: If inhalation of mist, fumes or spray causes irritation to nose and throat, or coughing, chest pain, difficulty in breathing and/or blueness of appearance; obtain medical advice urgently.
	Fire: ALWAYS ALERT THE FIRE BRIGADE. Control of small fires may be attempted by using dry powder (BCF. may be used but is less preferable environmentally). CO2 may also be used on very small fires. Note danger of flashback if hot metal or another source of ignition is present. Major fires will require the use of fluoroprotein or AFFF foams. Water may be used to cool/protect surrounding equipment and buildings. Ensure an escape route is available by trained personnel wearing approved positive pressure air supplied breathing apparatus and in accordance with statutory regulations.
	Spillage's: ALWAYS ALERT THE FIRE BRIGADE. Fire is the primary hazard. Take all necessary steps to prevent contact with all sources of ignition. (Including road traffic), evacuate all unnecessary personnel and if possible contain the spillage. Spillage can be smothered with foam to reduce risk of ignition. Ensure good ventilation and recover using suitable absorbent or other means. Do not wash into drains.

Disposal:	Dispose at approved waste disposal facilities in ports. Otherwise preferably incinerate under controlled conditions, or use as landfill at a suitable tip approved by the Local Authority.
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DO NOT DISPOSE OF AT SEA

Environmental:	Moderately toxic to aquatic life. Spillage's may destroy aquatic life and be harmful to other wildlife, particularly birds and may lead to a curtailment of amenity use. If allowed to enter aquatic sediments, contamination may be long term. May taint water supplies and render process water unsuitable for cooling or feedwater purposes. Advise appropriate authorities of spillage's.
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Product Label:*Risk Phrase:*

Indication of danger:

Xn (Harmful)

Symbol:

St Andrews Cross (Black or orange)

Risk Phrase:

R40 Possible risk of irreversible effects.

Safety Phrases:

S43 – In case of fire use foam/dry powder/CO2/halor. Never use water.

S24 – Avoid contact with skin.

S46 – If swallowed, seek medical advice immediately and show this container or label

-- Do not induce vomiting. See manufacturer literature.

Transport:

IMO Class:

3.3

United Nations No:

1202 Class 3.3

ADR/RID:

3.4

IATA:

3 (-), Packing Group III

Hazard Warning:

Flammable Liquid

Substance identification No:

1202 Class 3.3

Additional**Information:**

This HSE data sheet should be read in conjunction with the Medical Hygiene and the storage

and Handling Guidance Notes which are published by BP Oil UKK and which are normally distributed with data sheets. Additional copies may be obtained from the address below.

Within the United Kingdom Health and Safety Executive Publications/Notices are obtainable from her Majesty's Stationary Offices or from Local Offices of the Health and Safety Executive. The following are relevant to the handling of this product.

SHW 367	Dermatitis – Cautionary Notice
SHW 397	Effects of Mineral Oil on the skin
MS/B/5	Skin Cancer caused by Oil
MS/B/4	Skin Cancer caused by Pitch and Tar
MS/B/6	Occupational (ind) Dermatitis
EH 40	Occupational exposure limits

For marine operational procedures see:

The International Safety Guide for Oil Tankers and Terminals. Witherby and Co. Ltd. London

For further information on how to deal with oil spills users may consult two further publications:

Advice to Doctor:

Treatment should be directed to relieving the effects.

BATTERY COMMISSIONING PROCEDURE

Storage of batteries before filling

The plates in unfilled batteries are already fully charged. If stored under cool and dry conditions the battery has a shelf-life of several years.

Filling

Fill the battery acid (dilute sulphuric acid) of specific gravity 1.28 (or in tropical countries 1.23). Check that the acid reaches the indicated levels in the cells or on the battery casing. Both battery and acid should be at a temperature above +10°C when filling. If the temperature is below this, the battery should be placed on charge for a short time (see “charging”) to achieve it. Under normal conditions the battery is ready for use without charging.

Subsequent charging

The charging current in amps, should not be more than 1/10 of the battery's rated capacity in ampere-hours (ah) i.e. charge a 50 Ah battery at 5 amps. Before gassing commences, the charging rate can be higher than this for short periods, but in no case must the acid become hotter than +55°C. Observe the instructions of the battery-charger manufacturer. After charging, check the acid level again and if necessary top up with distilled or deionized water and fill to the acid level marking.

Maintenance

The new technology used in maintenance-free vehicle batteries means that under normal conditions of vehicle use it should no longer be necessary to top up the battery with distilled water. Under extreme conditions of use, such as frequent long distance travel or if the vehicle's electrical system (regulator) is not working correctly, above (14.4V), it can become necessary to top up. In such cases it is then advisable to check the acid level even on a maintenance-free battery.

Keep the battery clean and dry, and take care that the connections to the terminals are firm and secure.

Storing the battery

Before storing the battery should be fully charged. Although the self-discharge rate is low, the acid level (visual) and the specific gravity (hydrometer) should still be checked every few months. If the specific gravity falls below 1.24, the battery should be recharged —this will prolong its life.

The gases given off when charging are explosive

- No smoking or naked flames, ensure that cables and electrical equipment are handled in such a way as to avoid sparks.
- Before fitting or removing the battery make sure that all equipment connected to it is switched off, to avoid accidental sparking.
- When undoing the connections to the battery terminals, disconnect the earth (vehicle chassis) connection first; when reconnecting, connect the battery on. Reverse the process at the end of the charge.
- When charging indoors, ensure that there is adequate ventilation.

Use of jump leads

First, connect the position cable ends to both positive battery poles. Then connect the second cable to the negative battery pole of the vehicle to be started and, last, connect the negative cable to the negative terminal of the current supplying vehicle; however, if possible, do not connect it directly to the battery pole but to the car body at the end of the earthing cable. The cables should be removed in the opposite order.

BATTERY TESTING PROCEDURES

A VISUAL CHECK

- | | |
|--|---|
| 1. Does the battery leak? | Yes → Continue with A2
No → Continue with B |
| 2. Is external damage visible in vicinity of leak? | Yes → Reject claim. Ascertain cause of damage
No → Claim justified* |
| 3. Are the cells evenly covered with acid? | Yes → Continue with B
No → Reject claim. Not manufacturing defect.
Possible causes; overcharging or
Extreme ambient temperature. |

B SPECIFIC GRAVITY TEST

Functioning batteries should have same specific gravity (S.G) in all cells. Maximum permitted tolerance in all 6 cells is 0.030kg/dm³ between lowest and highest S.G. reading (e.g. 1.28 max and 1.25kg/dm³ min would be permitted.)

Important
If the specific gravity of the acid is less than 1,240kg/dm ³ at 27°, the battery must be charged before further testing

Specific gravity at 27° in kg/dm	Condition	Procedure
1,250 – 1,280	Fully charged	Proceed with test
1,200 – 1,240	Half charged	Charge recommended
LESS THAN 1,200	MINIMAL CHARGE	CHARGE IMMEDIATELY

- | | |
|---|--|
| 1. One cell with low specific gravity (S.G) | Yes → Replace battery, claim justified*

No → Continue with B2 |
| 2. Is the electrolyte discoloured (dark brown) and/or is there evidence of excessive water consumption. | Yes → Reject claim – damage caused by overcharging – test voltage regulator on vehicle. |
| 3. If the S.G is less then 1,250 kg/dm ³ in all cells → charge the battery. Is the charge acceptance at least 1/20 of the normal capacity? | Yes → Recharge the battery completely then test accordingly to C. If after recharging a reading of 1.24kg/dm ³ is achieved, there is no reason for a claim. The battery is ageing and therefore is given less then 100% performance → reject claim.

No → Reject claim – damage caused by deep discharge or undercharging. Check Vehicle electric's i.e. voltage regulator, alternator or fan belt. |
| 4. If the S.G in all cells is equal or above 1,250kg/dm ³ after charging | Proceed to test C |

C HIGH RATE DISCHARGE TEST

This test should only be carried out if the S.G. is equal or greater then 1,250kg/dm³ otherwise charge the battery first.

IMPORTANT: read the instruction notes on the battery tester.

- | | |
|---|--|
| Is the result 'defective' or 'replace'? | Yes → Replace battery*

No → Battery good. |
|---|--|

For the battery testers with switchable resistance (variable load), discharge the battery at about 3 X the 20hr rate for 10 seconds. (E.g. battery capacity 45 ampere hour (A.H.) = 3 x 45 = 135 amps). The voltage during discharge should be stable. (* Subject to our current sale and warranty conditions)

HEALTH AND SAFETY

Treat sulphuric acid with respect. It is highly corrosive liquid and will cause severe injury if splashed on the skin or in the eyes, or if taken internally. It rapidly destroys most clothing.

Sulphuric acid is scheduled as a poison in Part 2 of the Poisons List.

When handling BATTERY ACID always:

1. Wear acid-resistant clothing, goggles, PVC gloves and rubber boots.
2. Have a copious supply of water available.
3. Keep an eyewash bottle ready, containing 1% of boric saline solution.

SAFETY PRECAUTIONS

Take every precaution to avoid spillages

Handling

Wear full protective clothing (acid resistant Clothing, goggles, PVC gloves and rubber Boots) where there is a risk of splashes.

Spillage

Wearing full protective clothing and working from the windward side wash down immediately with copious supply of water, directing the water jet to the outside of the spillage and carefully working towards the centre. Large spillage's should be contained with soda ash, sand or earth and gradually neutralised with soda ash, finally washing down with water.

Storage

Use only appropriate vessels. Store them away from other chemicals in a cool place Away from sunlight and hot pipes, etc. Bungs on all containers should be kept

Uppermost. Adequate ventilation is essential In the building where acid is stored or Handled.

Fire

Sulphuric acid in contact with metals slowly enerates hydrogen which forms an explosive mixture with air. Naked lights should not be used in or around road tankers, storage tanks or other containers of sulphuric acid.

First Aid

Splashes in the Eyes

1. Immediately irrigate the eye for at least 15 minutes using large amounts of water of if available 1% boric saline solution
2. Obtain medical treatment

Splashes on Skin

1. Immediately remove contaminated clothing taking care to avoid self-contamination and wash the affected area with large quantities of water.
2. If symptoms occur obtain medical treatment

Swallowed

1. Drink copious amounts of lime water or milk of magnesia or alternatively plain water or milk
2. Do not induce vomiting
3. Obtain medical attention preferably at a hospital as soon as possible

PRODUCT HEALTH AND SAFETY INFORMATION

CHEMICAL SAFETY DATA

UN 2794 CLASS 8

PRODUCT – LEAD ACID BATTERIES/CELLS – OPEN VENTED TYPE

DESCRIPTION - Lead and lead dioxide plates immersed in dilute sulphuric acid with adjacent plates separated by a polythene leaf/separator.

MAJOR COMPONENTS - Lead (pb)
Lead Dioxide (pbO₂)
Sulphuric Acid (H₂SO₄) Sg = 1.270 – 1.300
Lead Sulphate (pb SO₄)
Polypropylene (in some cases hard rubber)

HAZARDS

Explosion explosive gas mixture
Evolved during charging

Spillage free electrolyte (dilute
Sulphuric acid)
'CORROSIVE'

First Aid Avoid contact of acid with
Skin and eyes

Avoid vapour inhalation

In event of ingestion

PRECAUTIONS

Prohibited smoking and naked flames.
Ensure adequate ventilation.

Avoid contact with skin and eyes
(TLV – 1mgm – 3). Goggles and gloves
should be worn. Neutralise area with sodium
carbonate and wash well with large quantities of
water.

If eyes, irrigate thoroughly with water. If skin
drench with water.

Ensure adequate ventilation during charging

Drink copious amounts of water or milk of magnesia.
DO NOT give emetic.

IN ALL CASES SEEK MEDICAL ATTENTION.

Short Circuit Avoid shorting of terminals with metallic objects. High voltage batteries can
cause electric shock.

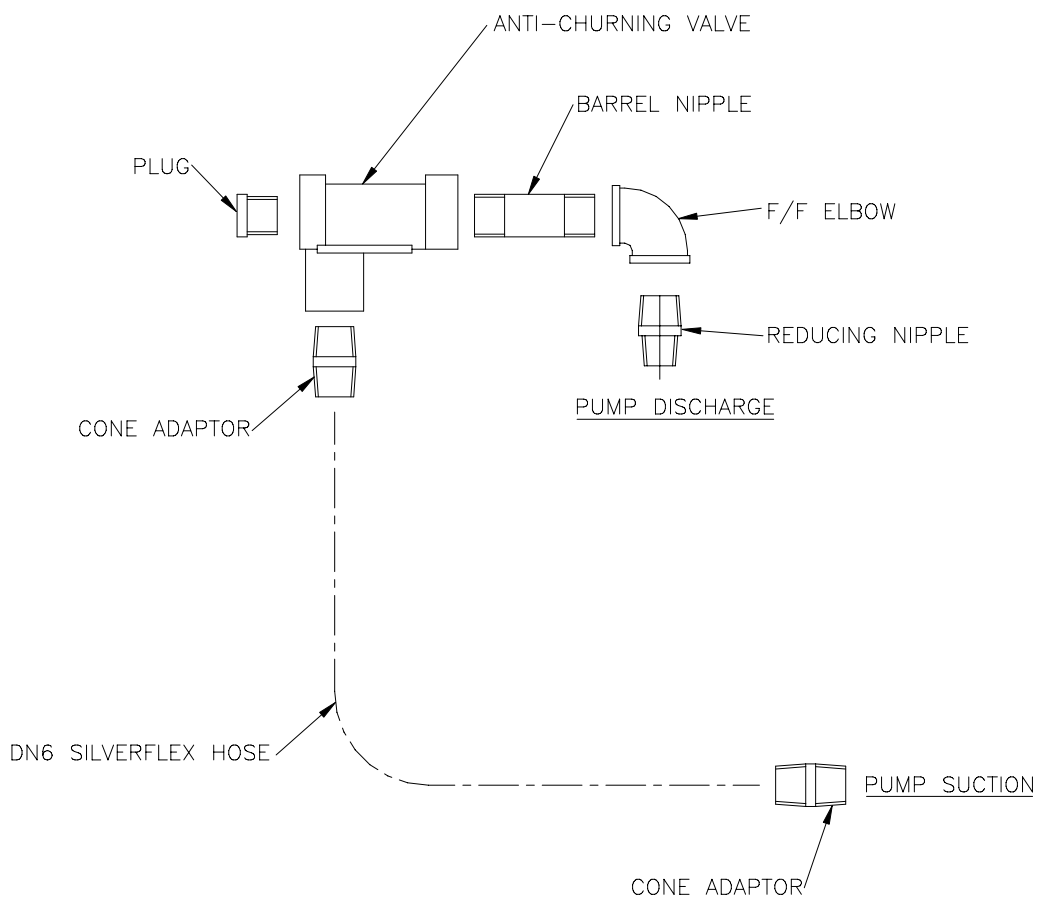
Fire Control In the event of fire use CO₂ or dry powder.

Disposal For battery disposal and further information on handling see British Standard 6133.

WARNING

Electric & Air Cooled Diesel Driven Fire Sets

THE PLUG FITTED TO THE ANTI-CHURNING VALVE MUST BE REMOVED AND THE WATER PIPED AWAY TO DRAIN BEFORE OPERATION OF THE PUMPS



ARMSTRONG



SALES ORDER NUMBER	xxxxxx
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Electrical Pump Data

Pump Model No	
Serial No	
G A Drawing No	
Performance Curve No	
Pump O & M Instructions	
Flow (L/min)	Pressure (Bar)

Electrical Motor Details					Supply		
Enclosure	kW	Frame	FLC	SC	V	Ph	Hz
Electrical Controller Diagram							

Diesel Pump Data

Pump Model No	65-250 4030FD 58 kW		
Serial No	xxxxxx - 01		
G A Drawing No	QF13626-L-1001 Rev 01	Dated 18 Apr 19	
Performance Curve No	xxxxxx - 01	Dated xx xxx xx	
Pump O & M Instructions	S6064-L-0015-01	Dated Jan 08	
Flow (L/min)	1500	Pressure (Bar)	8.0

Diesel Engine Details					
Make	Type	Manual Code	Hr Rating	Fuel Tank Size	
Clarke	JU4H-NL14	JU4H-NL14	6	250 litre usable / 275 litre actual	
Diesel Controller Diagram			Generic LPC D1 - D4		Dated 11 Aug 16

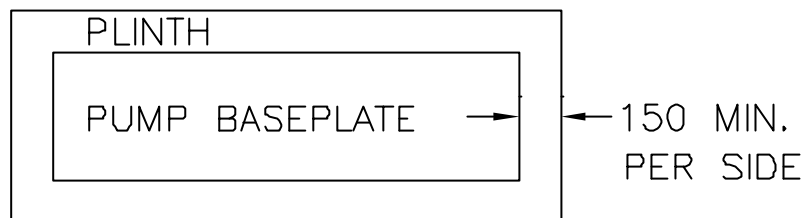
Jockey Pump Data

Pump Model No	VMS2-14B Vertical Multistage		
Serial No	xxxxxx - 02		
G A Drawing No	PX11558 Rev A	Dated 05 Sep 11	
Performance Curve No	S6004-L-2001	Dated Sep 11	
Pump O & M Instructions	S6064-L-0025-01	Dated Sep 11	
Flow (L/min)	25	Pressure (Bar)	8.0

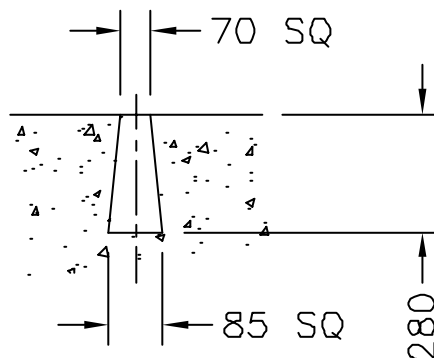
Electrical Motor Details					Supply		
Enclosure	kW	Frame	FLC	SC	V	Ph	Hz
TEFV	1.10	V18	2.43	21.39	415	3	50
Jockey Controller Diagram			S6064-L-0038-01		Dated Jun 17		

Remote Alarm Panel	S6064-L-0037-02	Dated Jul 17

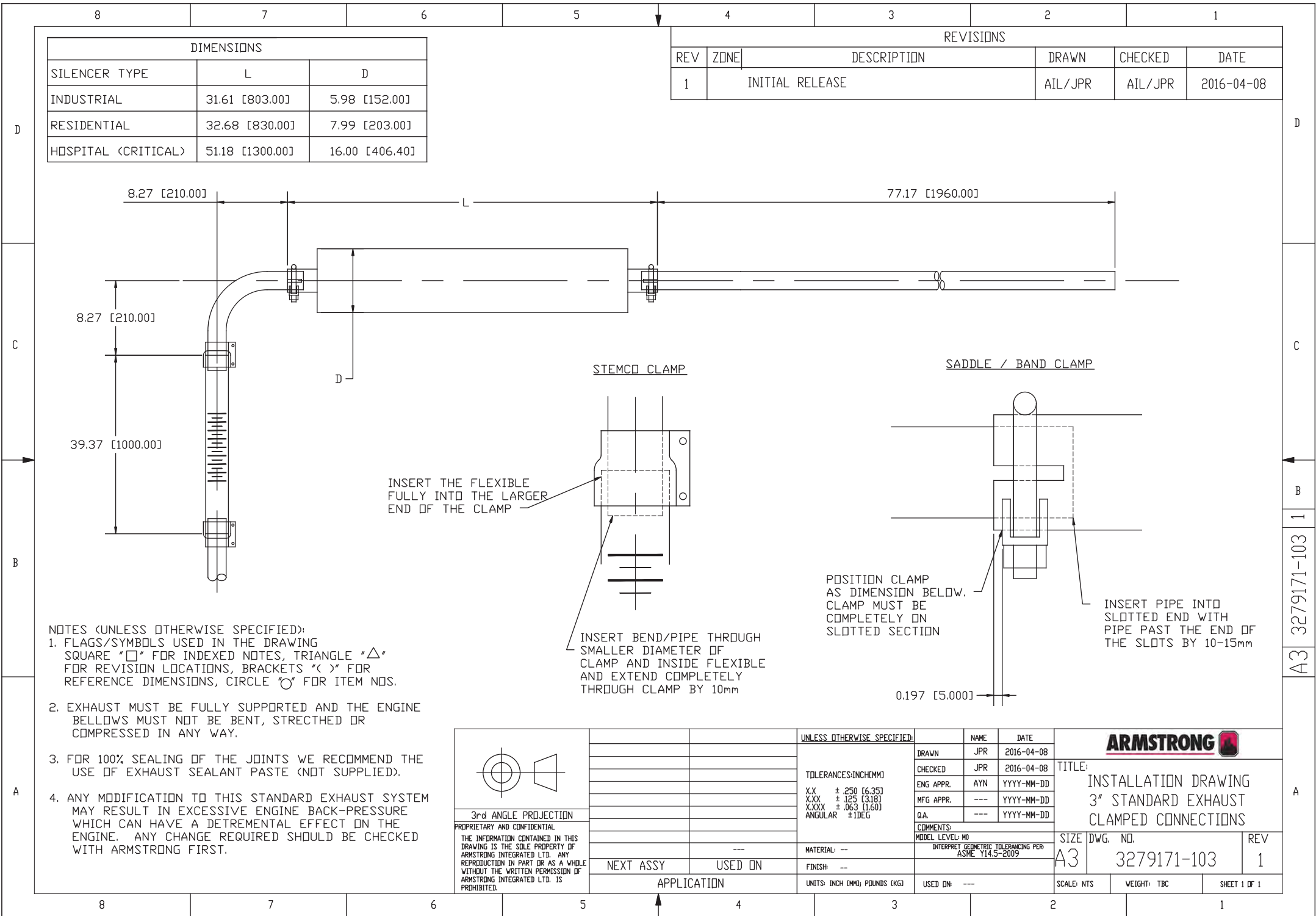
- 1) PUMP TO BE MOUNTED ON A FOUNDATION SUFFICIENTLY SUBSTANTIAL TO ABSORB ANY VIBRATION.
- 2) PLINTH SHOULD WEIGH AT LEAST 2« TIMES THE SHIPPING WEIGHT OF THE PUMP & HAVE A MINIMUM HEIGHT OF 300mm.
PLINTH SHOULD BE KEYED INTO FLOOR.
NB APPROX WEIGHT OF CONCRETE = 2200kg/m^3
- 3) PLINTH SHOULD BE LARGER BY AT LEAST 300mm THAN PUMP BASEPLATE AS SHOWN

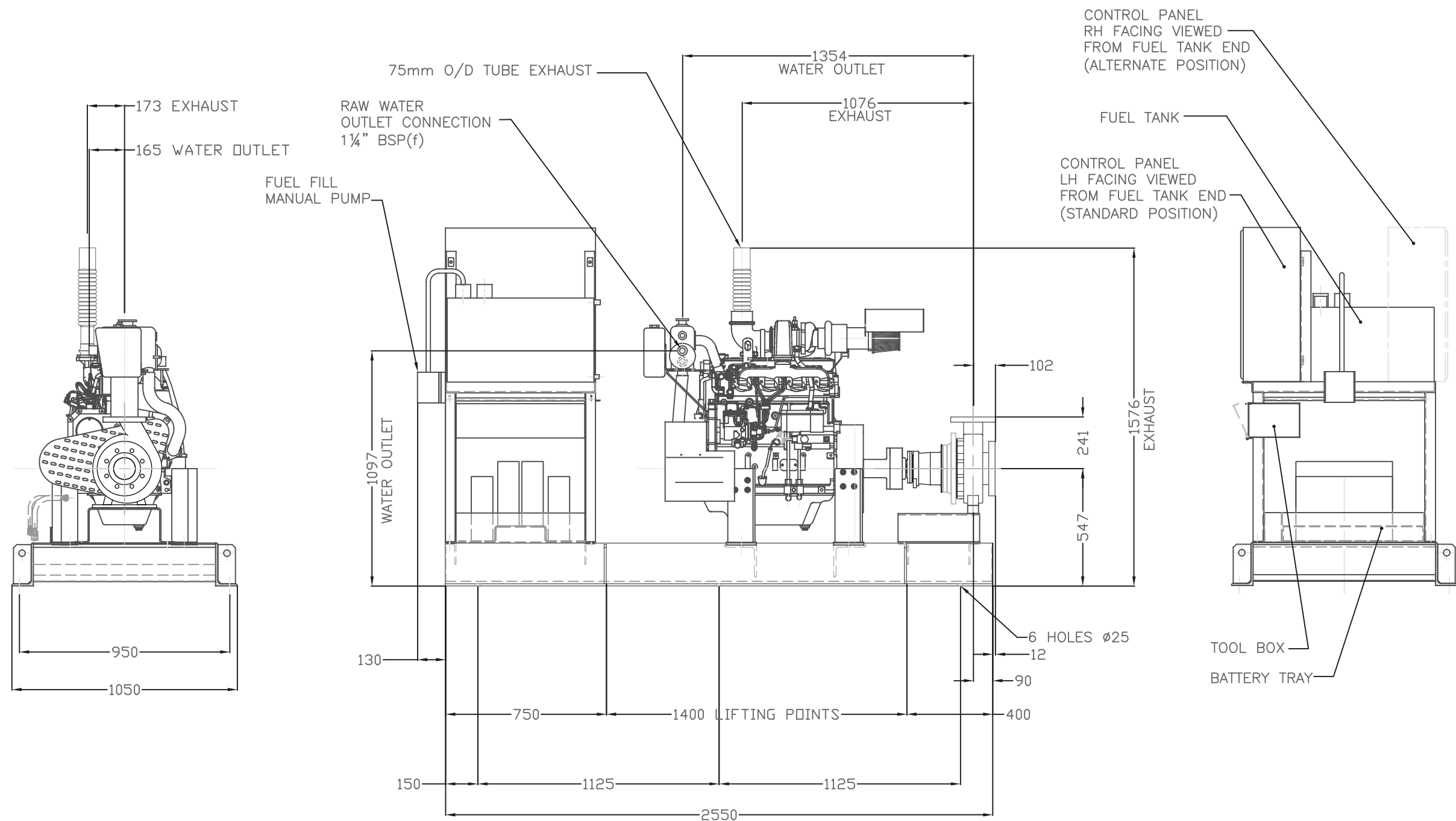


- 4) PUMP BASEPLATE SHOULD BE LEVELLED USING PACKING/SHIMS. GAP BETWEEN PLINTH & PUMP BASEPLATE TO BE 25mm FOR GROUTING.
- 5) FOUNDATION BOLTS SHOULD BE FITTED INTO TAPER POCKETS AS SHOWN BELOW.



- 6) FOUNDATION BOLTS SUPPLIED M20x260mm





CAD FILE : DO NOT ALTER BY HAND
DO NOT SCALE FROM THIS DRAWING : IF IN DOUBT ASK

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PROJECT ONLY. IT IS TO BE SHOWN TO YOUR SERVANTS OR AGENTS ONLY, FOR THE
PURPOSES OF YOUR BUSINESS AND TO NO OTHER PERSONS. IT IS TO BE RETURNED
TO US ON DEMAND, OR WHEN YOU NO LONGER REQUIRE IT, WHICHEVER IS EARLIER.

- Notes**
1. BASEPLATE BUND IS SIZED TO CONTAIN 110% OF THE FUEL TANK CAPACITY.
 2. PAINT COLOUR IS : BS381C (538) CHERRY.
 3. BATTERIES : CENTRE ROWS OF THE BATTERY ARE 'STEPPED UP' TO ALLOW VISUAL INSPECTION OF FLUID LEVELS IN ALL CELLS.
 4. WATER OUTLET CONNECTION IS TO BE PIPED TO DRAIN IN A MANNER WHICH DOES NOT CREATE ANY BACK-PRESSURE.
 5. EXHAUST BELLOWS : THIS MUST BE CONNECTED SO IT REMAINS STRAIGHT, AND IS NOT COMPRESSED OR STRETCHED.

01	18Apr19	AP	First Issue.
Rev.	Date	By	Description
DRAWING TITLE			
DIESEL FIRE PUMP			
3x2.5x10 (65-250) JU4H-NL14			
ENGINEER	DRAWN	CHECKED	APPROVED
AP	AP	AP	AP
SCALE	DATE		
NTS	18APR2019		
	DRG SIZE		
	A2		

MUCKLOW HILL,
HALESOWEN,
WEST MIDLANDS B62 8DJ
TEL. 0121 550 5333 FAX. 0121 550 1679
E' MAIL : ais@armlink.com
WEBSITE : www.armstrongintegratedsystems.com

F L A N G E D A T A							
	RATING	SIZE	TYPE	No. OF HOLES	SIZE OF HOLES	DEPTH	THICKNESS
SUCTION	PN16	80mm	FLANGE	8	18	N/A	25.4
DISCHARGE	PN16	65mm	FLANGE	4	18	N/A	22.225

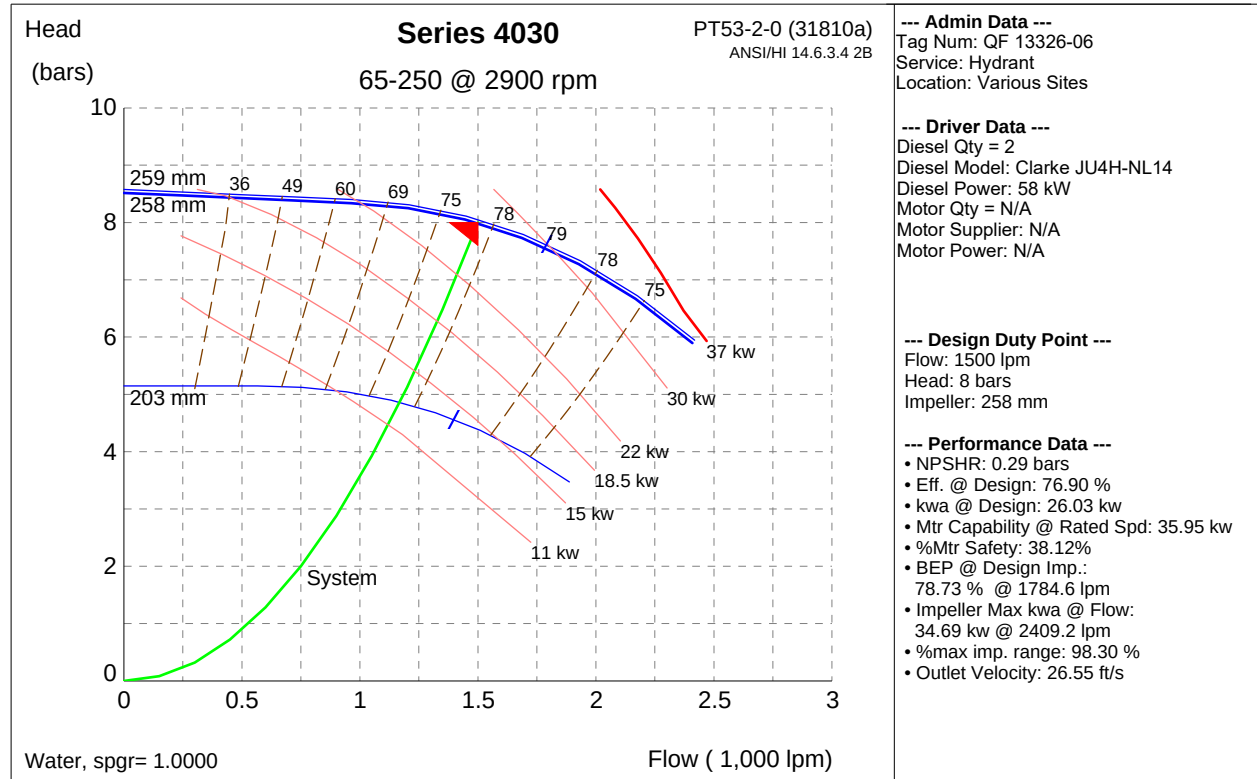
ARMSTRONG



Series 4030

65-250

Centerline Disc. End Suction Basemounted Pump





TORNATECH

LISTEN DEVELOP LEAD

**INSTALLATION AND MAINTENANCE MANUAL FOR
DIESEL ENGINE FIRE PUMP CONTROLLERS
MODEL LFD**



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-  1. Introduction
-  2. Installation
-  3. Main Features
-  4. Home
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Diesel engine fire pump controllers are designed to automatically start a diesel engine driven fire pump upon detection of an automatic start pressure switch in the fire protection system. A diesel engine fire pump controller provides automatic & manual starting. An automatic start is controlled by a pressure switch or by remote automatic devices as deluge valve. The "Operate Manual Start Test Pushbutton" implements a way to simulate the use of the "Emergency Pushbutton" by being activated after an automatic start followed by a stopping of the Firepump, or following a "Engine Fail to Start" alarm. A manual start is controlled by an Emergency Start pushbutton, hardwired to the relay board, that can securely start the engine. The diesel engine fire pump controller includes two battery chargers to maintain the engine batteries continuously charged.

Types of Diesel Engine Fire Pump Controllers

FIRE PUMP CATALOG NUMBER

MODEL No. EXAMPLE : LFD-12-220

Model Prefix LFD

Battery Voltage 12 : 12V

Incoming Voltage 220: 208/240V 50/60Hz

Methods of Starting/Stopping

The controllers are available as combination automatic / non-automatic.

METHODS OF STARTING

OPERATE MANUAL START TEST

The engine can be started by using this pushbutton after a "Fail to Start" alarm or after an automatic start followed by a stop. This method of starting will activate the last cranking starters that did not attempt to crank, and is in parallel with the "Emergency Start" button.

EMERGENCY START

The engine can be started from the Emergency Start Push Button located behind the breakable cover.

REMOTE AUTOMATIC START, DELUGE VALVE START

The engine can be started from a remote location by momentarily opening a contact of a pressure switch.

SEQUENTIAL START

In case of a multiple pump application, it may be necessary to delay the starting of each motor when there is a water pressure drop to prevent simultaneous starting of all motors.

METHODS OF STOPPING

MANUAL STOP

Manual stop is done by pressing the STOP push button. Note that pressing the stop push button will stop the engine in any circumstance, but if a starting demand is still present, the controller will initiate a cranking sequence upon releasing the STOP push button.

AUTO MODE BYPASS

An "Auto Mode bypass" switch is accessible from inside the enclosure door. If this switch is placed in "Auto Mode bypass", the controller will not initiate a cranking sequence from an automatic starting request. Use only for maintenance operations. This will ring the bell.

Cranking Sequence

When an automatic start signal is received by the controller, a cranking sequence is instigated. A cranking sequence is composed of 6 cranking attempts of 15 second separated by 10 second pauses. An alternation is made between the 2 batteries. During a cranking attempt, if no RPM is detected by the controller for 4 second, a pause of 1 second is made and the cranking attempt continues. This allows the movable pinion of the motor to re-engages with the flywheel gear rim. If the motor speed does not reach 120RPM but is higher than 0 RPM after 4 second of cranking, the cranking attempt is interrupted and the battery is declared weak. Further cranking attempt are made drawing power from the other battery to complete the 6 attempt sequence. If both batteries are declared weak, the fifth and sixth cranking attempts are made drawing power from both batteries simultaneously.

Weekly Test

- A weekly test is suggested to be carried out once a week by a qualified operator.
- The steps to realize this procedure are displayed on the controller door.
- The purpose of this test is to verify the normal operation of the fire pump, the engine and the controller.
- The procedure includes an automatic start and a manual start of the engine.
- The operator should be present the whole duration of this test.
- During the test, pay a special attention to any unusual sound, vibration or behavior of the engine, the pump or the controller.
- Stop the engine if an undesired alarm is activated during the test.
- Resolve any occurred problem before resuming the procedure.
- Contact the supplier if a problem cannot be resolved by the local technician.

Installation 2

The controller is built in accordance with the latest edition of the LPS1236 Standard: Requirements for control panels for diesel driven pumps used in automatic sprinkler installations.

This controller is designed to be used with approved engine without a speed switch, using a magnetic pickup for analog management of the Engine Run signal and Overspeed signal, shown using an on-screen gauge on the ViZiTouch. Find more information on the senders section of this manual.

Location

The controller shall be located as close as practical to the engine/motor it controls and shall be within sight of the engine/motor. The controller shall be located or protected such that it will not be damaged by water escaping from pump or pump connections. Current carrying parts of the controller shall be not less than 12 in. (305 mm) above the floor level.

The controller is suitable for use in locations subject to a moderate degree of moisture, such as a damp basement. The pump room ambient temperature shall be between 32°F (0°C) and 122°F (50°C) (If a temperature option is included, see the rating label for maximum temperature).

The standard controller enclosure is rated IP 55. It is the installer's responsibility to insure that either the standard enclosure meets the ambient conditions or that an enclosure with an appropriate rating has been provided. Controllers must be installed inside a building and they are not designed for outside environment. The paint color may change if the controller is exposed to ultraviolet rays for a long period of time.

Mounting

The fire pump controller shall be mounted in a substantial manner on a single incombustible supporting structure. Wall mounted controllers shall be attached to the structure or wall using all four (4) mounting ears provided on the controller with hardware designed to support the weight of the controller at a height not less than 12 in. (305 mm) above floor level. Floor mounted controllers shall be attached to the floor using all holes provided on the mounting feet with hardware designed to support the weight of the controller. The mounting feet provide the necessary 12 in. (305 mm) clearance for current carrying parts.

A concrete slab is recommended to avoid water accumulation at the controller's feet.

Storage

If the controller is not installed and energized immediately, Tornatech recommend following the instructions from the chapter 3 of the NEMA ICS 15 standard.

Wiring and Connections

Electrical Connections

A licensed electrician must supervise the electrical connections. The dimension drawings show the area suitable for incoming power and motor connections. No other location shall be used. Only watertight hub fittings shall be used when entering the cabinet to preserve the IP rating of the cabinet. The installer is responsible for adequate protection of the fire pump controller components against metallic debris or drilling chips. Failure to do so may cause injuries to personnel, damage the controller and subsequently void warranty.

Energy Consumption

Diesel Controller with boost charger and Lead Acid Batteries			
Model / State		220/ 240VAC	VDC Output
12VDC / @	No charge	0.5A	13.8V
12VDC / @	Full charge*	2A	
24VDC / @	No charge	0.5A	27.6V
24VDC / @	Full charge*	2A	

Diesel Controller with boost charger and NiCad Batteries			
Model / State		220/ 240VAC	VDC Output
12VDC / @	No charge	0.5A	14.1V
12VDC / @	Full charge*	2A	
24VDC / @	No charge	0.5A	28.2V
24VDC / @	Full charge*	2A	

*5 amps through each battery

Sizing

Wiring between controller and engine (terminals 1,9,10,12) must be stranded #10 AWG or 6mm² as minimum.
Wiring between controller and engine (terminals 6,8,11) must be stranded #8 AWG or 10mm² as minimum.

Power supply wiring must be stranded #14 AWG or 2.5mm² as minimum.
Incoming power supply terminals are sized for #16 AWG (1mm²) to #6 AWG (16mm²) wire.

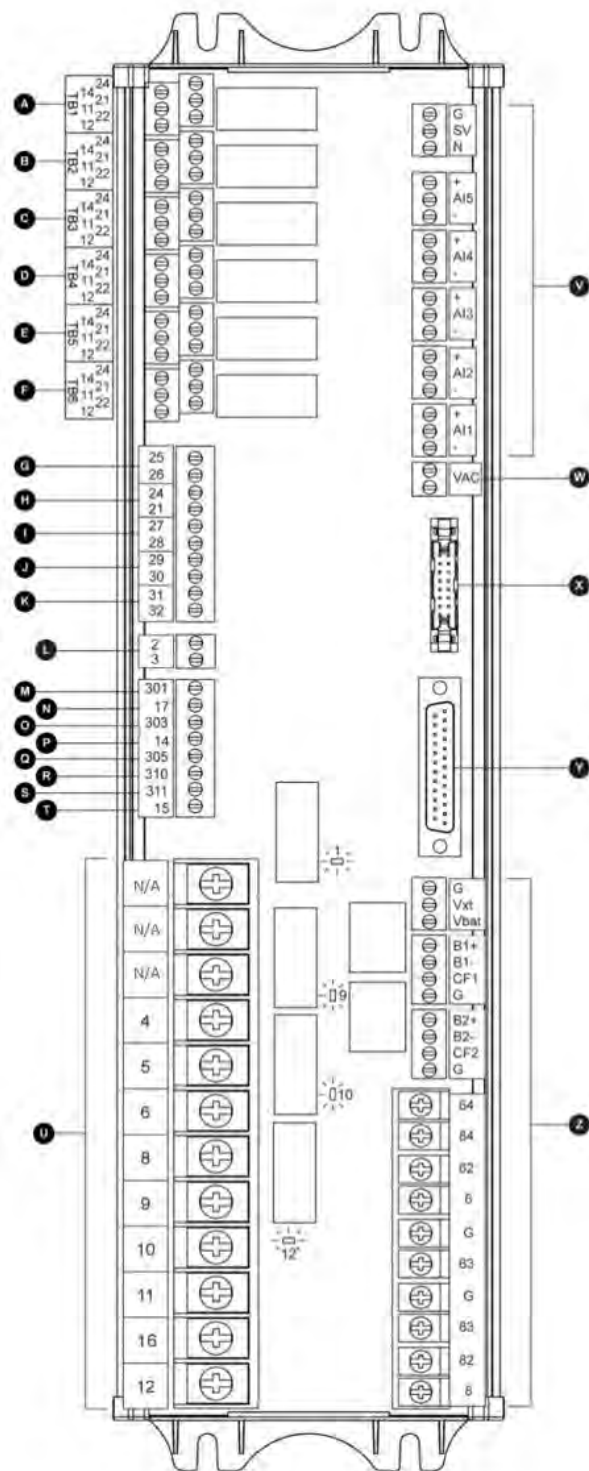
Incoming Power Connections

Diesel engine driven fire pump controllers shall be powered by a dedicated source protected by a fuse or circuit breaker. Verify the label on the cabinet to select the correct protection. Always follow this procedure when connecting or disconnecting the controller: Connect both batteries before connecting the AC power. Disconnect the AC power before disconnecting the batteries. Disconnecting the batteries while the AC is connected may result in severe damage to the controller electronic boards.

Circuit protection

CB1 protects battery charger 1 and CB2 protects battery charger 2. CB3 protects the control circuit from battery 1 and CB4 protects the control circuit from battery 2.
Always follow this procedure when connecting or disconnecting the controller: Connect both batteries before connecting the AC power. Disconnect the AC power before disconnecting the batteries.

Terminal Strip Descriptions



A-F : Alarm Output Terminals

(DPDT Relay, 11/21:Common, 12/22:Normally Closed, 14/24:Normally Open):

- A: Common Trouble (fail safe)
- B: Fan / Louver Activation
- C: Engine is running
- D: Automatic Start Unavailable
- E: Pump Fail to Start
- F: Pump on Demand

G-T : Field Input Terminal

(Dry Contact Only: Voltage Free):

- G: Emergency Start Push Button (NO)
- H: Pressure Switch Start (NC)
- I: Deluge Valve Start (NC)
- J: Pump Failed
- K: Low Fuel Level (NO)
- L: Magnetic Pickup
- M: Not Used
- N: Fuel Injection Fault
- O: Not Used
- P: ECM Fault
- Q: Not Used
- R: Not Used
- S: Not Used
- T: Low Engine Temperature

U : Engine Terminals :

The terminals are numbered according to the standard:

- 1 - Not used
- 2 - Not used
- 3 - Not used
- 4 - Low Oil Pressure
- 5 - High Engine Temperature
- 6 - B1 : battery #1 positive
- 8 - B2 : battery #2 positive
- 9 - C1 : start contactor #1
- 10 - C2 : start contactor #2
- 11 - GND : Ground
- 16 - Low Temperature Switch -
- 12 - ST : Stop fuel solenoid valve
(ETS - Energized To Stop)

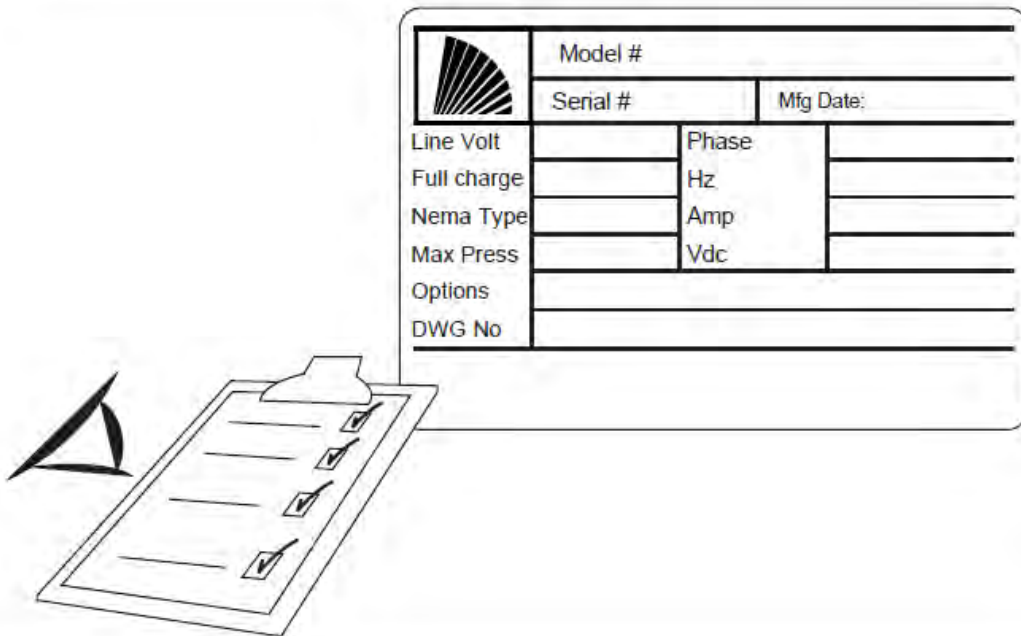
V: Analog inputs

- SOL V: Not Used
- AI1: Not Used
- AI2: Not Used
- AI3: Not Used
- AI4: Not Used
- AI5: Not Used
- W: 220Vac Power Supply monitoring
- X: CANBUS to IO cards
- Y: CANBUS to ViZiTouch

Z: Factory reserved power connections

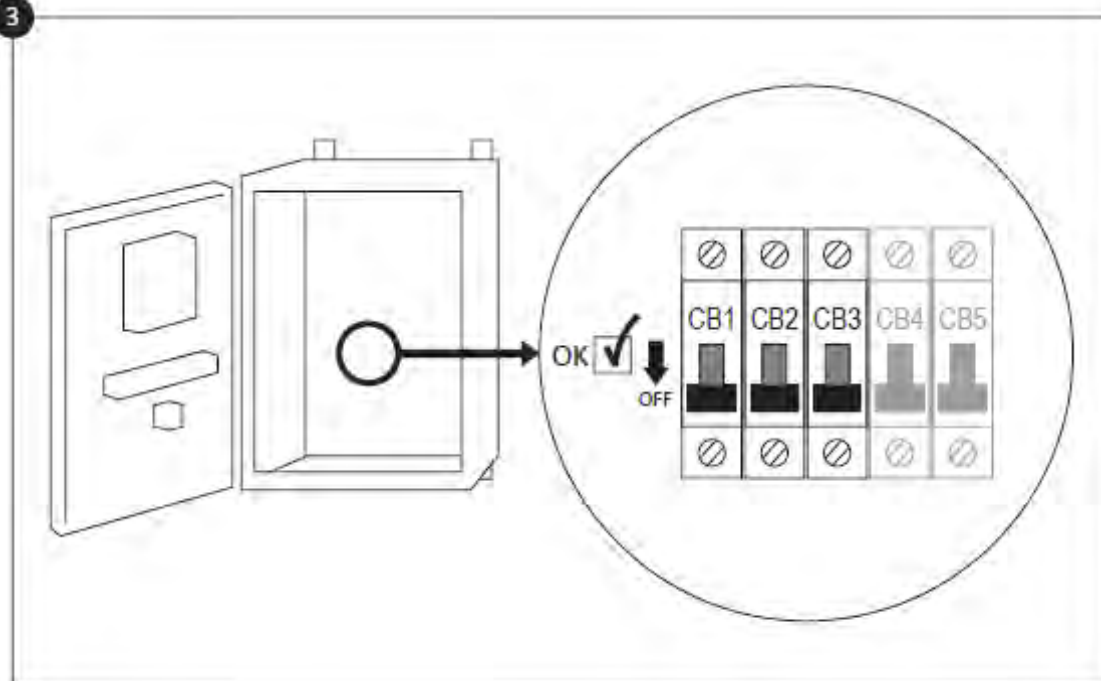
Quick Start-Up Guide

1

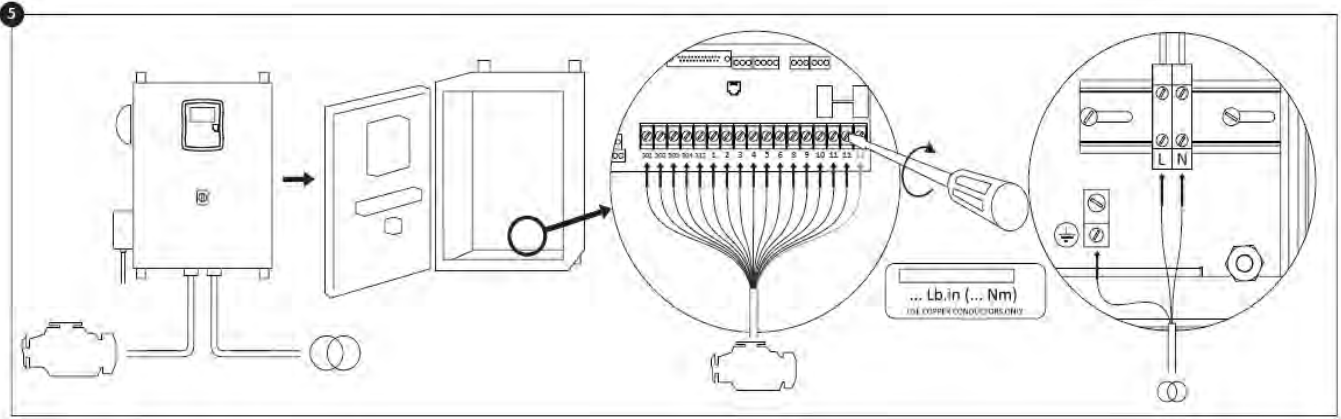


The rating label is the most important label. It must be read carefully to ensure the compatibility between the controller and the installation.

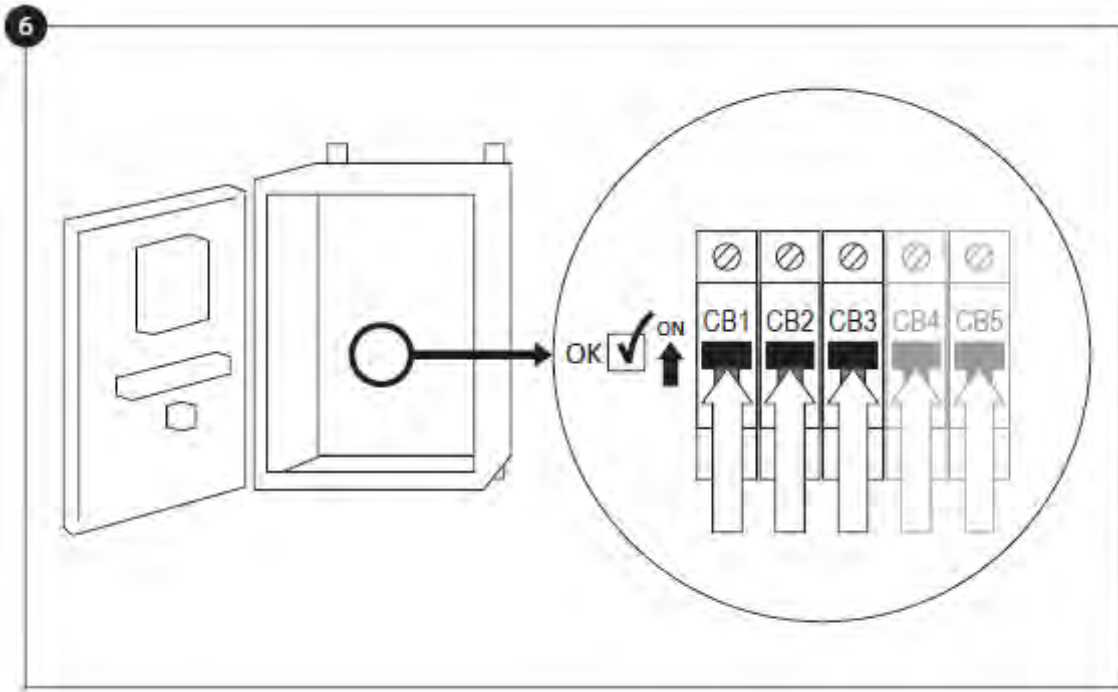
3



Open the controller's door and verify all circuit breakers are in the lower "OFF" position.



Connect all cables between the engine control panel and the controller engine terminals (Identified as “U” on the IO board diagram displayed in the Terminal Strips Descriptions in the manual). Secure with the appropriate torque as indicated on the torque label and verify all connections. Connect the AC main line and ground to the AC terminal in the controller.



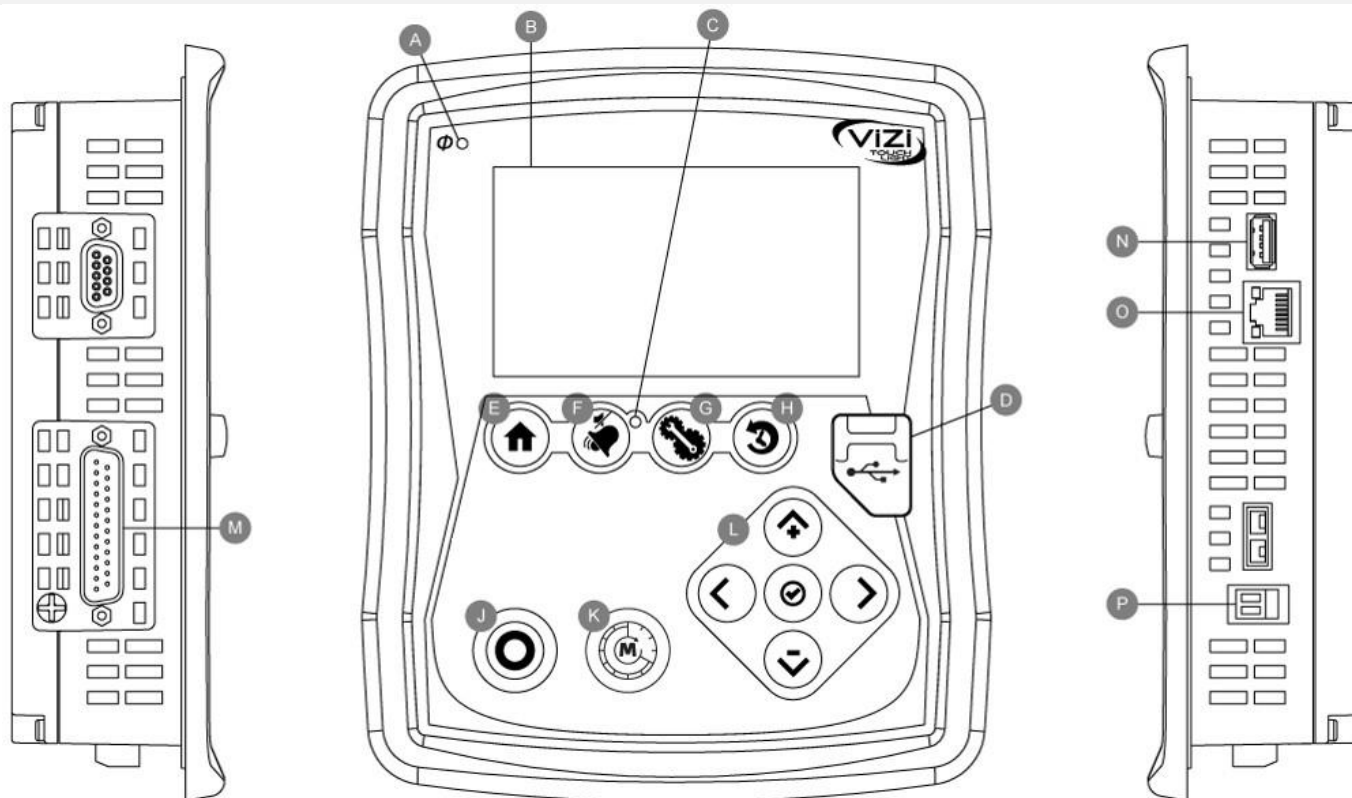
Activate the disconnect switch (if present) and all breakers by setting them to the "on" position. The controller will boot up for the first time.

Before trying to start the engine, verify that the engine setup is complete and the exhaust pipe is connected properly. Verify that the engine has started and is running properly.

Main Features

3

The ViZiTouch



A: Power LED: Indicates if the ViZiTouch is properly powered.

B: Touch Screen: 4.2 inches color touch screen LCD.

C: Alarm LED: Indicates if an alarm is currently active.

D: Front USB Connector: USB Device connector used for file download, software updates, service reports.

E: Home button: Used to navigate to the Home page.

F: Alarm button: Used to navigate to the Alarm page. It also allows the user to silence the alarm bell, hence the small “no speaker” symbol in the upper right corner of the button.

G: Config button: Used to navigate to the Configuration page.

H: History button: Used to navigate to the History page.

J: Stop button: Used to stop the engine if all starting conditions are gone.

K: OPERATE START TEST PUSH BUTTON: The engine can be started by using this pushbutton after a “Fail to Start” alarm or after an automatic start followed by a stop. This method of starting will activate the last cranking starter that did not attempt to crank.

L: Contextual navigation pad: Used to facilitate the navigation on specific pages. A small icon representing the contextual navigation pad will appear at the bottom right corner of a page if the pad is active. By clicking on the small pad icon, a menu explaining the specific functions of the arrows will appear. For example, it is possible to switch between the graphical or the table mode on the logs page, as well as navigate through the tables.

M: CAN bus connector to IO cards

N: USB 2.0 connector

O: Ethernet connector

P: Alarm Bell connector

Warning

After 2 years of service, the Vizitouch battery may become less efficient and could lose the time after a shutdown.

Alarm Bell

The alarm bell is activated under default faulty conditions and under optional or user defined conditions. Any of these conditions will energize the alarm bell but may be silenced, by pressing on the “Alarms / Silence” membrane button. When silenced, the alarm bell restarts ringing if a new fault occurs or if the alarm conditions remain unchanged after 24 hours. The alarm bell automatically stops ringing if alarm conditions are not present anymore.

Note: other external conditions may trigger optional conditions depending of the factory settings. Verify drawings affixed inside the cabinet.

Default Conditions :

- Engine Overspeed
- Engine Low Oil Pressure
- Engine High Coolant Temperature
- Engine Fail to Start
- Battery Failure 1-2
- DC Failure
- AC Fail
- I/O Cards Communication Loss
- CAN System Failure
- File System Failure

Chargers

Every LFD control panel is equipped with two battery chargers, one for each battery. Their role is to maintain the batteries voltage to a full charge level.

Battery switching

When an automatic start request is triggered, a cranking sequence is launched by the control panel. The automatic starting sequence will make up to six attempts to start the engine by cranking the engine starter. The control panel will alternate automatically between the two batteries after each cranking attempt. Each attempt will be of 15 seconds and separated by a 10 second pause. If after a cranking attempt, the motor did not reach 120 RPM, the battery will be declared weak and all the remaining attempts will be made from the other battery. After the six attempts, if the control panel doesn't read an engine speed, the “Fail to Start” alarm will be triggered.

WARNING!

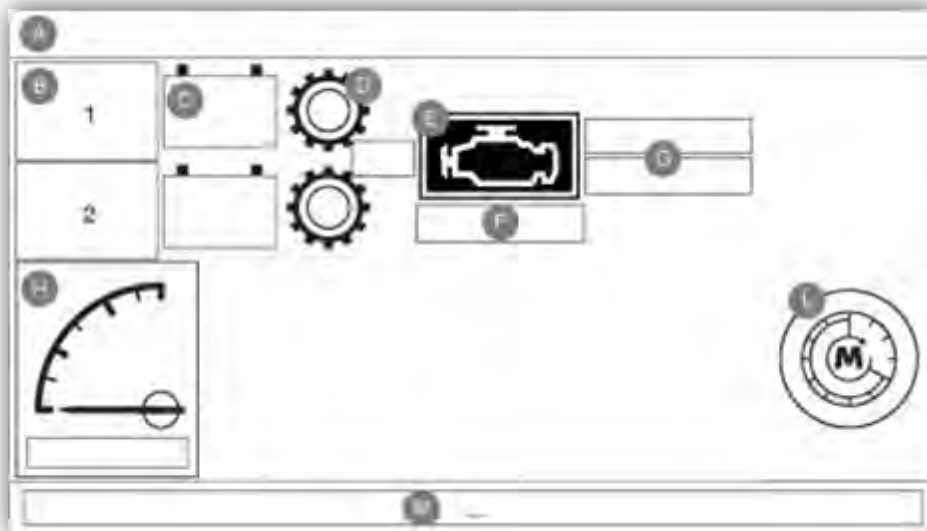
Do not under any circumstance use the batteries for any purpose other than for motor start-up.

Monitoring and Surveillance

Monitoring and surveillance is done using speed sensor, pressure switch and signals from the engine. A speed sensor sends a signal to the IO board which is translated into the engine speed. A pair of pressure switch is used to monitor the pressure switch on the sprinkler system and trigger the automatic starting sequence. The control panel also uses signals from the engine to monitor different parameter that trigger alarms such as “Low Oil Pressure”, “High Engine temperature” and “Low Temperature”.

Fan and Louvers

The Fan and Louvers are activated upon activation of the engine run signal. They should be wire to the TB2 relay, the fan on the Normally Opened contact (11-14) and the louvers on the Normally Closed contact (11-12).



The home page displays all controller statuses and important values of the controller. All voltages, currents, engine state and status, as well as all timers and cranking sequences.

The entire background will become red if an alarm becomes active. This feature will help the user identify a problem even at a significant distance away from the controller.

- A: Navigation bar which contains general information about:
- The language (the language may be changed by pressing on it)
 - The page title
 - The alarm banner (warning and alarm messages may be shown)
 - The date and time (adjustable in the Configuration page)

B: Battery charger state. It may become one of three colors and also explicitly describes the current battery charger state.

- POWER UP – Green
- BULK – Green
- OVER_CHARGE – Green
- FLOAT – Green
- CHARGER_FAIL – Red
- NO_AC – Red
- BATTERY_FAIL – Green

An orange rectangle between the battery and the charger will appear periodically. It is the boost mode. This charging mode enables the boost function on the charger, allowing a shorter charging time of the battery. Also, it allows the controller to detect a missing battery, and/or a problem with the charger.

C: Battery. The battery will be red if it is in failure and green otherwise. The first line of data shows the actual voltage of the battery in volts and the second line shows the actual current in amperage.

D: Starter gear. It represents the current state of the cranking sequence. The cranking sequence is made of 6 cranking attempt of 15 second separated by pauses of 10 second. The counter inside the gear indicates the remaining time of the current state. As there are two cranking modes, “waiting for crank” and “cranking”, the gear

will alternate between yellow (waiting) and green (cranking), allowing the user to know exactly the state of the cranking sequence.

E: State / Timer. During a cranking sequence, a counter will be visible between the two contactors. This counter indicates the state (1 to 6) of the cranking attempt inside the cranking sequence. It will stay on a state for 15 seconds of cranking, if it's not interrupted, and for 10 seconds of pause. Then, it will continue counting until the end of the sixth cranking attempt, which is the end of the cranking sequence. When the "Energize to Stop" fuel solenoid valve is activated, a timer appears in this box. This timer can be canceled by pressing the red cross above the timer.

F: Fuel solenoid. In this box, the user can see the state of the fuel solenoid. A red symbol represent the activation of the "Energize to Stop" fuel solenoid valve. This activation will stop the engine.

G: Diesel engine. It will be grey if the engine is stopped, green if an "Engine Run" signal is detected and red if an "Overspeed" or "Fail to start" occurred, after 6 unsuccessful cranking attempts. The engine will be yellow if running in test mode.

H: Time in use. This timer shows the amount of time the motor have been running.

I: Starting or stopping cause.

A green capsule will indicate the reason why the engine is running. Possible choices are:

LOCAL – Optional: This start cause is triggered if the engine is locally started directly from its own control panel and the option is enabled.

EMERGENCY – It receives a manual crank request from the emergency pushbutton.

DELUGE: Automatic engine starting activated by a deluge valve.

REMOTE AUTO: Automatic motor starting activated by remote equipment.

A red capsule will indicate the reason why the motor is not running despite the fact that a request is being made. Possible causes are:

FAILSTART – This failure happens when the controller receives a request to start, but a "Fail To Start" alarm is active after a cranking sequence failure, thus preventing its ability to effectively start the engine until this alarm is reset.

LOCKED: An interlock signal is preventing the motor from running.

AUTO MODE BYPASS: If Automatic/Off pushbutton inside the enclosure door is press, the AUTO MODE BYPASS ALARM will be activated. It will stop the engine if it was running, and will prevent starting from automatic causes, therefore ideal for maintenance and/or services. Deactivation is done by pushing the Automatic/Off pushbutton again, this will reset the alarm.

J: Pump on Demand: This green box will appear when an automatic start demand is activated.

K: Motor speed gauge: The first small green line and small red line on the gradations shows the Set point of the "Engine Run" Signal. When the engine runs with a speed above this threshold, the ViZiTouch will consider it is running, and when it slows down under the red line, it will be considered stopped. The second red line, usually set high on the gauge, represents the "Overspeed" threshold. If the engine speed reaches that mark, the "Overspeed" alarm will be activated. Please refer to chapter 6 for more information.

L,M: The "M" section shows the text: "OPERATE MANUAL START TEST PUSH BUTTON IF LIGHT IS LIT". It is grey when the corresponding button is offline. When the button becomes active, the message color turns Yellow, and the button's logo appear on screen ("L"), sending the message that the controller is ready for this test.

Screen Saver

After 5 minutes of inactivity on the ViZiTouch, the screen will dim it's brightness to 25%. After 10 minutes of inactivity on the ViziTouch, the "Black Screen" screen saver will activate. Its goal is to expand the lifetime of the LCD screen. The screen saver will be instantly deactivated if the engine is running or if an alarm is activated. To manually deactivate it, simply touch the screen or any membrane button. After deactivation, the screen saver will always redirect to the "Home" page. It will also log off any user by resetting the security level to 0 and save any new modifications to the settings.

Alarms 5

Alarms (Membrane button)

Alarms



Displays the list of currently active and occurred alarms. An alarm is called **ACTIVE** when its triggering condition is present. An alarm is called **OCCURED** when its triggering condition has been active, but is no longer true. Alarms representing serious concerns are **RED**. Alarms representing simple warnings are **YELLOW**. To silence the bell press the **ALARM** button or it will silence itself after the expiration of a factory set timer. Pressing on the **RESET** button will reset **OCCURED** alarms only.

The “Bell Test” button will activate the alarm bell for 3 seconds.

The table displays system events:

- Date and Time: Date and time stamp of the alarm in the YYYY.MM.DD format
- Message: Alarm message
- State: OCCURED or ACTIVE
- Color Code:
 - Red: The event is an alarm
 - Yellow: The event is a warning

Complete list of alarms :

Common Alarms:

Engine Trouble: The Engine Trouble common alarm is active when one or more of these conditions are active :

- Engine High Temperature
- Engine Low Temperature
- Engine Low Oil Pressure
- Engine Fail to Start
- Engine Fail when running
- Engine Overspeed
- Battery Failure 1-2
- Loss of continuity with contactor 1-2
- Pump Failed

Pump Room Trouble: A common alarm activated when the following events occur:

- Fuel Tank Leak
- Low Fuel Level
- High Fuel Level
- AC Failure
- Water Reservoir Low
- Water Reservoir High
- Water Reservoir Empty

CTRL Trouble: Important: this relay is normally energized when controller is in normal condition. The relay is de-energized when controller trouble is detected (fail safe). The controller trouble common alarm is active when one or more of these conditions are active :

- Charger Failure 1 OR 2
- Battery 1 AND 2 Failure

Common Trouble: This Global Common Alarm is activated if one of these alarms are active:

- Engine Trouble
- Pump Room Trouble
- CTRL Trouble

- AC Failure: Monitors the AC power and activates on a failure.

- Battery 1-2 Fail: Monitors the status of battery 1 and activates on a failure. This occurs when the battery is disconnected, is the wrong type or is unable to be recharged. When disconnecting a battery, there will be a delay before the alarm is activated. The boost signal will be active a minute later, or more if a ghost current is detected. If there is no response from the battery, it will execute a second test 30 seconds later, and then activate the battery failure alarm.

- Charger 1-2 Fail: Monitors the state of battery charger 1 and activates on a failure. This occurs when the battery charger has a defect, is not properly powered, or is unable to provide the needed current. It will also change to Boost Fault mode if during a boost test, the voltage does not rise. A NC dry contact is also connected from the charger to the IO Board. If this contact opens for 1 minute, the alarm will be activated. Chargers readings are not updated during cranking and/or running, due to reading instability under load. As soon as the engine returns to an idle state, all readings and failure analysis are reactivated.

(Note: With the option NiCad batteries, no boost is used and there is no NC dry contact. The "Charger Fail" alarm is detected when the battery voltage goes under the float voltage and no current is detected between the charger and the battery.)

- Loss of Continuity 1-2: Activates if the engine start contactors are disconnected from the controller.

- Water Res. Low (option): Activates if the "Water Reservoir Low" contact input is triggered or if the analog readout of the water reservoir is enabled and is lower than the water reservoir low set point in the "Water Level" sensor page.

- Water Res. Empty (option): Activates if an external contact triggers the optional "Water Reservoir Empty" input.

- Main Relief Valve Open (option): Activates if an external contact triggers the optional "Main Relief Valve Open" input.

- Fuel Tank Leak (option): Activates if the "Fuel Tank Leak" optional contact input is triggered.

- Low Fuel Level: Activates if the "Low Fuel Level" contact input is triggered or if the optional analog readout of the fuel level is enabled and goes lower than the low fuel level set point in the "Fuel Level" sensor page.

- High Fuel Level (option): Activates if the optional "High Fuel Level" contact input is triggered or if the analog readout of the fuel level is enabled and goes higher than the high fuel level set point in the "Fuel Level" sensor page.

- Engine Fail When Running: Activates if the "Engine Run" signal is lost while the engine is running.
- Engine Fail to Start: Activates if the engine fail to start after completing a 6 attempts crank sequence. The engine will turn red.
- Engine High Temperature: Activates if the specific "High Temp" input (5) is triggered on the engine connector strip and the engine is running.
- Engine Low Temperature: Activates if the specific "Low Temp" input (15) is triggered on the engine connector strip.
- Engine Low Oil Pressure: Activates if the specific "Low Oil Pressure" input (4) is triggered on the engine connector strip and the engine is running.
- Engine Overspeed: Activates if the speed read is higher than the set Overspeed value.
- Io_expX-inX alarm (option): Activates if the specific expansion programmable input on the specific expansion board is activated and triggered.
- Battery1-2 Overvoltage: Activates if the voltage of the specific battery is higher than the specified overvoltage set point.
- IO Diesel Communication Error: Activates if no communication with the diesel IO board could be established for 15 seconds. If this alarm persists for more than 1 minute the controller will reboot to try to fix the problem.
- IO Expansion Communication Error (option): Activates if no communication with the Expansion IO board could be established for 15 seconds.
- Communication System Failure: Activates when the communication task has stopped responding. This alarm condition is critical and will be followed by a controller reboot to try and fix the problem.
- Pump Failed: A pressure switch needs to be installed at the pump exit for this alarm to be meaningful. The pressure switch close if the pressure is high enough and open otherwise. If the pump is running and the pressure switch is still open 5 seconds after having engine run, this alarm will be triggered.
- Emergency Start Activated: Activates when the Emergency Start push button is pressed.
- Engine Run: Activates when the engine is running.

Configuration

6

Config (Membrane button)

Config

Setup all basic configuration parameters.

The main configuration page provides a quick means of changing the most common settings. The padlock icon indicates the current authorization level. A locked padlock indicates that only basic settings can be changed. Press on the padlock to enter an authorization code to unlock additional settings. An unlocked padlock showing an authorization number indicates that some settings are unlocked. Press on the padlock again when you have concluded your operation.

Access Level 0:

- The “Advanced” button activates the advanced configuration pages.
- Date and Time adjustment are accessed by pressing the clock. Refer to the “Date and Time” page for more information.

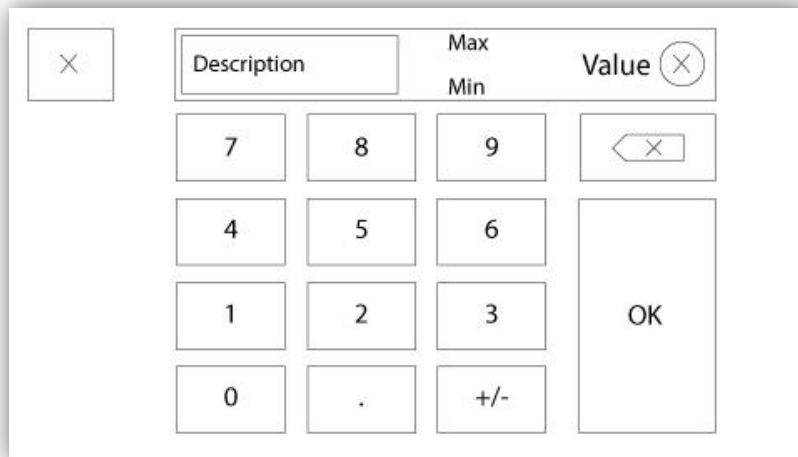
Access Level 1:

Inside the left box, the engine speed parameters can be set. Adjustment of the Minimum and the Maximum of the speed gauge displayed on the Homepage.

Inside the middle box, a battery selection can be made. This setting should always be “AUTO”, unless if doing maintenance on one battery or for testing purposes.

Inside the lower box, two “overvoltage” set points can be adjusted to trigger battery Overvoltage alarms.

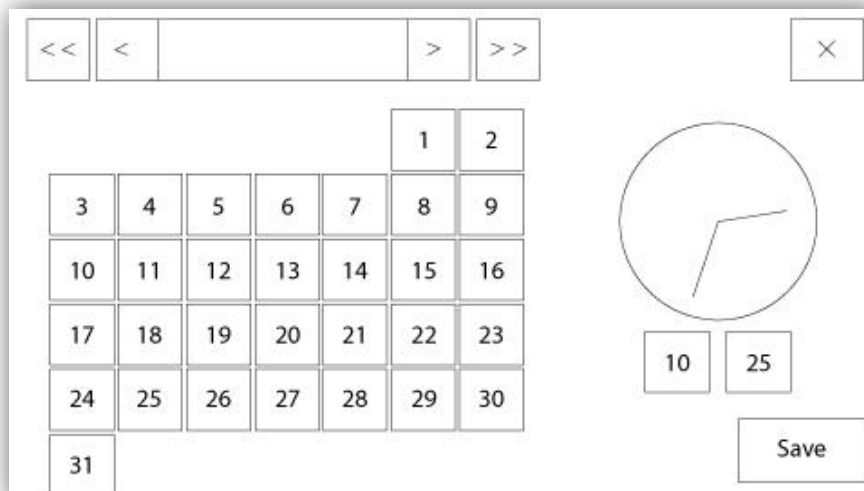
NumPad Page



The NumPad interface consists of a top header and a main grid. The header contains a close button (X) on the left, a 'Description' text field, 'Max' and 'Min' labels, and a 'Value' text field with a close button (X). The main grid contains a numeric keypad with buttons for 7, 8, 9, 4, 5, 6, 1, 2, 3, 0, ., and +/-, and a large 'OK' button on the right. A back arrow button with an 'X' is located above the 'OK' button.

The NumPad is activated every time the user clicks on a white square box representing a number that can be set. On top of the NumPad, the current parameter is shown. The text will flash red if the value entered is invalid and the OK button will be black, indicating that the value is out of range. The MIN and MAX show the range of values accepted for that particular parameter. The “X” button allows the user to cancel editing the value. The back arrow erases the last entered number and the “CA” button clears the whole text field. Simply click the “OK” button once the value is set.

Date and Time Page



The Date and Time interface includes a top navigation bar with buttons for navigating between pages (<<, <, >, >>) and a close button (X). The main area is divided into two sections. The left section is a date picker with a grid of days from 1 to 31. The right section is a time picker with a circular clock face and buttons for 10 and 25. A 'Save' button is located at the bottom right.

Confirm changes

WARNING: Changing the date and time will affect the LOGs chronology. Are you sure you want to commit your changes?

Cancel

Save

The Date and Time can be configured by selecting the current month and year by pressing the arrow buttons on each side of the "Month-Year" display and selecting the day of the month by selecting the actual day. The time is set by pressing the two square boxes under the clock; the left sets the hours and the right sets the minutes. Press the Save button to commit the changes. A dialog box will appear to confirm the change "Date and Time". The user may cancel the changes by pressing the "Cancel" button. Please note that changing the date and time will have an effect on the logs chronology.

User Login Page / KeyPad Page

×

1	2	3	4	5	6	7	8	9	0
q	w	e	r	t	y	u	i	o	p
a	s	d	f	g	h	j	k	l	
Shift	z	x	c	v	b	n	m	← ×	
,							.	OK	

User Login Keypad:

This page allows the user to log into a higher security level by entering a password. If the password is valid the text field will turn green and if it is invalid, the text field will turn red. A "X" button appears in the text field as soon as a character is entered, allowing for a quick erase of the written password.

If the password is invalid for a consecutive number of times, the user will be redirected to the "Service Dealer" page, allowing the user to communicate with the appropriate Service Dealer.

If the password is valid, the "Configuration" page will reload and the access security level will be shown inside the lock. To log off, click on the lock and the user security level will return to "0"

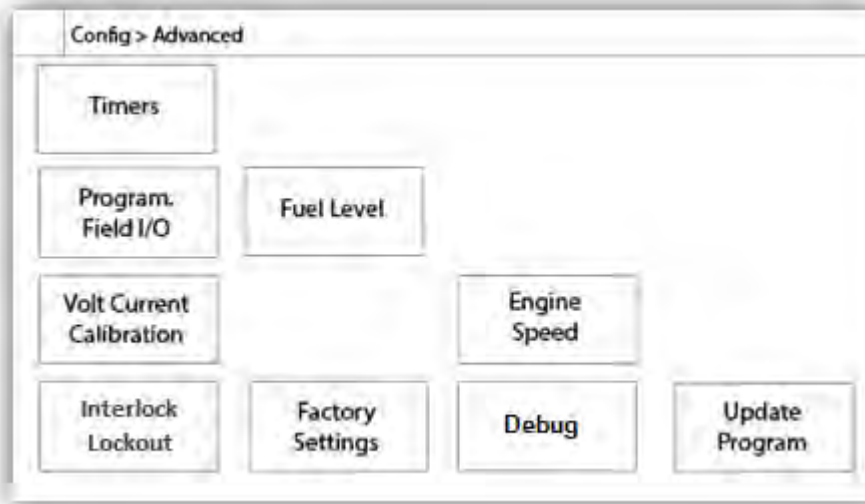
Other KeyPads:

The Keypad is activated every time the user clicks on a grey rectangle box with white text representing a text that can be set. The "X" button allows the user to cancel editing the value. The back arrow erases the last entered

character and the "CA" button clears the whole text field. Simply click the "OK" button once the value is set. This type of text field is mostly used to generate a digital text indication for a custom alarm input.

Advanced Configuration Page

Config > Advanced



This page is the portal to all the advanced configuration parameters of the ViZiTouch.

All timers, sensors, factory settings, software update, service dealer and debug pages may be accessed simply by clicking on the appropriate buttons.

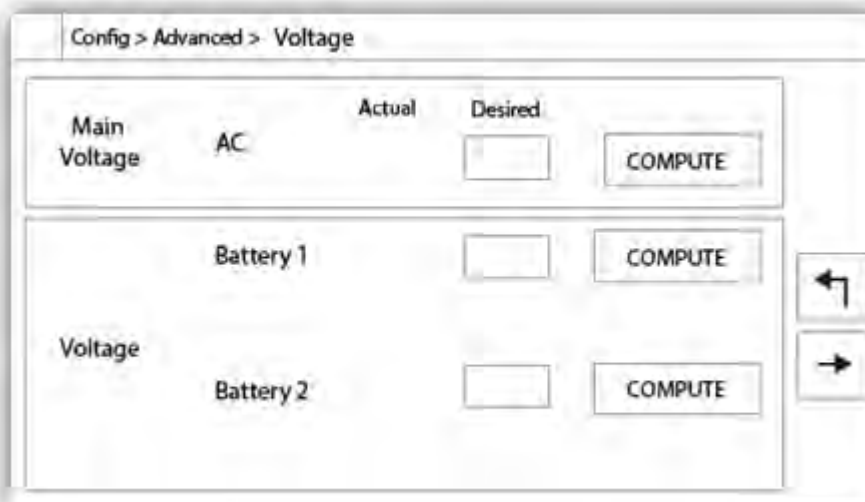
Since two of the analog inputs are using the same physical connector, only one of these can be installed at once. These analog inputs are shown in the grey box surrounded by a black dotted line. Each time one of these sensors is installed, the other will turn orange, preventing the dual installation of these sensors.

All buttons are set to security "Level 0" except "Update Program" which is set at "Level 1" security.

Details of the Advanced Configuration Page

Volt-Current Calibration

Config > Advanced > Calibration Voltage-Current



This page is used to calibrate all analog voltages. The actual column shows the actual value calculated by the ViZiTouch. The "desired" column allows a level 2 user to enter the desired value read from a calibrated external device (multimeter). For the AC voltage and the 2 DC voltage, the calibration is done by entering the desired value and pressing on the "COMPUTE" buttons. The DC values must be entered with no batteries connected, to allow the

calibration of the battery chargers in the “power supply” mode. To do so, simply turn the batteries circuit breaker to OFF.

Config > Advanced > Current

mA

Calibration

Battery 1 2650

2650 Read < 8880 Read ZERO COMPUTE

Calibration

Battery 2 2725

2725 Read < 8880 Read ZERO COMPUTE

This page is used to calibrate all analog currents. The first number right beside the Battery 1 and Battery 2 text shows the actual current reading. First, Set the CB3 Breaker in the OFF position. This will disconnect the battery. Press the ZERO button. Then, put the CB3 breaker back in the ON position. Connect a small charge to the 6 and 11 terminals, to create a low current around 2600 mA. Enter this value in the most left field of battery 1, and press the Read button. Then, connect a bigger charge to the 6 and 11 terminals, around 8800 mA. Write the measured value in the second text field, and press the second read button. Finally, press the COMPUTE button to complete the calibration. Repeat for the second battery, linked to CB4 Breaker and terminals 8 and 11.

Battery Test Configuration

Max Current for Boost Test Batt.1 Batt.2

Charger 1 Power Supply Voltage Reference

Charger 2 Power Supply Voltage Reference

Disconnect Battery

This page is used to adjust the calibration of the battery test.

Max Current for Boost Test : Under this current value in Amps, no test on the battery is made. (Note: With the NiCad batteries option, this field is not available)

Charger 1-2 Power Supply Voltage Reference : This is the voltage that is applied by the battery charger in power supply mode (no battery connected). To measure this voltage, the battery must be disconnected.

Config > Advanced > Timers1

Engine Starting and Stopping Sequential Start Timer s	Energize to Stop Timer On s
Fail When Running Timer Timer On s Enable ☐	⏪ ⏩

Config > Advanced > Timers2

Local Request Detection Timer On s	High Raw Water Temp. Timer On s
	High Engine Temperature Timer On s
	⏪ ⏩

Config > Advanced > Timers3

Low Oil Pressure Delay s	⏪
	High Fuel Level Alarm Timer On s
Low Water Level Alarm Timer On s	⏩
Low Fuel Level Alarm Timer On s	

Most common timers for fire pump control can be configured here. Note that any timer set to 0 will remove the delay in the decision process.

Access level 1:

- Engine starting and stopping:

The "Sequential Start Timer" allows a delayed response on an automatic start request.

- Energize to Stop:

This timer set the time in second the fuel solenoid valve will close after a stop.

- Fail When Running Timer:

If Enabled, this timer will delay the "Fail When Running Alarm".

- Local Request Detection:

This is the delay it will take to the controller to detect a Local start of the pump.

The other timers are self explanatory and set the time delay on alarms.

Inputs/Outputs Configuration

Config > Advanced > IO Diesel Input Selection -
Config - Output Config

Config > Advanced > IO Diesel Input Selection

Field programmable Input 3

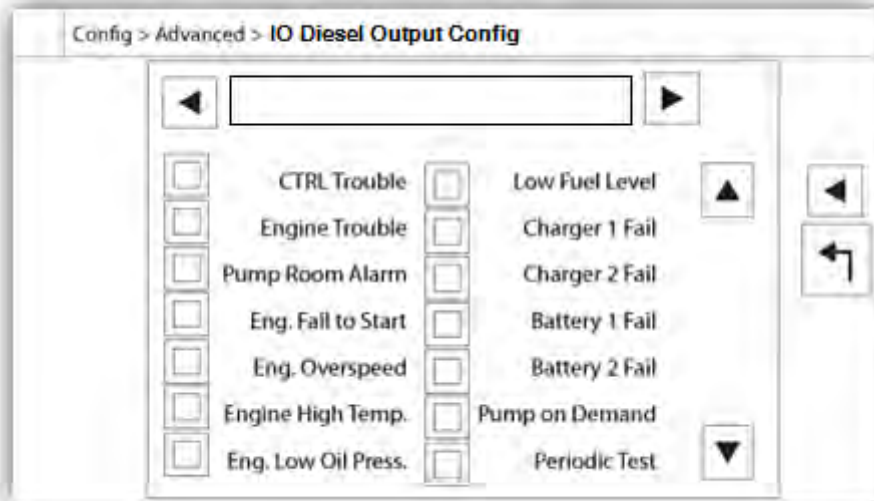
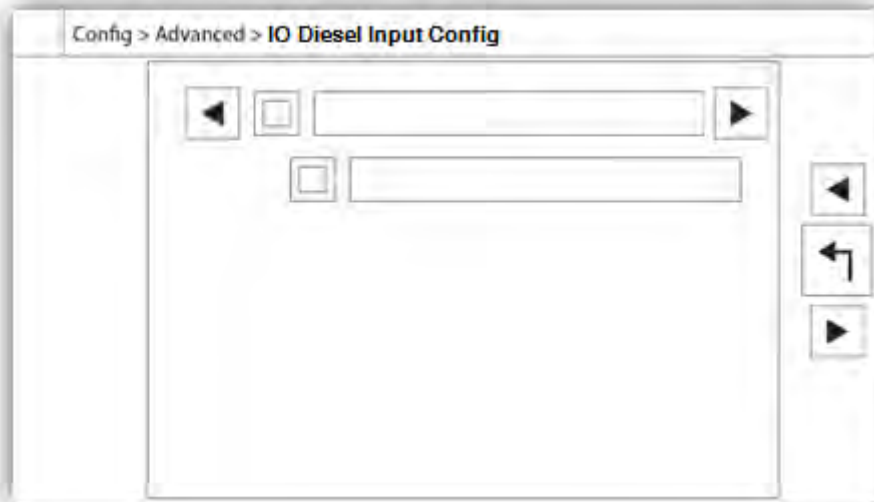
Field programmable Input 4

Field programmable Input 5

The Deluge Valve Start Signal is Normally Closed
Alarms Signals are configurable on the next page

This page, if logged in, allows the re-assignment of 3 programmable inputs by pressing on the signal name. If the Deluge Valve signal is selected, it will be assigned as a normally closed input. Proceed with caution as this may cause the engine to start. If an alarm signal is chosen, it can be configured on the next page (Enabled, NO/NC, Audible, Importance (Alarm or Warning)). The available signals are:

- Low Fuel Level, High Fuel Level, Fuel Tank Leak
- Water Reservoir Empty, Water Reservoir Low, Water Reservoir High
- Flow Meter ON, Main Relief Valve Open
- Low Suction Pressure
- Lockout
- Remote Manual Start
- Deluge Valve Start (NC)



This page allows the configuration of alarm signals on the inputs, and outputs relay signals. Two buttons located far right navigates between the input and output section of the page.

Input:

The input page has four elements: The NO/NC setting, the “Digital Text Indication” field, the “Alarm Bell Icon” and the “Alarm Icon”. Each one can be enabled or disabled. The first step is to click on the square button beside the text field to activate the management of the input signal. If the “Alarm Bell Icon” is enabled, the input signal will trigger the Alarm Bell. If the “Alarm Icon” is enabled, the input signal will be treated as an alarm, if not, as a warning. As on the output page, the buttons at the top allow for an easy navigation between all available inputs of the diesel board.

Output:

The configuration is performed by pressing on the square box located beside one of the signal needed. The box will swap between BLANK (none), a NO (normally open) and a NC (normally close) symbol, allowing the desired configuration to be obtained. The final state of the output signal is a logical “OR” combination of all selected signal.

Config > Advanced > Expansion Board 1

	1	2	3	4	5	6	7	8
Input	☐	☐	☐	☐	☐	☐	☐	☐
CTRL Trouble			☐		Low Fuel Level			☐
Engine Trouble			☐		Charger 1 Fail			☐
Pump Room Alarm			☐		Charger 2 Fail			☐
Eng. Fail to Start			☐		Battery 1 Fail			☐
Eng. Overspeed			☐		Battery 2 Fail			☐
Engine High Temp.			☐		Pump on Demand			☐
Eng. Low Oil Press.			☐		Periodic Test			☐

IN

OUT

Navigation buttons: Up, Down, Left

Config > Advanced > Expansion Board 1

IN

OUT

Navigation buttons: Up, Down, Left

Configuration area:

- ☐ [Text Field]
- ☐ [Alarm Bell Icon]
- ☐ [Warning Icon]

This page allows the configuration of both programmable inputs and outputs available on an IO Expansion board. Two buttons located far right navigates between the input and output section of the page.

Input:

The input page has four elements: The NO/NC setting, the "Digital Text Indication" field, the "Alarm Bell Icon" and the "Alarm Icon". Each one can be Enabled or disabled. The first step is to click on the square button beside the text field to activate the management of the input signal. If the "Alarm Bell Icon" is Enabled, the input signal will trigger the Alarm Bell. If the "Alarm Icon" is Enabled, the input signal will be treated as an alarm, if not, as a warning. As on the output page, the buttons at the top allow for an easy navigation between all available inputs of the diesel board.

Output:

The configuration is performed by pressing on the square box located beside one of the signal needed. The box will swap between BLANK (none), a NO (normally open) and a NC (normally close) symbol, allowing the desired configuration to be obtained. On top of all outputs signals available, it is possible to link in the same way the expansion board inputs to the selected output in any combination. The final state of the output signal is a logical "OR" combination of all selected signal.

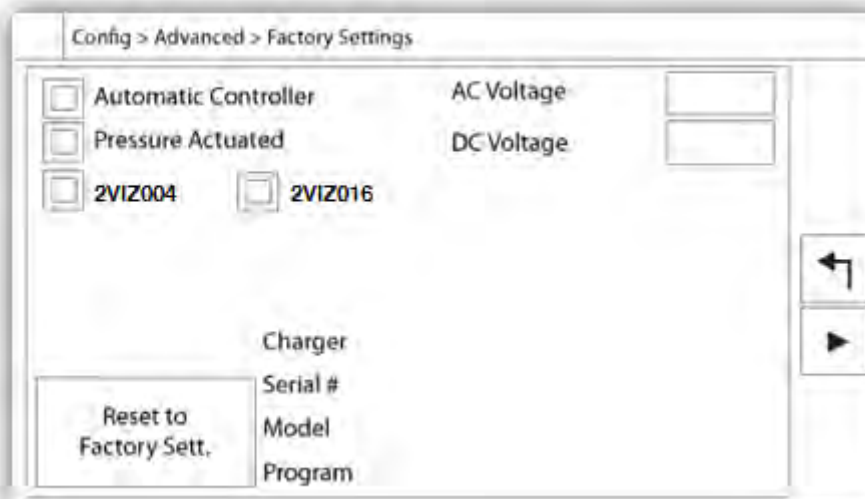
Update Program Page



This procedure is highly important and must be attempted with care. Please make sure to contact the factory prior to using the Update Software function.

Factory Settings

Config > Advanced > Factory Settings



Config > Advanced > Factory Settings 5

ip address:

subNet mask:

◀

◀✓

This page is only available if one or more Expansion Board is installed as an option.

The factory settings are always pre-configured at the factory and set the main parameters of the controller.

Left Section:

Automatic Controller – Non-Automatic Controller: An automatic controller will respond to automatic start requests, like a pressure drop announced by a pressure transducer or a pressure switch, a deluge valve signal or a remote automatic start trigger. A non-automatic controller will only start the engine on manual requests.

2VIZ004 – 2VIZ016: These refer to older version of the IO Diesel Board. If the controller hosts one of these version, the corresponding check box must be activated.

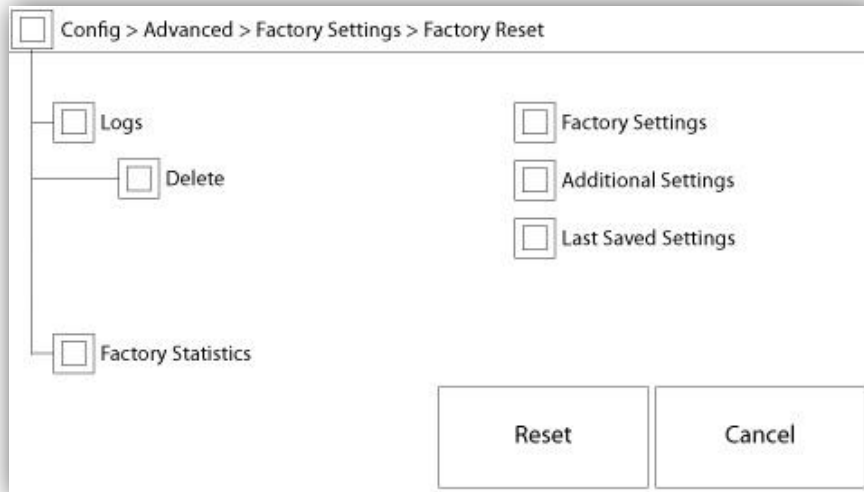
“Reset to Factory Settings”: This button redirects to the “Reset to Factory Settings” page. This is a major operation that must be used with care and only if the factory was contacted first. See the “Reset to Factory Settings” help for more details.

Right Section:

The first two settings set the nominal AC and DC voltage for the controller.

Technical information about the controller: Serial Number, Battery Charger Type, Model Name and Software Revision.

Reset to Factory Settings Page



This page will reset the ViZiTouch to the original factory configuration, thus clearing all subsequent configurations performed during the life of the controller.

This procedure should only be used as a last attempt to bring back the controller to a usable state.

User “Level 2”:

The “RESET” button will be activated (will become blue) only if no square buttons from the left column are activated and the “Last Saved Settings” from the right column is not activated as well. A “Level 2” user can only reset the “Factory Settings” and/or the “Additional Settings” from the right column.

The “Factory Settings” reset will restore the controller to its original factory configuration and service state. This means that the first service will be undone, automatic mode settings, as well as the controller’s “Homepage” will be deactivated until “First Service” is completed again. Please refer to the “Quick Start-Up” guide for more information on how to perform the “First Start-Up” and how to complete the “Field Acceptance Test Report”.

Please note that all logs, pump curves and statistics will not be reset.

The “Additional Settings” reset will update the controller with an additional configuration sent by the manufacturer. It does not perform a true “Factory Reset”. Its purpose is to allow an update of configuration variables that can only be updated by Tornatech Inc.

All other square buttons on this page are “Level 9” security and can only be used by certified Tornatech representatives, unless otherwise specified. The first square in the upper left corner performs the “Select all” function for these parameters.

Important Notice!

Every analog sensor cable used for this controller should be shielded. The shield has to be grounded on the motor side. Not complying to these recommendations may affect the controller good functioning and void its warranty.

The tachometer (analog speed reading) gives the possibility to support engine with no electronic speed switch. The magnetic pickup must be connected to the 2(MP+) and 3(MP-) inputs on the I/O Board.

The first small green line and small red line on the gradations shows the Set point of the “Engine Run” Signal. When the engine runs with a speed above this threshold, the ViZiTouch will consider it is running, and when it slows down under the red line, it will be considered stopped. The second red line, usually set high on the gauge, represents the “Overspeed” threshold. If the engine speed reaches that mark, the “Overspeed” alarm will be activated.

Pressing on the gauge will bring the user to the “Config > Advanced > Engine Speed” page.

The left section is use to show the “Disable/Enable” state of the engine RPM Counter. The “teeth” input box allows the user to match the number of teeth on the flywheel. This is an important setting to allow a precise calculation of the RPM. The digital RPM value is shown just under to acknowledge the calculated RPM.

The right section’s purpose is to configure the set points of both “Engine Run” and “Overspeed” signal. The top square box enables/disables the “Overspeed” alarm, and should always be activated. The following square box links the alarm bell to the alarm, and the third one sets the signal category (alarm or warning). The “SET” input field sets the trigger threshold for the “Overspeed” alarm. The next two input fields allows the configuration of the “Engine Run” signal set/reset points, preventing the “Engine Run” signal to toggle too fast. “Reset” should be at least 300 RPM lower than the “Set” point.

Fuel Level

The “Fuel Level” analog input gives the possibility to support engine with no electronic “Low-High Level;” switch. The sender must be connected to the AI4 analog inputs on the I/O Board.

The first small green line and small red line on the gradations shows the Set point of the “Low Fuel Level” Signal. It is active if the level goes below the set point.

The second small green line and small red line on the gradations shows the Set point of the “High Fuel Level” Signal. It is active if the Level goes above the set point.

The rectangle box below the gauge displays the actual value.

Pressing on the gauge will bring the user to the “Config > Advanced > Fuel Level” page.

Config > Advanced > Fuel Level

Sensor

☐ Installed

Calib.

Range

Apply

Alarms

☐ High Fuel Level

☐

SET

DRY

☐

RESET

☐

☐ Low Fuel Level

☐

SET

DRY

☐

RESET

☐

Calibration

Read < Read

COMPUTE

The left section is use to show the “Installed” state of the Fuel Level Sensor. The rest of the page is already explained in the “Analog sensors” section of the manual.

If the “Calibration Type” is selected to be “ON/OFF” (to be use with powered low fuel level switch), the frame at the bottom of the page will be empty, and a “NO/NC” setting will be available to configure the signal.

Details of the Debug Page

Calibration

Config > Advanced > Debug > Calibration

This table displays all calibration parameters. The “Scaled” value is the final calculated value used in the ViZiTouch. It is calculated by multiplying the “Raw” value by the “Gain” coefficient and by adding the “Offset” value. This information is useful when debugging the analog inputs on the IO board.

IO Debug

Config > Advanced > Debug > IO

The small white circle beside each signal is a representation of its state. If the white circle is filled with a green dot, then the signal is activated. Comparing these software signals and the physical state of the signal on the electronic board is the best way to troubleshoot. In the right column, additional “TEST” buttons are located beside each output signal. Clicking on these buttons will toggle the output state of this signal, again allowing a comparison between the software and hardware state of these signals to help troubleshoot.

The image displays two screenshots of the 'Interlock Lockout' configuration window. The top screenshot shows the 'Interlock' tab, which includes a dropdown menu set to 'Interlock' and a right-pointing arrow button. Below this are six checkboxes: 'Interlock in Emergency', 'Interlock in Remote', 'Interlock in Manual', 'Interlock in Flow', 'Interlock in Automatic', and 'Engine Run Required'. The bottom screenshot shows the 'Lockout' tab, which includes a dropdown menu set to 'Lockout' and a right-pointing arrow button. Below this are five checkboxes: 'Lockout in Emergency', 'Lockout in Remote', 'Lockout in Manual', 'Lockout in Flow', and 'Shutdown Engine'.

These pages allow to configure the Lockout input and the interlock output parameters. To be active, those options need to be assigned to an Input or an Output on the I/O board.

Lockout is an Input that disables the engine from starting.

- Enable in emergency: If checked, this option will prevent the electronic assistance on an Emergency start.
- Enable in manual mode: If checked, this option will prevent the Manual start.
- Enable in automatic mode: If checked, this option will prevent the Automatic start.
- Enable in remote manual mode: If checked, this option will prevent the Remote Manual start.
- Enable in "start/stop" mode: If checked, this option will prevent the "start/stop" mode.
- Shutdown Engine: If enabled, the lockout signal will also act as a shutdown and will stop the engine if it is running.

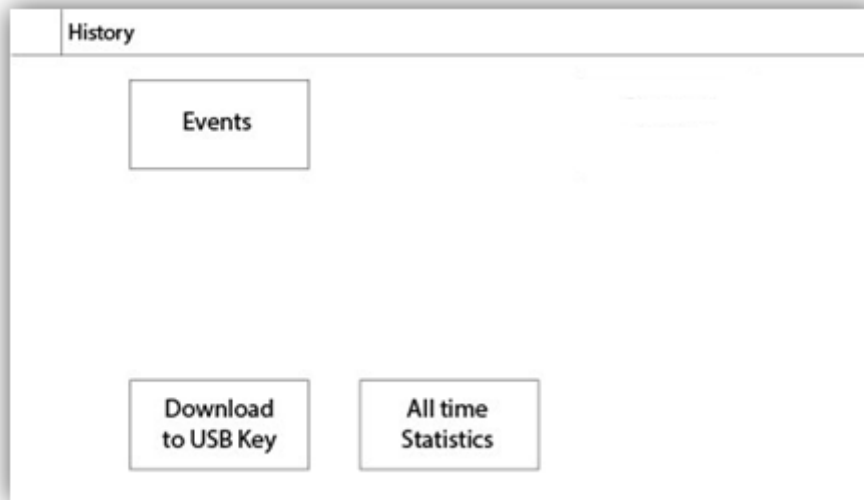
Interlock is an Output that prevents a second engine from starting.

- Enable in emergency: If checked, this option will activate the output "interlock" on an Emergency start.
- Enable in manual mode: If checked, this option will activate the output "interlock" on a Manual start.
- Enable in automatic: If checked, this option will activate the output "interlock" on a Automatic start.
- Enable in Remote Manual mode: If checked, this option will activate the output "interlock" on a Remote Manual start.
- Enable in "start/stop" mode: If checked, this option will activate the output "interlock" on a "start/stop" mode.
- Engine Run required: If enabled, the controller will wait to have the Engine Run signal before activating the Interlock output.

History 7

History (Membrane button)

History



Select specific pages within the History section. Everything related to the statistics, events, pressure, power logs and the download to USB is available within the History page.

-Events: This button leads to the “Events” page, which displays the most recent 500 events. Each event log contains the date and time of occurrence as well as a brief description of the event.

-Download to USB Device: This button leads to the “Download to USB Device” page, which allows the user to download information, including the user manual, drawings, logs, statistics and configuration.

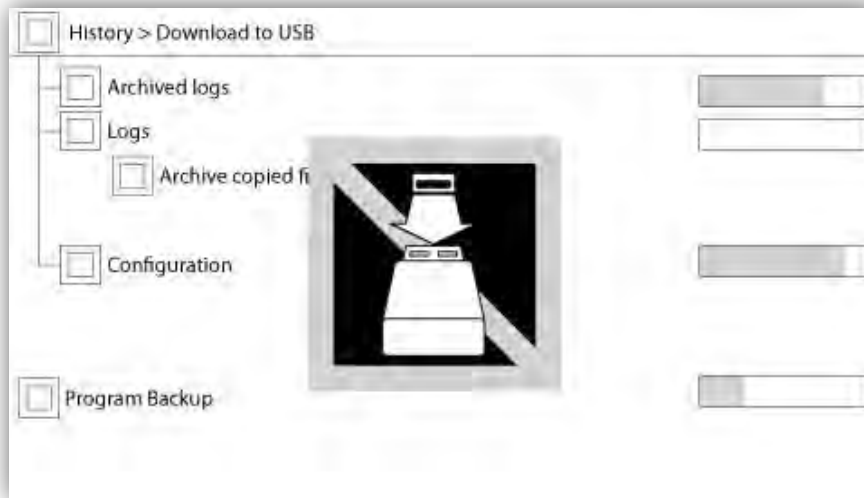
-All Time Statistics: This button leads to the “All Time Statistics” page, which displays the date and time of the first power up, the date and time when the first start-up was completed and the total “On Time” of the controller. These statistics can never be reset.

History > Events Log			
	Date	Time	Message
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

It shows the last 500 events which occurred in chronological order. The first column is the date, the second one is the time of occurrence and the third column is the “Event message”. To obtain a log that is older than 500 events, visit the “Download to USB Device” page and select “Events”. This method will generate a file containing all events logs in the ViZiTouch history.

The contextual navigation pad is implemented in this page. It allows quick navigations functions, like “previous page”, “next page”, “first page” and “last page”. As always, clicking on the Navigation Pad Icon in the lower right corner of the screen will pop-up the Navigation Pad functions specific for this page.





To download information from the ViZiTouch to a USB Device a user with at least a "level 1" password must be logged in. The first square beside the title is a "Select All" button. Pressing it will select all categories except "Archive copied files", which serves a separate purpose. The "Download to USB" button will execute the command. The entire right side is filled with different progress bars, to help monitor the current transfer. If a USB Device is not present or if there is an error, a message saying "Could not mount USB drive" will appear and any further action is cancelled. To try again, remove the device, re-insert and press the button once more.

-Archived logs: All logs files that were archived using the "Archive copied files" square button. The purpose of archiving files is to free up memory on the ViZiTouch by archiving older log files.

-Logs: All logs are currently available in the ViZiTouch memory. A "Comma Separated Values" or ".csv" file is created every day and is named accordingly. Most software in modern computers will be able to read and interpret these files. The log files contain the event logs, the pressure logs and the power logs.

-Configuration: All configuration parameters contained in a ".txt" file, including but not limited to nominal values, serial number, calibration parameters.

Program Backup: A compressed and encrypted file, only readable by the ViZiTouch. This allows the user to copy a complete ViZiTouch to another one. **IMPORTANT:** The ViZiTouch is not in service while downloading the program backup.

History > All Time Statistics	
First Power Up	
First Start Up	
On Time	

All statistics shown here are calculated since the controller's first start-up was done. All dates are in the YYYY.MM.DD format and all time references are in the HH:MM:SS format.

- First Power Up: Date and time of when the controller was first powered up.
- First Start Up: Date and time of when the controller's first start-up was completed.
- On Time: Total duration of controller powered on since the first power-up. In Day.Hour.Minutes.

How to Test:

Charger 1 Fail

Unpower the charger 1 by putting the circuit breaker in the off position.

Charger 2 Fail

Unpower the charger 2 by putting the circuit breaker in the off position.

DC Failure

Switch Circuit Breaker 3 (CB3) and Circuit Breaker 4 (CB4) in Off position or disconnect #6 and #8 engine wires (See drawing for more details).

Controller Trouble

To activate this common alarm, at least one of the following alarms must be active: Charger Failure 1, Charger Failure 2, DC Failure.

Low Fuel Level

Put a jumper between the dry contact 29-30 of the J25 connector on the I/O board.

High Fuel Level

Disconnect Fuel Level connector. Depending of your sensor type, put a jumper between positive pin (left) or negative pin (right) and signal pin (middle) of this connector (See drawing for more details).

Fuel Tank Leak

Put a jumper between Fuel Tank Leak input and ground (See drawing for more details).

AC Failure

Make sure both batteries are connected and all circuit breakers are in On position. Switch Circuit Breaker 1 (CB1) and Circuit Breaker (CB2) in Off position. Disconnect J44 from the I/O board.

Water Reservoir Low

Disconnect Water Level connector. Depending of your sensor type, put a jumper between positive pin (left) or negative pin (right) and signal pin (middle) of this connector (See drawing for more details).

Pump Room Alarm

To activate this common alarm, at least one of the following alarms must be active: Low Fuel Level, High Fuel Level, Fuel Tank Leak, AC Fail, Low Ambient Temperature, High Ambient Temperature, Low Suction Pressure, Water Reservoir Empty, High Water Level or Water Reservoir Low.

Fail to Start

Disconnect #9, #10 and #12 engine wires (See drawing for more details). Start cranking sequence (Example: Remove Remote Start / Low Water Level jumper). Wait until cranking sequence ends.

Overspeed

You need to be logged in to do this test. Press Config button (On the membrane). Go to Config>Advanced>Engine Speed. Change the Nominal speed at 50% of the regular nominal speed. Start your engine. Don't forget to put back the normal Nominal speed of the engine.

Low Engine Temperature (15)

Disconnect #15 engine wire. Put a jumper between #15 input and ground (See drawing for more details).

Low Oil Pressure

Put a jumper between #4 input and ground (See drawing for more details).

High Engine Temperature

Put a jumper between the #5 input and ground (See the drawing for more details).

Battery 1 Failure

Disconnect #6 engine wire (See drawing for more details).

Battery 2 Failure

Disconnect #8 engine wire (See drawing for more details).

Battery 1 Overvoltage

You need to be logged in to modify these settings. Press Config button (On the membrane). Go to Config. Change Overvoltage Battery 1 setpoint to minimum allowable.

Battery 2 Overvoltage

You need to be logged in to modify these settings. Press Config button (On the membrane). Go to Config. Change Overvoltage Battery 2 setpoint to minimum allowable.

Loss of Continuity 1

Disconnect #9 engine wire (See drawing for more details). Wait 1-2 minutes.

Loss of Continuity 2

Disconnect #10 engine wire (See drawing for more details). Wait 1-2 minutes

Engine Trouble

To activate this common alarm, at least one of the following alarms must be active: Fail to start, Overspeed, Fuel Injection Malfunction (17), Electronic Control Module Fault (14), Low Engine Temperature (15), Low Oil Pressure (4), High Engine Temperature (5), Battery 1 Failure, Battery 2 Failure, Loss of Continuity 1, Loss of Continuity 2, Overpressure or Low Pneumatic Pressure

Engine Fail When Running

Start the engine. Depending of your engine type, disconnect #1 or put a jumper between #12 and #6 to stop the engine. (See drawing for more details).

IO Diesel Communication Error

Press Reset button of the Diesel IO Board (Small button close to the phone jack)

IO Expansion 1 Communication Error

Press the Reset button of the Expansion 1 IO Board (Small button close to the phone jack)

IO Expansion 2 Communication Error

Press the Reset button of the Expansion 2 IO Board (Small button close to the phone jack)

IO Expansion 3 Communication Error

Press the Reset button of the Expansion 3 IO Board (Small button close to the phone jack)

IO Expansion 4 Communication Error

Press the Reset button of the Expansion 4 IO Board (Small button close to the phone jack)

Patents

Country	Title	Grant No
CA	Mechanical activator for contactor	2741881
US	Mechanical activator for contactor	US8399788B2
CA	Mechanical activator for electrical contactor	165512
CA	Mechanical activator for electrical contactor	165514
US	Mechanical activator for electrical contactor	D803794
US	Mechanical activator for electrical contactor	Patent pending
EP	Mechanical activator for electrical contactor	002955393-0001/2
AE	Mechanical activator for electrical contactor	Patent pending
AE	Mechanical activator for electrical contactor	Patent pending
CA	Fire pump digital operator	163254
US	Fire pump digital operator interface	D770313
AE	Fire pump digital operator interface	Patent pending
EP	Fire pump digital operator interface	002937250-0001
CA	System and method for detecting failure in a pressure sensor of a fire pump system	Patent pending
US	System and method for detecting failure of a pressure sensor in a fire pump system	Patent pending

**TORNATECH MODEL LFD DIESEL FIRE PUMP CONTROLLER
PRE- FIELD ACCEPTANCE TEST
CHECK LIST**

Note: This document should be an official indication of whether or not the installation and general condition of the equipment is adequate for a field acceptance test. This document should also aid the individual responsible for executing the field acceptance test to decide whether or not to carry out the field acceptance test of the equipment.

Installation Check List:		YES	NO
1	Verify that the nameplate voltages of the Fire Pump Controller corresponds with the AC voltage available and the DC starting voltage of the engine.		
2	Procede to a visual inspection for any damage done to the exterior of the Fire Pump Controller. Make sure the enclosure, alarm bell, membrane and display are not damaged.		
3	Verify that the Fire Pump Controller has been installed within sight of the pump and engine or motor.		
4	Verify that the Fire Pump Controller has been installed not less than 12 inches from the floor of the mechanical room.		
5	Verify that all electrical connections to the Fire Pump Controller are done using liquid tight conduit and connectors.		
6	With the Fire Pump Controller door open, visually inspect for any drill chips, dirt or foreign objects in the bottom of the enclosure, loose wires, broken components and general proper electrician workmanship.		
7	Verify that the correct AC voltage is supplied to the controller by taking a voltage reading at the L & N (220-240) terminals.		
8	Verify that the terminal connections between the Fire Pump Controller and the engine (3, 4, 5, 6, 8, 9, 10, 11, 12, 15, 16 and 20) are properly done.		
9	Verify that wiring to terminals #6, #8 (batteries) and #11 (ground) are of the appropriate gauge size. See label inside controller.		
10	Verify proper grounding of the Fire Pump Controller.		
Initial Power-Up Check List:		YES	NO
1	With the Fire Pump Controller door open, turn to "ON" the circuit breakers CB3 and CB4 (DC) then CB1 and CB2 (AC), then IS1. This sequence is very important.		
2	Close the Fire Pump Controller door. Verify on the ViZiTouCh Homepage that the correct battery voltage appears.		
Manual and Automatic Start Check List:		YES	NO
1	Verify the starting of engine by pressing the emergency push button.		
2	Stop engine by pressing the "Stop" membrane button.		

T
ornatech Controller S/N: _____

Installation address: _____

Check list completed? _____ Yes _____ No

Check list completed by: _____

Company: _____

Date: _____

Witnessed By: _____

Comments: _____

Americas

Tornatech Inc. (Head Office) - Laval, Quebec, Canada

Tel.: +1 514 334 0523

Toll free: +1 800 363 8448

Europe

Tornatech Europe SPRL - Wavre, Belgium

Tel.: +32 (0)10 84 40 01

Middle East

Tornatech FZE - Dubai, United Arab Emirates

Tel.: +971 (0)4 887 0615

Asia

Tornatech Pte Ltd. - Singapore

Tel.: +65 6795 8114

Tel.: +65 6795 7823



TORNATECH

LISTEN DEVELOP LEAD

www.tornatech.com

Diesel Engine Fire Pump Controller

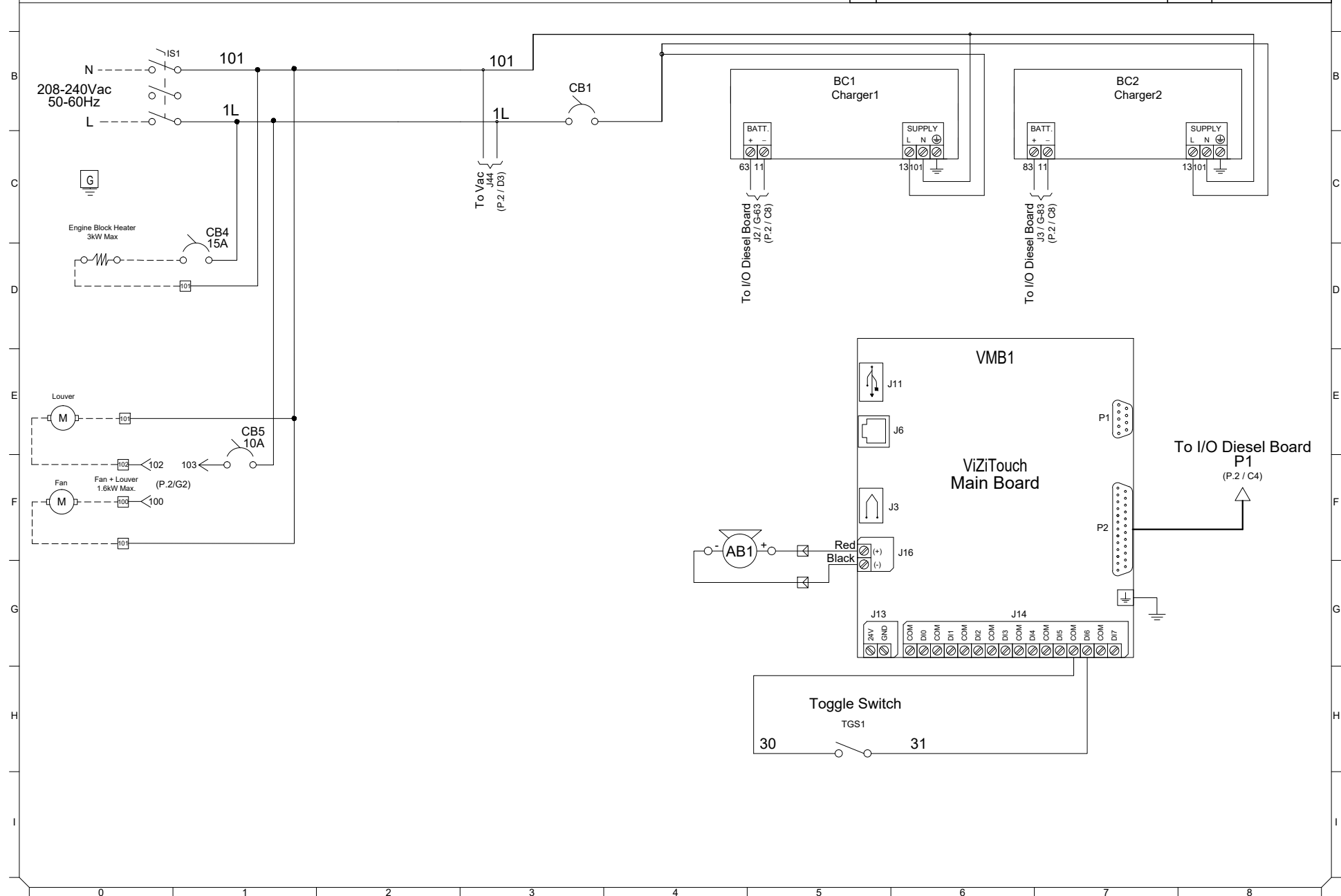
24VDC Negative Ground

Wiring schematic

Model:LFD

Built to the latest edition of the LPS 1236

PER QUOTE DRAWING No.		CE	
REV.	DESCRIPTION	DD/MM/YY	Drawing No. A Generic - LPC D1
0	Generic - LPC D1	11/08/16	



Diesel Engine Fire Pump Controller

24VDC Negative Ground

Wiring schematic

Model:LFD

Built to the latest edition of the LPS 1236

PER QUOTE DRAWING No.



REV.

DESCRIPTION

DD/MM/YY

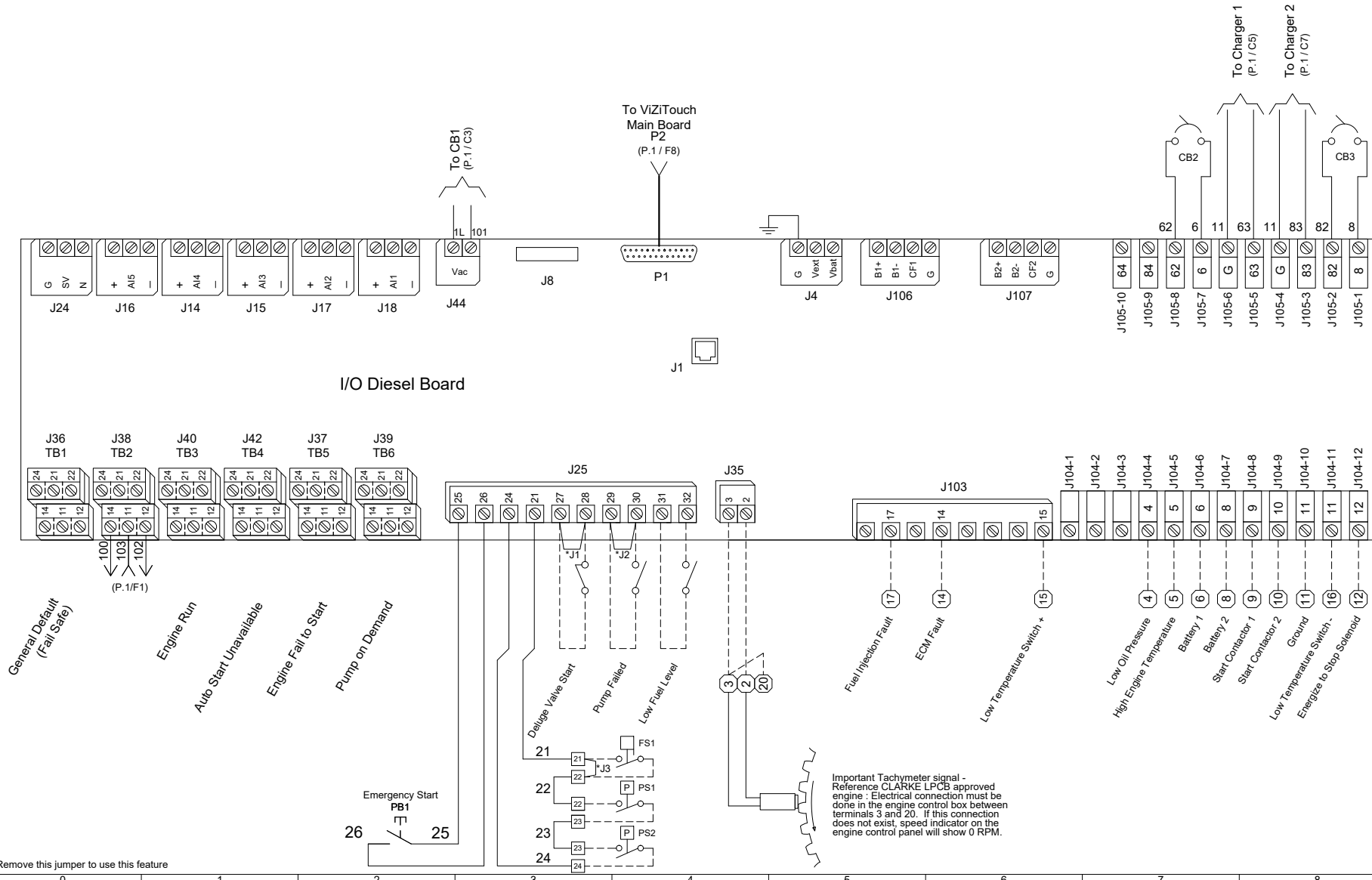


Drawing No.]

0 Generic - LPC D2

11/08/16

Generic - LPC D2



* Remove this jumper to use this feature

Model:LFD

Built to the latest edition of the LPS 1236

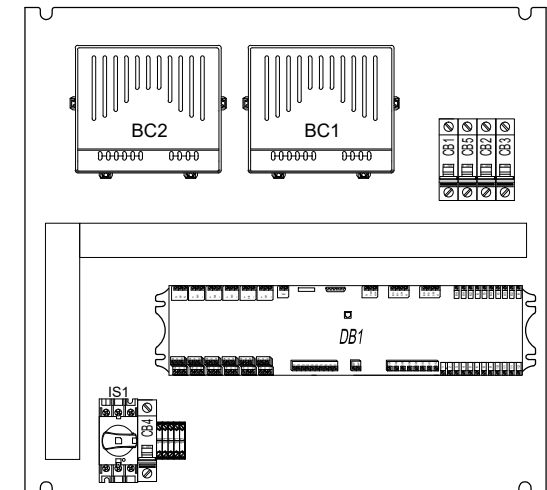
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REV.	DESCRIPTION	DD/MM/YY	Drawing No. Generic - LPC D3
0	Generic - LPC D3	11/08/16	



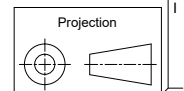
Model:LFD

Built to the latest edition of the LPS 1236

TORNATECH

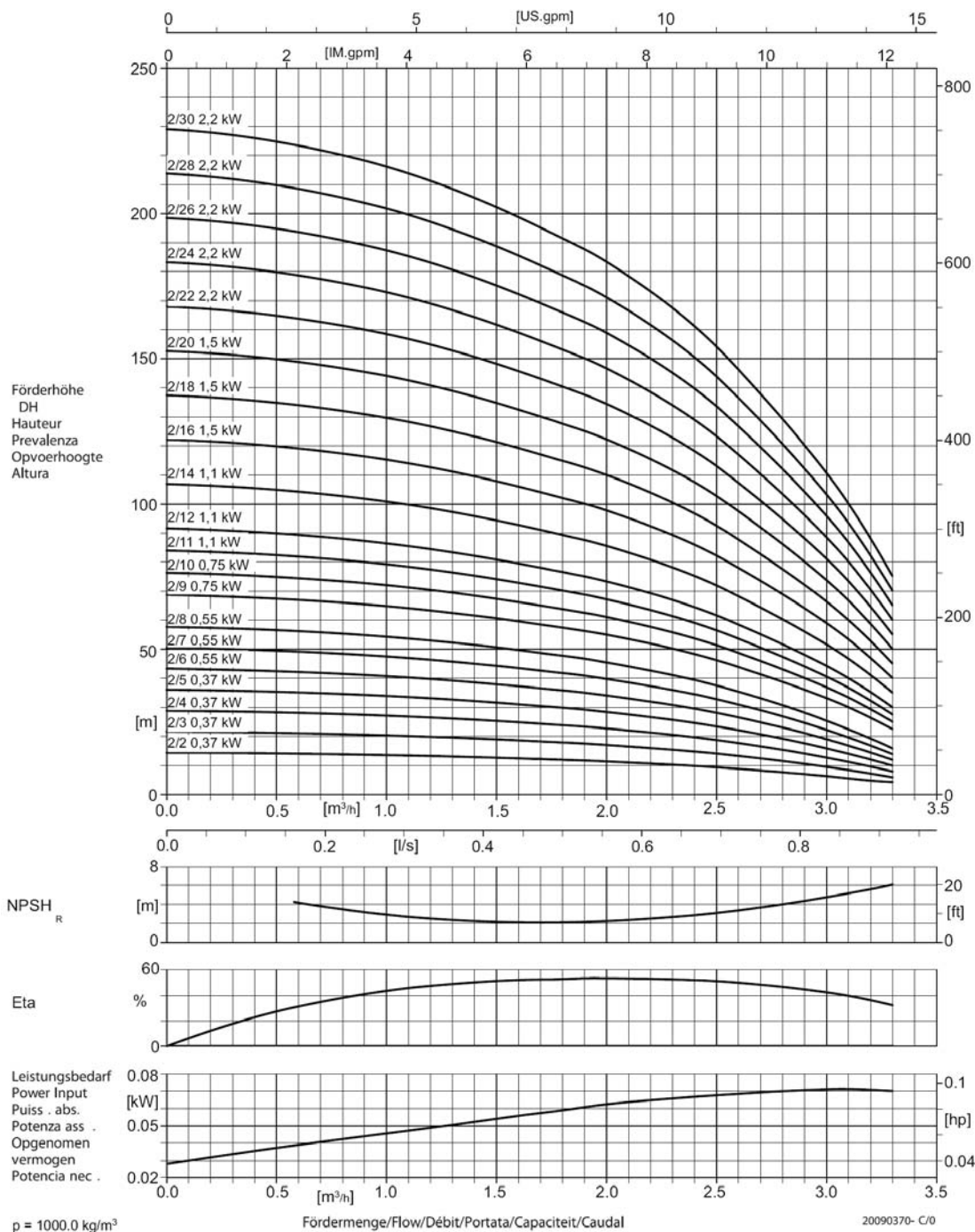
[illegible]

- Use Watertight Conduit and Connector Only.
- Protect Equipment Against Drilling Chips.
- Ambient Temperature : Between 39°F (4°C) and 104°F (40°C)
- Shipping Weight, Wall Mounted: Approximate 98 Lbs - 45 Kg



LAST MODIFICATION DETAILS			ALL DIMENSIONS IN mm DRAWN TO BS308 WELDING SYMBOLS TO BS499 SURFACE FINISH SHOWN IN MICROMETERS MACHINE WHERE SHOWN ✓ TO TOLERANCE ± 0.3MM UNLESS OTHERWISE STATED	JOB No.	PART No.	WEIGHT KG	FILE NAME	TITLE GENERAL ARRANGEMENT MULTISTAR PUMPS TYPE VMS2B SIZE (3 PHASE MOTOR)	DRG No.		
-				-	-	-	-		PX11558		
-				DESIGN No.	PATTERN No.	MATERIAL	MAT'L SPEC.		DATE 05/09/2011 DRN BSD		
-				-	-	-	-		CHK BSD APP PK		
ISSUE	DATE	DRN	THIS DRAWING IS THE PRIVATE AND CONFIDENTIAL PROPERTY OF ARMSTRONG HOLDEN BROOKE PULLEN LTD. ALL COPYRIGHT, MANUFACTURING AND SALES RIGHTS RESERVED.						SCALE 1:1		WENLOCK WAY, MANCHESTER. M12 5JL TEL: +44 (0) 161 223 2223
A	CHK -	APP -							SHEET 1 OF 1		

VMS 2 Jockey Pump Curves



Jockey Starter

General

This jockey pump controller is designed to control one electric motor driven jockey pump to maintain a certain water pressure within a fire sprinkler system, for LPC and EN12845 applications.

The base panel is made up of the following components:

- Mains isolator, motor contactor and electronic overload.

The mains isolator and motor contactor are rated up to 4.2kW, and then the overload is selected to suit the actual motor.

If the control panel is to be stored prior to installation, then it should be stored vertically in a dry place. Preferably it should be stored under cover in a dust free environment. If the controller is to be stored for greater than four weeks, then action should be taken to avoid the build-up of moisture inside.

Every care has been taken during the design and testing stage to ensure that this controller will operate reliably within the intended environment. However, certain measures should be taken on site to help reduce installation issues. For example, all cables relating to this product should ideally be installed in dedicated conduit, well away from other electrical and power cabling.

The entirety of this manual should be read before the controller is first switched on. Please call Armstrong Fluid Technology for advice if you have any doubts regarding the suitability of this product for the intended installation or if you have any questions regarding the operation and function of this controller.

Mounting

This controller should be mounted on a flat vertical surface to ensure that the box does not twist or warp. It should also be mounted away from potential dripping water and spillage. Note that the controller is rated for indoor use to IP56.

The controller should be mounted using the four mounting holes provided, as shown on the general arrangement drawing.

The controller is arranged so that the motor and mains cables enter the enclosure at the bottom.

Switch on

Before the mains supply is applied for the first time the complete controller should be physically examined for damage. In particular, ensure that the motor overload is securely fastened in place.

Note: Ensure that the electrical rating of the motor driving the jockey pump is in line with the electrical rating of the jockey pump controller.

Note: This controller is arranged to start the pump upon activation of a pressure switch, closing to terminals 1 and 2.

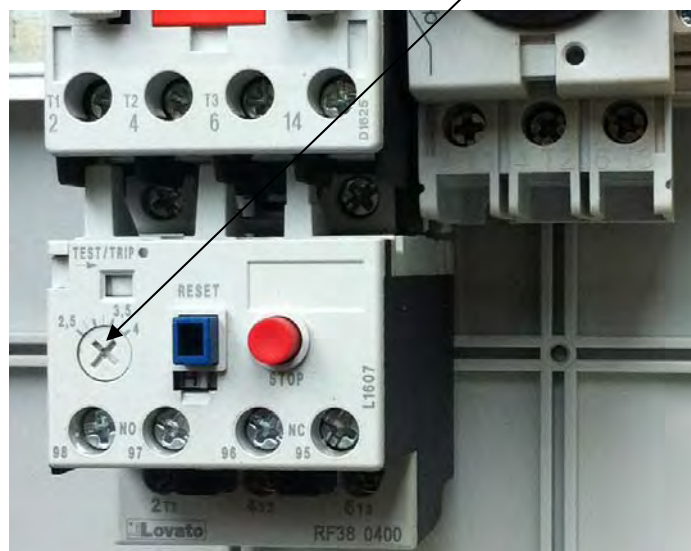
Warning: The control circuit of this control panel is 240v, including the pressure switch input.

Apply the AC power:

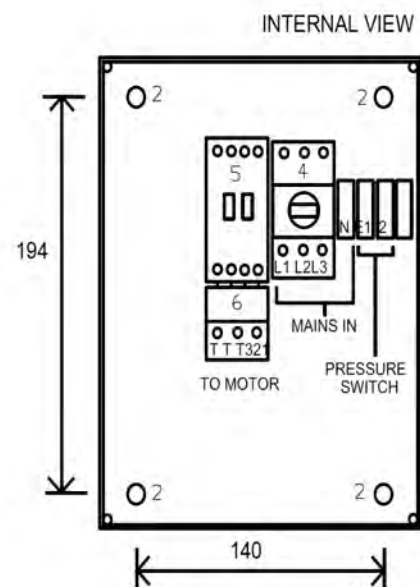
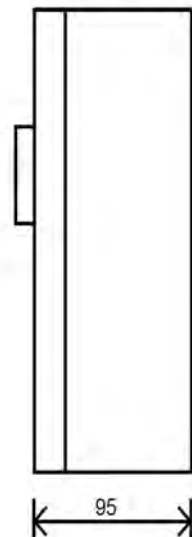
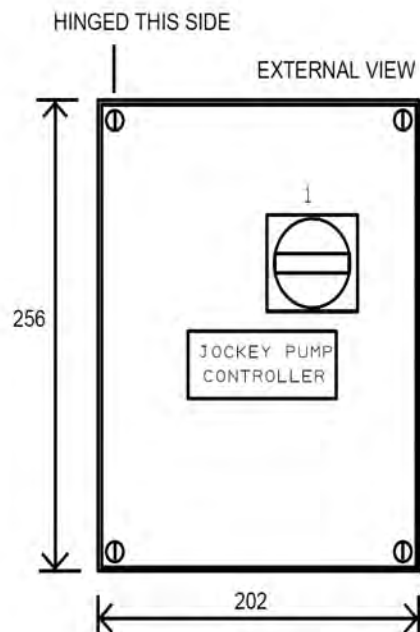
CAUSE / STATUS	EFFECT
	Mains supply on
If the pressure switch is open	No change, motor stopped
When the pressure switch is closed	Motor runs while the pressure switch is closed

Motor Overload

The controller contains a thermal overload which will cause the motor to stop if the running current is high. The overload can be adjusted by a dial located on the overload itself:



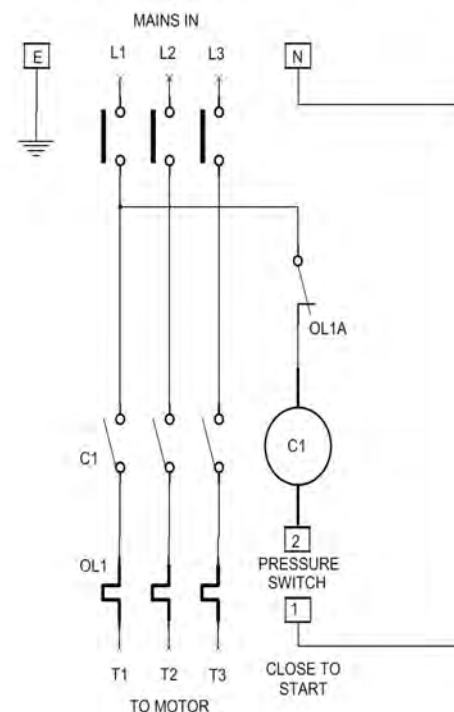
The overloads are set to automatically reset in the event of a motor problem.



ITEM	DESCRIPTION
1	AC ISOLATOR
2	4 x MOUNTING HOLES
3	.
4	SWITCH DISCONNECTOR
5	MOTOR CONTACTOR
6	MOTOR OVERLOAD

DO NOT SCALE

SCHEMATIC DIAGRAM



RATING: 415V UP TO 4.2 kW - F.L.A. = 8 AMPS
415V, 3 PHASE & NEUTRAL
MATERIAL: 2mm TECHNOLPOLYMER
FINISH: SMOOTH WALL
INGRESS: IP56
LOVATO CONTACTOR

CAD FILE : DO NOT ALTER BY HAND
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Notes

Rev.	Date	By	Description
02	15/09/2016	DC	JG002

DRAWING TITLE
Jockey Pump Panel General Arrangement

ENGINEER	DRAWN	CHECKED	APPROVED
DC	DC	JPR	JPR
SCALE	DATE	DRG SIZE	
NTS	15/09/2016	A2	

ARMSTRONG
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DRG No. **3272711-xxx** REV **01**

Remote Alarm Panel

This remote alarm panel is designed for monitoring the status of fire pump houses, especially those based in the UK complying to EN12845. The unit though can be used for monitoring any device equipped with volt free contacts.

The panel is made of up three electronic modules. The first is the indicator board that also contains the microprocessor and three push buttons with 4 dip switches for selecting various functions and is mounted on the door. The second board is mounted on the back panel of the remote alarm panel and contains electrical isolation for all the inputs, allows the user to select normally open or normally closed for each input and contains the +5v power supply for the electronic system. These two boards communicate with each other via serial data link in the form of a 10-way ribbon cable. The final board is a mains power supply which also charges the battery. This board also switches over the control system from mains to battery power when the mains supply is removed.

Note: the power supply module on the gear tray contains mains voltage. Before examining the fuses, the mains supply should be fully isolated first.

If the remote alarm panel is to be stored prior to installation, then it should be stored vertically in a dry place. Preferably it should be stored under cover in a dust free environment. If the controller is to be stored for greater than four weeks then action should be taken to avoid the build-up of moisture inside, such as a temporary anti-condensation heater.

Every care has been taken during the design and testing stage to ensure that this controller will operate reliably within the intended environment. However, certain measures should be taken on site to help reduce installation issues. For example, all input signal cables should be installed in dedicated conduit, well away from noisy electrical and power cabling.

The entirety of this manual should be read before the controller is first switched on. Please call Armstrong for advice if you have any doubts regarding the suitability of this product for the intended installation or if you have any questions regarding the operation and function of this controller.

Switch on

Before the mains supply is applied for the first time the complete remote alarm panel should be physically examined for damage. In particular, examine the battery and its connections and the power supply board for signs of damage.

Temporarily remove the two 10x inputs plugs, and move all the dip switches on the input board to the up 'ON' position (Normally open).

Apply the AC power:

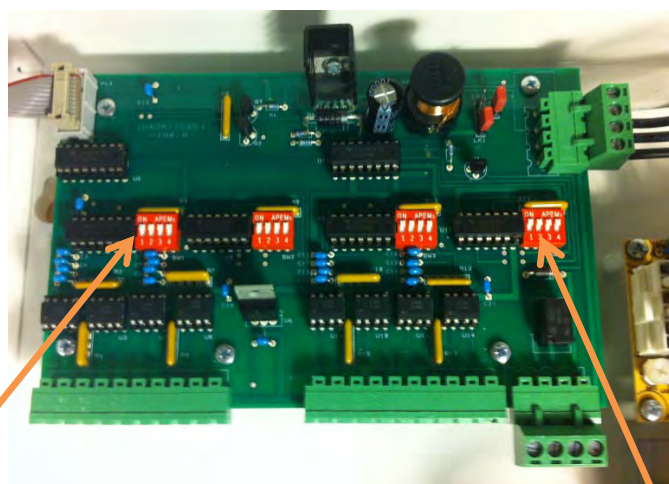
CAUSE / STATUS	EFFECT
Annunciator	Mains supply on
	Battery / PSU healthy
Common fault Volt free	Healthy, no fault

This is the standby condition, system healthy.

Press the lamp test push button briefly and ensure that all indicators are lit and that the buzzer sounds continuously.

Installation of the Alarm Channels

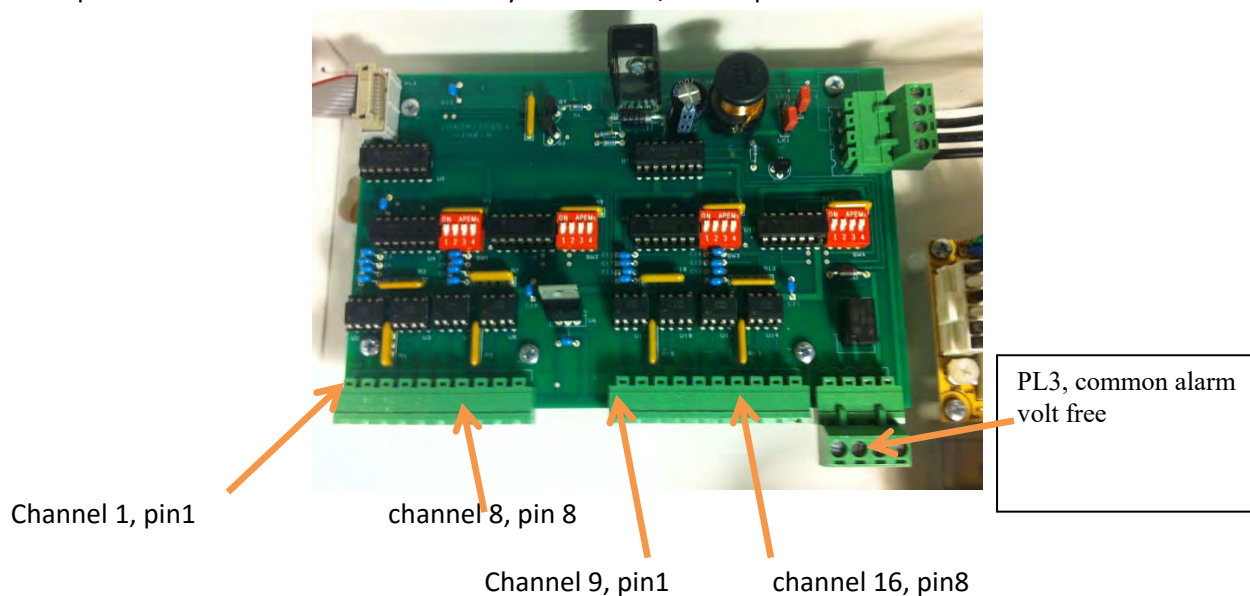
Each input is electrically isolated from the field via on board opto-isolators and also has an in built 500mS firmware delay to ensure that only true alarms are shown and to prevent nuisance alarms from occurring. Each input can also be individually selected for normally open or normally closed operation via dip switches and are arranged sequentially across the board:



Dip switch
For channel 1

Dip switch
For channel 16

The inputs enter the board via two ten way connectors, with input 1 on the left:



There are four common return points on pins 9 & 10 of each connector.

The common alarm output is a changeover volt free relay on PL3, pin 1 is the left most connection.

Plug 3, Pin 2 is the common, pin 4 is system healthy and pin 2 is closed when there is any fault channel activated. The contacts are rated at 2A.

Alarm Operation

The remote alarm panel is programmed with an annunciator sequence that operates as follows, single channel operation.

CAUSE / STATUS	EFFECT
Standby	All 16 alarm channels are off, sounder is silent and common alarm contacts are normal.
An alarm is activated	Corresponding indicator is flashing
Sounder	On, pulsing
Common alarm volt free	In Fault condition
Mute pb is pressed	Corresponding indicator is steady
Sounder	Silent
Common alarm volt free	In Fault condition
The alarm is cleared	No change
Reset pb is pressed	Corresponding indicator goes off
Common alarm volt free	Standby

Multiple Alarm Operation:

CAUSE / STATUS	EFFECT
Standby	All 16 alarm channels are off, sounder is silent and common alarm contacts are normal.
An alarm is activated	Corresponding indicator is flashing
Sounder	On, pulsing
Common alarm volt free	In Fault condition
Mute pb is pressed	Corresponding indicator is steady
Sounder	Silent
Common alarm volt free	In Fault condition
Second alarm is activated	Corresponding indicator is flashing
Sounder	On, pulsing
Common alarm volt free	In Fault condition
All alarm are cleared	No change
Reset pb is pressed	Corresponding indicator goes off
Common alarm volt free	Standby

Remote Alarm Panel Operation

The remote alarm panel has four dedicated indicators to show the present status.

1.. Mains Supply healthy:

CAUSE / STATUS	EFFECT
Mains supply on	Mains supply healthy indicator on
Mains supply goes off >1s	Mains supply healthy indicator, off
	Mains supply failed indicator, on
Sounder	Pulsing intermittently
Common alarm volt free	Standby

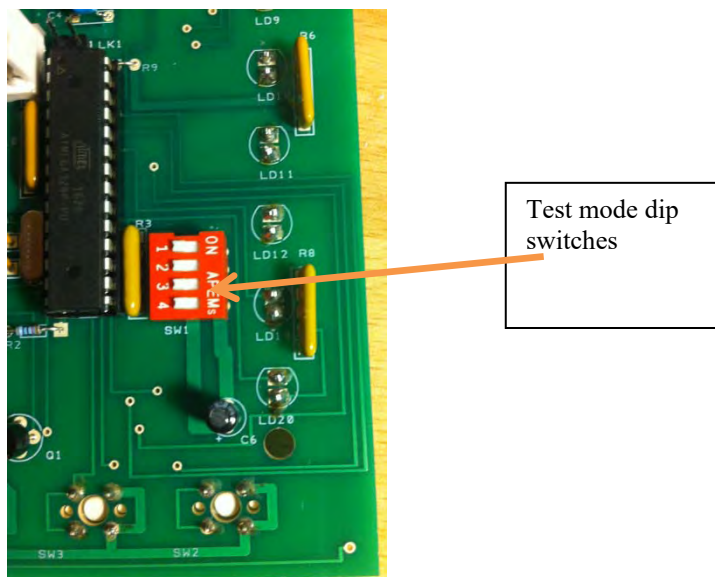
There is around a 2s delay between the mains failing and the remote alarm panel registering the failure. Also, there is a 2s restoration timer in the firmware before the mains healthy indicator is restored. The mains failure signal is derived on the battery charger / PSU module.

2.. Battery / PSU Supply Healthy

This indicator is lit if the Mains operated power supply or the battery is above around 8V. This condition is for monitoring purposes only and does not operate the sounder or the common alarm volt free contact.

3.. Test Mode

This facility enables the commissioning engineer to disable the common alarm output and/or the alarm sounder during testing. These features are enabled via the dip switches on the indicator board:



Dip switch number 3 is for the sounder, dip switch 4 is for the common alarm. Normally, both of these switches should be in the off position, to the left. If the test mode remains on for >15 minutes, then the alarm sounder operates to remind the engineer to return the remote alarm panel back to normal mode.

If dip switch number 4 is turned to the right, on then:

CAUSE / STATUS	EFFECT
Dip switch 4, on	Test mode on indicator on
Sounder	Works as normal
Common alarm volt free	Always in standby, regardless of fault shown
After 15 minutes	Alarm is activated.

If dip switch number 3 is turned to the right, on then:

CAUSE / STATUS	EFFECT
Dip switch 3, on	Test mode on indicator on
Sounder	Always silent, including lamp test
Common alarm volt free	Works as normal
After 15 minutes	Alarm is activated.

Battery & Battery Charger

During normal operation the battery charger will provide a trickle charge to main the battery. While the battery is discharged the charger will produce a higher output current at a maximum rate of 900mA to ensure that it is recharged again as quickly as possible. Typically, the battery can be fully recharged in 10 to 12 hours, based on the standard 9A/hour battery.

When the mains supply fails, the battery charger / power supply module will automatically change the power source to the battery to ensure the remote alarm panel continues to operate.

The 9A/hour battery will provide power for the following minimum times:

Standby (no alarms), mains failure lamp on, sounder on	>109 hours
One alarm activated, sounder on common fault on	>90 hours
Two alarms activated, sounder on, common fault on	>85 hours
Three alarms activated, sounder on, common fault on	>81 hours
Four alarms activated, sounder on, common fault on	>78 hours
All 16 alarms activated, sounder on, common fault on	>50 hours

(Values are taken with all inputs set to normally closed).

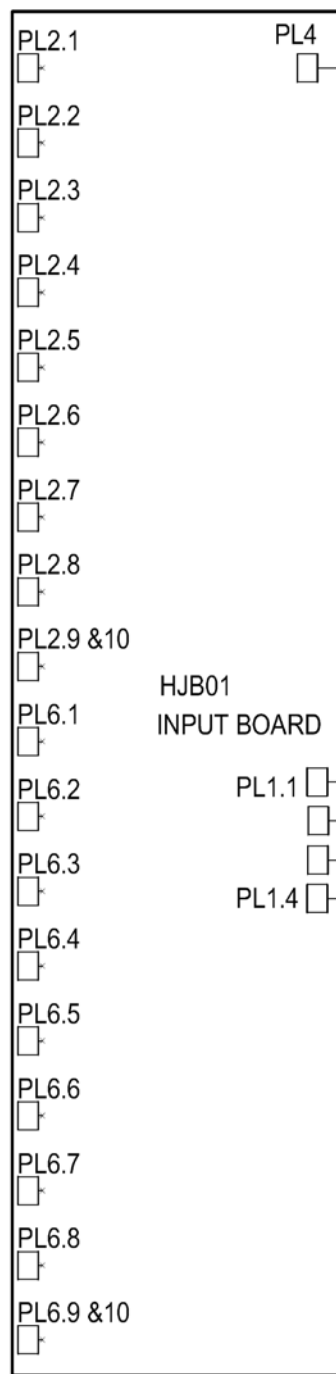
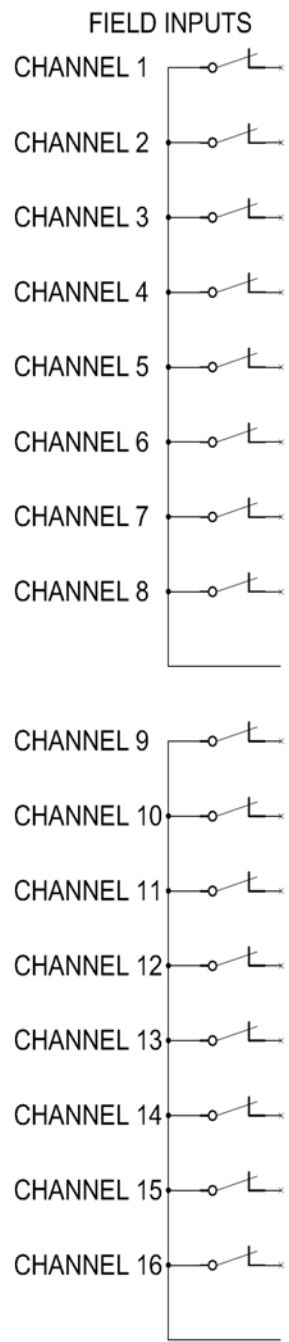
The above times are based upon the battery charger board removing the battery power when the battery voltage falls below 10.2v. This is to ensure that the battery does not become damaged by a complete discharge. When the mains supply is re-established then the battery will begin to be charged again and will be available once again for emergency power in the event of a mains failure.

Jockey Pump Monitor

Channel 15 can be used to monitor a jockey pump controller, and bring on an alarm if it starts too many times within the last hour. To enable this feature, turn on dip switch 1 with the power off. With dip switch 1 on, input 15 is monitored for frequent jockey pump starts. If the input is activated 10 or more times within the last hour, then:

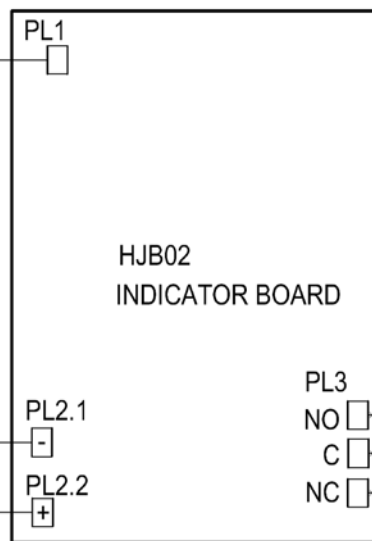
CAUSE / STATUS	EFFECT
>10 starts within an hour	LED 15, flashing
Sounder	Active
Common Alarm	Does not change state upon this alarm
Press mute pb	
Sounder	Silent

To reset this special counter, press the mute and reset push buttons at the same time.

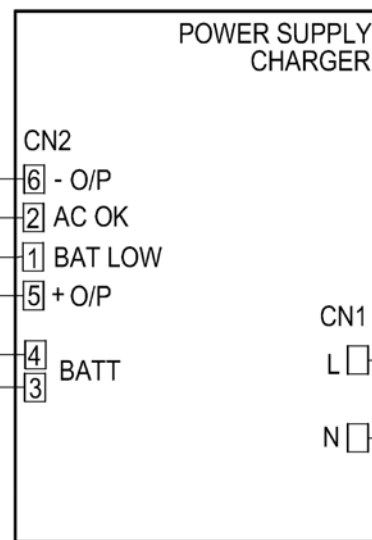
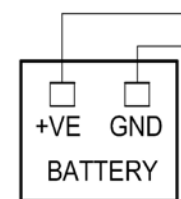


RIBBON CABLE

SOUNDER



COMMON FAULT
VOLT FREE



MAINS SUPPLY
INPUT

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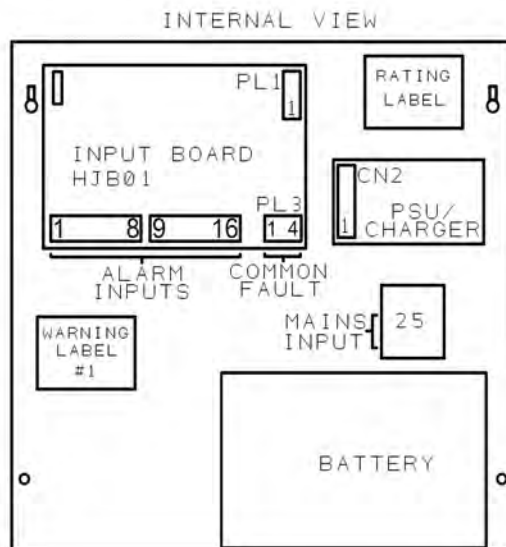
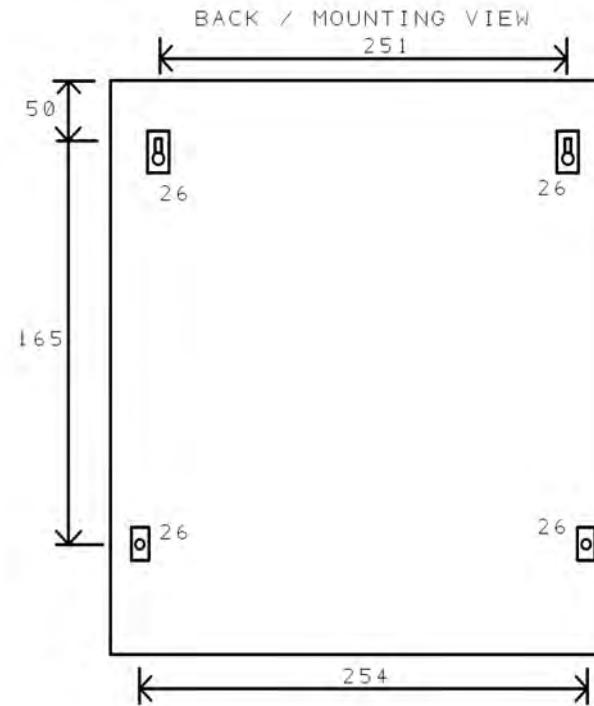
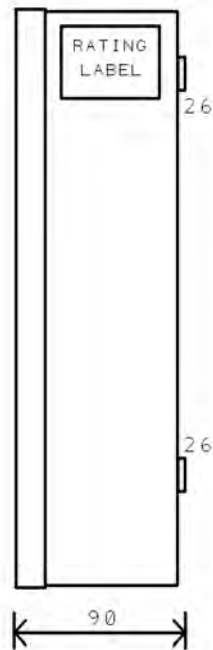
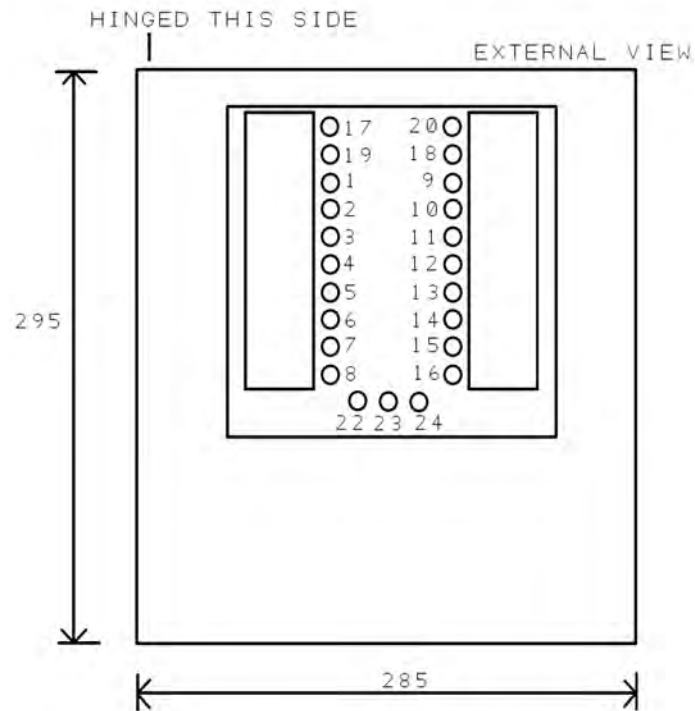
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Notes

02 Rev.	21/12/2016 Date	DC By	RS001 Description
DRAWING TITLE			
Remote Alarm Panel			
Internal Schematic Diagram			
ENGINEER DC	DRAWN DC	CHECKED JPR	APPROVED JPR
SCALE NTS	DATE 21/12/2016	DRG SIZE A2	

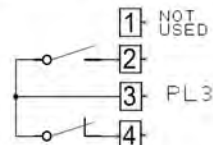
ARMSTRONG
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WEBSITE: www.armstrongintegratedsystems.com



#1
TO COMPLY WITH EN12845,
CHANNELS MUST BE SET
TO NORMALLY CLOSED.

COMMON FAULT
VOLT FREE
(SHOWN IN
HEALTHY STATE)



ITEM	DESCRIPTION
1-16	16 CHANNEL MONITORING
17	MAINS SUPPLY ON
18	TEST MODE ON
19	MAINS FAILED
20	BATTERY/PSU HEALTHY
21	.
22	MUTE PUSH BUTTON
23	LAMP TEST PUSH BUTTON
24	RESET PUSH BUTTON
25	MAINS TERMINALS
26	4X WALL MOUNTING FEET

ITEM	LED COLOUR
17	GREEN
19	RED
20	GREEN
18	RED
1-15	YELLOW
16	RED

WEIGHT 4.8KG
RATING: IP21
MATERIAL: 0.7MM SHEET STEEL DC01
FINISH: SMOOTH WALL, GREY RAL9003

CAD FILE : DO NOT ALTER BY HAND
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Notes

Rev.	Date	By	Description
05	06/04/2017	DC	MG011

DRAWING TITLE
Remote Alarm Panel
General Arrangement Diagram

ENGINEER	DRAWN	CHECKED	APPROVED
DC	DC	JPR	JPR
SCALE	DATE	DRG SIZE	
NTS	06/04/2017	A2	

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WEBSITE: www.armstrongintegratedsystems.com

DRG No.
3272721-xxx

REV
05

FIRE PUMPS

Series 4280FE Motor Mounted Pumps & Series 4030FE Base Mounted Pumps

CE CONFORMITIES

For declaration of Conformities contact Armstrong Pumps.

INTRODUCTION

This document contains specific information regarding the safe installation, operating and maintenance of the Series 4280FE & 4030FE pumps and should be read and understood by installing, operating and maintenance personnel. The equipment supplied has been designed and constructed to be safe and without risk to health and safety when properly installed, operated and maintained. The instructions following must be strictly adhered to. If clarification is needed on any point please contact Armstrong quoting the equipment serial number.

WARNING SYMBOLS



Safety instruction where an electrical hazard is involved.



Safety instruction where non-compliance would affect safety risk.



Safety instruction relating to safe operation of the equipment. (ATTENTION)

INSTRUCTIONS FOR SAFE USE

No installation of this equipment should take place unless this document has been studied and understood. handling, transportation and installation of this equipment should only undertaken by trained personnel with proper use of lifting equipment. See later diagrams for lifting advice. Refer to the pump nameplate for pump speed, pressure and temperature limitations. The limits stated must not be exceeded without written permission from Armstrong Pumps.

TEMPERATURE

Where under normal operating conditions the limit of 68°C/155°F (Restricted Zone) for normal touch, or 80°C/176°F (Unrestricted Zone) for unintentional touch, may be experienced, steps should be taken to minimize contact or warn operators/users that normal operating conditions will be exceeded. In certain cases where the temperature of the pumped liquid exceeds the above stated temperature levels, pump casing temperatures may exceed 100°C/212°F and not withstanding pump insulation techniques appropriate measures must be taken to minimize risk for operating personnel.

NOISE LEVELS

Estimated Pumping Unit Sound Level, Decibels, A-Weighted, at 1m (3ft) from unit.

Motor Size (kW)	1000 min ⁻¹ (dB-A)	1500 min ⁻¹ (dB-A)	3000 min ⁻¹ (dB-A)
> 2.2 - 5.5	77	78	85
> 5.5 - 11	80	83	90
> 11 - 22	84	89	93
> 22 - 37	88	92	95
> 37 - 55	90	94	97
> 55 - 110	92	98	100
> 110 - 220	96	102	102

STORAGE

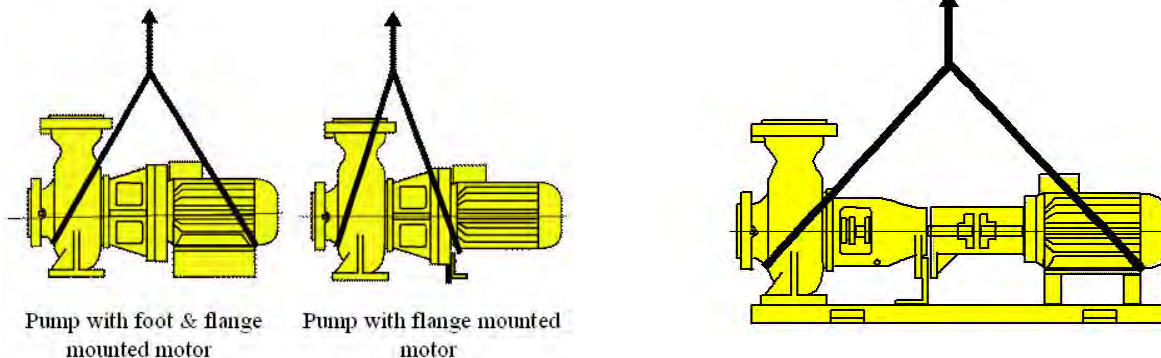
Pumps not immediately placed into service, or removed from service and stored, must be properly prepared to prevent excessive rusting. Pump port protection plates must not be removed until the pump is ready to connect to the piping. Rotate the shaft periodically (at least monthly) to keep rotating element free and bearings fully functional. For long-term storage, the pump must be placed in a vertical position in a dry environment. Internal rusting can be prevented by removing the plugs at the top and bottom of the casing and drain or air blow out all water to prevent rust buildup or the possibility of freezing. Be sure to reinstall the plugs when the unit is made operational. Rust proofing or packing the casing with moisture absorbing material and covering the flanges is acceptable. When returning to service be sure to remove the drying agent from the pump.

UNCRATING

Armstrong End Suction pumps are thoroughly inspected before shipment to assure they meet with your order requirements. After removing the pump from the crate, make sure the equipment is in good order and that all components are received as called for on the packing list. Any shortages or damage should be reported immediately. Use extreme care in handling the unit, placing slings and hooks carefully so that stress will not be imposed on the pump. **NEVER PLACE CABLE SLINGS AROUND THE PUMP SHAFT.** The eye bolts or lifting lugs on the motor are intended for lifting the motor and not the complete unit.

HANDLING

Use slings as shown in the diagram to lift the set. Do not use the motor eyebolts to lift the pump set. See the delivery note for the weight of the set.



LIMITATIONS

See pump nameplate for speed, duty and maximum pressure/temperature limitations. These limits must not, under any circumstances, be exceeded without prior consultation with Armstrong Pumps.

IMPORTANT:

Do not run the pump for any length of time under very low flow conditions or with the discharge valve closed. To do so could cause the water in the casing to reach super heated steam conditions and will cause premature failure and could cause serious and dramatic damage to the pump and surrounding area.

INSTALLATION

1. LOCATION

- In open systems, locate the unit as close as practical to the liquid being pumped, with a short, direct suction pipe. Ensure adequate space is left above and around the unit for operation, maintenance, service and inspection of parts.
- In closed systems, where possible, the pumps should be installed immediately downstream of the expansion tank/make-up connection. This is the point of zero pressure change and is necessary for effective pump operation. Do not install more than one expansion tank connection into any closed hydronic system.
- Electric motor driven pumps should not be located in damp or dusty location without special protection.
- Airflow into the motor and/or motor fan should not be obstructed.

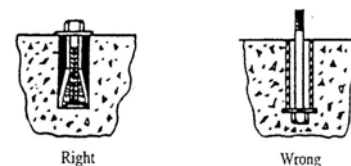
2. INSTALLATION

- Recommended installation arrangements are:

2.1 FOUNDATION

The foundation should be sufficiently substantial to absorb any vibration and to form a permanent rigid support for the baseplate. This is essential in maintaining the alignment of a direct connected unit. A good foundation should weigh approx. 2.5 times the shipping weight of the pump. In building the foundation make ample allowance for grouting. Foundation bolts of the proper size should be arranged as shown, with a pipe sleeve embedded in the concrete to permit adjustment of the bolts after the concrete has been poured. Use sleeves with a diameter 2.5 times the diameter of the bolts.

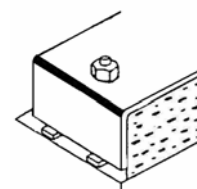
Locate the pump on its foundation holes using the motor feet as a template. Drill four holes of the required size and insert the anchors. Take the tamping tool (supplied with the anchors) and drive home the lead sleeve until it is below the level of the foundation and firmly fixed in the concrete.



2.2 LEVELLING

When the unit has been placed on its foundation, slacken off the coupling setscrews and slide back the coupling halves so that the pump and motor shafts are free to rotate independently. Re-tighten the setscrews in this position. Do not re-connect the coupling until after the unit has been piped up, finally aligned and checked for correct direction of rotation.

Insert metal wedges approx. 15mm thick on either side of the foundation bolts under the baseplate as shown. Adjust wedges until the shafts of the pump and motor are level. On flanged pumps check suction and discharge flanges for vertical or horizontal position using a level and correct as necessary by adjusting the wedges. When the baseplate is completely level, the foundation bolts should be tightened evenly and firmly. Do not over-tighten bolts at this stage.



2.3 ALIGNMENT

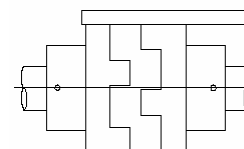
The pump unit is accurately aligned in our factory prior to being shipped. However all baseplates are flexible to some extent and must not be relied upon to maintain factory alignment. Re-alignment is necessary as follows:

- After the unit has been set level on its foundation.
- After the grout has set and the foundation bolts have been tightened.
- After the pipes have been connected.

Accurate alignment is absolutely essential, proper mechanical operation of the equipment cannot be guaranteed unless the factory alignment is reproduced in the field.

Coupling Alignment

Check the alignment by placing a straight edge across the coupling rims at the top, bottom and both sides. Care must be taken to have the straight edge parallel to the axis of the pump and motor shaft. Alignment is obtained when the straight edge rests evenly on both rims in all four positions.



Adjust as necessary by placing shims under the motor feet.

2.4 GROUTING

After levelling the unit and checking the alignment. Fill the baseplate completely with grout, allowing it to flow around the wedges under the baseplate. Allow 48 hours for the grout to harden before final tightening of the foundation bolts.

2.5 PIPING

Both the suction and discharge pipes should be independently supported near the pump so that no strain is imposed on the pump when the pipes are connected. All connecting pipework should be accurately located – do not attempt to force the suction and discharge pipes into position.

Suction Piping

Use short direct suction piping one or two times larger than the pump suction nozzle. Arrange piping to eliminate potential air pockets and use an eccentric reducer to connect to the suction nozzle. A strainer three or four times the area of the suction pipe will prevent foreign materials entering the pump.

Discharge Piping

A check valve and gate valve should be installed in the discharge line. If an increaser is used on the discharge side to increase the size of the discharge pipe it should be placed between the check valve and the pump.

2.6 FINAL ALIGNMENT

When the piping has been connected, check the alignment and make corrections if necessary. Energise the motor (with coupling halves disconnected) and check that the rotation corresponds with the direction arrow on the pump to reverse the rotation on a three-phase motor, interchange two leads.

When rotation and alignment are correct, re-connect the coupling with both halves butting against the rubber insert. Tighten the coupling set screws.

3. PUMP PIPING - GENERAL

- Never connect a pump to piping, unless extra care is taken to measure and align the piping flanges well. Always start piping from pump. Use as few bends as possible and preferably long radius elbows.
- Ensure the piping exerts no strain on the pump as this could distort the casing causing breakage or early failure due to pump misalignment.
- All connecting pipe flanges must be square to the pipework and parallel to the pump flanges.
- Suction and discharge pipes may be increased or decreased at the pump nozzle to suit pump capacity and particular conditions of installation. Use eccentric reducers on suction connection with flat side uppermost.
- Layout the suction line with a continual rise towards the pump without high points, thus eliminating possibility of air pockets that may prevent the pump from operating effectively.
- A strainer of three or four times the area of the suction pipe, installed in the suction line, will prevent the entrance of foreign materials into the pump. 5mm diameter perforations in the strainer is typical.
- In open systems, test suction line for air leaks before starting; this becomes essential with long suction line or static lift.
- Install, at the pump suction, a straight pipe of a length equivalent to 4 or 6 times its diameter; this becomes essential when handling liquids above 49°C (120°F). Armstrong suction guides may be used in place of the straight pipe run and in-line strainer.
- Install an isolation valve in both suction and discharge lines on flooded suction application; these valves are used primarily to isolate the pump for inspection or repair
- Install a non-slam non-return check valve in discharge line between pump and isolation valve to protect pump from excessive back pressure and to prevent water running back through the pump in case of driver failure on open systems. An Armstrong Flo-Trex valve may be used in place of non-return check valve and isolation valve on pump discharge.

CAUTION:

The discharge valve only is to be used to throttle pump flow, not the suction valve. Care must be taken in the suction line layout and installation, as it is usually the major source of concern in centrifugal pump applications

OPERATION

4. STARTING PUMP



- Ensure that the pump turns freely by hand, or with some mechanical help such as a strap and lever on larger pumps. Ensure that all protective guarding is securely fixed in position.
- The pump must be fully primed on start up. Fill the pump casing with liquid and rotate the shaft by hand to remove any air trapped in the impeller.
- “Bump” or energize the motor momentarily and check that the rotation corresponds with the directional arrow on the pump casing.
- To reverse rotation of a three-phase motor, interchange any two power leads.
- Start the pump with the discharge valve closed and the suction valve open, then gradually open the discharge valve when the motor is at operating speed. The discharge valve may be “cracked” or open slightly at start up to help eliminate trapped air.
- When stopping the pump: Close the discharge valve and de-energize the motor.
- DO NOT run the pump against a closed discharge valve for an extended period of time. (a few minutes maximum).
- Star-Delta motor starters should be fitted with electronic/mechanical interlocks that have a timed period of no more than 40 milli-seconds when switching from star (Starting) to delta (Run) connection yet allow the motor to reach full star (Starting) speed before switching to delta (Run).
- Should the pump be noisy or vibrate on start-up a common reason is overstated system head. Check this by calculating the pump operating head by deducting the suction pressure gauge value from the discharge gauge reading. Convert the result into the units of the pump head as stated on the pump nameplate and compare the values. Should the actual pump operating head be significantly less than the nameplate head value it is typically permissible to throttle the discharge isolation valve until the actual operating head is equal to the nameplate value. Any noise or vibration usually disappears. The system designer or operator should be made aware of this soon as some adjustment may be required to the pump impeller diameter or drive settings, if applicable, to make the pump suitable for the system as installed.

CAUTION:



Check the direction of rotation against the rotation arrow prior to operating the unit.

5. GENERAL CARE

- The pumps are built to operate without periodic maintenance, other than bearing lubrication on some units. A systematic inspection made at regular intervals will ensure years of trouble-free operation, give special attention to the following:
- Keep the unit clean.
- Provide the motor with correctly sized overload protection.
- Keep moisture, refuse, dust or other loose particles away from the pump and ventilating openings of the motor.
- Avoid operating the unit in overheated surroundings (above 40°C/100°F).

WARNING:



Whenever any service work is to be performed on a pumping unit, disconnect the power source to the driver, LOCK it OFF and tag with the reason. Any possibility of the unit starting while being serviced must be eliminated.

- If mechanical seal environmental accessories are installed, ensure water is flowing through the sight flow indicator and that filter cartridges are replaced as recommended. (See Armstrong files 43.85 & 43.86 for seal environmental instructions).

CAUTION:



Under no circumstances should the pump be used for flushing out the system. In line with CIBSE commissioning code W: 1994, the pump should be out of line or bypassed during flushing.

6. LUBRICATION

Pump

Sealed Grease Bearings

- If the pump is fitted with greased lubricated bearings, no external lubrication is required.
- These bearings are custom greased for general service applications and sealed.

Oil Lubricated Bearings

- If the pump is fitted with oil lubricated bearings; use a non-detergent oil equal to No.10 motor oil.
- Prior to start up check to make sure the oil level is visible in the sight glass.
- Under normal operating conditions the oil should be changed every year or 3000 hours as follows:
 - a) Drain the oil from the old bearing bracket.
 - b) Thoroughly flush the bearing bracket with Kerosene.
 - c) Refill the oil through the vent on top of the bracket until the oil level is visible in the middle of the sight glass.

Motor

- Follow the lubrication procedures recommended by the motor manufacturer. Many small and medium sized motors are permanently lubricated and need no added lubrication. Generally if there are grease fittings evident the motor needs periodic lubrication. None if not.
- Check the lubrication instructions supplied with the motor for the particular frame size indicated on the motor nameplate.

Mechanical Seal

- Mechanical seals require no special attention. If leakage occurs investigate the cause and replace the seal following the makers recommendations, then realign the pump and motor shafts.
- Do not run the pump unless properly filled with water as the mechanical seals need a film of liquid between the faces for proper operation.
- Mechanical seals may 'weep' slightly at start-up. Allow the pump to continue operating for several hours and the mechanical seal to 'seat' properly prior to calling for service personnel.

7. SYSTEM CLEANLINESS

- Before starting the pump the system must be thoroughly cleaned, flushed and drained and replenished with clean liquid.
- Welding slag and other foreign materials, "Stop Leak" and cleaning compounds and improper or excessive water treatment are all detrimental to the pump internals and sealing arrangement.
- Proper operation cannot be guaranteed if the above conditions are not adhered to.

CAUTION:



Under no circumstances should the pump be used for flushing out the system. In line with CIBSE commissioning code W: 1994, the pump should be out of line or bypassed during flushing.

NOTE:

Particular care must be taken to check the following before the pump is put into operation:

- a) Pump primed?
- b) Rotation OK?
- c) Lubrication OK?
- d) Pipework properly supported?
- e) Voltage supply OK?
- f) Overload protection OK?
- g) Is the system clean?
- h) Is the area around the pump clean?

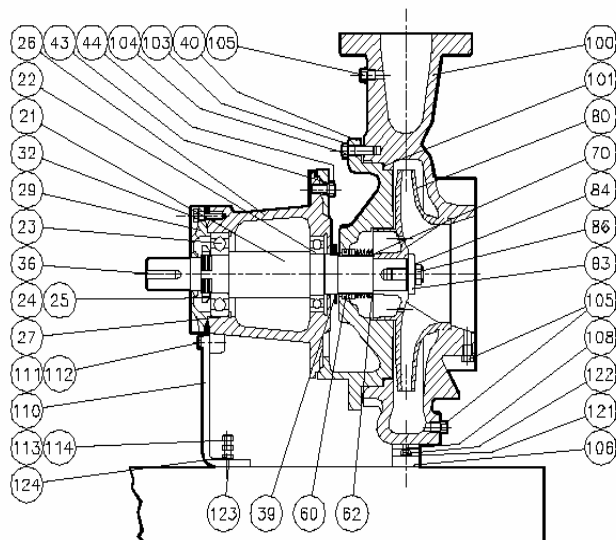
WARRANTY

Does not cover any damages to the equipment resulting from failure to observe the above precautions. Refer to Armstrong General Terms and Warranty sheet. Contact your local Armstrong representative for full information.

Symptoms	Reasons
<i>Pump fails to deliver</i>	• Pump not primed. • Suction line not filled. • Air or vapour pocket in suction line. • Inlet of suction pipe insufficiently submerged. • N.P.S.H. available too low. • Suction lift too high. • Air leaks in suction line, gland or pump joints. • Blocked suction. • Incorrect rotation. • Speed too low. • Total head of system higher than that of pump.
<i>Pump vibrates</i>	• Misalignment. • Air or vapour pocket in suction line. • Inlet of suction pipe insufficiently submerged. • N.P.S.H. available too low. Suction lift too high. • Blocked suction. • Impeller damaged. • Packing too tight. • Misalignment of pipework. • Operation at low capacity. • Rotating element out of balance. • Shaft bent. • Poor foundations.
<i>Seal leaks or fails</i>	• Misalignment. • Impurities in water. • Entrained air. • Cavitation. • Bearing failure. • Water treatment not allowed for.
<i>Low delivery rate</i>	• Air or vapour pocket in suction line. • Inlet of suction pipe insufficiently submerged. • N.P.S.H. available too low. • Suction lift too high. • Air leaks in suction line, gland or pump joints. • Blocked suction. • Incorrect rotation. • Speed too low. • Excessive system friction. • Impeller damaged
<i>Insufficient pressure</i>	• Incorrect rotation. • Speed too low. • Excessive system friction. • Impeller damaged.
<i>Low bearing life</i>	• Misalignment. • Dirt in bearings. • Bearings too tight. • Bearings badly installed. • Misalignment of pipework. • Rotating element out of balance. • Shaft bent.
<i>Bearings overheat</i>	• Misalignment. • Insufficient cooling to stuffing box. • Badly packed stuffing box. • Misalignment of pipework. • Dirt in bearings. • Bearings too tight. • Bearings badly installed.
<i>Stuffing box overheats</i>	• Packing too tight. • Insufficient cooling to stuffing box. • Badly packed stuffing box. • Misalignment of pipework.
<i>Pump delivery fails after start</i>	• Suction line not filled. • Air or vapour pocket in suction line. • Inlet of suction pipe insufficiently submerged. • N.P.S.H. available too low. • Suction lift too high. • Air leaks in suction line, gland or pump joints. • Blocked suction. • Impeller damaged.

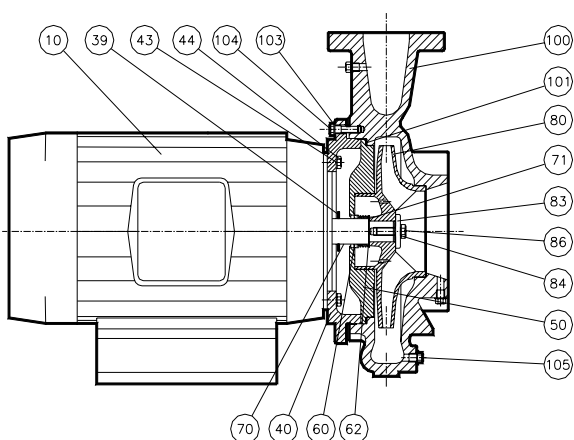
Symptoms	Reasons
Pump seized	• Pump not primed. • Misalignment of pipework. • Operation at low capacity
Pump does not prime	• Pump not primed. • Inlet of suction pipe insufficiently submerged. • Suction lift too high. • Blocked suction. • Incorrect rotation. • Badly packed stuffing box
Pump Noisy	• Misalignment. • Air or vapour in suction line. • Inlet or suction pipe insufficiently submerged. • N.P.S.H. available too low. • Air leaks in suction line, gland or pump joints. • Blocked suction. • Impeller damaged. • Operation at low capacity. • Rotating element out of balance. • Shaft bent. • Poor foundations. • Packing too tight. • Operation at high capacity.
Motor overloading	• Misalignment. • Speed too high. • Low system friction. • Pumped liquid density is greater than anticipated. • Packing too tight.
Motor overheating	• Misalignment. • Speed too high. • Low system friction. • Pumped liquid density is greater than anticipated. • Packing too tight.

4030FE ITEM DESCRIPTION



21	Shaft	84	Lockwasher (when fitted)
22	Bearing (Inboard)	86	Capscrew Hex Hd.
23	Bearing (Outboard)	100	Casing
24	Lockwasher	101	Gasket
25	Lock Nut	103	Washer
26	Bearing Housing	104	Capscrew Hex Hd.
27	Snap Ring	105	Pipe plug
29	Cap (O/B)	106	Support foot
32	Capscrew Hex Hd.	108	Capscrew
36	Key	110	Support foot (casing)
39	Water Slinger	111	Washer
40	Adapter	112	Capscrew Hex Hd.
43	Washer	113	Nut jam (when fitted)
44	Capscrew Hex Hd.	114	Capscrew (when fitted)
60	Seat	121	Washer
62	Mechanical Seal	122	Capscrew Hex Hd.
70	Shaft Sleeve	123	Washer
80	Impeller	124	Capscrew Hex Hd.
83	Washer Impeller		

4280FE ITEM DESCRIPTION



10	Motor
39	Water Slinger
40	Adapter
43	Washer
44	Capscrew Hex Head
50	Stuffing Box Cover (when required)
60	Seat
62	Mechanical Seal Head
70	Shaft Sleeve
71	Spacer
80	Impeller
83	Washer Imp.
84	Washer (when required)
86	Capscrew Hex Head
100	Casing
101	Gasket
103	Washer
104	Capscrew Hex Head
105	Pipe Plug

INSTALLATION AND OPERATING INSTRUCTIONS

Vertical multi-stage centrifugal pumps
Series: VMS 2, VMS 4, VMS 6, VMS 10, VMS 15, VMS 85
Design Version B

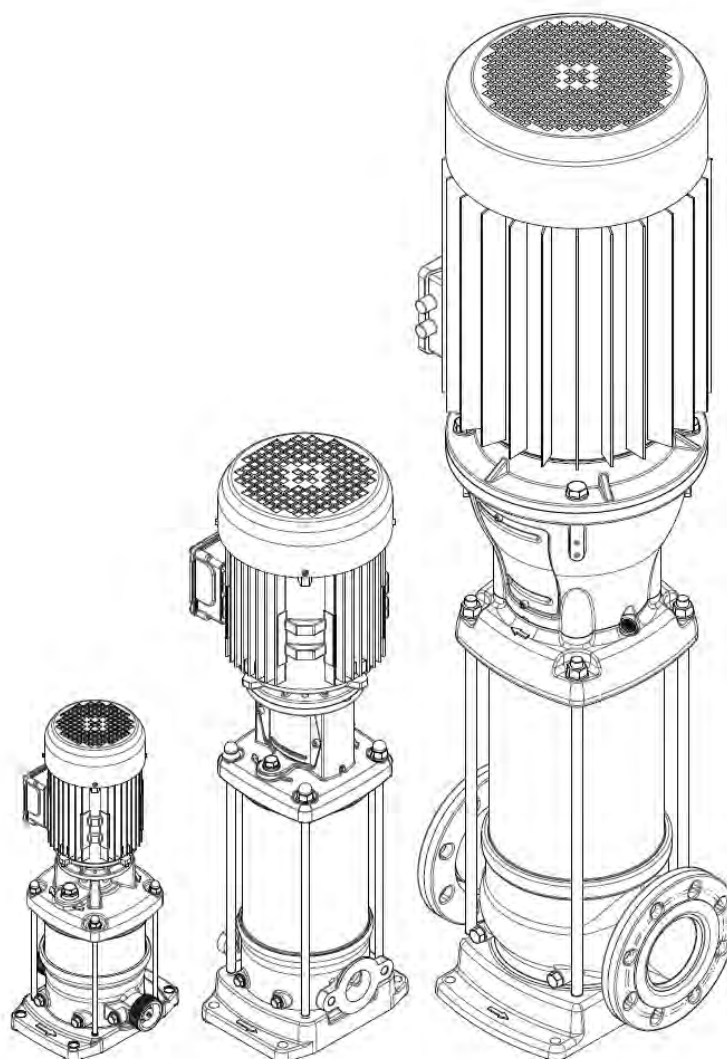


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1.0 MANUAL INTRODUCTION

1.1 PREFACE

This manual contains important information for reliable proper and efficient operation. Compliance with the operating instructions is of vital importance to ensure reliability and a long service life of the product and to avoid any risks.

The first chapters contain information about this manual and safety in general. The following chapters provide information about normal use, installation, maintenance and repairs of the product. The annexes contain the technical data, the parts drawings and the declaration(s) of conformity.

- Make yourself familiar with the content.
- Accurately follow the directions and instructions.
- Never change the sequence of the operations to be carried out.
- Keep this manual or a copy of it together with the logbook in a fixed place near the product which can be accessed by all personnel.

1.2 ICONS AND SYMBOLS

In this manual and in all accompanying documentation the following icons and symbols are used.

 **WARNING**
 Danger of electric Voltage. Safety sign according to IEC 417 - 5036

 **WARNING**
 Operations or procedures, if carried out without caution, may cause personal injury or damage to the product. General hazard sign according to ISO 7000-0434

 **ATTENTION**
 Is used to introduce safety instructions whose non-observance may lead to damage to the product and its functions.

 **ENVIRONMENTAL INSTRUCTION**
 Remarks with respect to the environment.

2.0 IDENTIFICATION, SERVICE AND TECHNICAL SUPPORT

2.1 OBTAINING DATA AND INFORMATION

The name plate indicates the type series / size, main operating data and identification number. Please quote this information in all queries, repeat orders and particularly when ordering spare parts. If you need any additional information or instructions exceeding the scope of this manual or in case of damage please contact Armstrong's nearest customer service centre.

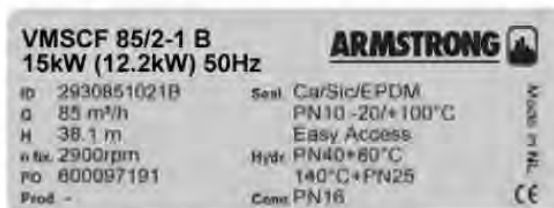


Figure 1: Pump with motor

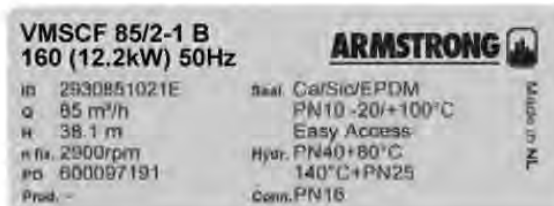


Figure 2: Pump without motor

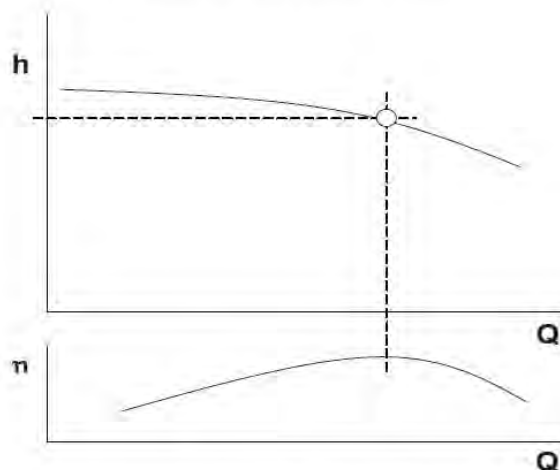


Figure 3: Duty point

Table 1: Description sticker

Indication		Meaning
VMSCF 85/2-1 B		Basic pump type (design version B)
15 kW (12.2 kW)		Nominal motor power ¹ (required power)
50 Hz		Nominal frequency
Ca/Sic		Mechanical Seal Surface Code, See: 2.2 Seal codes
EPDM		Pump Elastomers
Q	23.6 l/s	Optimum capacity running at fixed speed (see fig. Duty point)
H	38.1	Optimum heads running at fixed speed (see fig. Duty point)
n fix	2900 rpm	Rotation speed indication at which Q/H are given
Hydr.	140° C+PN25	Maximum temperature at mentioned pressure
Conn.	PN16	Pressure Class connection
Seal.	PN10 -20/+100° C	Maximum pressure at mentioned temperature ²
	Easy access	Seal construction type
ID	2930851021B	Pump ID > as build file
PO	600097191	Production order number
Prod	WW / YYYY - XXX	Production week/year and production serial number

1. Frame size in case without motor
2. At lower pressure a higher temperature is allowed (please consult your supplier)

Address data for service and technical support:

Armstrong Integrated Limited

Wenlock Way, Manchester

United Kingdom, M12 5JL

Tel: +44 (0) 8444 145 145

2.2 SEAL CODES

Table 2: Material code shaft seal

Code acc. to EN 12756	Description	Material		Note
B	Spring loaded ring	Carbon graphite	Ca	Resin impregnated
Q1		Silicon carbide	SiC	Sintered pressureless
U3		Tungsten carbide	TuC	CrNiMo-binder
A	Seat ring	Carbon graphite	Ca	Antimony impregnated
B		Carbon graphite	Ca	Resin impregnated
Q1		Silicon carbide	SiC	Sintered pressureless
U3		Tungsten carbide	TuC	CrNiMo-binder
E	Elastomers	EPDM	EPDM	Ethylene propylene rubber
V		Viton	Viton	Fluor carbon rubber
X4		HNBR	HNBR	Hydrogenated nitrile rubber
G	Spring	CrNiMo steel		
G	Other metal parts	CrNiMo steel		

2.3 NOMINAL CURRENT

The nominal allowable current of the motor is stated on the motor plate. This shows the nominal working range of the motor and can be used to protect the motor.

Measuring the actual current of the pump during operation can be used to pre-set the motor protection switch to protect the pump/motor combination. This current value can also be used to determine the proper electrical equipment such as variable frequency drive, main switch, wiring diameter etc.



WARNING

Not only the motor, but also the pump has to be protected in its application.

2.4 SUPPLEMENTARY DOCUMENTATION

Apart from this manual, the documentation given below is also available:

Table 3: Supplementary documentation

Position	Date/ version	Code
General terms of delivery	10-1998	119 / 1998
Technical Data VMS 2, 4, 6, 85 50 Hz Version B	02/2010	97004455
Technical Data VMS 2, 4, 6, 85 60 Hz Version B	02/2010	97004456
See also armstrongintegrated.com		

3.0 WARRANTY

3.1 TERMS OF WARRANTY

The warranty period is settled by the terms of your contract or at least by the general terms and conditions of sales.



ATTENTION

Modifications or alterations of the product supplied are only permitted after consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer ensure safety. The use of other parts can invalidate any liability of the manufacturer for consequential damage.



ATTENTION

The warranty relating to the operating reliability and safety of the product supplied is only valid if the product is used in accordance with its designated use as described in the following sections of this manual. The limits stated in the data sheet must not be exceeded under any circumstances.

The warranty becomes invalid if one or more of the points below occur.

- The buyer makes modifications himself.
- The buyer carries out repairs himself or has these carried out by a third party.
- The product has been handled or maintained improperly.
- The product has non original Armstrong spare parts fitted.

Armstrong remedies defects under warranty if the points below are observed.

- Defects are caused by flaws in the design, the materials or the production.
- The defect has been reported within the warranty period.

Other terms of warranty have been included in the general terms of delivery, which are available upon request.

4.0 SAFETY AND ENVIRONMENT

4.1 GENERAL

This Armstrong product has been developed using state-of-the-art technology; it is manufactured with utmost care and subject to continuous quality control. Armstrong does not accept any liability for damage and injury caused by not observing the directions and instructions in this manual. This also applies in cases of carelessness during the installation procedure, use and maintenance of the product.

Non-compliance with safety instructions can jeopardize the safety of personnel, the environment and the product itself. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages. For example, in particular non-compliance can result in:

- Failure of important pump/system functions,
- Failure of prescribed maintenance and servicing practices,
- Injury to persons by electrical, mechanical and chemical effects,
- Hazard of the environment due to leakage of
- Hazardous substances,
- Explosions.

Depending on specific activities, extra safety measures may be required. Contact Armstrong if a potential danger arises during use.



ATTENTION

The owner of the product is responsible for compliance with the local safety regulations and internal company guidelines.



ATTENTION

Not only must the general safety instructions laid down in this chapter on "Safety" be complied with, but also the safety instructions outlined under specific headings

4.2 USERS

All personnel involved in the operation, maintenance, inspection and installation of the product must be fully qualified to carry out the work involved.

Personal responsibilities, competence and supervision must be clearly defined by the operator. If the personnel in question is not already in possession of the required know-how, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to take care of such training. In addition, the operator is responsible for ensuring that the contents of the operating instructions are fully understood by the responsible personnel.

4.3 SAFETY PROVISIONS

The product has been designed with the greatest possible care. Original parts and accessories meet the safety regulations. Modifications in the construction or the use of non-original parts may lead to a safety risk.



ATTENTION

Make sure that the product operates within its working range. Only then the product performance is guaranteed.

4.3.1 LABELS ON THE PRODUCT

The icons, warnings and instructions applied to the product are part of the safety provisions. The labels may not be removed or covered. Labels must remain legible during the entire life of the product. Replace damaged labels immediately.

4.4 SAFETY PRECAUTIONS

4.4.1 DURING NORMAL USE

- Contact the local electricity company for questions about the power supply.
- Cover the parts that can become hot, so direct contact is impossible.
- When applicable, always place undeformed coupling protection plates to protect the coupling, before putting the pump into use. Make sure that the coupling protection plates are never in contact with the running coupling.
- Always close the terminal box on the pump.

4.4.2 DURING INSTALLATION, MAINTENANCE AND REPAIR

During installation, maintenance and Repair

Only authorised personnel may install, maintain and inspect the product and repair electrical components. Observe the local safety regulations.



WARNING

Always disconnect the energy supply to the product first, before installation, maintenance and repairs. Secure this disconnection.



WARNING

Surfaces of a pump can be hot, after continuous operation.



WARNING

Make sure that no one can be near rotating components when starting a pump.



WARNING

Handle a pump with dangerous liquids with the utmost care. Avoid danger for persons or the environment when repairing leakages, draining liquids and venting. It is strongly recommended to place a relief barge under the pump.



WARNING

Immediately following completion of the work, all safety-relevant and protective devices must be re-installed and / or re-activated.



WARNING

Please observe all instructions set out in the chapter "Commissioning/Startup" before returning the product to service.

4.5 ENVIRONMENTAL ASPECTS

4.5.1 GENERAL

The products of Armstrong are designed to function in an environmentally friendly way during their entire life. Therefore, when applicable, always use biodegradable lubricants for maintenance.



ENVIRONMENTAL INSTRUCTION

Always act according to the laws, bylaws regulations and instructions with respect to health, safety and the environment.

4.5.2 DISMANTLING

Dismantle the product and dispose of it in an environmentally friendly way. The owner is responsible for this.



ENVIRONMENTAL INSTRUCTION

Ask at the local government about the re-use or the environmentally friendly processing of discarded materials

5.0 PUMP INTRODUCTION

5.1 MODEL KEY

Table 4: Model key Example VMSSF85/3-1 B

	VM	SS	F	85	/3	-1	B	
Label	VM							Product Label
Material/Construction		VC						Cast Iron pump foot and top bracket hydr. 1.4301 / AISI 304
		V						All wetted parts Stainless Steel 1.4301 / AISI 304
		VM						All wetted parts Stainless Steel 1.4301 / AISI 304 with closed coupled motor
		VS						All wetted parts Stainless Steel 1.4401 / AISI 316
Connections			E					Male thread (with non-return valve insert)
								Oval flange with female thread
			F					Round flange
			V					Victaulic connections
			T					Tri-clamp connections
				85				Capacity in m ³ /h at Q _{opt.}
					/3			Number of stages
					/3	-1		Number of stages of which one stage with reduced head
							B	Design version

5.2 DESCRIPTION OF THE PRODUCTS

The vertical, single or multi stage centrifugal pump series are designed for pumping clean, or lightly aggressive, watery mediums.

Suction and discharge of the pump are in-line, making the pump easy to install.

The hydraulic assembly is driven by an electric motor. All hydraulic parts of the pump are made of stainless steel.

5.3 MODULAR SELECTION

To suit almost every application the pump is assembled out of modules which can be selected depending on the required working range. Basic modules are:

- **Basic pump model**, which defines the capacity, pressure and basic material
- **Connections**, which define the suction and discharge connection as well as the base plate.
- **Sealings**, which define the elastomers, the mechanical seal and the shaft seal type.
- **Electric motor**, which defines all requirements of the motor such as motor size, power, voltage, frequency and all possible motor accessories.

5.4 OPERATION

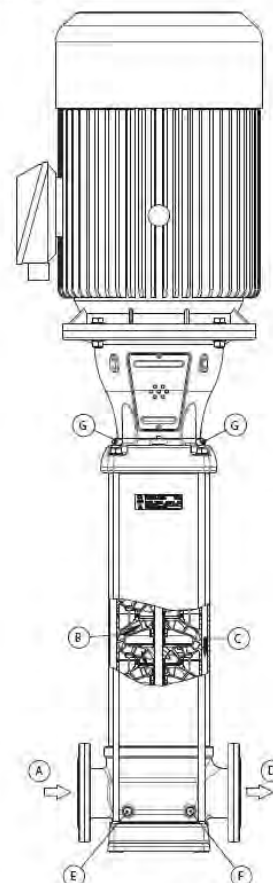


Figure 4: VMSF 85

During centrifugal operation of the pump an negative pressure is created at the inlet of the impeller. This underpressure enables the medium to enter the pump at the suction connection (A).

Every stage (B) consists of an impeller and diffuser. The passage of this stage determines the capacity of the pump. The diameter of the stages is related to the centrifugal forces and its "stage pressure": the more stages, the more pressure.

This total capacity and raised pressure will be guided to the outside of the pump, between the pump stages and the outer sleeve (C) and the medium will leave the pump at the discharge connection (D).

5.5 MEASURING DRAINING AND VENTING

The pump is provided with plugs for measuring, draining and venting.

Connection (E) is meant to drain the inlet part of the pump. Or to measure the inlet / suction pressure using a G 1/4 connection.

Connection (F) is meant to drain the outlet part of the pump. Or to measure the discharge pressure using a G 1/4 connection.

Connections (G) are meant to vent the pump system when the pump is not in operation. Or to measure the discharge pressure of the pump using a G 3/8 connection.

5.6 WORKING RANGE

The working range depends on the application and a combination of pressure and temperature. For specific and detailed limits advice the working ranges are described in the chapter 5.3 Modular selection. The overall working range of the pumps can be summarised as follows:

Pump type	VMS	Note
Ambient temperature [°C]	-20 up to 40	1
Minimum inlet pressure	NPSH _{req} + 1m	
Viscosity [cSt]	1-100	2
Density [kg/m ³]	1000-2500	2
Cooling	forced motor cooling	3
Minimum frequency [Hz]	10	
Maximum frequency [Hz]	60	4
Allowable size of solids pumped	5µm to 1mm	

Table 5: Specification of the working range

1. If the ambient temperature exceeds the above value or the motor is located more than 1000 m above sea level, the motor cooling is less effective and could require an adapted motor power. See table 9: Motor load dep. sea level or amb. temp or please contact your supplier for more detailed advice.
2. Deviation in viscosity and/or density could require an adapted motor power. Please contact your supplier for more detailed advice.
3. The free space above the motor cooling fan must be at least 1/4 of the diameter of the inlet of the cooling fan in order to have a sufficient flow of (cooling) air.
4. Pumps that are intended for 50 Hz operation, may not be connected to 60 Hz power supply.

For minimum flow at medium temperature of 20 °C see table 6 Minimum capacity (Q_{min}); for higher temperatures see table

Table 6: Minimum capacity (Q_{min})

Size	Q _{min} [m ³ /h]			
	50 Hz		60 Hz	
	2 pole	4 pole	2 pole	4 pole
2	0.2		0.2	
4	0.4		0.5	
6	0.6		0.8	
10	1.1	0.5	1.3	0.6
15	1.6	0.8	2.0	1.0
85	8.5	4.3	10.2	5.1

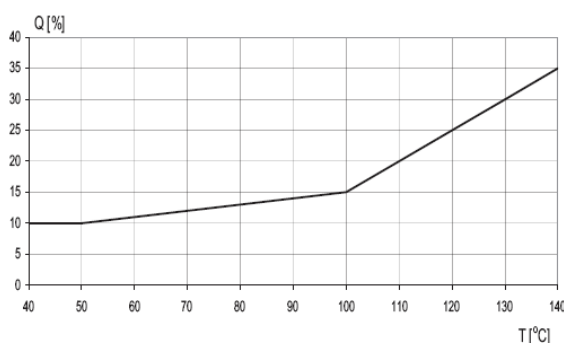


Figure 5: Minimum capacity vs. temperature (in % of Q optimum)

5.7 EXPLOSION SAFETY



ATTENTION

This sub chapter contains fundamental information which has to be taken in consideration when installing the pump with ATEX permission in a hazardous environment.

5.7.1 GENERAL

Stickers or indicators on the pump sleeve and the motor indicate whether the pump is suitable for use in an environment with risk of explosion.

It is allowed to install the pump in a zone which is classified in directive 1999/92/EC.

When in doubt it is compulsory to check the above directive.

5.7.1 INDICATION



Figure 6: Indication sticker explosion safety

Table 7: Explosion safety

Indication	Meaning
II	Product group for use above ground, with the exception of mine working where there can be danger of explosion due to mine gas and/or flammable substances.
2	Category 2: Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists or by air/dusts mixtures are likely to occur.
G	Suitable for an environment that is explosive due to gas, vapour or fumes; not suitable for an environment that is explosive due to dust.
T4/T3	Temperature class: T4 for medium temperatures up to 100° C; T3 for medium temperatures up to 60° C



ATTENTION

When the pump is placed in an explosion hazardous environment no pump should be opened or disassembled on site. Due to the probable creation of sparks during loosening and tightening of nuts and bolts.

5.7.3 COMMISSIONING (CHECK LIST)

It is compulsory to check these points prior putting the pump in operation.

- Check if the ATEX-data on the motor and the pump are in line with the specified category. See table 8 ATEX-Categories 13.
- When the categories of the motor and the pump are different, the lowest category is leading.
- For category 2: make sure that the pump is protected against damage from outside.
- Check that the motor cable is suitable for the current drawn by the motor. See: motor type plate.
- Check that the pump is fully filled with the liquid (de-aerated). Do not run the pump dry.
- Check the rotational direction of the motor. The motor has to run clockwise (seen from the non driven side). This direction is indicated with an arrow on the pump top bracket.
- Make sure that the liquid temperature never exceeds the temperature mentioned in the explosion safety code T3 or T4. See table 7 Explosion safety 12.
- Avoid overheating of the pump to ensure a minimum flow in the pump according with the description in chapter 5.6 Working range 11.
- The pumps has to be de-aerated again when:
 - The pump is taken out of operation.
 - Some air has gathered in the pump.
- Make sure that the pump and the motor shaft are running smoothly and without excessive noise (e.g. no parts are running against each other).
- Make sure that the pump is connected to ground.

Table 8: ATEX-Categories

Group	Category	Zone	Pumps	Motors
I	M	1	None	none
		2	None	none
II	1	G	0	None
		D	20	None
	2	G	1	V(C/S) 2G Eex e T3 2G Eex d T4
		D	21	None
	3	G	2	V(C/S) 2G Eex e T3 2G Eex d T4
		D	22	None

6.0 TRANSPORT

6.1 TRANSPORT

1. Transport the pump in the position as indicated on the pallet or packaging.
2. Make sure the pump is stable.
3. If present, observe the instructions on the packaging.



WARNING

Lift the pump, if necessary using a hoist and suitable slings. Attach the slings to the transport lugs on the packaging, where present.



WARNING

The pump must be lifted according to the current hoist guidelines. Only qualified personnel is allowed to lift the pump.



WARNING

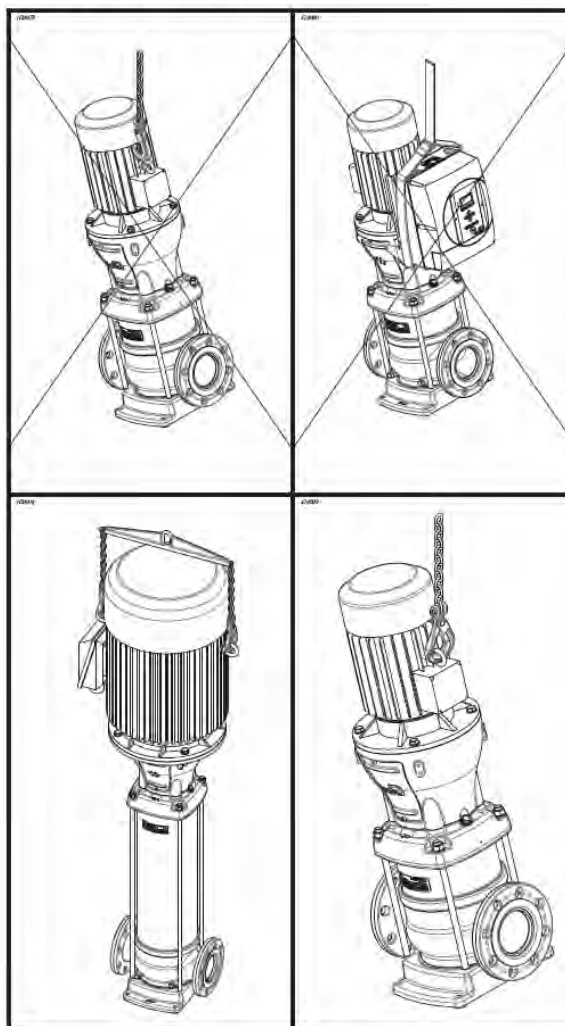
Do not lift the pump by using the frequency converter (if placed), electrical parts or the motor cover. Be sure that the pump is always in balance.



WARNING

Pumps could tilt while lifting. Do not remove the lifting devices from the pump before the pump is placed and mounted correctly.

Table 9: Transport positions



6.2 STORAGE

Fill the pump with glycol in order to protect it against the risk of frost.

Table 10: Storage

Storage	
t _{ambient} [°C]	-10/40
Max. rel. humidity [%]	80% at 20°C not condensing

6.2.1 INSPECTION DURING STORAGE

1. Turn the shaft every three months and just before putting into operation.

7.0 INSTALLATION INSTRUCTIONS

7.1 SETTING UP THE PUMPS



ATTENTION

Make sure that the pump connections are not over-stressed at the inlet and outlet connections. Please see the table below.

Table 11: Allowable forces VMS(S)F

Type	DN [mm]	Force [N]			
		F _x	F _y	F _z	ΣF
V(S)F 2 B	25	3300	2400	1700	4400
V(S)F 4 B	25	3300	2400	1700	4400
V(S)F 6 B	32	3300	2400	1700	4400
V(S)F 10 B	40	4000	3100	3100	5900
V(S)F 15 B	50	4000	3100	3100	5900
V(S)F 85 B	100	3500	2500	1000	4400

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Table 12: Allowable torque VMS(S)F

Type	DN [mm]	Moment [Nm]			
		M _x	M _y	M _z	ΣM
V(S)F 2 B	25	280	95	210	400
V(S)F 4 B	25	280	95	210	400
V(S)F 6 B	32	280	95	210	400
V(S)F 10 B	40	440	180	200	500
V(S)F 15 B	50	440	180	200	500
V(S)F 85 B	100	750	500	625	1100

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Table 13: Allowable forces VMSCF

Type	DN [mm]	Force [N]			
		M _x	M _y	M _z	ΣM
VCF 2 B	25	9400	3200	3200	10400
VCF 4 B	25	9400	3200	3200	10400
VCF 6 B	32	9400	3200	3200	10400
VCF 10 B	40	11000	2000	6500	12900
VCF 15 B	50	11000	2000	6500	12900
VCF 85 B	100	60000	40000	40000	82500

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Table 14: Allowable torque Armstrong VCF

Type	DN [mm]	Moment [Nm]			
		M _x	M _y	M _z	ΣM
VCF 2 B	25	600	300	360	800
VCF 4 B	25	600	300	360	800
VCF 6 B	32	600	300	360	800
VCF 10 B	40	460	460	1000	1200
VCF 15 B	50	460	460	1000	1200
VCF 85 B	100	3600	6100	4800	8600

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ATTENTION

For the values mentioned in the tables above, it is assumed that they occur simultaneously.

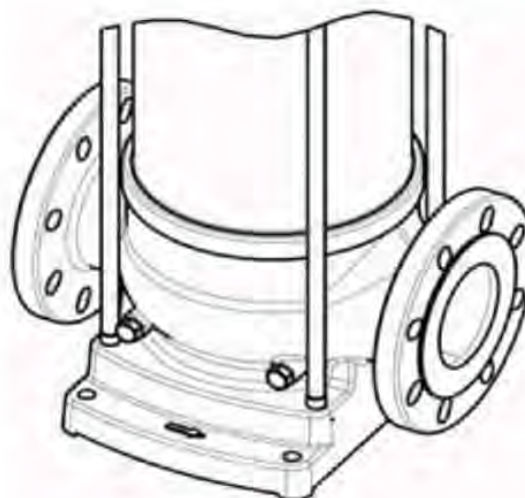


Figure 7: Allowable forces



ATTENTION

Pumps which do not stand steady or stable on their own, should be mounted on a rigid and stable base.



ATTENTION

Locate the pump at the place with the lowest risk for noise nuisance.

1. Place and install the pump on a level, stable surface in a dry and frost-free room.
2. Make sure that sufficient air can reach the cooling fan of the motor. For this purpose the free space above the cooling fan should be at least 1/4 of the diameter of the fan cover air intake.
3. Install the pump with counter flanges. For pumps with non-standardised connections, counter flanges are delivered separately.
4. It is advised to install a valve on the supply and on the delivery connection of the pump.
5. To avoid medium flowing back through the pump, when idle, make sure a non-return valve is installed.
6. Make sure that the inlet of the pump is never clogged.

7.1.1 INDICATORS

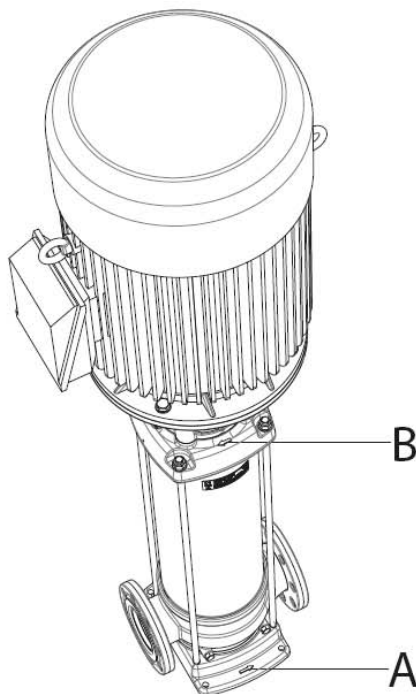


Figure 8: Pump indicators

The arrow (A) on the pump foot indicates the flow direction of the liquid. The arrow (B) on the top bracket indicates the rotating direction of the motor.

7.1.2 INSTALL BYPASS

Install a bypass if the pump operates against a closed valve. The required capacity of the bypass is at least 10% of the optimum volume flow. At high operating temperatures a higher volume flow is required. Refer to the table "Minimum volume flows" in the paragraph "Working range".

7.2 MOUNTING A MOTOR ON THE PUMP



ATTENTION

It is advised to use a specially designed Armstrong motor. Before installing an other brand/standard IEC-norm motor, Armstrong has to be consulted to verify the applicability.

The motor has to conform to the following conditions:

- Reinforced bearing at driven end (to withstand the axial force)
- Axially fixed rotor (to minimize the axial play of the pumps hydraulic)
- Smooth shaft, no key lock (to improve the coupling grip and to improve the motor balance)

The advised bearings per motor type are:

Table 15: Minimum required motor Driven-end Bearing

Bearing type			
Power output	1 phase 50 Hz	3 phase 50/60 Hz	
[kW]		2 pole	4 pole
0.25			6203-2Z-C3
0.37	6202-2Z-C3	6203-2Z-C3	6203-2Z-C3
0.55	6202-2Z-C3	6203-2Z-C3	6204-2Z-C3
0.75	6204-2Z-C3	6204-2Z-C3	6204-2Z-C3
1.1	6305-2Z-C3	6204-2Z-C3	6305-2Z-C3
1.5	6305-2Z-C3	6305-2Z-C3	6305-2Z-C3
2.2	6305-2Z-C3	6305-2Z-C3	6306-2Z-C3
3		6306-2Z-C3	6306-2Z-C3
4		6306-2Z-C3	6306-2Z-C3
5.5		6308-2Z-C3	6308-2Z-C3
7.5		6308-2Z-C3	6308-2Z-C3
11		7309-BEP	
15		7309-BEP	
18.5		7209-BEP	
22		7311-BEP	
30		7312-BEP	
37		7312-BEP	
45		7313-BEP	

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Or use a thrust bearing housing.

7.3 ELECTRICAL INSTALL



WARNING

Only authorised personnel is allowed to make electrical connections to the motor. This is in accordance with the local regulations.



ATTENTION

Connect the motor according to table and always check the rotation direction.

$V \sim$ (M)	1x 230V	$V \sim$ (M)	3x 230V	3x 400V
230V		230/400V		
		400/692V		

Figure 9: Motor connections

PTC connection STM 140 EK:

- Standard motors 3 kW and up are equipped with a PTC thermistor. Consult Table 16 Technical specifications PTC STM 140 EK.
- Connect the PTC on a thermistor relay.

Table 16: Technical specifications PTC STM 140 EK

	Value
t_h [°C]	140
$R_{20\text{ °C}}$ [Ω]	~ 20
$R_{tn-20\text{ °C}}$ [Ω]	~ 250
$R_{tn+5\text{ °C}}$ [Ω]	< 550
$R_{tn+5\text{ °C}}$ [Ω]	> 1330
$R_{tn+15\text{ °C}}$ [Ω]	> 4000
U_n [VDC]	$2.5 < U < 30$

Electrical connections:

- Make sure that the motor specifications correspond with the power supply to which the pump motor is connected. Consult "Electrical diagrams" in the annexes for the correct connection diagram.
- Connect the motor using a motor safety switch.

7.4 COMMISSIONING



WARNING

The pump must not be switched on when it is not completely filled up.



ATTENTION

Seen from the top of the motor the pump should rotate clockwise. See 7.1.1 Indicators 16 (B). In case of a 3-phase motor the rotating direction can be changed by exchanging two of the three phase wires.

7.4.1 IN AN OPEN OR CLOSED CIRCUITE WITH SUFFICIENT SUPPLY PRESSURE

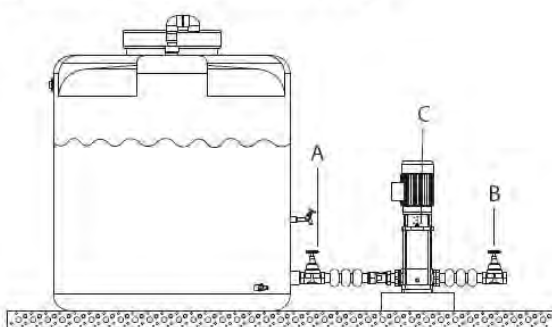


Figure 10: Pump with open or closed circuit

1. Close the suction shut-off valve (A) and the outlet shut-off valve (B).
2. Open the fill plug (C).
3. Gradually open the suction shut-off valve until the liquid flows from the fill plug (C).
4. Close the fill plug.
5. Fully open the suction shut-off valve.
6. Check the rotational direction of the pump.
7. Fully open the outlet shut-off valve.

7.4.1 IN AN OPEN CIRCUITE WITH LIQUID LEVEL LOWER THAN THE PUMP

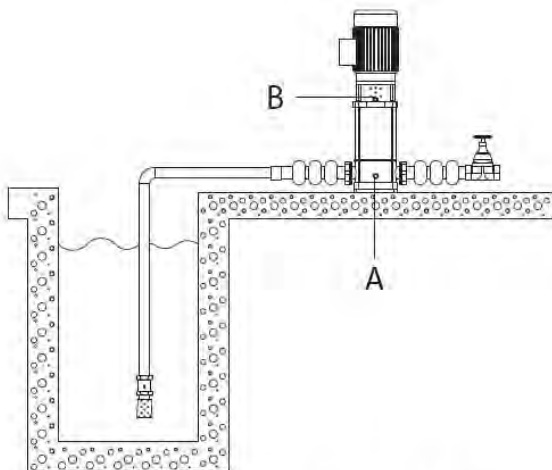


Figure 11: Liquid level lower then pump

1. Remove the fill plug (B) from the top bracket.
2. Close the outlet shut-off valve.
3. Fill the pump housing to the maximum through the fill plug with the liquid that is to be pumped.
4. Insert the fill plug in the top bracket.
5. Check the rotational direction of the pump.
6. Open the outlet shut-off valve.

7.4.3 AFTER AN EXTENDED PERIOD OF NON-OPERATION OR STORAGE

During first start-up, check the mechanical seals for leakage due to seizure or dehydration of the lubricating film. If so, please proceed as following:

1. Turn shaft manually or;
2. Start up the pump, then open and close the outlet shut-off valve quickly during operation.
3. Check if the mechanical seal is still leaking.

If the shaft is still leaking:

1. Disassemble the mechanical seal.
2. Thoroughly clean and decrease the running surfaces.
3. Assemble the mechanical seal again and retry start-up.

If this doesn't solve the shaft leakage, replacement of the mechanical seal is necessary.

8.0 OPERATION

8.1 OPERATION

The pump is controlled externally and therefore does not need any operation guidance.

9.0 MAINTENANCE

9.1 INTRODUCTION



WARNING

Observe the general safety precautions for installation, maintenance and repair.

Regular maintenance is necessary for the correct operation of a pump. For maintenance of the pump, please contact your supplier.

9.2 LUBRICATION

Standard motors, with a maximum power of 7.5 kW, are provided with maintenance free sealed bearings.

Motors with lubricating nipples must be lubricated after 2000 hours. If the pump works under extreme conditions, such as vibrations and high temperatures, the motors must be lubricated more often.

Use a lithium based -30 °C / 160 °C bearing lubricant (about 15 grams).

When the pump is delivered without a motor and fitted with an other brand or the standard motor is replaced by an other brand than Armstrong, please consult the maintenance instructions of the motor supplier.



ATTENTION

Also follow the instructions in § 7.2 Mounting a motor on the pump.

9.3 MAINTAINING THE PUMP FOR AN EXTENDED PERIOD OF NON-OPERATION

Turn the shaft every three months. This protects the seals from seizure.

Protect the pump against if there is a risk of frost. Proceed as follows:

1. Close all pump valves.
2. Drain each pump and/or the system.
3. Remove all plugs from the pump.
4. Open the shut-off and fill/air vent plug, if present.

10.0 FAILURES

10.1 FAILURES TABLE



WARNING

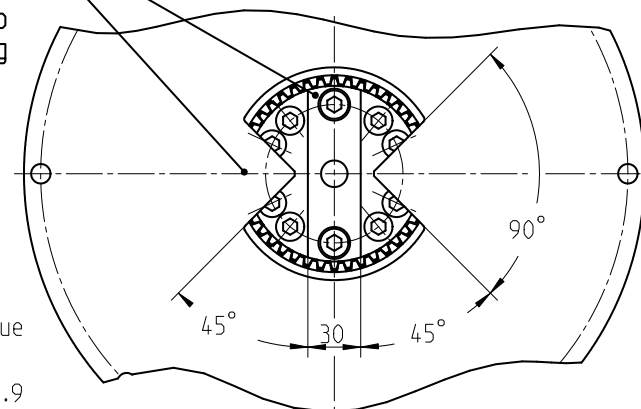
Observe the general safety precautions before install, maintenance and repair.

Problem	Possible cause	Possible solution	Checkpoints
Leakage along the shaft	Running surfaces of the mechanical seal worn or damaged	Replace the mechanical seal.	Check the pump for dirt - abrasive parts.
	New pump: seal stuck due to assembly	Open and close the outlet shut-off valve quickly during operation	
	Mechanical seal mounted incorrectly	Install the mechanical seal correctly. Use water and soap as a lubricant	
	Elastomers affected by medium	Use the right rubber compound for the mechanical seal	
	Pressure too high	Use the right type of mechanical seal	
	Shaft worn	Replace shaft and mechanical seal	
	Pump has been operating without water	Replace the mechanical seal	
Leakage along the shroud at the top bracket or at the pump foot	O-ring worn	Replace the O-ring	
	O-ring not resistant to the medium to be pumped	Replace O-ring by an O-ring with better resistance	
	Too much tension on the pump foot; it becomes oval	Decrease tension on piping Mount the pump foot tensionless Support the connections	

Problem	Possible cause	Possible solution	Checkpoints
Pump is vibrating or noisy	Coupling mounted incorrectly	Install the coupling in parallel	
	Faulty setting of the hydraulic assembly	Adjust the assembly according to the manual	
	There is no water in the pump	Fill and vent the pump	
	No supply	Make sure there is sufficient supply. Check for blockages in the supply line	
	Bearings of pump and/or motor worn	Have the bearings replaced by a certified company	
	Available NPSH too low (cavitation)	Improve suction condition	
	Pump does not work in its working range	Select another pump or adjust the system to work within its working range	
	Pump is standing on an uneven surface	Level the surface	
Malfunction	Internal blockage in the pump	Have the pump inspected by a certified company	
Pump does not start	No voltage on the terminal clamps	Check the power supply	• Circuit • Main switch • Fuses
		Check the motor safety relay	• Earth leakage switch • Protective relay
	Thermal motor safety switch triggered	Reset the thermal motor-safety. Contact the supplier, if this problem occurs more often.	Check if the correct value is set. Find the correct value (I_{nom}) on the motortype plate
The motor is running, but the pump does not work	The pump shaft has broken	Contact the supplier	
	The coupling between pump- and motor shaft is loose	Tighten the connecting screws to the recommended torque	

Problem	Possible cause	Possible solution	Checkpoints
Pump supplies insufficient capacity and/or pressure	Outlet and/or inlet shut-off valve is closed	Open both shut-off valves	
	There is air in the pump	Vent the pump	
	The suction pressure is insufficient	Increase the suction pressure	
	Pump rotates in the wrong direction	Change over L1 and L2 of the three phase supply.	
	The suction line has not been vented	Vent the suction line	
	Air bubble in the suction line	Install the suction line with pump end higher than the other end	
	Pump sucks air because of leakage in the suction line	Repair the leakage	
	Too little water consumption so air bubbles clog up in the pump	Make sure the consumption increases or use a smaller pump	
	The diameter of the suction line is too small	Increase the diameter of the suction line	
	Capacity of water meter in the supply line is too small	Increase the capacity of the water meter	
	Foot valve blocked	Clean the foot valve	
	The impeller or the diffuser is blocked	Clean the inside of the pump	
	O-ring between impeller and diffuser is gone	Replace the O-rings	
	O-ring not resistant to the medium to be pumped	Replace O-ring by an O-ring with better resistance	

7:20



	gezeichnet drawn	Werkstoff Material	NR-57SHA	Kz	Lfd.-Nr. Current number	Index Rev.	
Datum Date	30.05.17	Norm Standard		M	623617	3	
Name	VA	Gewicht Weight					





KTR-Group

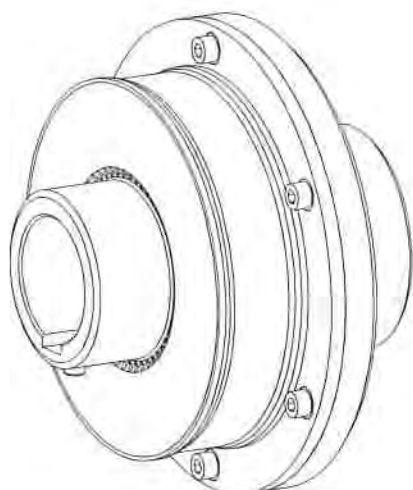
BoWex-ELASTIC®
Operating/Assembly instructions
Type HEW, HEW Compact and HEW-ZS

KTR-N 40114 EN
Sheet: 1 of 22
Edition: 7

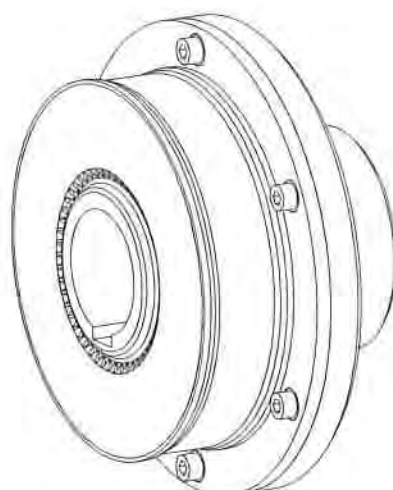
BoWex-ELASTIC®

highly flexible flange coupling type
HEW1, HEW2 and their combinations

according to directive 2014/34/EU
for finish bored, pilot bored and unbored couplings



Type HEW1

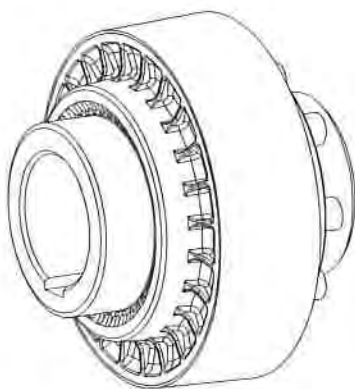


Type HEW2

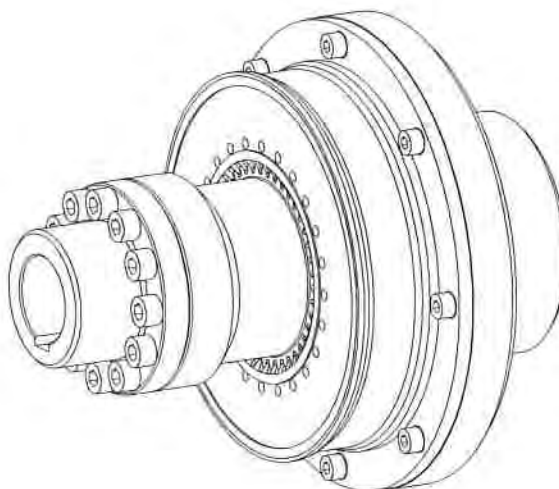
BoWex-ELASTIC®

highly flexible flange coupling types
HEW Compact and HEW-ZS and their combinations

for finish bored, pilot bored and unbored couplings



Type HEW Compact



Type HEW-ZS

Please observe protection
note ISO 16016.

Drawn: 2017-04-24 Shg/Hk
Verified: 2017-04-24 Shg

Replacing: KTR-N dated 2013-06-10
Replaced by:

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BoWex-ELASTIC® HEW is a highly flexible plug-in shaft coupling. It dampens torsional vibrations, reduces shocks and insulates structure-borne noise.

The **BoWex-ELASTIC® HEW** coupling compensates for relatively large shaft displacements, for example caused by inaccuracies in production, thermal expansion etc.

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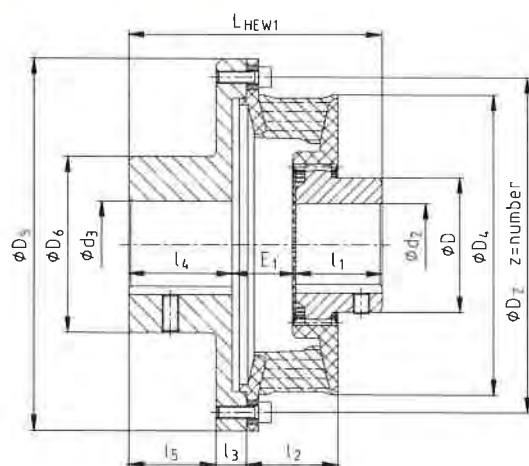
1 Technical data


Illustration 1: BoWex-ELASTIC® type HEW1

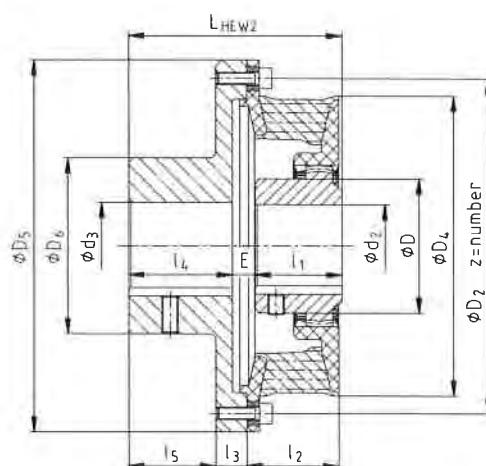


Illustration 2: BoWex-ELASTIC® type HEW2

Table 1: Dimensions – type HEW1 and HEW2

Size	Max. finish bore [mm]		Dimensions [mm]								
	d ₂	d ₃	D	D ₂	z x M		D ₄	D ₅	D ₆	l ₁	l ₂
42	48	50	68	162	6	M6	146	180	85	50	45
48	48	55	68	180	8	M6	164	200	92	50	45
65	65	75	96	224	8	M8	205	245	125	70	55
80	80	80	124	295.27	8	M10	266	318	130	90	70
G 80	85	95	124	333.4	8	M10	302	358	145	90	80
100	100	110	152	438.15	8	M12	350	478	158	110	80
125	125	125	192	438.15	16	M12	416	478	175	140	99
G 125	125	125	192	489	8	M12	440	530	175	140	95
150	160	160	225	542.9	6	M16	470	585	225	150	100
G 150	160	160	225	542.9	6	M16	504	585	225	150	108
200	180	200	250	641.35	12	M16	568	683	280	175	149
G 200	180	200	200	250	12	M16	600	683	280	175	149

Table 1: Continuation of Dimensions – type HEW1 and HEW2

Size	Dimensions [mm]							Weight with max. bore [kg]	Mass moment of inertia [kgm ²]	
	l ₃	l ₄	l ₅	E	E ₁	L _{HEW} ¹	L _{HEW} ²		J _A	J _L
42	15	50	42	4	32	132	104	4.3	0.0121	0.0015
48	17	55	45	4	32	137	109	5.5	0.0204	0.0019
65	28	75	63	5	42	187	150	13.2	0.0752	0.0071
80	17	80	70	5	45	215	160	19.7	0.1449	0.0285
G 80	22	90	78	5	55	235	185	25.9	0.2748	0.0422
100	14	111.5	113	26	57	278	207	48.5	0.8356	0.1050
125	14	170	158	-	45	327	-	67.2	0.9498	0.2617
G 125	14	170	158	-	45	327	-	76.6	1.4492	0.3034
150	18	150	145	-	70	380	-	110	2.7206	0.5303
G 150	18	150	145	-	70	380	-	113.4	2.7809	0.5861
200	26	220	214	-	85	480	-	195	6.6418	1.1406
G 200	26	220	214	-	85	480	-	200	6.6099	1.3419

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BoWex-ELASTIC®
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1 Technical data**Table 2: Torques – type HEW1 and HEW2**

Size	Elastomer hardness [Shore A]	Torque [Nm]		Size	Elastomer hardness [Shore A]	Torque [Nm]	
		T _{KN}	T _{K max}			T _{KN}	T _{K max}
42	40 / T40	130	390	125	40 / T40	3000	9000
	50 / T50	150	450		50 / T50	4000	12000
	65 / T65	180	540		65 / T65	5000	15000
48	40 / T40	200	600	G 125	40 / T40	4000	12000
	50 / T50	230	690		50 / T50	5200	16000
	65 / T65	280	840		65 / T65	6500	20000
65	40 / T40	350	1050	150	T40	5500	16500
	50 / T50	400	1200		T50	7000	21000
	65 / T65	500	1500		T65	9000	27000
80	40 / T40	750	2250	G 150	T40	7000	21000
	50 / T50	950	2850		T50	9200	27600
	65 / T65	1200	3600		T65	11500	34500
G 80	40 / T40	1250	3750	200	T40	9500	28500
	50 / T50	1600	4800		T50	12500	37500
	65 / T65	2000	6000		T65	16000	48000
100	40 / T40	2000	6000	G 200	T40	11500	34500
	50 / T50	2500	7500		T50	15000	45000
	65 / T65	3200	9600		T65	19500	58500

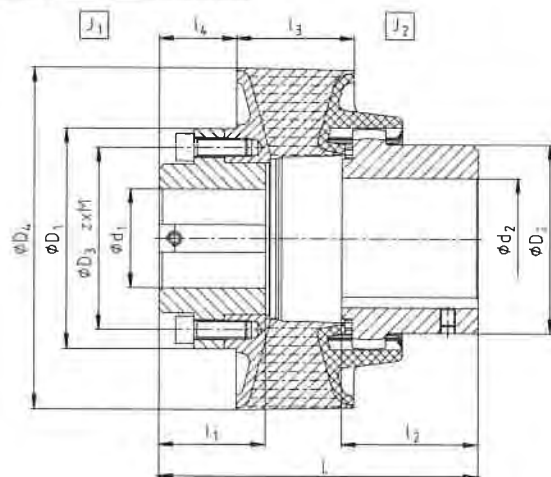
BoWex® HEW Compact

Illustration 3: BoWex-ELASTIC® type HEW1

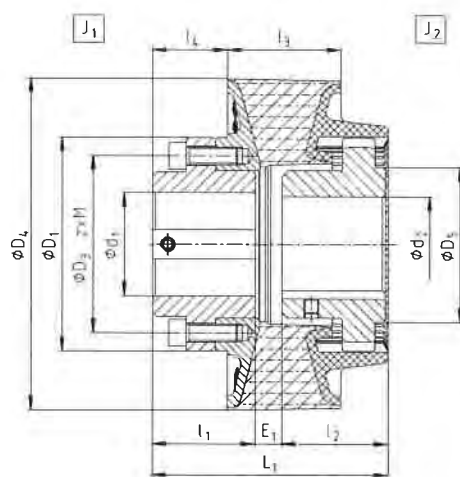


Illustration 4: BoWex-ELASTIC® type HEW2

Table 3: Dimensions – type HEW Compact

Size	Max. finish bore [mm]		Dimensions [mm]													Weight with pilot bored coupling [kg]	Mass moment of inertia with pilot bored coupling [kgm ²]	
	d ₁	d ₂	D ₁	D ₂	D ₃	D ₄	l ₁	l ₂	l ₃	l ₄	E	L	L ₁	z	M		J ₁	J ₂
42-130	42	42	90	65	78	131	42	42	45	37	34	118	98	6	M6	3.4	0.003	0.001
65-180	65	65	130	96	110	180	60	55	55	47	30	145	122	8	M10	9.0	0.014	0.006
80-225	75	80	145	124	120	225	70	90	77	51	50	210	158	10	M12	18.9	0.035	0.029
100-305	100	100	200	152	175	305	90	110	90	73	58	258	187	16	M12	40.2	0.152	0.087
125-365	125	125	235	192	205	365	120	140	150	90	68	328	240	12	M16	75.0	0.36	0.26

Please observe protection
note ISO 16016.

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1 Technical data**Table 4: Technical data - HEW Compact**

Size	Elastomer hardness [Shore A]	Torque			Operating speed n_{max} [rpm]	Perm. damping power P_{KW} [W]			C_{dyn} with 60 °C [Nm/rad]	Relative damping ψ	Resonance factor $V_R \approx 2 \cdot \pi/\psi$	Radial spring stiffness C_r [N/mm]
		T_{KN} [Nm]	T_{Kmax} [Nm]	T_{KW} [Nm]		60 °C	80 °C	90 °C				
42	T50	150	450	45	7300	24	12	6	780	0.6	10.5	178
	T65	180	540	54					2400	0.8	7.9	600
	T70	210	630	63					2900	1.2	5.2	710
65	T50	400	1200	120	5500	48	24	12	2850	0.6	10.5	379
	T65	500	1500	150					7800	0.8	7.9	955
	T70	575	1725	173					9500	1.2	5.2	1240
80	T50	900	2700	270	4400	96	48	24	5000	0.6	10.5	420
	T65	1100	3300	330					13000	0.8	7.9	1090
	T70	1300	3900	390					16500	1.2	5.2	1450
100	T50	2000	6000	600	3200	156	78	39	17000	0.6	10.5	760
	T65	2600	7800	780					44000	0.8	7.9	1850
	T70	3000	9000	900					50000	1.2	5.2	2250
125	T40	3000	9000	900	2900	192	96	48	15000	0.6	10.5	476
	T50	4000	12000	1200					25000	0.8	7.9	750
	T65	5000	15000	1500					62000	1.2	5.2	1930

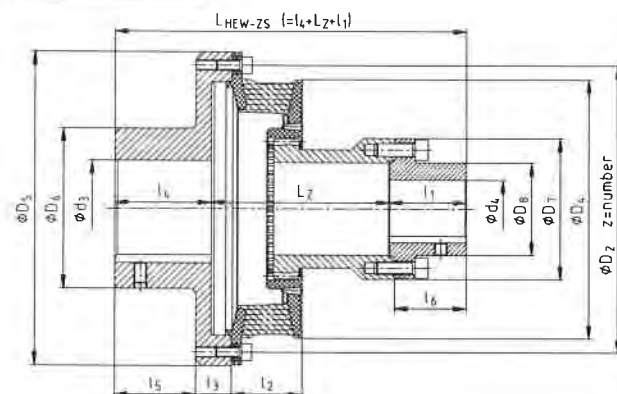
BoWex® HEW-ZS

Illustration 5: BoWex-ELASTIC® type HEW-ZS (size 48 to G 80)

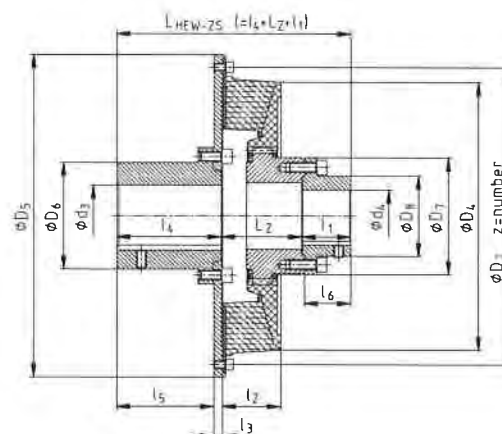


Illustration 6: BoWex-ELASTIC® type HEW-ZS (size 100 to G 125)

Table 5: Dimensions – type HEW-ZS¹⁾

Size	Max. finish bore [mm]		Dimensions [mm]										
	d ₃	d ₄	D ₂	z x M		D ₄	D ₅	D ₆	D ₇	D ₈	l ₁	l ₂	l ₃
48	55	28	180	8	M6	164	200	92	78	45	50	45	17
65	75	45	224	8	M8	205	245	125	110	72	55	55	28
80	80	65	295.27	8	M10	266	318	130	145	100	90	70	17
G 80	95	65	333.4	8	M10	302	358	145	145	100	90	80	22
100	110	90	438.15	8	M12	350	478	158	180	135	80	80	16
125	125	120	438.15	16	M12	416	478	175	225	180	80	99	18
G 125	125	120	489	8	M12	440	530	175	225	180	80	95	15

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1 Technical data

Table 5: Continuation of Dimensions – type HEW-ZS¹⁾

Size	Dimensions [mm]			Spacer HEW-ZS L _Z [mm]					Weight with max. bore [kg]	Mass moment of inertia [kgm ²]	
	l ₄	l ₅	l ₆	100	120	140	180	250		J _A	J _L
48	55	45	45	●	●				6.9	0.0203	0.0050
65	75	63	56		●	●			16.0	0.0747	0.0160
80	80	70	75			●	●		25.5	0.1447	0.0699
G 80	90	78	75				●	●	34.2	0.2752	0.1412
100	111.5	110	76				●	●	54.0	0.8459	0.0992
125	170	171	76				●	●	84.2	1.1814	0.3017
G 125	170	157	76				●	●	93.5	1.6853	0.3690

¹⁾ Torques of BoWex-ELASTIC® type HEW-ZS see table 2.



BoWex-ELASTIC® couplings with attachments that may generate heat, sparks and static charging (e. g. combinations with brake drums, brake disks, overload systems such as torque limiters, fans etc.) are not permissible for the use in potentially explosive atmospheres. A separate analysis must be performed.

2 Advice

2.1 Coupling selection



For a long-lasting and failure-free operation of the coupling it must be selected according to the selection instructions (according to DIN 740 part 2) for the particular application (see catalogue drive technology "BoWex-ELASTIC®").

If the operating conditions (performance, speed, modifications on engine and machine) change, the coupling selection must be reviewed.

Please make sure that the technical data regarding torque refer to the elastomer part only. The transmittable torque of the shaft-hub-connection must be reviewed by the customer and is subject to his responsibility.

For drives subject to torsional vibrations (drives with cyclic stress due to torsional vibrations) it is necessary to perform a torsional vibration calculation to ensure a reliable selection. Typical drives subject to torsional vibrations are e. g. drives with diesel engines, piston pumps, piston compressors etc. If requested, KTR will perform the coupling selection and the torsional vibration calculation.

2.2 General advice

Please read through these operating/assembly instructions carefully before you start up the coupling.

Please pay special attention to the safety instructions!



The **BoWex-ELASTIC®** coupling is suitable and approved for the use in potentially explosive atmospheres. When using the coupling in potentially explosive atmospheres, please observe the special advice and instructions regarding safety in enclosure A.

The operating/assembly instructions are part of your product. Please store them carefully and close to the coupling.

The copyright for these operating/assembly instructions remains with **KTR**.

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2 Advice

2.3 Safety and advice symbols



Warning of potentially explosive atmospheres

This symbol indicates notes which may contribute to preventing bodily injuries or serious bodily injuries that may result in death caused by explosion.



Warning of personal injury

This symbol indicates notes which may contribute to preventing bodily injuries or serious bodily injuries that may result in death.



Warning of product damages

This symbol indicates notes which may contribute to preventing material or machine damage.



General advice

This symbol indicates notes which may contribute to preventing adverse results or conditions.



Warning of hot surfaces

This symbol indicates notes which may contribute to preventing burns with hot surfaces resulting in light to serious bodily injuries.

2.4 General hazard warnings



With assembly, operation and maintenance of the coupling it has to be made sure that the entire drive train is secured against accidental switch-on. You may be seriously hurt by rotating parts. Please make absolutely sure to read through and observe the following safety indications.

- All operations on and with the coupling have to be performed taking into account "safety first".
- Please make sure to switch off the power pack before you perform your work on the coupling.
- Secure the power pack against accidental switch-on, e. g. by providing warning signs at the place of switch-on or removing the fuse for current supply.
- Do not reach into the operating area of the coupling as long as it is in operation.
- Please secure the coupling against accidental contact. Please provide for the necessary protection devices and covers.

2.5 Intended use

You may only assemble, operate and maintain the coupling if you

- have carefully read through the operating/assembly instructions and understood them
- had technical training
- are authorized by your company

The coupling may only be used in accordance with the technical data (see table 1 to 4 in chapter 1). Unauthorized modifications on the coupling design are not admissible. We will not assume liability for any damage that may arise. In the interest of further development we reserve the right for technical modifications.

The **BoWex-ELASTIC® type HEW, HEW Compact and HEW-ZS** described in here corresponds to the technical status at the time of printing of these operating/assembly instructions.

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2 Advice**2.6 Reference to EC Machinery Directive 2006/42/EC**

The couplings supplied by KTR should be considered as components, not machines or partly completed machines according to EC Machinery Directive 2006/42/EC. Consequently KTR does not have to issue a declaration of incorporation. For details about safe assembly, start-up and safe operation please refer to the present operating/assembly instructions considering the warnings.

3 Storage, transport and packaging**3.1 Storage**

The coupling hubs are supplied in preserved condition and can be stored at a dry and roofed place for 6 - 9 months.

With favourable storage conditions the properties of the elastomer part remain unchanged up to 5 years.



The storage rooms must not include any ozone-generating devices like e. g. fluorescent light sources, mercury-vapour lamps or electrical high-voltage appliances.

Humid storage rooms are not suitable.

Please make sure that condensation is not generated. The best relative air humidity is less than 65 %.

3.2 Transport and packaging

In order to avoid any injuries and any kind of damage please always make use of proper transport and lifting equipment.

The couplings are packed differently each depending on size, number and kind of transport. Unless otherwise contractually agreed, packaging will follow the in-house packaging specifications of KTR.

4 Assembly

The coupling is generally supplied in individual parts. Before assembly the coupling has to be inspected for completeness.

4.1 Components of the couplings**Components of BoWex-ELASTIC®, type HEW1 and HEW2**

Component	Quantity	Description
1	1	Elastomer part
2	1	Hub
4	1	Coupling flange
5	see table 1 ¹⁾	Cap screws DIN EN ISO 4762 ¹⁾
7	2	Setscrews DIN EN ISO 4029

¹⁾ With size 150 nuts as per DIN EN ISO 4014 are required additionally.

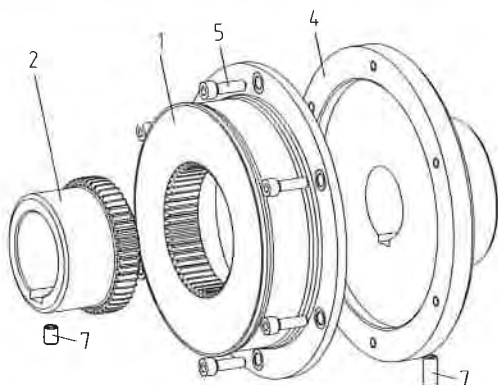


Illustration 7: BoWex-ELASTIC® type HEW1

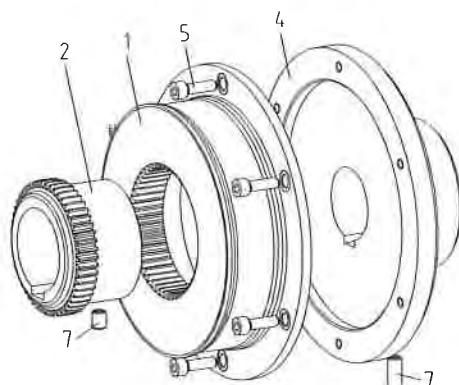


Illustration 8: BoWex-ELASTIC® type HEW2

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4 Assembly

4.1 Components of the couplings

Components of BoWex-ELASTIC®, type HEW compact

Component	Quantity	Description
1	1	Elastomer part
2	1	Hub
4	1	Coupling flange
5	see table 3	Cap screws DIN EN ISO 4762
7	2	Setscrews DIN EN ISO 4029

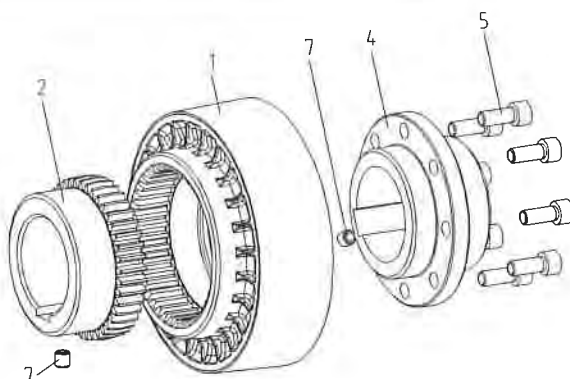


Illustration 9: BoWex-ELASTIC® type HEW Compact

Components of BoWex-ELASTIC®, type HEW-ZS

Component	Quantity	Description
1	1	Elastomer part
2	1	Hub spec.
3	1	Intermediate flange hub
4	1	Coupling flange
4.1	1	Additional flange
4.2	1	Flange hub
4.3	see table 5	Cap screws DIN EN ISO 4762
5	see table 1	Cap screws DIN EN ISO 4762
6	see table 5	Cap screws DIN EN ISO 4762
7	2	Setscrews DIN EN ISO 4029

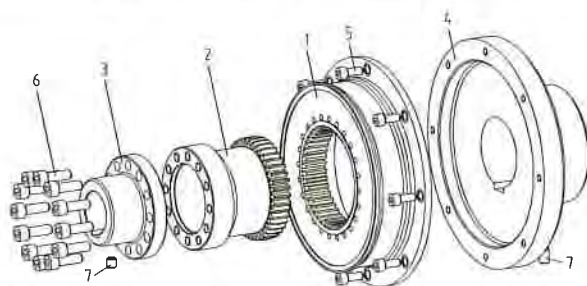


Illustration 10: BoWex-ELASTIC® type HEW-ZS (size 48 to G 80)

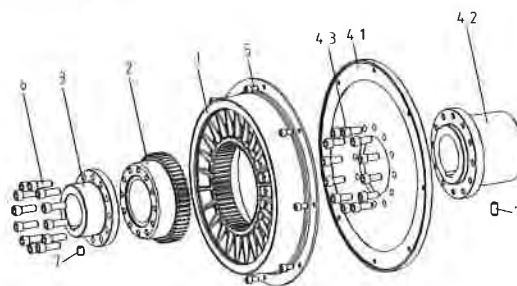


Illustration 11: BoWex-ELASTIC® type HEW-ZS (size 100 to G 125)

Table 6: Cap screws DIN EN ISO 4762

Size	48	65	80	G 80	100	125	G 125
Quantity z (component 4.3)	-	-	-	-	15	12	12
Quantity z (component 6)	8	12	12	12	12	12	12



4 Assembly

4.2 Advice for finish bore



The maximum permissible bore diameters d (see table 1 to 5 in chapter 1 - technical data) must not be exceeded. If these figures are disregarded, the coupling may tear. Rotating particles may cause danger to life.

- Bores on the hubs/coupling flange machined by the customer have to observe concentricity or axial runout (see illustration 12).
- Please make absolutely sure to observe the figures for $\varnothing d_{\max}$.
- Carefully align the hub or coupling flange when the finish bores are drilled.
- Provide for a setscrew according to DIN EN ISO 4029 with a cup point or an end plate to fasten the hub or coupling flange axially.

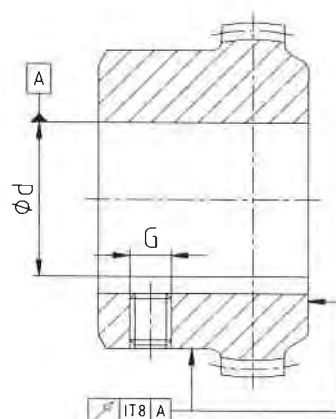


Illustration 12: Concentricity and axial runout



The customer bears the sole responsibility for all machining processes performed subsequently on unbored or pilot bored as well as finish machined coupling components and spare parts. KTR does not assume any warranty claims resulting from insufficient re-machining.

Table 7: Setscrews DIN EN ISO 4029

Size	42	48	65	80	G 80	100	125	G 125	150	G150	200	G 200
Thread size	M8	M8	M10	M10	M10	M12	M16	M16	M16	M16	M20	M20
Tightening torque T_A [Nm]	10	10	17	17	17	40	80	80	80	80	140	140

Table 8: Recommended fit pairs acc. to DIN 748/1

Bore [mm]		Shaft tolerance	Bore tolerance
above	up to		
	50	k6	H7 (KTR standard)
50		m6	

If a feather keyway is intended to be used in the hub, it should correspond to the tolerance ISO JS9 (KTR standard) with normal operating conditions or ISO P9 with difficult operating conditions (frequently alternating torsional direction, shock loads, etc.).

The transmittable torque of the shaft-hub-connection must be reviewed by the customer and is subject to his responsibility.

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4 Assembly

4.3 Assembly of the coupling



We recommend to inspect bores, shaft, keyway and feather key for dimensional accuracy before assembly.



Heating the hubs lightly (approx. 80 °C) allows for an easier mounting on the shaft.



Please pay attention to the ignition risk in potentially explosive atmospheres!



Touching the heated hubs causes burns.
Please wear safety gloves.



With the assembly please make sure that the distance dimension E (see table 1 and 4) is observed to allow for axial clearance of the sleeve while being in operation.
Disregarding this advice may cause damage to the coupling.



With the assembly please make sure that the spline of the hub is fully covered by the internal spline of the elastomer. (Please observe mounting dimensions L, L_{HEW1}, L_{HEW2} or L_{HEW-ZS}.)
Disregarding this advice may cause damage to the coupling.

- **Applies with type HEW-ZS only (size 100 to G 125)!**

Screw the flange hub (component 4.2) with the additional flange (component 4.1) at the tightening torques T_A specified in table 9.

Table 9: Cap screws DIN EN ISO 4762

Size	100	125	G 125
Tightening torque T _A [Nm]	355	355	355

- Mount the hub, flange hub with additional flange or the coupling flange onto the shaft of the driving and driven side.
- Shift the power packs in axial direction until the mounting dimension L, L_{HEW1}, L_{HEW2} or L_{HEW-ZS} has been achieved.
- If the power packs have already been firmly assembled, shifting the hub, flange hub or the coupling flange or coupling flange axially on the shafts allows for adjusting the mounting dimension.
- Fasten the hub, flange hub or coupling flange by tightening the setscrews DIN EN ISO 4029 with a cup point (tightening torques see table 7).
- **Valid for type HEW-ZS only!**
Mount the hub spec. (component 2) in front of the intermediate shaft hub (component 3) and screw the components at the tightening torques T_A specified in table 10.

Table 10: Cap screws DIN EN ISO 4762

Size	48	65	80	G 80	100	125	G 125
Tightening torque T _A [Nm]	41	69	120	120	190	295	295

Please observe protection note ISO 16016.	Drawn: 2017-04-24 Shg/Hk	Replacing: KTR-N dated 2013-06-10
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4 Assembly

4.3 Assembly of the coupling

Valid for type HEW only!

Mount the elastomer part (component 1) in front of the coupling flange (component 4) and screw the components at the tightening torques T_A specified in table 11.

Table 11: Cap screws DIN EN ISO 4762

Size	42	48	65	80	G 80	100	125	G 125	150	G 150	200	G 200
Tightening torque T_A [Nm]	14	14	35	69	69	120	120	120	295	295	410	410

- Position the elastomer part (component 1) in front of the flange hub with additional flange or coupling flange.
- Hand-tighten the components first. Afterwards tighten the screws at the tightening torque T_A specified in table 11.

Valid for type HEW Compact only!

Mount the coupling flange (component 4) in front of the elastomer part (component 1) and screw the components at the tightening torques T_A specified in table 12.

Table 12: Cap screws DIN EN ISO 4762

Size	42	65	80	100	125
Tightening torque T_A [Nm]	14	69	120	120	250



If used in potentially explosive atmospheres the setscrews to fasten the hubs as well as all screw connections must be secured against working loose additionally, e. g. conglomerating with Loctite (average strength).



Please observe the manufacturer's instructions regarding the use of adhesives. Do not apply glue on the rubber surfaces.

4.4 Displacements - alignment of the couplings

The **BoWex-ELASTIC® HEW** couplings accept a position deviation of the machine parts to be connected up to the data specified in table 13.

With alignment, the radial and angular displacement should be kept as small as possible, because the service life is increased in this way if the operating conditions are otherwise maintained.

The **BoWex-ELASTIC® HEW** coupling has to be aligned from the coupling hub on the shaft side towards one of the machined surfaces of the flange hub.



In order to ensure a long service life of the coupling and avoid danger with the use in potentially explosive atmospheres, the shaft ends must be accurately aligned.

Please absolutely observe the displacement figures specified (see table 11).

If the figures are exceeded, the coupling will be damaged.

The more accurate the alignment of the coupling, the longer is its service life.

If used in hazardous areas for the explosion group IIC (marking II 2GD c IIB T X), only half of the displacement figures (see tables 13 and 14) are permissible.



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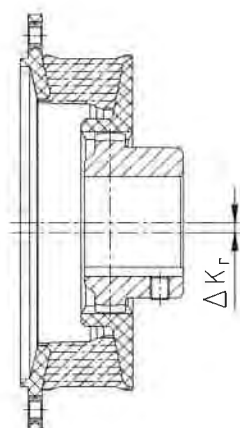


4 Assembly

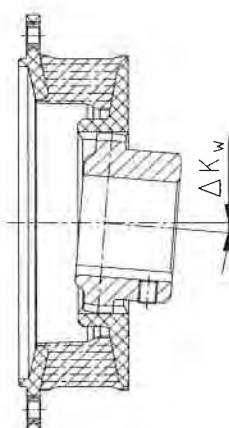
4.4 Displacements - alignment of the couplings

Please note:

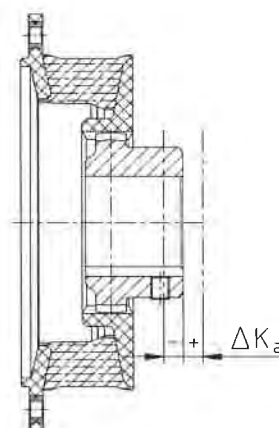
- The displacement figures specified in tables 13 and 14 are maximum figures which must not arise in parallel. If radial and angular displacements arise at the same time, the permissible displacement values may only be used proportionally (see illustration 14).
- The displacement figures specified are general standard figures that apply up to an ambient temperature of 80 °C, ensuring a sufficient service life of the **BoWex-ELASTIC®** coupling.
- Displacement figures between the speeds specified have to be interpolated accordingly. If necessary, please ask about the displacement for the corresponding coupling type.
- Please inspect with a dial gauge, ruler or feeler whether the permissible displacement figures of tables 13 and 14 can be observed.



Radial displacement



Angular displacement



Axial displacement

Illustration 13: Displacements

Examples of the displacement combinations specified in illustration 14:

Example 1:

$$\Delta K_r = 30 \%$$

$$\Delta K_w = 70 \%$$

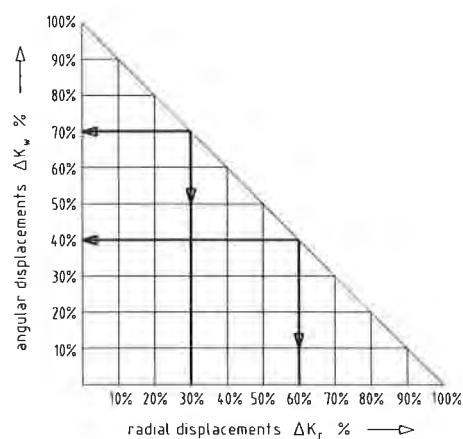
Example 2:

$$\Delta K_r = 60 \%$$

$$\Delta K_w = 40 \%$$

$$\Delta K_{\text{total}} = \Delta K_r + \Delta K_w \leq 100 \%$$

Illustration 14: Combinations of displacement



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BoWex-ELASTIC®
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4 Assembly**4.4 Displacements - alignment of the couplings****Table 13: Displacement figures**

Displacement figures	Elastomer hardness [Shore A]	Size							
		42 HE	48 HE	65 HE G 65 HE	80 HE G 80 HE	100 HE	125 HE G 125 HE	150 HE G 150 HE	200 HE G 200 HE
Perm. radial displacement with n = 1500 rpm ΔK_r [mm]	40 ³⁾	1.1	1.2	1.6	1.8	2.2	2.5	2.8	3.0
	50 ³⁾	1.0	1.1	1.5	1.7	2.0	2.3	2.5	2.7
	65 ^{2) 3)}	0.5	0.5	0.7	0.8	1.0	1.1	1.3	1.5
Perm. radial displacement with n = 3000 rpm ΔK_r [mm]	40 ³⁾	0.8	1.1	1.4	1.6	2.0	2.2	2.5	2.8
	50 ³⁾	0.7	1.0	1.3	1.5	1.8	2.0	2.2	2.5
	65 ^{2) 3)}	0.4	0.4	0.5	0.6	0.8	0.8	1.0	1.2
Max. radial displacement $\Delta K_{r \max}$ [mm] ¹⁾	40 ³⁾	3.6	3.8	5.1	5.7	6.5	7.5	8.0	8.5
	50 ³⁾	3.3	3.5	4.7	5.3	6.0	6.9	7.5	8.0
	65 ^{2) 3)}	1.5	1.7	2.2	2.4	3.0	3.3	4.0	4.5
Perm. angular displacement with n = 1500 rpm ΔK_w [°]	40 ³⁾	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	50 ³⁾	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	65 ^{2) 3)}	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Perm. angular displacement with n = 3000 rpm ΔK_w [°]	40 ³⁾	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	50 ³⁾	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	65 ^{2) 3)}	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Max. angular displacement $\Delta K_{w \max}$ [°] ¹⁾	40 / 50 / 65 ^{2) 3)}	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Perm. axial displacement ΔK_a [mm]	40 / 50 / 65 ^{2) 3)}	±2	±2	±2	±2	±3	±3	±5	±5

¹⁾ For short-term start-up operation²⁾ With size 125 = 70 ShA³⁾ applies for compound T as well**Table 14: Displacement figures of HEW Compact**

Displacement figures	Size														
	42-130			65-180			80-225			100-305			125-365		
Elastomer hardness [Shore A]	T50	T65	T70	T50	T65	T70	T50	T65	T70	T50	T65	T70	T40	T52	T65
Max. axial displacement ΔK_a [mm]	± 2			± 2			± 2			± 2			± 2		
Max. radial displacement with n=1500 rpm ΔK_r [mm] ±	±1.1	±1	±0.5	±1.6	±1.5	±0.7	±1.8	±1.7	±2.2	±2.2	±2	±1	±2.5	±2.3	±1.1
Max. radial displacement with n=3000 rpm ΔK_r [mm]	±0.55	±0.5	±0.25	±0.8	±0.75	±0.35	±0.9	±0.85	±1.1	±1.1	±1	±0.5	±1.25	±1.15	±0.55
Max. angular displace- ment with n=1500 rpm ΔK_w [°]	±1	±0.75	±0.5	±1	±0.75	±0.5	±1	±0.75	±1	±1	±0.75	±0.5	±1	±0.75	±0.5
Max. angular displace- ment with n=3000 rpm ΔK_w [°]	±0.5	±0.4	±0.25	±0.5	±0.4	±0.25	±0.5	±0.4	±0.5	±0.5	±0.25	±0.25	±0.5	±0.4	±0.25

 Please observe protection
 note ISO 16016.

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5 Start-up

Before start-up of the coupling, please inspect the tightening of the setscrews in the hubs, the alignment and the distance dimension L, L_{HEW1}, L_{HEW2} or L_{HEW-ZS} and adjust, if necessary, and also inspect all screw connections for the tightening torques specified, dependent on the type of coupling.



If used in potentially explosive atmospheres the setscrews to fasten the hubs as well as all screw connections must be secured against working loose additionally, e. g. conglomerating with Loctite (average strength).

Finally the coupling protection against accidental contact must be fitted. It is required in accordance with DIN EN ISO 12100 (Safety of Machinery) and the directive 2014/14/EU and must protect against

- access with the little finger
- falling down of solid foreign objects.

The cover may provide for openings intended for necessary heat dissipation. These openings have to comply with DIN EN ISO 13857.

The cover must be electrically conductive and included in the equipotential bonding. Bell housings (magnesium share below 7.5 %) made of aluminium and damping rings (NBR) can be used as connecting element between pump and electric motor. The cover may only be taken off with standstill of the unit.



If the couplings are used in locations subject to dust explosion and in mining the user must make sure that there is no accumulation of dust in a dangerous volume between the cover and the coupling. The coupling must not operate in an accumulation of dust.

For covers with unlocked openings on the top face no light metals must be used if the couplings are used as equipment of equipment group II (*if possible, from stainless steel*). If the couplings are used in mining (equipment group I M2), the cover must not be made of light metal. In addition, it must be resistant to higher mechanical loads than if it is used as equipment of equipment group II.

During operation of the coupling, please pay attention to

- different operating noise
- vibrations occurring.



If you note any irregularities with the coupling during operation, the drive unit must be switched off immediately. The cause of the breakdown must be specified by means of the table „Breakdowns“ and, if possible, be eliminated according to the proposals. The potential breakdowns mentioned can be hints only. To find out the cause all operating factors and machine components must be considered.

Coating of coupling:



If coated (priming, paintings, etc.) couplings are used in potentially explosive atmospheres, the requirements on conductivity and coating thickness must be considered. In case of paintings up to 200 µm electrostatic load does not have to be expected. Multiple coatings exceeding 200 µm are prohibited for explosion group IIC.

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6 Breakdowns, causes and elimination

The below-mentioned failures can result in a use of the **BoWex-ELASTIC®** coupling other than intended. In addition to the specifications given in these operating and assembly instructions please make sure to avoid such failures.

The errors listed can only be clues to search for the failures. When searching for the failure the adjacent components must generally be considered.



If used other than intended the coupling can become a source of ignition.

EU directive 2014/34/EU requires special care by the manufacturer and the user.

General failures with use other than intended:

- Important data for the coupling selection were not forwarded.
- The calculation of the shaft-hub-connection was not considered.
- Coupling components with damage occurred during transport are assembled.
- If the heated hubs are assembled, the permissible temperature is exceeded.
- The clearance of the components to be assembled is not coordinated with one another.
- Tightening torques have been fallen below/exceeded.
- Components are mixed up by mistake/assembled incorrectly.
- No original KTR components (purchased parts) are used.
- Old/already worn out elastomer parts or those stored for too long are used.
- The coupling used/the coupling protection used is not suitable for the operation in potentially explosive atmospheres or does not correspond to EU directive 2014/34/EU.
- Maintenance intervals are not observed.

Breakdowns	Causes	Hazard notes for potentially explosive atmospheres	Elimination
Different operating noise and/or vibrations occurring	Micro friction by faulty alignment on the spline of the elastomer part	Danger of ignition due to hot surfaces	1) Set the unit out of operation 2) Eliminate the reason for misalignment (e. g. loose foundation bolts, breaking of the engine mount, heat expansion of unit components, modification of the installation dimension E of the coupling) 3) For inspection of wear see item 5.4
	Screws for axial fastening of hubs working loose		1) Set the unit out of operation 2) Inspect alignment of coupling 3) Tighten the screws to fasten the hubs and secure against working loose 4) For inspection of wear see item 5.4
Fracture of elastomer part / spline	Fracture of elastomer part / spline caused by high dynamic energy / overload	none	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Find out the reason for overload

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6 Breakdowns, causes and elimination

Breakdowns	Causes	Hazard notes for potentially explosive atmospheres	Elimination
Fracture of elastomer part / spline	Operating parameters do not meet with the performance of the coupling	none	1) Set the unit out of operation 2) Review the operating parameters and select a bigger coupling (consider mounting space) 3) Assemble new coupling size 4) Inspect alignment
	Operating error of the unit		1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Instruct and train the service staff
Excessive wear on the spline of the elastomer part, fracture of elastomer	Vibrations of drive	Danger of ignition due to hot surfaces	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Find out the reason for vibrations
	Ambient/contact temperatures which are too high for the elastomer part, max. permissible e. g. T4 = - 30 °C/+ 80 °C		1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Inspect and adjust ambient/contact temperature
	e. g. contact with aggressive liquids/oils, influence by ozone, too high ambient temperature etc. causing a physical change of the elastomer part	none	1) Set the unit out of operation 2) Disassemble the coupling and remove remainders of the elastomer part 3) Inspect coupling components and replace coupling components that are damaged 4) Insert elastomer part, assemble coupling components 5) Inspect alignment, adjust if necessary 6) Make sure that other physical modifications of the elastomer part are excluded



If you operate with a worn elastomer part (see chapter 9.3 and 9.4) a proper operation meeting the explosion protection requirements and the directive 2014/34/EU is not ensured.

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7 Disposal

In respect of environmental protection we would ask you to dispose of the packaging or products on termination of their service life in accordance with the legal regulations and standards that apply, respectively.

- **Metal**
Any metal components have to be cleaned and disposed of by scrap metal.
- **Nylon materials**
Nylon materials have to be collected and disposed of by a waste disposal company.

8 Spares inventory, customer service addresses

A basic requirement to ensure the readiness for use of the coupling is a stock of the most important spare parts on site.

Contact addresses of the KTR partners for spare parts and orders can be obtained from the KTR homepage at www.ktr.com.



KTR does not assume any liability or warranty for the use of spare parts and accessories which are not provided by KTR and for the damages which may incur as a result.

9 Enclosure A

Advice and instructions regarding the use in  potentially explosive atmospheres

Type HEW1 and HEW2: hub / elastomer / coupling flange

Annex A applies for BoWex-ELASTIC® HEW1 and HEW2 only.

9.1 Intended use in hazardous locations

Conditions of operation in  potentially explosive atmospheres

BoWex-ELASTIC® couplings are suitable for the use according to EU directive 2014/34/EU.

Industry (with the exception of mining)

- Equipment group II of category 2 and 3 (*coupling is not approved for equipment group 1*)
- Media class G (*gases, fogs, steams*), zone 1 and 2 (*coupling is not approved for zone 0*)
- Media class D (*dusts*), zone 21 and 22 (*coupling is not approved for zone 20*)
- Explosion group IIB (*explosion class IIA are included in IIB*)

Temperature class:

Temperature class	Ambient or operating temperature T _a	Max. surface temperature ¹⁾
T4, T3, T2, T1	- 30 °C to + 80 °C	115 °C ²⁾
T5	- 30 °C to + 65 °C	100 °C
T6	- 30 °C to + 50 °C	85 °C

Explanation:

The maximum surface temperatures each result from the maximum permissible ambient or operating temperature T_a plus the maximum temperature increase ΔT of 35 K which has to be taken into account.

- 1) The ambient or operating temperature T_a is limited to + 80 °C due to the permissible permanent operating temperature of the BoWexELASTIC® elastomer parts used.
- 2) The maximum surface temperature of + 115 °C applies for the use in locations which are potentially subject to dust explosion, too.

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9 Enclosure A

Advice and instructions regarding the use in  potentially explosive atmospheres

9.2 Inspection intervals for couplings in potentially explosive atmospheres

Explosion group	Inspection intervals
3G 3D	For couplings which are classified in category 3G or 3D the operating and assembly instructions that are usual for standard operation apply. During the standard operation which has to be subject to the ignition risk analysis the couplings are free from any ignition source. Merely the temperature increase produced by self-heating and depending on the coupling type has to be considered: for BoWex-ELASTIC®: $\Delta T = 35 \text{ K}$
II 2GD c IIB T4, T5, T6	An inspection of the torsional backlash and a visual inspection of the elastomer set must be performed after 3000 operating hours for the first time, at the latest after 6 months after start-up of the coupling. If you note insignificant or no wear on the elastomer part upon this initial inspection, further inspections can each be performed after 6000 operating hours or at the latest after 18 months, provided that the operating parameters remain the same. If you note significant wear with the initial inspection so that it would be recommendable to replace the elastomer part, please find out the cause according to the table „Breakdowns“, if possible. The maintenance intervals must be adapted to the modified operating parameters without fail.

BoWex-ELASTIC®

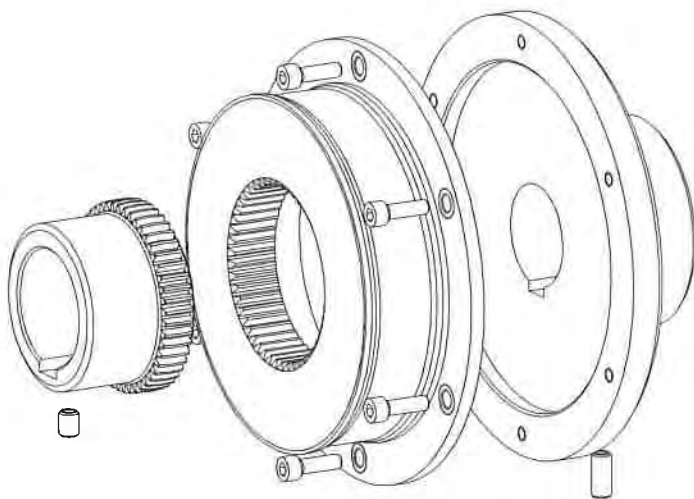


Illustration 15: BoWex-ELASTIC® type HEW1

- Here the backlash between the hub and the nylon spline must be inspected via torsional backlash, each separately from the driving and the driven side.
The friction/wear may only be $X_{max.}$ of the original spline thickness before the elastomer part must be replaced.
When reaching the torsional backlash $\Delta S_{max.}$, the elastomer part must be replaced immediately, irrespective of the inspection intervals.
- Visual inspection of the elastomer part (cracks, holes or anything similar).

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9 Enclosure A

Advice and instructions regarding the use in  potentially explosive atmospheres

9.3 Inspection of torsional backlash



To inspect the torsional backlash the power pack which is switched off needs to be secured against accidental switch-on.

- Turn the hub opposite the direction of drive.



Here the elastomer part must not be axially displaced from its position of wear.

- Mark elastomer part and hub (see Illustration 16).
- Turn the hub in the direction of drive and measure the torsional backlash $\Delta S_{\max}$.
- When reaching the torsional backlash $\Delta S_{\max}$ the elastomer part must be replaced.

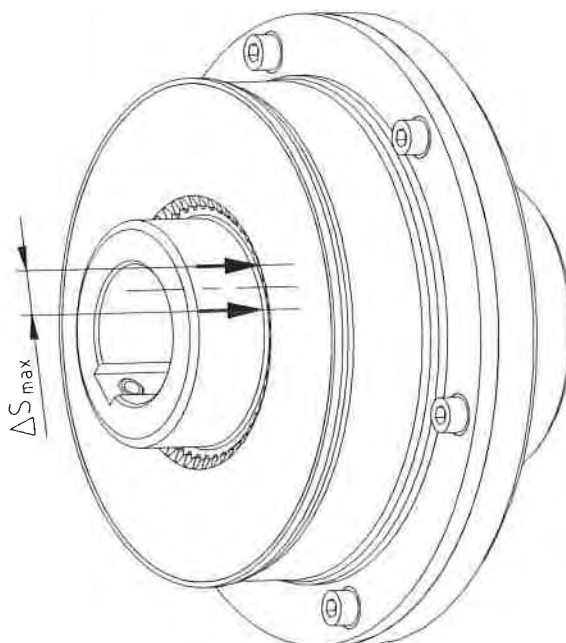


Illustration 16: Marking of the elastomer part and hub

9.4 Standard values of wear

If the torsional backlash is $\geq \Delta S_{\max}$ [mm] / friction $\geq X_{\max}$ [mm], the elastomer part must be replaced.

Reaching the limits for replacing depends on the operating conditions and the existing operating parameters.



In order to ensure a long service life of the coupling and avoid danger with the use in potentially explosive atmospheres, the shaft ends must be accurately aligned.
 Please absolutely observe the displacement figures specified (see tables 13 and 14).
 If the figures are exceeded, the coupling will be damaged.

Please observe protection
 note ISO 16016.

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 Replaced by:

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9 Enclosure A

Advice and instructions regarding the use in  potentially explosive atmospheres

9.4 Standard values of wear

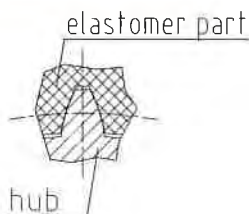


Illustration 17: Elastomer part in new condition

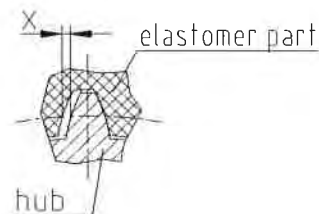


Illustration 18: Wear of elastomer part

Table 15:

Size	Limits of wear each hub		Size	Limits of wear each hub	
	Wear X_{max} [mm]	Torsional back-lash ΔS_{max} [mm]		Wear X_{max} [mm]	Torsional back-lash ΔS_{max} [mm]
42	1.0	1.7	100	1.8	3.1
48	1.0	1.8	125	2.0	3.5
65	1.4	2.5	G 125	2.0	3.5
80	1.6	2.7	150	2.0	3.5
G 80	1.6	2.7			

9.5 marking of coupling for potentially explosive atmospheres

The ATEX marking of the BoWex-ELASTIC® coupling is done on the polyamide flange of the elastomer specifying the following details:

Short labelling:
(standard)

 II 2GD c IIB T X

Complete labelling:

 II 2G c IIB T6, T5 resp. T4
 - 30 °C ≤ T_a ≤ + 50 °C, + 65 °C resp. + 80 °C
 II 2D c T 115 °C - 30 °C ≤ T_a ≤ + 80 °C

The labelling with explosion group IIB includes the explosion group IIA.



The customer bears the sole responsibility for all machining processes performed subsequently on unbored or pilot bored as well as finish machined coupling components and spare parts. KTR does not assume any warranty claims resulting from insufficient machining.

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9 Enclosure A

Advice and instructions regarding the use in  potentially explosive atmospheres

9.6 EU Certificate of conformity

EU Certificate of conformity

according to EU directive 2014/34/EU dated February 26, 2014
and to the legal regulations

The manufacturer - KTR Systems GmbH, D-48432 Rheine - states that the

BoWex-ELASTIC® highly flexible flange couplings

in an explosion-proof design described in these operating/assembly instructions are devices corresponding to article 1 (3) b) of directive 2014/34/EU and comply with the general safety and health requirements according to enclosure II of directive 2014/34/EU.

The BoWex-ELASTIC® complies with the specifications of directive 2014/34/EU. One or several directives specified in the respective type examination certificate IBExU01ATEXB004_05 X were in part replaced by updated versions.

KTR Systems GmbH being the manufacturer confirms that the product mentioned above is in accordance with the specifications of the new directives, too.

According to article 13 (1) b) ii) of directive 2014/34/EU the technical documentation is deposited with the institution:

IBExU
Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7

09599 Freiberg

Rheine,

2017-04-24
Date

i. V.


Reinhard Wibbeling
Engineering/R&D

i. A.


Andreas Huecker
Product Manager

Please observe protection
note ISO 16016.

Drawn: 2017-04-24 Shg/Hk
Verified: 2017-04-24 Shg

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Replaced by:

Operation and Maintenance Instructions Manual

JU/JW MODEL ENGINES FOR FIRE PUMP APPLICATIONS

This manual covers John Deere Engines
prepared by Clarke
for fire pump service

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Check factory availability for a manual in one of the following languages:

Spanish	MP-7 C13961
French	MP-7 C13962
German	MP-7 C13963
Italian	MP-7 C13964

NOTE

The information contained in this book is intended to assist operating personnel by providing information on the characteristics of the purchased equipment.

It does not relieve the user of their responsibility of using accepted practices in the installation, operation, and maintenance of the equipment.

NOTE: CLARKE FPPG Reserves the right to update the contents of this publication without notice.

1.0 INTRODUCTION

SCOPE OF SUPPLY

The following paragraphs summarize the “Scope of Supply” of the Engine:

- The CLARKE Engine supplied has been designed for the sole purpose of driving a stationary Emergency Fire Pump. It must not be used for any other purpose.
- Shall not be subjected to Horsepower requirements greater than the certified nameplate rating (for UL/cUL/FM/LPCB only).
- Engines must be sized to cover fully the maximum power absorbed by any particular driven equipment together with a safety factor on no less than 10%. (For Non-listed only).
- Derates for elevation and temperature need to be considered for maximum pump power.
- Fuel delivery settings are factory set with-in the injection pump and must not be tampered with or adjusted. Minor RPM adjustments to meet pump requirements are permissible.
- The engine shall be installed and maintained in accordance with the guidelines stated in this manual.
- Periodic running checks to ensure functionality should be kept to a maximum of ½ hour per week.

1.1 IDENTIFICATION/NAMEPLATE

- Throughout this manual, the terms “Engine” and “Machine” are used.
- The term “Engine” refers solely to the diesel engine driver as supplied by CLARKE.
- The term “Machine” refers to any piece of equipment with which the engine might interface.

This manual provides all the information necessary to operate your newly acquired engine safely and efficiently, and perform routine servicing correctly. Please read it carefully.

MODEL NUMBERING & IDENTIFICATION

There are two identification plates attached to each engine. Clarke Identification Plate: Engine Model, Serial Number, Rating and Date of Manufacture are shown on this identification plate. The JU Series identification plate is mounted on the stiffening plate that connects the two mounting feet at the rear of the engine. The JW and JX Series identification plate is mounted on right rear engine mount.

John Deere Identification Plate: The second identification plate contains the John Deere Model Number and Serial Number. On the JU Series, the John Deere identification plate is located on the right side of the cylinder block behind the fuel filter. On the JW and JX Series, the John Deere Serial identification plate is located on the left-hand side of the engine between the intake manifold and starting motor.

Note that there are four types of identification plates, dependent on whether the engine is a “Listed/Approved” or “Non-Listed” Model. These are typical examples. (See *Figure #1*).

Clarke Identification Plates

USA Listed/Approved

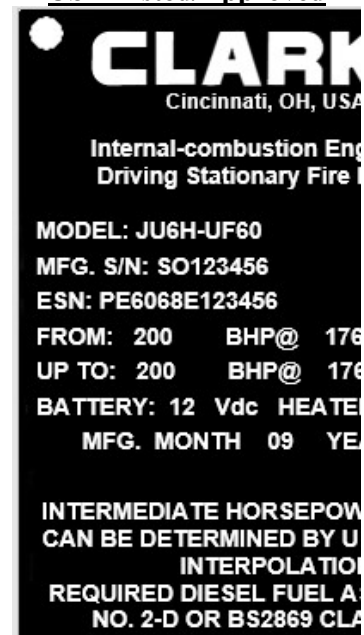
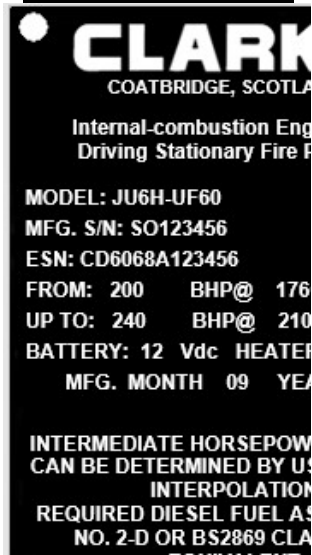


Figure #1

UK Listed/Approved



The Clarke eight digit model numbers reflects the base engine type, number of cylinders, cooling system, approval listing and a power rating code.

Example: JU6H-UF50

- J = John Deere base engine prepared by CLARKE
- U = base engine series (4.5 liter 4 cylinder or 6.8 liter 6 cylinder)
- 6 = number of cylinders
- H = Heat Exchanger cooled (R = Radiator)
- UF = Underwriters Laboratories Listed/ Factory Mutual Approved, FM = Factory Mutual Approved, LP = LPCB Loss Prevention Council Board Approved, AP = Plenary Assembly of Damage Insurance Companies, NL = Non-Listed
- 50 = A power rating code

UK Listed/Approved

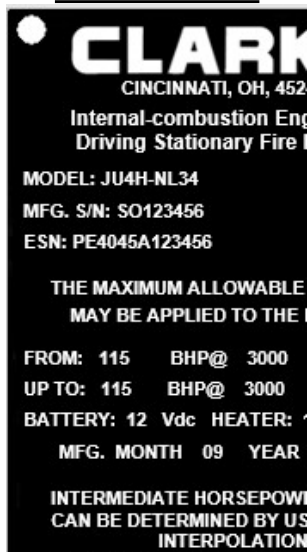


The Clarke 10 digit model numbers reflects the base engine type, number of cylinders, cooling system, approval listing, manufacturing location, emissions code and a power rating code.

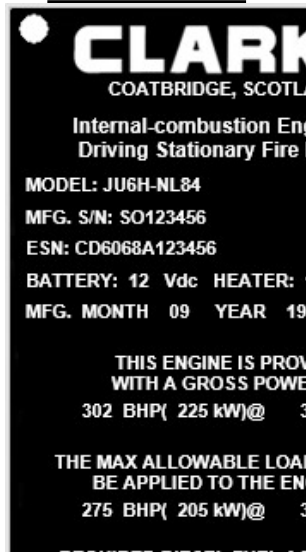
Example: JU6H-UFAARG

- J = John Deere base engine prepared by CLARKE
- U = base engine series (4.5 liter 4 cylinder or 6.8 liter 6 cylinder)
- 6 = number of cylinders
- H = Heat Exchanger cooled (R = Radiator)
- UF = Underwriters Laboratories Listed/ Factory Mutual Approved, FM = Factory Mutual Approved, LP = LPCB Loss Prevention Council Board Approved, AP = Plenary Assembly of Damage Insurance Companies, NL = Non-Listed
- A=Manufacturing Location (A= Cincinnati, B= Coatbridge)
- A=Non-Emissioned, C=EPA Tier 2 Certified, D=EPA Tier 3 Certified, E=EPA Interim Tier 4 Certified (EPA=USA Environmental Protection Agency)
- 54 = A power rating code

US Non – Listed



UK Non-Listed



The nameplate also contains a QR code that can be scanned with a smartphone barcode reader app. The QR code links to a Clarke webpage specific to the engine serial number where engine specific data can be verified against the nameplate. This information will safeguard against counterfeiting and provide assurance to the authenticity of the Clarke engine.

Figure #1 cont'd

1.2 SAFETY/CAUTION/WARNINGS

ATTENTION: This engine has components and fluids that reach very high operating temperatures and is provided with moving pulleys and belts. Approach with caution. It is the responsibility of the builder of the machine using a Clarke engine to optimize the application in terms of maximum end user safety.

BASIC RULES

The following recommendations are given to reduce the risk to persons and property when an engine is in service or out of service.

Engines must not be used for applications other than those declared under “Scope of Supply”.

Incorrect handling, modifications and use of non-original parts may affect safety. When lifting the engine, take care to use suitable equipment to be applied to the points specially provided as shown on the appropriate Engine Installation Drawing. Engine weights are shown in *figure #2*

ENGINE MODEL	WEIGHT lbs (kg)
JU4H-UF10,12,14,20,22,24, UFAB26, NL14,20,22,24, LP20,24, JU4H-AP50,54	910 (413)
JU4H-UF28,30,32,34,40,42,44,50, 52,54, H8,H0,H2,J4,58, NL30,32, 34,40,42,44,50,52,54,K4,LP50,54, L4, JU6H-AP30, 34, 50, 54, 60, 84	935 (424)
JU4H-UF84, JU4H-LP84	1085 (492)
JU4H-UFADJ8, UFADJ2, UFADHG JU4H-UFAEA0, UFAEE8, UFAEF2	873 (396)
JU4R-UF09,UF11,13,19,21,23 JU4R-NL09,UF11,13,19,21,23	956 (434)
JU4R-UF40,49,51,53,NL40,49,51,53, UFAEA9, E7, F1	982 (445)
JU6H-UF30,32,34,44,50,52, 54, D0, D2,G8,M8,M0,M2,58,KAL2, UFABL0,L2,L8, JU6H- NL30,32,34,50,52,54,M4, LP50,54	1657 (750)
JU6H-UF60,62, 68,74,84,94, AAT2, AAT0, AAT8, ,KAS2 KAT2, KAT0, KAT8, AB76, AARG, Q8, PG, S0, KARG, Q8,PG, S0, NL60, 62,74,84,94,R4, JU6H- NL94,NLKARG,Q8,PG,S0,T8,T0,T2, LP60,84	1693 (766)
JU6R-NLAAD9, JU6R-NLAAD1, JU6R- NLAA29, JU6R-NLAA31, JU6R-NLAA33, JU6R-NLAAG7, JU6R-NLAAL7, JU6R- NLAAL9, JU6R-NLAAL1, JU6R- NLAAM7, JU6R-NLAAM9, JU6R- NLAAM1, JU6R-NLAA57, JU6R- NLAA49, JU6R-NLAA51, JU6R-NLAA53, JU6R-NLKAD9, JU6R-NLKAD1, JU6R-	1744 (791)

NLKA29, JU6R-NLKA31, JU6R-NLKA33, JU6R-NLKAG7, JU6R-NLKAL7, KU6R- NLKAL9, JU6R-NLKAL1, JU6R- NLKAM7, JU6R-NLKAM9, JU6R- NLKAM1, JU6R-NLKA57, JU6R- NLKA49, JU6R-NLKA51, JU6R-NLKA53, JU6R-UFAAD9, JU6R-UFAAD1, JU6R- UFAA29, JU6R-UFAA31, JU6R-UFAA33, JU6R-UFAAG7, JU6R-UFAAL7, JU6R- UFAAL9, JU6R-UFAAL1, JU6R- UFAAM7, JU6R-UFAAM9, JU6R- UFAAM1, JU6R-UFAA57, JU6R- UFAA49, JU6R-UFAA51, JU6R-UFAA53, JU6R-UFKAD9, JU6R-UFKAD1, JU6R- UFKA29, JU6R-UFKA31, JU6R-UFKA33, JU6R-UFKAG7, JU6R-UFKAL7, JU6R- UFKAL9, JU6R-UFKAL1, JU6R- UFKAM7, JU6R-UFKAM9, JU6R- UFKAM1, JU6R-UFKA57, JU6R- UFKA49, JU6R-UFKA51, JU6R-UFKA53	1744 (791)
JU6R-NLAA67, JU6R-NLAA59, JU6R- NLAA61, JU6R-NLAAPF, JU6R- NLAAQ7, JU6R-NLAARF, JU6R- NLAAS9, JU6R-NLAA83, JU6R-NLKA67, JU6R-NLKA59, JU6R-NLKA61, JU6R- NLKAPF, JU6R-NLKAQ7, JU6R- NLKARF, JU6R-NLKAS9, JU6R- NLKA83, JU6R-UFAA67, JU6R-UFAA59, JU6R-UFAA61, JU6R-UFAAPF, JU6R- UFAAQ7, JU6R-UFAARF, JU6R- UFAAS9, JU6R-UFAA83, JU6R-UFKA67, JU6R-UFKA59, JU6R-UFKA61, JU6R- UFKAPF, JU6R-UFKAQ7, JU6R- UFKARF, JU6R-UFKAS9, JU6R-UFKA83	1844 (836)
JW6H-UF30 (JDFP-06WA),38,NL30 JW6H-AP30	2012 (910)
JW6H-UF40 (JDFP-06WR),48,NL40, JW6H-AP40	2003 (906)
JW6H-UF50,60,58,H8,NL50, 60, JW6H-AP50, 60	2053 (929)

Figure #2

Figure #3 shows the typical lifting arrangement of a bare engine. Note the lifting points on the engine are for lifting the engine only. *Caution, when lifting, lift point should always be over the equipment Center of Gravity.*

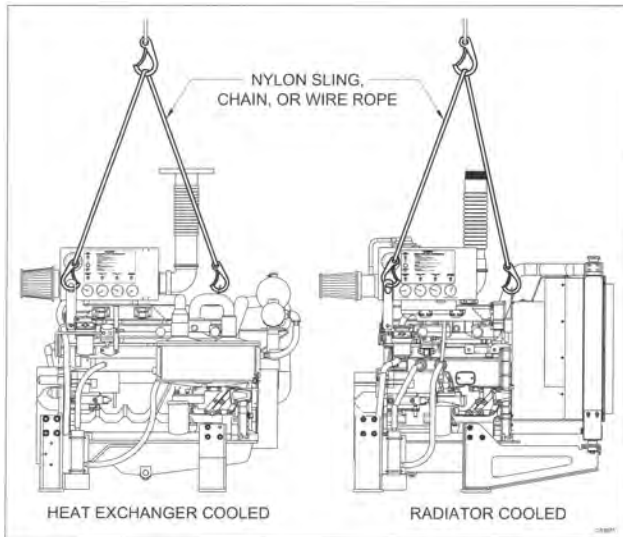


Figure #3

Note: The engine produces a noise level exceeding 70 dB(a). When performing the weekly functional test, it is recommended that hearing protection be worn by operating personnel.

CLARKE UK provides the machine manufacturer with a “Declaration of Incorporation” for the Engine, when required, a copy of which is enclosed in the manual. This document clearly states the machine manufacturers’ duties and responsibilities with respect to health and safety. Refer to *Figure #5*.

Figure #4 shows the typical lifting arrangement of a base mounted engine and pump set when the base (or module) is furnished with lifting holes.

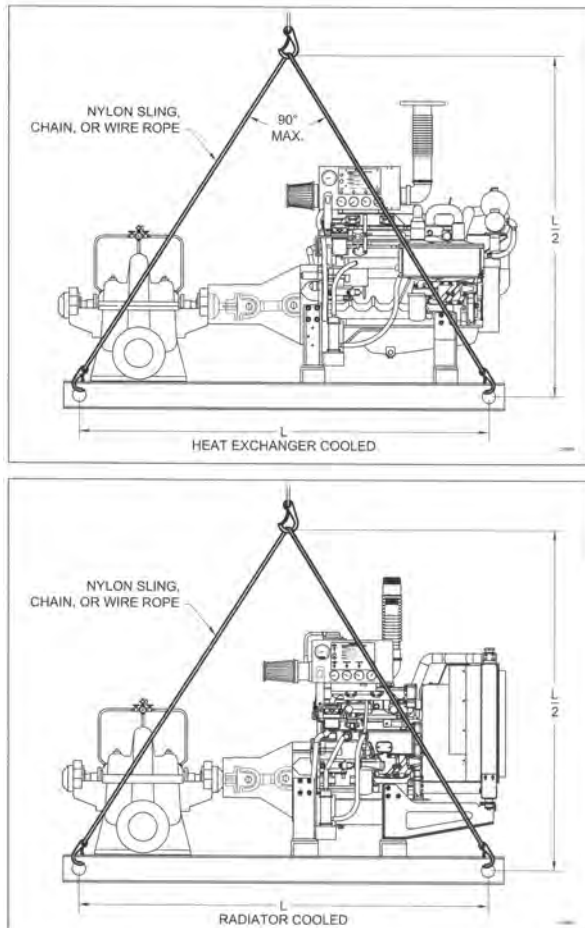


Figure #4

When Clarke furnishes the base (or module) for the engine and pump set, the combined weight of the engine and base (or module) will be indicated on the unit. *Caution, when lifting, lift point should always be over the equipment Center of Gravity.*



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Cincinnati, Ohio 45246
United States of America
Tel: +1 (513) 475-3473
Fax: +1 (513) 771-0726

CE, UKCA & UKNI DECLARATION OF INCORPORATION

Product:

Description – Diesel Engines
Manufacturer – Clarke Fire Protection Products, USA
Model Number –
Serial Number –
Year of Manufacture –
Contract Number –
Customer Order Number –

Name and address of manufacturer:

Clarke Fire Protection Products, Inc.
100 Progress Place
Cincinnati, Ohio 45246
United States of America

Declaration

We hereby declare that the engine is intended to be incorporated into other machinery and must not be put into service until the relevant machinery, into which the engine is to be incorporated, has been declared in conformity with the essential health and safety requirements for that machinery.

The object of the declaration described above is manufactured in accordance with the following directives:

<u>CE</u>	UKCA & UKNI
Machinery Directive 2006/42/EC	Supply of Machinery (Safety) Regulations 2008
Low Voltage Directive 2014/35/EU	Electrical Equipment (Safety) Regulations 2016
EMC Directive 2014/30/EU	Electromagnetic Compatibility Regulations 2016

References to the relevant harmonized standards used:

(BS) EN ISO 12100:2010 - Safety of machinery. General principles for design. Risk assessment and risk reduction
(BS) EN 60204-1:2006+A1:2009 - Safety of machinery. Electrical equipment of machines. General requirements
(BS) EN 61000-6-2:2005 - Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments
(BS) EN 55011:2016+A1:2017 - Industrial, scientific and medical equipment. Radio-frequency disturbance characteristics.

A technical file for the product listed above has been compiled in accordance with requirements of the relevant standards.

The engine has moving parts, areas of high temperatures and high temperature fluids under pressure. In addition, it has an electrical system, which may be under strong current.

The engine produces harmful gases, noise and vibration and it is necessary to take suitable precautionary measures when moving, installing and operating the engine to reduce risk associated with the characteristics stated above.

The engine must be installed in accordance with local laws and regulations. The engine must not be started and operated before the machinery into which it is to be incorporated and/or its overall installation has been made to comply with local laws and regulations. The engine must only be used in accordance with the scope of supply and the intended applications.

Signed Ken Wauligman Date: _____
Ken Wauligman – Engineering Manager

C138176, Rev A 216Dec20

Figure #5

WHAT TO DO IN AN EMERGENCY

Any user of the Engine who follows the instructions set out in this manual, and complies with the instructions on the labels affixed to the engine are working in safe conditions.

If operating mistakes cause accidents call for help
If operating mistakes cause accidents call for help immediately from the EMERGENCY SERVICES.
In the event of an emergency, and while awaiting the arrival of the EMERGENCY SERVICES, the following general advice is given for the provision of first aid.

FIRE

Put out the fire using extinguishers recommended by the manufacturer of the machine or the installation.

BURNS

- 1) Put out the flames on the clothing of the burns victim by means of:
 - × drenching with water
 - × use of powder extinguisher, making sure not to direct the jets onto the face
 - × blankets or rolling the victim on the ground
- 2) Do not pull off strips of clothing that are sticking to the skin.
- 3) In the case of scalding with liquids, remove the soaked clothing quickly but carefully.
- 4) Cover the burn with a special anti-burn packet or with a sterile bandage.

CARBON MONOXIDE POISONING (CO)

Carbon monoxide contained in engine exhaust gases is odorless and dangerous because it is poisonous and with air, it forms an explosive mixture.

Carbon monoxide is very dangerous in enclosed premises because it can reach a critical concentration in a short time.

When attending a person suffering from CO poisoning in enclosed premises, ventilate the premises immediately to reduce the gas concentration.

When accessing the premises, the person providing the aid must hold his breath, not light flames, turn on lights or activate electric bells or telephones so as to avoid explosions.

Take the victim to a ventilated area or into the open air, placing him on his side if he is unconscious.

CAUSTIC BURNS

- 1) Caustic burns to the skin are caused by acid escaping from the batteries:
 - × remove the clothes
 - × wash with running water, being careful not to affect injury-free areas
- 2) Caustic burns to the eyes are caused by battery acid, lubricating oil and diesel fuel.
 - × Wash the eye with running water for at least 20 minutes, keeping the eyelids open so that the water runs over the eyeball and moving the eye in all directions.

ELECTROCUTION

Electrocution can be caused by:

- 1) The engine's electrical system (12/24 VDC)
- 2) The electrical coolant pre-heating system 120/240 Volt AC (if supplied) AC current.

In the first case, the low voltage does not involve high current flows through the human body; however, if there is a short circuit, caused by a metal tool, sparks and burns may occur.

In the second case, the high voltage causes strong currents, which can be dangerous.

If this happens, break the current by operating the switch before touching the injured person.

If this is not possible, bear in mind that any other attempt is highly dangerous also for the person assisting; therefore, any attempt to help the victim must be carried out without fail using means that are insulating.

WOUNDS AND FRACTURES

The wide range of possible injuries and the specific nature of the help needed means that the medical services must be called.

If the person is bleeding, compress the wound externally until help arrives.

In the case of fracture do not move the part of the body affected by the fracture. When moving an injured person permission from that person must be

received until you can help him. Unless the injury is life threatening, move the injured person with extreme care and then only if strictly necessary.

WARNING LABELS



Coolant Mixture



Lifting Point



Automatic Start



Rotating Parts



Warning labels, in picture form, are applied to the engine. Their meanings are given below.

Important Note: Labels that show an exclamation mark indicate that there is a possibility of danger.

Heat Exchanger Maximum Working Pressure

Jacket Water Heater Voltage



Air Filter Installation



2.0 INSTALLATION/OPERATION

2.1 TYPICAL INSTALLATION

A typical Fire Pump installation is shown in *Figure #6 & 6A*.

1. Pump/Engine set
2. Main Pump Controller
3. Pump discharge
4. Air louver
5. Entrance door with air louver
6. Exhaust silencer
7. Exhaust system supports
8. Exhaust outlet pipe
9. Concrete base
10. Exhaust flexible connection joint/pipe
11. Air Discharge Duct from Radiator

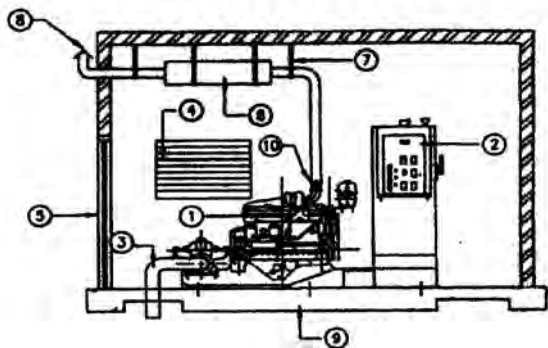


Figure #6
Typical Installation
Heat Exchanger Cooled Engine

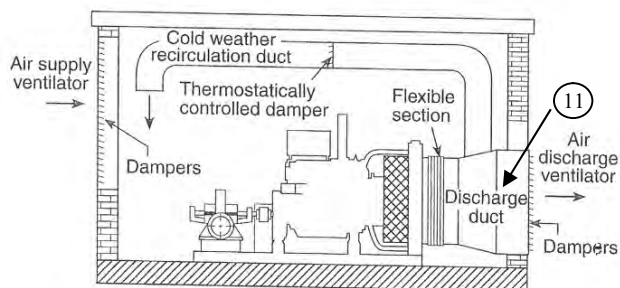


Figure #6A
Typical Installation
Radiator Cooled Engine

For radiator cooled engines, the total air supply path to the pump room, which includes any louvers or dampers, shall not restrict the flow of the air more than 0.2" (5.1mm) water column. Likewise, the air discharge path, which includes any louvers, dampers, or ducting, shall not restrict the flow of air more than 0.3" (7.6mm) water column.

2.2 ENGINE STORAGE

2.2.1 Storage less than 1 year

Storing engines requires special attention. Clarke engines, as prepared for shipment, may be stored for a minimum of one year. During this period, they should be stored indoors in a dry environment. Protective coverings are recommended provided they are arranged to allow for air circulation. The stored engine should be inspected periodically for obvious conditions such as standing water, part theft, excess dirt buildup or any other condition that may be detrimental to the engine or components. Any such conditions found must be corrected immediately.

2.2.2 Extended Storage Maintenance Procedure

After a one year storage period or if the engine is being taken out of service for more than 6 months, additional preservation service must be performed as follows:

- 1) Drain the engine oil and change the oil filter.
- 2) Refill the engine crankcase with MIL-L-21260 preservative oil.
- 3) Change the fuel filter.
- 4) Install the coolant plugs and install coolant in the normal mix percentage of 50% coolant, 50% water, premixed.
- 5) Remove the protection from the intake and exhaust openings.
- 6) Prepare a container as a fuel source using a mixture of Mobilarma or Sta-Bil with **ONLY** Diesel #2 fuel or "Red" diesel fuel (ASTM D-975) or BS2869 Class A2. (Refer to Section 3.1.1 for Fuel Specification.)
- 7) Disconnect the coupling or drive shaft from the pump.
- 8) Start and run the engine at a slow speed for 1-2 minutes being careful not to exceed the normal operating temperature.
- 9) Drain the oil and coolant.
- 10) Replace the protective plugs that were used for shipping and storage.
- 11) Attach to the engine a visible card, specifying "ENGINE WITHOUT OIL" DO NOT OPERATE".

IMPORTANT: THIS TREATMENT MUST BE REPEATED EVERY 6 MONTHS

PUTTING ENGINE INTO SERVICE AFTER ADDITIONAL PRESERVATION SERVICE:

To restore the normal operation running conditions of the engine, carry out the following:

- 1) Fill the engine sump with the normal recommended oil, to the required level.
- 2) Remove the protective plugs used for shipping and storage.
- 3) Refill cooling water to proper level.
- 4) Remove the card "ENGINE WITHOUT OIL, DO NOT OPERATE".
- 5) Follow all steps of the Installation Instructions when the engine will be put into service.

2.3 INSTALLATION INSTRUCTIONS

The correct installation of the engine is very important to achieving optimum performance and extended engine life.

In this respect, the engine has certain installation requirements, which are critical to how it performs. These requirements are generally associated with the cooling, exhaust, induction air, and fuel systems.

This section of the manual should be read in conjunction with the relevant Installation and Operation Data Sheets. If there is any doubt about an installation, contact should be made with Clarke Customer Support giving exact details of the problem.

All installations should be clean, free of any debris and dry. Care should be taken to ensure that there is easy access to the engine for maintenance and repair. The safety of personnel who may be in the area of the engine when it is running is of paramount importance when designing the installation layout.

- 1) Secure pump set to foundation and complete installation in accordance with pump manufacturer's instructions. Perform engine-to-pump coupling alignment. Lubricate Falk coupling with supplied grease or driveshaft universal joints with NLGI grade #1 or #2 grease at the (3) Zerk fittings. (Refer to section 2.4 for specific alignment instructions).
- 2a) Engine with Heat Exchanger Cooling: Install the heat exchanger discharge pipe. The discharge pipe should be no smaller than the outlet connection on the heat exchanger. Discharge water piping should be installed in accordance with applicable codes. All plumbing connecting to the heat exchanger must be secured to minimize movement by the engine. Cooling loop water pressure to the heat exchanger must not exceed the limit that is stated on the heat exchanger supplied with the engine.
- 2b) Engine with Radiator Cooling: Connect radiator air discharge ducting to radiator duct flange. Discharge ducting should be installed in accordance with applicable codes. A flexible duct section should be provided to isolate engine from building.
- 3) Install all engine cooling system draincocks and plugs.

Qty	Description	Location	Engine Model
1	1/8" draincock	Water Heater inlet tube	JU4/6H, JU4/6R
1	1/8" draincock	Coolant heater inlet tube	JDFP, JW6
1	Plug RE46686	Oil Cooler	JU4/6H, JU4/6R
1	3/8" pipe plug	Heat exchanger	JDFP, JW6
1	Electrode plug	Bottom of heat exchanger	JU4/6H

- 4) Fill engine cooling system with premixed 50% water / 50% coolant solution. Use only coolants meeting ASTM-D6210 specifications for heavy-duty diesel engines. Never use light-duty or automotive coolants in the engine that are stated as ASTM-D3306 only. Refer to *Figure #34* in section 3.4.3 for cooling system capacity. Refer to section 3.4.5 for filling procedure.
- 5) Engine is shipped with oil **installed**. For make-up oil specification refer to section 3.3 Lubrication System.
- 6) Connect fuel supply and return line to fuel supply tank plumbing. Reference the Fuel System section of the Installation and Operation Data (see Page 5), for piping size, maximum allowable fuel pump suction, and maximum allowable fuel head requirements. Fill supply tank with **ONLY** #2 diesel fuel (ASTM D-975) or BS 2869 Class A2 "Red" diesel fuel, bleed supply system of air and check for leaks. **CAUTION:** All diesel fire pump drivers manufactured by Clarke are designed and tested for use with only No. 2-D diesel fuel conforming to ASTM D-975. Additionally, in European countries an acceptable alternative fuel is "red" diesel fuel conforming to BS2869 Class A2. Both of these fuel specifications must contain **NO** (0%) bio-fuel. Fuel supply level must meet applicable code requirements. Do not use a copper based or galvanized material for any component of a diesel fuel system. The fuel will chemically react with the zinc resulting in clogged fuel filters and injector systems.
- 7) Remove protective covering on air cleaner element.

- 8) Connect jacket water heater (if supplied) to AC power source. For JU4/6 Series the electrical supply requirements are indicated on the heater body. Connect the supplied heater connection wire directly to a customer supplied electrical junction box. For JDJP/JW6 Series the electrical supply requirements are indicated on the connection box. Connect to the heater directly to the junction box at the end of the heater only. ***Supply wiring should never be routed through the engine gauge panel.*** Severe damage to critical engine control components could result. Energize heater only after step #4 is completed.
- 9) Connect exhaust system to flexible connection on the engine. The exhaust system plumbing must be supported by the building structure and not the engine. The exhaust flexible connection is provided only for the purpose of thermal expansion and vibration isolation, not for misalignment or directional change.
- 10) Make electrical DC connections between the engine gauge panel terminal strip (if supplied) and the controller per the controller manufacturer's instructions. Refer to the wiring diagram sticker located on the inside cover of the engine gauge panel for proper connection of the water solenoid.
- 11) Fill batteries with electrolyte per battery manufacturer's instructions. Connect cables between engine and batteries only after electrolyte is installed. Refer to the wiring diagram inside the engine gauge panel cover (if supplied), or appropriate wiring diagram (see Page 5), for correct positive and negative connections. Connect negative cables directly to the brass ground bolt, as indicated with tag C133445. On JU4/6 Series connect each positive cable to the large electrical post of the starter motor as indicated with tag C133443. Note: the JU4/6 Series have a separate starter motor for each battery set. On the JDJP/JW6 Series connect each positive cable to the large outer post of the manual starting contactors as indicated with tag C133443.
- 12) Always follow fire pump controller operating instructions when switching on/off battery chargers and disconnecting/reconnecting batteries from engine.
- 13) Note: Clarke Operation and Maintenance Instructions Manual and Clarke parts

illustration pages are located inside the engine gauge panel.

- 14) IMPORTANT! In order to obtain prompt Warranty Service and to comply with Emissions Regulations, this engine **must** be registered to the final installation name and address. To register this engine, go to www.clarkefire.com and select Warranty Registration.

2.4 SPECIFIC FLYWHEEL COUPLING ALIGNMENT INSTRUCTIONS

2.4.1 Listed Driveshafts

Refer to Listed Driveshaft Installation, Operation and Maintenance Manual C132355

2.4.2 Driveshaft

To check the alignment of the pump shaft and engine crankshaft centerlines for proper Parallel Offset and Angular tolerance, the driveshaft must be installed between the flywheel drive disc (no drive disc on JW6 models) and the flanged hub on the pump shaft.

Before removing the driveshaft guard, disconnect the negative battery cable from both batteries.

Before beginning the alignment checks and making any necessary corrections, install the driveshaft and re-torque all driveshaft connection bolts to the values given in the following table:

MODELS	DRIVE SHAFT	BOLT SIZE/ MATERIAL GRADE	TIGHTENING TORQUE ft-lbs (N-m)
JU4H-10,12, 14,20,22,24 AB26, AEA0, JU4R-09, 11,13,19, 21,23, AEA9	CDS10-SC SC41 SC41A	7/16-20 Grade 8 (Hi-Tensile)	50 - 55 (68 – 75)
JU4H-28,30,32,34, 40,42,44,J4,H8, H0, H2, AEE8, AEF2, ADJ8, ADJ2, JU4R-40, AEE7, AEF1	CDS20-SC SC55 SC55A	1/2-20 Grade 8 (Hi-Tensile)	75 - 82 (102 – 112)
JU6H- D0, D2,30, 32, 34,KAL2 JU6R- D9, D1,29, 31, 33	CDS20-S1 SC55L-A	1/2-20 Grade 8 (Hi-Tensile)	75 - 82 (102 – 112)
JU4H- 50,52,54,58, JU4R- 49,51,53	CDS30-S1	3/8-24 Grade 8 (Hi-Tensile)	30-35 (41-48) (See Note 2)
JU6H- G8, M8, M2, M0,44,58,50,52, 54, ABL8, ABL0, ABL2, AB76, 68,60,62, 74,84,94 JU6R- AAG7, AAL7, AAL9, AAL1, AAM7, AAM1, AAM9, AA57, AA49, AA51, AA53, AA67, AA59, AA61, AA83, KAG7, KAL7, KAL9, KAL1, KAM7, KAM1, KAM9, KA57, KA49, KA51, KA53, KA67, KA59, KA61, KA83	CDS30-S1 SC61L-A	3/8-24 Grade 8 (Hi- Tensile)	30-35 (41-48) (See Note 2)
JW6	CDS50-SC SC81A	7/16-20 Grade 8 (Hi-Tensile)	50 - 55 (68 – 75) (See Note 2)
JU6H-AAQ8, KAQ8, AARG, KARG, AAPG, KAPG, AAS0, KAS0,KAS2,AAT8,KAT8, AAT0, KAT0, AAT2, KAT2 JU6R- AAPF, KAPF, AAQ7, KAQ7, AARF, KARF, AAS9, KAS9,	CDS50-SC SC81A	7/16-20 Grade 8 (Hi-Tensile)	50 - 55 (68 – 75) (See Note 2)

Note 1 – It is recommended that a medium strength threadlocker (Loctite 243–blue) be used in the assembly and torquing of all hardware. This may be purchased as part number C126758, 50ml bottle.

Note 2 – 4 of the hi-tensile bolts and/or nuts, that are used to connect the driveshaft to the drive disc (all JU6 models) or flywheel (all JW6 models) and that connect the driveshaft to the pump companion flange, will require a “crow’s foot” wrench attached to a standard torque wrench in order to apply the required tightening torque. A standard socket will not work

due to close proximity of the bolts and/or nuts with the driveshaft yoke. The tightening torque values listed for these bolts and/or nuts have been corrected for using a “crow’s foot” adapter which extends the standard torque wrench’s length.

The following steps describe the proper way to check alignment. A small pocket scale or ruler with millimeter markings is recommended to make all measurements.

A) To check the Horizontal Parallel Offset, the driveshaft must be in the proper orientation.

1. Rotate the shaft so the reference “AB” on the flywheel adapter disc or the circumference of the drive shaft flange (against the flywheel adapter disc) is in the 12 o’clock position shown on *figure #7a*.
2. Measure from the face of the flywheel adapter disc to point E. (Point E is on the bearing bore as shown in *Figure #7a*). This measurement must be:

Measurement	Driveshaft
$58 \pm 1\text{mm.}$	CDS10-SC / SC41 / SC41A
$68 \pm 1.5\text{mm.}$	CDS20-SC / SC55 / SC55A
$68 \pm 1.5\text{mm.}$	CDS20-S1 / SC55L-A
$92 \pm 1.5\text{mm.}$	CDS30-S1 / SC61L-A
$109 \pm 2\text{mm.}$	CDS50-SC / SC81A

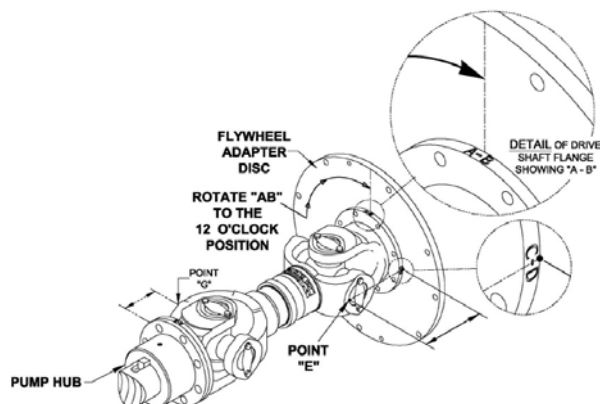


Figure #7a

B) With the driveshaft in the same orientation as the previous step (Step A), check the Horizontal Angular alignment of the shafts.

1. Measure from the mating surface of the companion hub to point G shown on figure #7b. (Point G is the furthestmost point on the bearing bore). This measurement must be equal to the measurement at point E ± 0.5 mm.

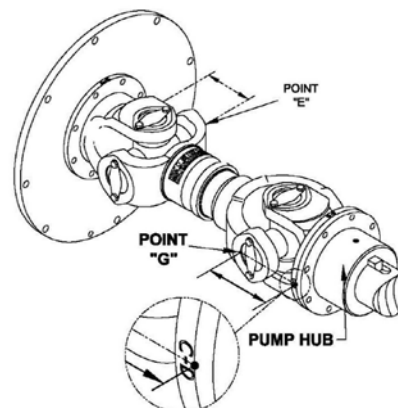


Figure #7b

C) To check the Vertical Parallel Offset, the driveshaft must be re-orientated.

1. Rotate the shaft 90° so the reference “CD” on the flywheel adapter disc or the circumference of the drive shaft flange (against the flywheel) is in the position shown on *Figure#7c*.
2. Measure from the face of the flywheel adapter disc to point H. (Point H is the furthestmost point on the bearing bore diameter). The measurement must be:

Measurement	Driveshaft
$60 \pm 1\text{mm.}$	CDS10-SC / SC41 / SC41A
$70.5 \pm 1\text{mm.}$	CDS20-SC / SC55 / SC55A
$70.5 \pm 1\text{mm.}$	CDS20-S1 / SC55L-A
$94.5 \pm 1\text{mm.}$	CDS30-S1 / SC61L-A
$112.5 \pm 1\text{mm.}$	CDS50-SC / SC81A

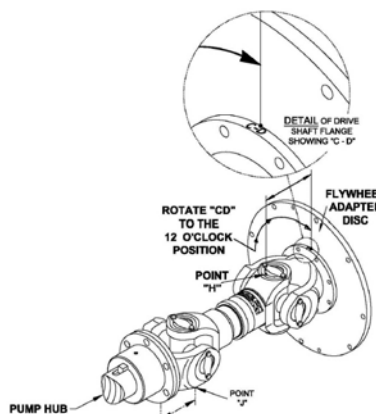


Figure #7c

D) With the driveshaft in the same orientation as the previous step (Step C), check the Vertical alignment of the shafts.

1. Measure from the mating surface of the pump companion hub of the drive shaft to point J as shown in figure #7d. (Point J is the same as point G, with the driveshaft rotated

90°). This measurement must be equal to the measurement at point H $\pm$ 1 mm.

Re-install all guards and grease fittings before reconnecting the battery cables.

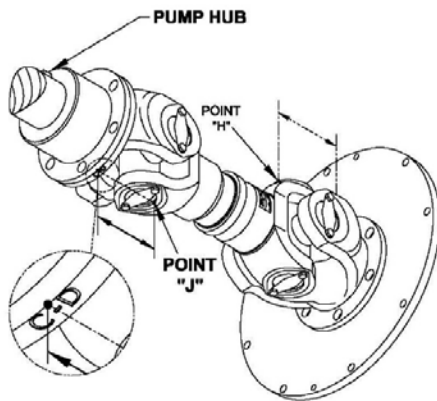


Figure #7d

DRIVESHAFT MAINTENANCE

1. To service the driveshaft disconnect the negative battery cables, remove the top of guard and set aside.
2. Rotate engine shaft manually so the u-joint grease fittings are accessible.
3. Using a hand held grease gun with N.L.G.I. grade 1 or 2 grease position on grease fitting. Pump with grease until grease is visible at all four cap seals.
4. Verify all driveshaft connecting bolts remain tight. Re-torque per 2.4.1 if necessary.
5. Reinstall top of guard and connect negative battery cables.

2.4.3 Other Coupling Types

Consult Factory or Clarke website at www.clarkefire.com for additional information.

2.5 WEEKLY TEST

It is recommended that the engine be tested weekly as allowed by local jurisdictions. An experienced operator should be present during the weekly test.

NOTE: This engine is designed to operate at rated load conditions. For testing purposes the engine can be run at lower load (lower flow) conditions. Running times in any one period should not exceed 30 minutes maximum.

Before starting the engine make sure of the following:

- 1) The operator has free access to stop the engine in an emergency.
- 2) The plant room ventilation ducts are open and the engine has good access for air.
- 3) All the guards are in position and, if not, for whatever reason, any rotating parts will be free and clear without restriction.
- 4) Battery covers are in place and there is nothing on top of or touching the engine, which is not part of the original supply specification.
- 5a) Heat Exchanger Cooling: The water supply for coolant is available again without restriction.
- 5b) Radiator Cooling: The air supply for cooling is available again without restriction.

When engine is running make sure that the coolant temperature and oil pressure raw cooling water flow are within the limits specified on the relevant Installation & Operation Data Sheet (see Page 5).

If the coolant temperature is excessive, check:

- a) Cooling loop strainers
- b) Proper functioning of thermostat
- c) Condition of heat exchanger tube bundle

2.6 STARTING/STOPPING THE ENGINE

2.6.1 Special Notes to Equipment Installer of an LPCB Approved (LPS1239) Engine Model:

Any device fitted to the engine or controller, which could prevent the engine starting automatically, shall return automatically to the normal position after manual application. The electrical fuel shutoff actuator shall be connected to an Engine Stop button on the main pump controller.

The main pump controller shall de-energize the start motor when the engine has achieved 700-1000 rpm.

2.6.2 To Start Engine:

Use main pump controller for starting. Follow instructions provided by controller manufacturer.

On UL/FM engines, use main pump controller for starting and stopping the engine. Should the main pump controller become inoperable, the engine can be manually started and stopped from the engine gauge panel. For manual starting and stopping of an engine with a gauge panel: Position **MODE**

SELECTOR to **MANUAL RUN**. (Refer to *Figure #9*). 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. If **COOLING WATER** is not flowing or engine **TEMPERATURE** is too **HIGH**, open cooling system manual by-pass valves (applies to heat exchanger cooled engines only).

Note: On JW Engines you can also start engines using manual starting contactors.

On LPCB engines, use main pump controller for starting and stopping the engine. Should the main pump controller become inoperable, the engine can be manually started from the engine gauge panel. For manual starting of an engine with a gauge panel. (Refer to *Figure #9A*): Lift and hold **MANUAL**

CRANK #1, until engine starts, or release after 15 seconds. If unit fails to start, wait for 10 seconds, use **MANUAL CRANK #2** and repeat step. If **COOLING WATER** is not flowing or engine **TEMPERATURE** is too **HIGH**, open cooling system manual by-pass valves (applies to heat exchanger cooled engines only).

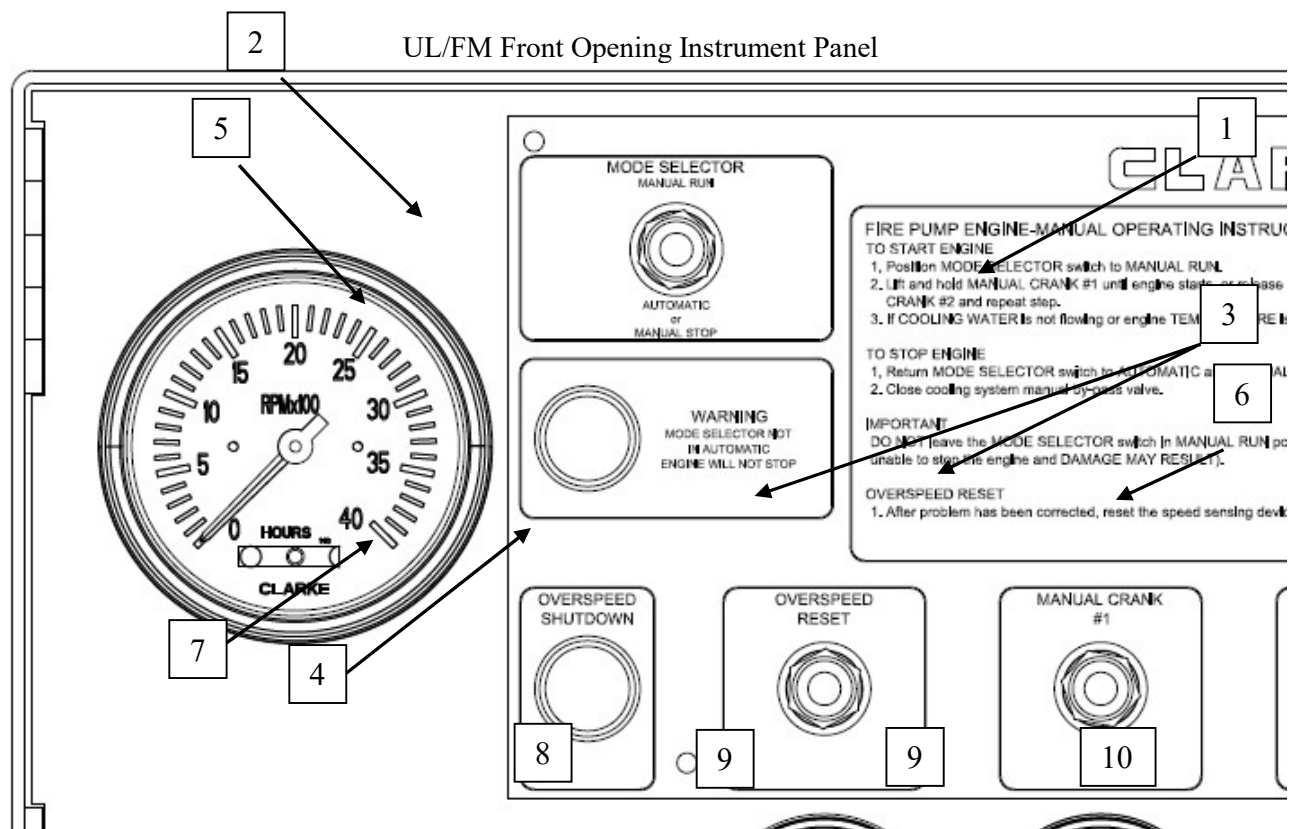
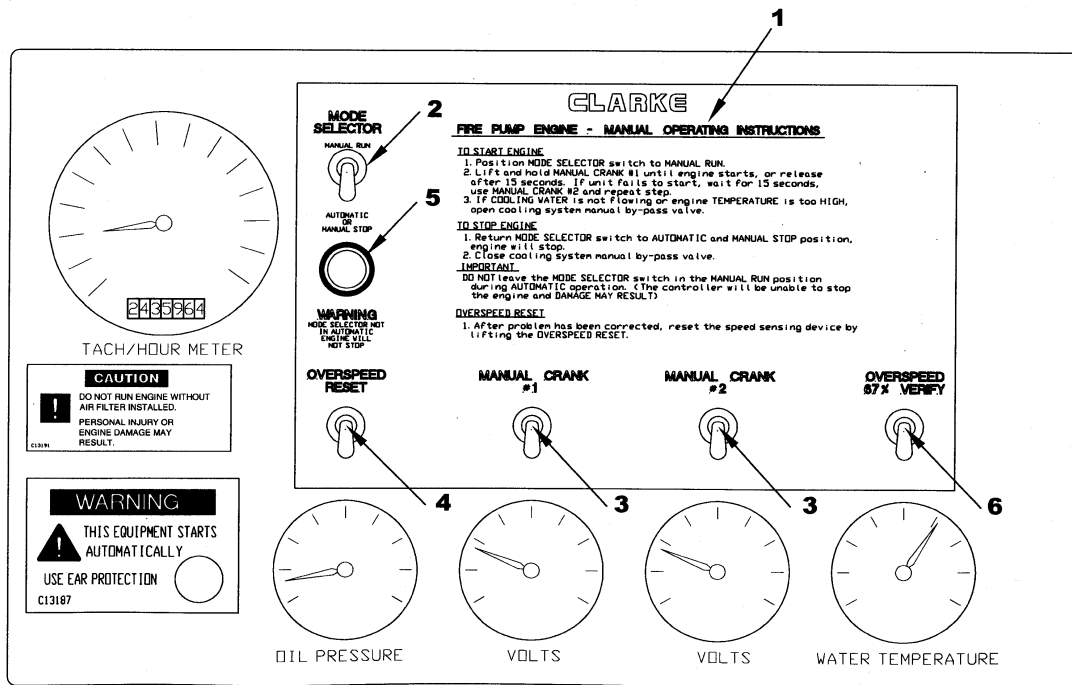


Figure #9

- 1 – Emergency Operating Instructions
- 2 – Automatic / Manual Mode Selector
- 3 – Manual Crank Controls
- 4 – Overspeed Reset
- 5 – Manual Mode Warning Light

- 6 – Overspeed Verification
- 7 – Overspeed Indication Light
- 8 – Oil Pressure Gauge
- 9 – Voltmeters Battery 1 & 2
- 10 – Coolant Temperature Gauge

Non-Listed Instrument Panel (Optional)



- 1 – Emergency Operating Instructions
- 2 – Automatic-Manual Mode Selector
- 3 – Manual Crank Controls
- 4 – Overspeed Reset
- 5 – Warning Light
- 6 – Overspeed Verification

LPCB Instrument Panel

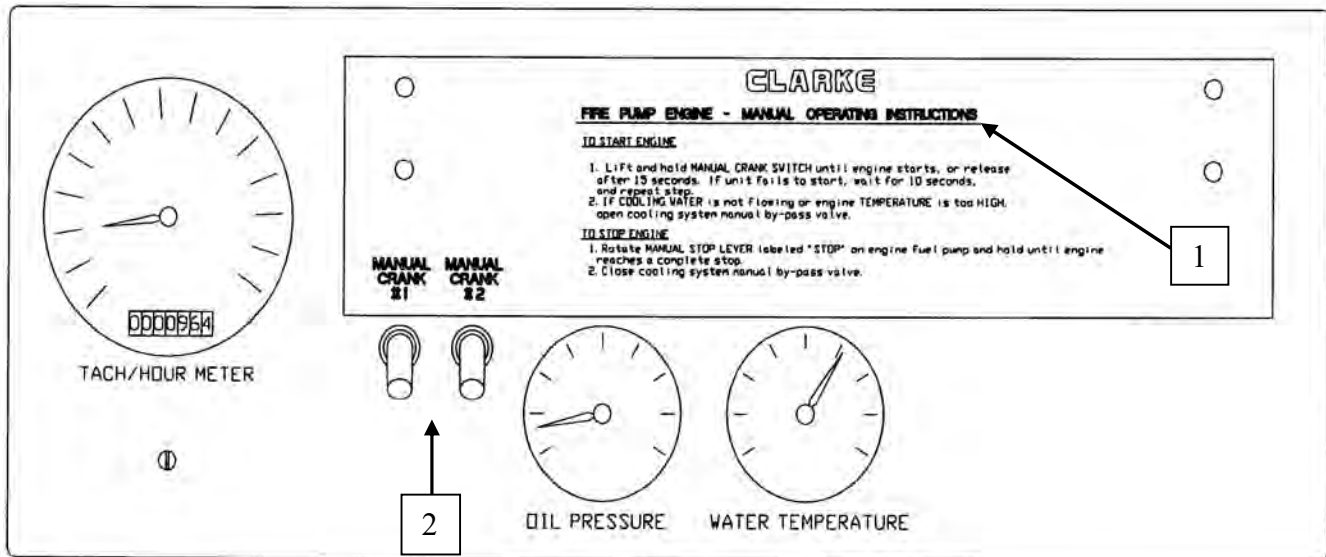


Figure #9A

- 1 - Emergency Operating Instructions
- 2 – Manual Crank Controls

IMPORTANT: Main pump controller selector should be in the **OFF** position when starting from engine gauge panel. Be sure to return selector on

main pump controller and engine gauge panel to **AUTOMATIC** after completing manual run.

2.6.3 To Stop Engine

If engine is started from main pump controller use main pump controller to stop the engine.

If engine is started from engine gauge panel: Return **MODE SELECTOR** switch to

If engine is started from main pump controller use main pump controller to stop the engine.

If engine is started from engine gauge panel: Return **MODE SELECTOR** switch to **AUTOMATIC/MANUAL STOP** position, engine will stop. Close cooling system manual by-pass valve if opened.

IMPORTANT: DO NOT leave the **MODE SELECTOR** switch in the **MANUAL RUN** position during **AUTOMATIC** operation. (The controller will be unable to stop the engine and **DAMAGE MAY RESULT**).

Engines not equipped with an engine gauge panel, and LPCB engines, have a manual shutdown lever on the engine for shutdown.

2.6.4 Emergency Operation – ETR Engines Only

UL/FM Energized to Run (ETR) engines only

In the event that the speed switch fails to energize the engine's fuel injection pump solenoid, the engine instrument panel has been equipped with an Emergency Run Switch. This switch sends battery voltage directly to the fuel injection pump solenoid which allows for operation of the engine.

Additionally, the Emergency Run Switch will activate the engine raw water cooling loop solenoid if the engine is equipped with one.

If engine fails to run with standard starting procedures, follow these steps to start engine with Emergency Run Switch:

1. Open the door of the instrument panel
2. Locate the Emergency Run Switch, denoted by the yellow indication label
3. Remove the lock-out screw
4. Toggle switch to the ON position
 - a. Battery voltage will be sent to the fuel injection pump solenoid and the raw water cooling loop solenoid
5. To shut engine down ensure engine mode selector switch is set to Auto/Manual Stop, fire pump controller is keyed to OFF, and

toggle the engine Emergency Run Switch to OFF position.

Note, activating the Emergency Run Switch will energize the fuel solenoid and the raw water cooling loop solenoid until the switch is returned to the OFF position. The switch should only be used as a manual, emergency means for operation of the engine in the event of speed switch failure. Replace speed switch immediately upon finding failure.

3.0 ENGINE SYSTEMS

3.1 FUEL SYSTEM

3.1.1 Diesel Fuel Specification

All diesel fire pump drivers manufactured by Clarke are designed, tested and warranted for use only with No. 2-D Diesel Fuel conforming to ASTM International D-975-11b or British Standard BS2869:2010+A1:2011 Fuels oils for agricultural, domestic and industrial engines and boilers - Specification.

Although the above referenced fuel specifications allow limited amounts of Biodiesel, 100% petroleum fuel is preferred and should be used whenever possible. Biodiesel in any amount greater than that allowed by the above referenced specifications should not be used. The use of fuels not referenced above, or Biodiesel in amounts greater than allowed in the above referenced specifications, may affect performance and reliability, and may result in a non-warrantable engine condition.

To insure engine reliability and performance, the fuel provided for Clarke fire pump drivers must be maintained in a quality condition. Refer to NFPA 25 2014, reprint provided below, for guidance to the minimum requirements for fuel maintenance for all Clarke fire pump engine installations.

The following is reprinted from the "NFPA 25 2014 Standard for the Inspection, Testing, and maintenance of Water-Based Fire Protection Systems," Copyright © 2013 National Fire Protection Association®. All Rights Reserved.

8.3.4 Diesel Fuel Testing and Maintenance

8.3.4.1 Diesel fuel shall be tested for degradation no less than annually.

8.3.4.1.1* Fuel degradation testing shall comply with ASTM D975-11b Standard Specification for Diesel Fuel Oils, or ASTM D6751 -11b Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels as approved by the engine manufacturer, using ASTM D 7462 - 11 Standard Test Method for Oxidation Stability of Biodiesel (B100) and Blends of Biodiesel with Middle Distillate Petroleum Fuel (Accelerated Method).

8.3.4.2* If diesel fuel is found to be deficient in the testing required in 8.3.4.1.1, the fuel shall be reconditioned or replaced, the supply tank shall be cleaned internally, and the engine fuel filter(s) shall be changed.

8.3.4.2.1 After the restoration of the fuel and tank in 8.3.4.2, the fuel shall be retested each 6 months until experience indicates the fuel can be stored for a minimum of one year without degradation beyond that allowed in 8.3.4.1.1

8.3.4.3 When provided, active fuel maintenance systems shall be listed for fire pump service.

8.3.4.3.1 Maintenance of active fuel maintenance systems shall be in accordance with the manufacturer's recommendations.

8.3.4.3.2 Maintenance of active fuel maintenance systems shall be performed at a minimum annual frequency for any portion of the system that the manufacturer does not provide a recommended maintenance frequency.

8.3.4.3.3 Fuel additives shall be used and maintained in accordance with the active fuel maintenance system manufacturer's recommendations.

A.8.3.4.1.1 Commercial distillate fuel oils used in modern diesel engines are subject to various detrimental effects from storage. The origin of the crude oil, refinement processing techniques, time of year, and geographical consumption location all influence the determination of fuel blend formulas.

Naturally occurring gums, waxes, soluble metallic soaps, water, dirt, blends and temperature all contribute to the degradation of the fuel as it is handled and stored. These effects begin at the time of fuel refinement and continue until consumption. Proper maintenance of stored distillate fuel is critical for engine operation, efficiency, and longevity.

Storage tanks should be kept water-free. Water contributes to steel tank corrosion and the development of microbiological growth where fuel and water interface. This and the metals of the system provide elements that react with fuel to form certain gels or organic acids, resulting in clogging of filters and system corrosion. Scheduled fuel maintenance helps to reduce fuel degradation. Fuel maintenance filtration can remove contaminants and water and maintain fuel conditions to provide reliability and efficiency for standby fire pump engines. Fuel maintenance and testing should begin the day of installation and first fill.

A.8.3.4.2 Where environmental or fuel quality conditions result in degradation of the fuel while stored in the supply tank, from items such as water, micro-organisms and particulates, or destabilization, active fuel maintenance systems permanently installed on the fuel storage tanks have proven to be successful at maintaining fuel quality. An active fuel maintenance system will maintain the fuel quality in the tank, therefore preventing the fuel from going through possible cycles of degradation, risking engine reliability, and then requiring reconditioning.

3.1.2 Bleeding the Fuel System

CAUTION: Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting fuel or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles, which eject fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use your hand.

If ANY fluid is injected into the skin, it must be surgically removed within a few hours by a doctor

familiar with this type injury or gangrene may result. Doctors unfamiliar with this type of injury may call the Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source. *Ref figure #10*



Figure #10

Whenever the fuel system has been opened up for service (lines disconnected or filters removed), it will be necessary to bleed air from the system.

3.1.2.1 JU4/6-UF, NL Engine Series:

- 1) Loosen the air bleed vent screw (A) two full turns by hand on fuel filter base. *Ref. Figure #11*
- 2) Operate supply pump primer lever (B) until fuel flow is free from air bubbles. *Ref. Figure #12.*
- 3) Tighten bleed plug securely; continue operating hand primer until pump action is not felt. Push hand primer inward (toward engine) as far as it will go.
- 4) Start engine and check for leaks.



Figure #11

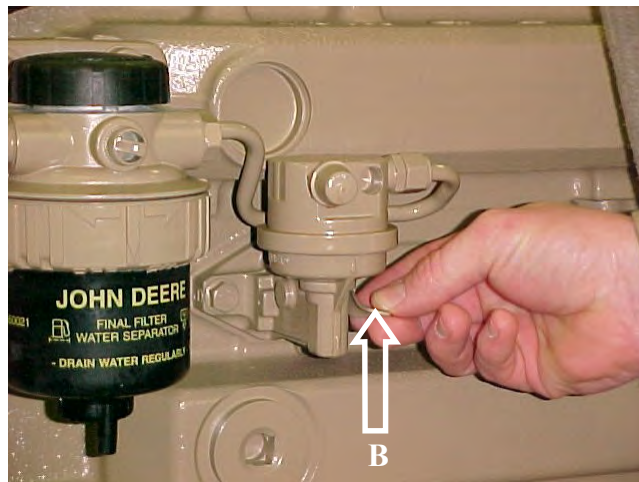


Figure #12

If engine will not start, it may be necessary to bleed air from fuel system at fuel injection pump or injection nozzles as explained next.

At Fuel Injection Pump:

- 1) Slightly loosen fuel return line connector (A) at fuel injection pump. *Ref figure #13*
- 2) Operate fuel supply pump primer lever until fuel, without air bubbles, flows from fuel return line connection.
- 3) Tighten return line connector at 16N-m (12 lb-ft).
- 4) Leave hand primer in the inward position toward cylinder block. *Ref. Figure #14.*

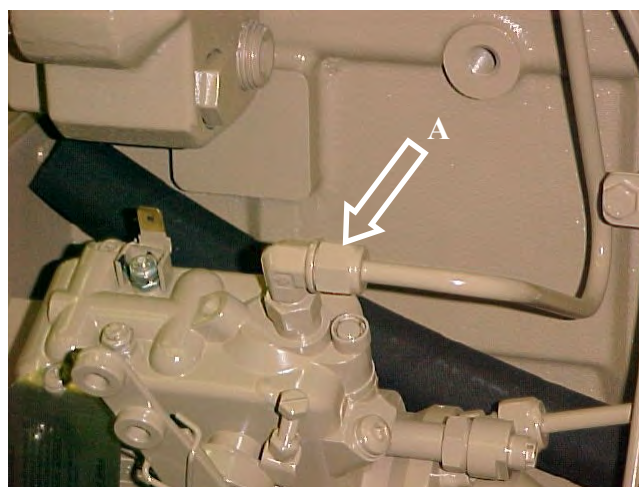


Figure #13



Figure #14

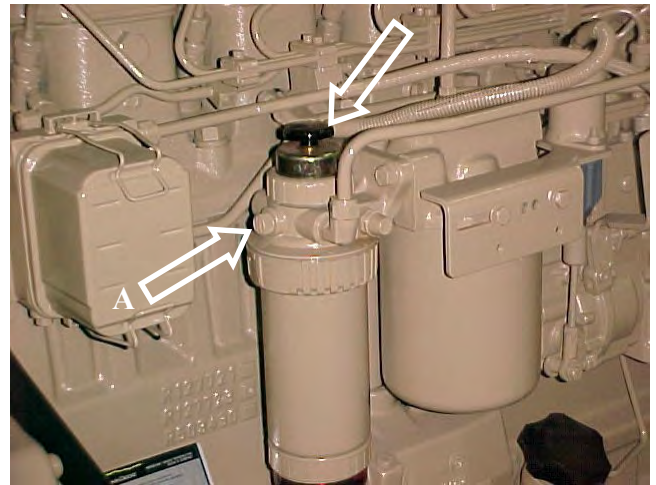


Figure #15

3.1.2.2 JU4/6 LP Engine Series

Photo to follow later

3.1.2.3 JDFP/JW6 Engine Series:

Refer to *Figure #19* for system components location.

- A – Primary Fuel Filter
- B – Secondary Fuel Filter
- C – Fuel Injection Pump
- D – Speed Adjustment

At Round Primary Fuel Filter/Water Separator:

- 1) Drain water and contaminants from clear sediment bowl.
- 2) Loosen air bleed vent screw (A) on fuel filter base (*Figure# 15*)
- 3) Operate hand primer (B) until fuel flow is free from air bubbles (*Figure#15*)
- 4) Tighten vent screw as hand primer is held in downward pumping position.

At Rectangular Final Fuel Filter:

- 1) Loose bleed plug (A) on fuel filter base (*figure#16*).
- 2) Operate hand primer (B) on fuel supply pump (*figure#17*), until a smooth flow of fuel, free of bubbling, comes out of the plug hole.
- 3) Simultaneously stroke the hand primer down and close the filter port plug. This prevents air from entering the system. Tighten plug securely. DO NOT over tighten.
- 4) Start engine and check for leaks.

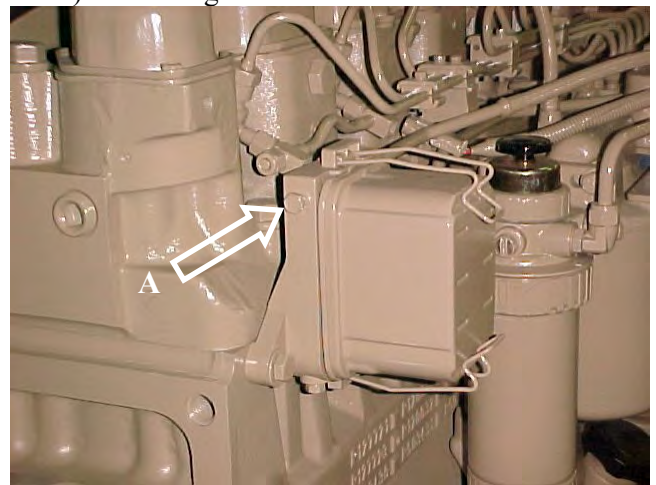


Figure #16

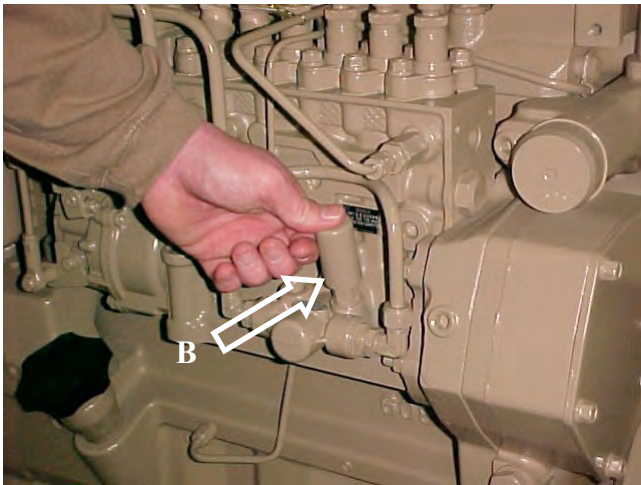


Figure #17

If engine will not start, it may be necessary to bleed air from fuel system at injection nozzles as explained below.

At Fuel Injection Nozzle

- 1) Loosen fuel line connection at no. 1 injection nozzle (A) (figure#18)
- 2) Crank engine with starting motor (but do not start engine), until fuel free from bubbles flows out of loosened connections. Retighten connection.
- 3) Start engine and check for leaks.
- 4) If engine does not start, repeat procedure at remaining injection nozzles (if necessary) until enough air has been removed from fuel system to allow engine to start.

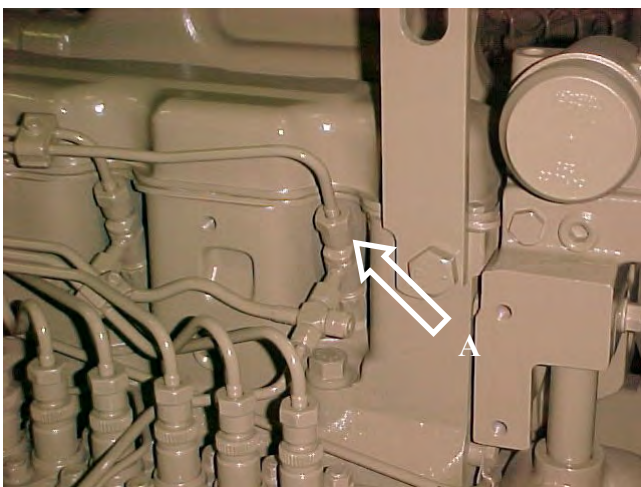


Figure #18

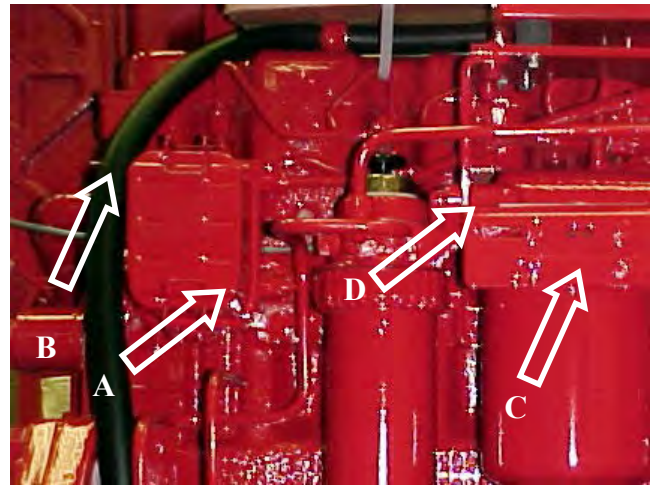


Figure #19

3.1.3 Draining the Condensate from the Fuel Filter

Drain the condensate from the fuel filter. Fuel filters have a drain (B) located at the bottom of their body (A) figure#20, these filters should be drained each week to relieve built up water.

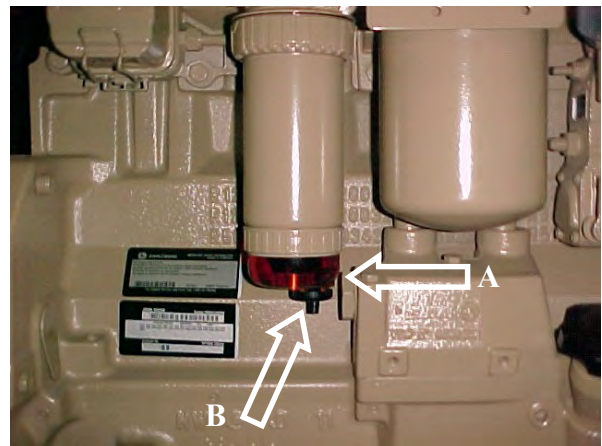


Figure #20

3.1.4 Changing the Fuel Filter Cartridges

Changing the cartridges and bleed any air from the fuel system as per instructions given in section 3.1.1. Fuel filter changes should take place as per recommendations and only using approved filters. It may also be necessary to change filters out with the recommendations in the event of:

- 1) The engine has had an overhaul.
- 2) The quality of the fuel is questionable.
- 3) The engine has been subjected to temporary adverse conditions outwith its normal operating parameters.

- 4) The fuel tank condensation trap has not been drained in line with manufacturer's recommendations.

3.1.4.1 JU4/6-UF,NL Engine Series

- 1) Close fuel shut-off valve, if equipped
- 2) Thoroughly clean fuel filter assembly and surrounded area.
- 3) Loosen drain plug (C) and drain fuel into a suitable container. Ref *figure#21*

Note: Lifting up on retaining ring and rotate it helps to get past raised locators.

- 4) Firmly grasp the retaining ring (A) and rotate it counterclockwise $\frac{1}{4}$ turn. Remove ring with filter element (B). Ref *figure#21*
- 5) Inspect filter mounting base for cleanliness. Clean as required.

Note: Raised locators on fuel filter canister must be indexed properly with slots in mounting base for correct installation.

- 6) Install new filter element onto mounting base. Be sure element is properly indexed and firmly seated on base. It may be necessary to rotate filter for correct alignment.

If equipped with water separator, remove filter element from water separator bowl. Drain and clean separator bowl. Dry with compressed air. Install water separator bowl onto new element. Tighten securely.

- 7) Align keys on filter element with slots in filter base.
- 8) Install retaining ring onto mounting base making certain dust seal is in place on filter base. Hand tighten ring (about $\frac{1}{3}$ turn) until it "snaps" into the detent. DO NOT over tighten retaining ring.

Note: The proper installation is indicated when a "click" is heard and a release of the retaining ring is felt.

A plug is provided with the new element for plugging the used element.

- 9) Open fuel shut-off valve and bleed the fuel system. Tighten bleed plug (D). Reference *Figure #21*

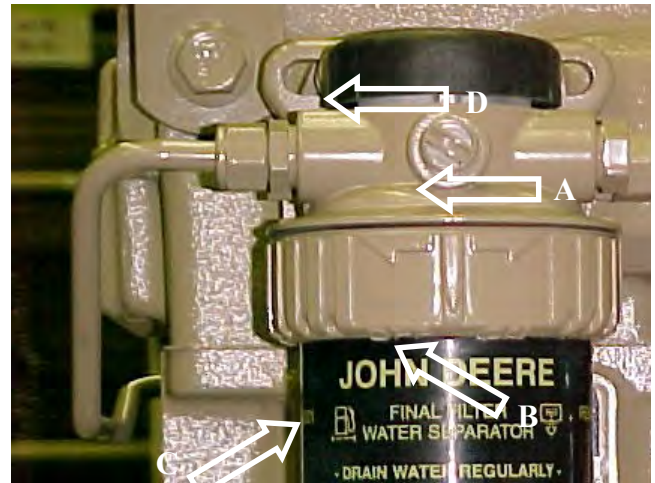


Figure #21

3.1.4.2 JU4/6 LP Engine Series

3.1.4.3 JDFP/JW6 Engine Series

Each engine has two fuel filters. For the purpose of identity, the primary filter incorporates the transparent water separator.

Replacing (round) Primary Fuel Filter/Water Separator

- 1) Close fuel shut-off valve at bottom of fuel tank, if equipped.
- 2) Thoroughly clean fuel filter/water separator assembly and surrounding area.

Note: Lifting up on retaining ring (F) as it is rotated helps to get it past retaining dent. Ref. *Figure #22*

- 3) Rotate retaining ring counterclockwise $\frac{1}{4}$ turn. Remove ring with filter element.
- 4) Remove water separator bowl (G) from filter element (E). Drain and clean separator bowl. Dry with compressed air. Ref. *Figure #22*

Note: Notice raised locators on filter element. These locators insure proper alignment of filter element to filter base.

- 5) Install water separator bowl onto new filter element. Tighten securely.
- 6) Index filter element until longer, vertical locator (D) is oriented opposite mounting base. Insert filter element into base securely.

It may be necessary to rotate filter for correct alignment. Ref. *Figure #22*

- 7) Install retaining ring to filter base, making certain dust seal (C) is in place on filter base. Tighten retaining ring until it locks into detent position and a “click” sound can be heard. Ref. *Figure #22*
- 8) Bleed fuel system.

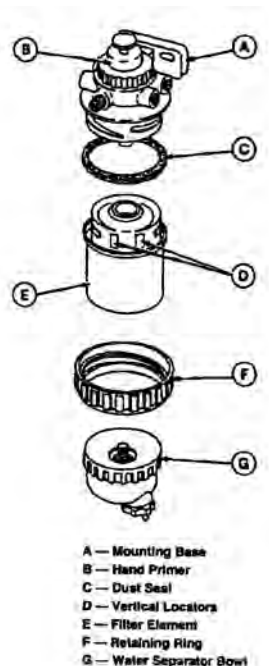


Figure #22

Replacing (rectangular) Secondary Fuel Filter Element

- 1) Close fuel shut-off valve at bottom of fuel tank, if equipped.
- 2) Loosen bleed plug (C) on side of filter base. Remove drain plug (B) to drain from fuel filter. Ref. *Figure #23*

Note: Keep a small container under drain plug to catch draining fuel.

- 3) With fuel filter firm against base, lift up on top retaining spring and pull down on bottom retaining spring. Pull fuel filter off guide pins of fuel filter base and discard.
- 4) Install new fuel filter onto guide pins of fuel filter base. Hold filter firmly against base.
- 5) Secure bottom filter retaining spring first, then secure top retaining spring (four arrows).

- 6) Install new drawn plug, shown installed. Tighten bleed plug and drain plug securely. Do not over tighten.
- 7) Open fuel shut-off valve and bleed the fuel system. Ref. *Figure #23*

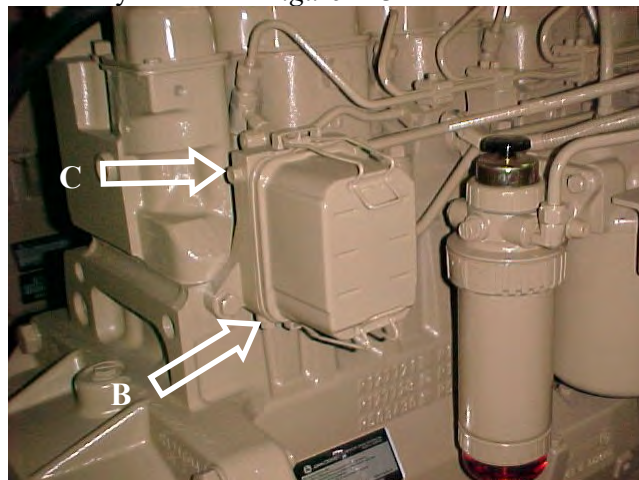


Figure #23

3.1.5 Fuel Tanks

Keep the fuel tank filled to reduce condensation to a minimum. Open drain at the bottom of the fuel tank once a week to drain off any possible water and/or sediment. Fill tank after each test run.

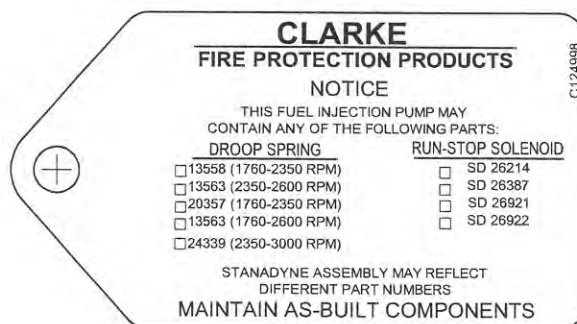
Note: Per NFPA 25 standards, the fuel tank level must never be less than 67% of its capacity.

Maximum Allowable Fuel Head above Fuel pump, Supply or Return.

Engine model	feet	meters
JU4 & JU6	4.5	1.4

3.1.6 JU4/6 Fuel Injection Pump Components

THIS TAG IS SUPPLIED ON ALL JU4 AND JU6 ENGINES



The above tag is stamped to identify the “As Built” Components. Refer to the next two tables to identify:

Table 1) Droop Spring Part Number by Engine Model and Speed.

Table 2) Run-Stop Solenoid (Internal to Injection Pump) Part Number by engine voltage.

**Injection Pump
“Droop Spring” Part Number**

RPM	1760 2100 2350	2350 2600	2800 2960 3000
MODEL			
JU4H-UF10 JU4R-UF09 JU4R-UF11 JU4H-UF20 JU4R-UF19 JU4R-UF21 JU4H-LP20 JU4R-UF23 JU4H-UFADJ8 JU4H-UFADJ2 JU4H-UFAEA0 JU4H-UFAEE8 JU4H-UFAEF2 JU4R-UFAEA9 JU4R-UFAEE7 JU4R-UFAEF1	13563 or C02353		
JU4R-UF13 JU4H-UF14 JU4H-UF24 JU4H-UFAAB26			24339
JU4H-UF12 JU4H-UF22 JU4H-UF32 JU4H-UF42 JU4R-UF51 JU4H-UF52 JU4H-UFH2		13563 or C02353	
JU4H-UF34 JU4H-UFJ4 JU4H-UF44 JU4H-UF54 JU4R-UF53 JU4H-LP54 JU4H-LPL4 JU4H-UF84			24339
JU4H-UF30 JU4H-UF40 JU4R-UF40 JU4H-UF50 JU4H-UFH8 JU4H-UFH0 JU4H-UF58 JU4R-UF49 JU4H-LP50	20357		
JU6H-UF30 JU6H-UFD0 JU6H-UF88 JU6H-UFABL0 JU6H-UFABL2 JU6H-UFABL8 JU6H-UFM8 JU6H-UFM0 JU6H-UF58 JU6H-UF50 JU6H-UF68 JU6H-UF60 JU6H-UFAAQ8 JU6H-UFAARG JU6H-UFKAQ8 JU6H-UFKARG JU6H-UFAAPG JU6H-UFKAPG JU6H-UFAAS0 JU6H-UFKAS0 JU6H-LP50 JU6H-LP60 JU6R-UFAA29 JU6R-UFKA29 JU6R-UFAAD9	13558		

JU6R-UFKAD9 JU6R-UFAAG7 JU6R-UFKAG7 JU6R-UFAAL9 JU6R-UFKAL9 JU6R-UFAAL1 JU6R-UFKAL1 JU6R-UFAAL7 JU6R-UFKAL7 JU6R-UFAAM7 JU6R-UFKAM7 JU6R-UFAAM9 JU6R-UFKAM9 JU6R-UFAA57 JU6R-UFKA57 JU6R-UFAA49 JU6R-UFKA49 JU6R-UFAA67 JU6R-UFKA67 JU6R-UFAA59 JU6R-UFKA59 JU6R-UFAAQ7 JU6R-UFKAQ7 JU6R-UFAARF JU6R-UFKARF JU6R-UFAAPF JU6R-UFKAPF JU6R-UFAAS9 JU6R-UFKAS9			
JU6H-UF32 JU6H-UFD2 JU6H-UFM2 JU6H-UF52 JU6H-UF62 JU6H-UFKAL2 JU6R-UFAA31 JU6R-UFKA31 JU6R-UFAAD1 JU6R-UFKAD1 JU6R-UFAAM1 JU6R-UFKAM1 JU6R-UFAA51 JU6R-UFKA51 JU6R-UFAA61 JU6R-UFKA61		13563 or C02353	
JU6H-UF34 JU6H-UF44 JU6H-UF54 JU6H-UF74 JU6H-UF84 JU6H-UFAB76 JU6R-UFAA33 JU6R-UFKA33 JU6R-UFAA53 JU6R-UFKA53 JU6R-UFAA83 JU6R-UFKA83			24339
RPM	1760 1900	2100 2350 2600	2800 3000
JU6H-UFAAT8 JU6H-UFKAT8	15617		
JU6H-UFKAS2 JU6H-UFAAT0 JU6H-UFKAT0 JU6H-UFAAT2 JU6H-UFKAT2		13563 Or C02353	
JU6H-UF94			16385 Or C02762

Run-Stop Solenoid Part Number

	ETR	ETS
12 Volt	SD26214 or	SD26921 or

	C07853	C07827
24 Volt	SD26387 or C07826	SD26922 or C07828

Legend:

ETR – Energized to Run

ETS – Energized to Stop

SD # - Stanadyne Part Number

C # - Clarke Part Number

3.1.7 JW6 Fuel Injection Pump Components

For Droop Spring and Run-Stop Solenoid (external to Injection Pump) part numbers consult factory.

3.2 AIR/EXHAUST SYSTEM

3.2.1 Ambient Conditions

Clarke engines are tested in accordance with SAE J1349 (Clarke USA) or ISO 3046 (Clarke UK). In this capacity they may be de-rated to meet certain site conditions, failure to do so can seriously impede the performance of the engine and could lead to premature failure.

3.2.2 Ventilation

The engine must be provided with adequate ventilation to satisfy the requirements of the combustion system, radiator cooling systems where fitted, and allow adequate dissipation of radiated heat and crankcase emissions. For all this data refer to Installation & Operation Data (see Page 5). This data can be used for proper sizing of inlet and outlet louvers.

3.2.3 Standard Air Cleaner

Base engine	Speed	Air filter restriction
All JU4		10
All JU6 except models below		12
UF30, UFABL8, UFM8, UF58, UF68, UFAAPG	1470	10
UFD0, UFD2, UF30, UF32, UFABL0, UFABL2, UFM0, UFM2, UF50, UF52, UF60, UF62	2350	13
UFD2, UF32, UFABL2, UFM2,	2600	13

UF52, UF62		
JU6H-UF94, UFKAS2, UFAAT8, UFKAT8, UFAAT0, UFKAT0, UFAAT2, UFKAT2	ALL	13

The standard air cleaner is a reusable type. Should a situation occur where the air cleaner becomes plugged with dirt (starving the engine of air), loss of power and heavy black smoke will result; the air cleaner should be serviced immediately. See *figure #39* for air cleaner part numbers by Clarke Engine Model.

CAUTION: Do not attempt to remove the air cleaner while an engine is running nor run the engine while the air cleaner is off. Exposed components could cause severe injury to personnel and major internal engine damage could occur should any foreign matter be drawn into the engine.

The air cleaner manufacturer recommends the following:

1. The pre-oiled reusable elements are serviced with a special oil. The elements can be serviced or replaced.
2. *Figure #24* shows the air filter service instructions.
3. When servicing the element is not practical, you can improve filter efficiency by re-spraying with oil.

NOTE: Do not attempt this while engine is running

NOTE: Do not over oil the reusable element

AIR FILTER SERVICE INSTRUCTIONS



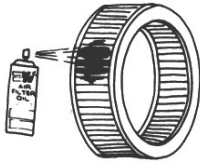
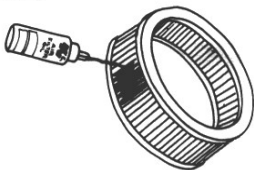
3. PAN CLEANING Large K&N elements can be rolled or soaked in a shallow pan of K&N air filter cleaner. Remove immediately and let soak for approximately 10 minutes. 	4. CLEANING HINTS Use only K&N air filter cleaner. NO gasoline cleaning. NO steam cleaning. NO caustic cleaning solutions. NO strong detergents. NO high pressure car wash. NO parts cleaning solvents. Any of these NO's can cause harm to the cotton filter media, plus shrink and harden the rubber end caps.
5. RINSE OFF Rinse off the element with low pressure water. Tap water is OK. Always flush from the clean side to dirty side. This removes the dirt and does not drive it into the filter. 	6. DRYING HINTS Always dry naturally. After rinsing, shake off all excess water and let the element dry naturally. DO NOT USE COMPRESSED AIR DO NOT USE OPEN FLAME DO NOT USE HEAT DRYERS EXCESS HEAT WILL SHRINK THE COTTON FILTER MEDIA. COMPRESSED AIR WILL BLOW HOLES IN THE ELEMENT.
7. AEROSOL OILING After cleaning air filter always re-oil before using. Spray K&N air filter oil down into each pleat with one pass per pleat. Wait 10 minutes and reoil any white spots still showing. 	8. SQUEEZE BOTTLE OILING After cleaning air filter always re-oil before using. Squeeze K&N air filter oil down into the bottom and along each pleat — only one pass per pleat. Let oil wick into cotton for 20 minutes. Re-oil any white spots still showing. 
9. OILING HINTS Never use a K&N air filter without oil. (The filter will not stop the dirt without the oil.) Use only K&N formulated air filter oil. K&N air filter oil is a compound of mineral and animal oil blended with special polymers to form a very efficient tack barrier. Red dye is added to show just where you have applied the oil. Eventually the red color will fade but the oil will remain and filter the air. NEVER USE Automatic Transmission Fluid. NEVER USE Motor Oil. NEVER USE Diesel Fuel. NEVER USE WD-40, LPS, or other light weight oils.	

Figure #24

Note: Intake Air Shutoff Valve - Engine may include an intake air shutoff valve as an optional feature that is activated by an overspeed event and provides a positive shutoff of combustion air to the engine. The optional air intake shutoff valve has not been evaluated by UL as part of a UL Listed fire pump driver.

3.2.4 Crankcase Ventilation

3.2.4.1 Open Crankcase Ventilation (Refer to figure #27b)

Vapors which may form within the engine are removed from the crankcase and gear train compartment by a continuous, pressurized ventilation system.

A slight pressure is maintained within the engine crankcase compartment. Vapors expelled through a vent pipe attached to the rocker cover breather element. Ref. Figure #25, 26, & 27.

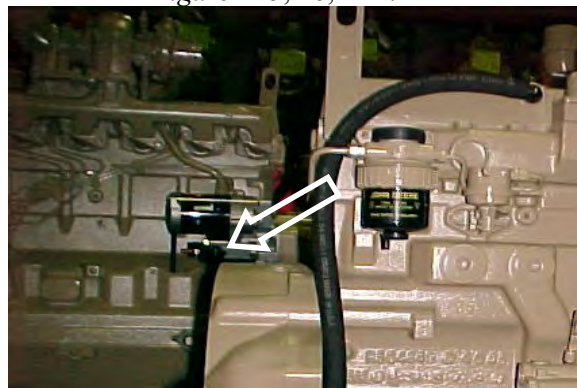


Figure #25

JU4H-UF10, 12, 20, 22, UFADA0, JU4-LP20, 24

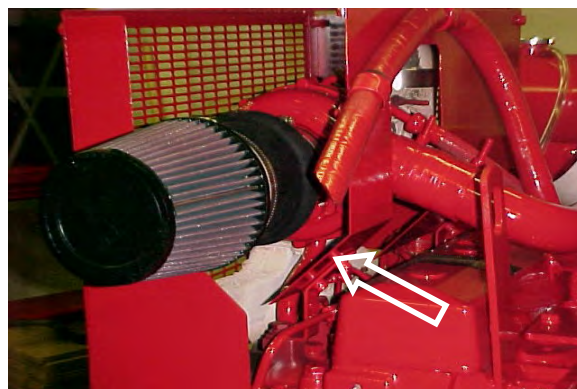


Figure #26

JU4H-UF30, 32, 40, 42, 50, 52, H8, H0, H2, 58, UFADJ8, ADJ2, ADE8, ADF2, ADHG, LP50, 54, & all JU6H



Figure #27 (JDFP/JW6H)

3.2.4.2 Crankcase Ventilation System

A crankcase ventilation system allows for the recirculation of vapors (expelled through a vent pipe attached to the rocker cover breather element) to the combustion air inlet. Refer to *figure 27a*.



Figure #27a

Engine Model	Open Crankcase Ventilation	Crankcase Ventilation System
All Models	Standard	Optional

Figure #27b

3.2.5 Exhaust System

Excessive back pressures to the engine exhaust can considerably reduce both engine performance and life. It is therefore important that exhaust systems should be the proper diameter and be as short as possible within the minimum amount of bends. Refer to Installation & Operating Data (see Page 5) for exhaust data. Also refer to table below for maximum exhaust restriction.

Base engine	Speed	Exhaust backpressure limit
All JU4		30
All JU6 except models below		30
UF34, UF54, UFAB76, UF84	2800	25
UF34, UF54, UF84	3000	25
UF30, UFG8, UFABL8, UFM8, UF58, UF68, UFAAPG	1470	20

The installation of the exhaust system should consist of the following:

- Personnel protection from hot surfaces.
- Adequate supports to prevent strain on the engine exhaust outlet and minimize vibration.
- Protection against entry of water and other foreign matter.

While the engine is running inspect exhaust pipe outlet outside of the pump room itself for environmental hazards such as excessive smoke conditions. The following could be used as a guide for general engine operating conditions.

- 1) Blue Smoke – Possible engine oil consumption.
- 2) White Smoke – Possibility of water in cylinders, water in fuel or internal engine problem.

3.3 LUBRICATION SYSTEM

3.3.1 Checking Sump Oil

Check the sump oil level using the dipstick on the engine as shown in *Figure #28 &29*.

This level must always be between the dipstick marks Min. and Max. with the engine not running.

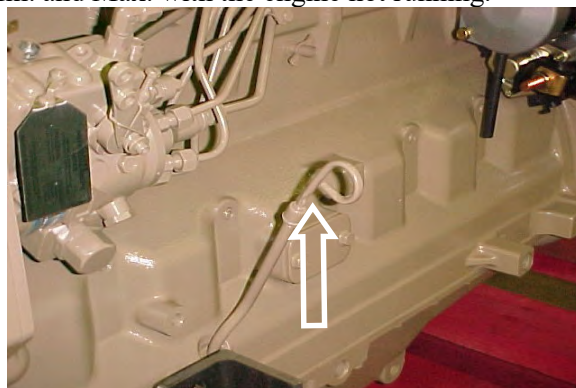


Figure #28
JU4/6

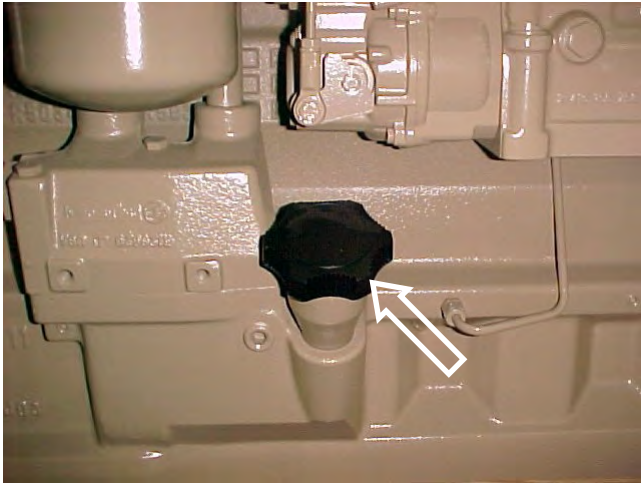


Figure #29
JDFP/JW6

3.3.2 Changing Engine Oil

- 1) Operate the engine until it is warm.
- 2) Stop the engine. Remove the sump drain plug and drain the lubricating oil from the sump. Fit the drain plug tighten the plug to 34 Nm (25lbf-ft) / 3.5 kgf-m.
- 3) Fill the sump to the 'FULL' mark on the dipstick with new and clean lubricating oil of an approved grade.
- 4) Return the unit back into service by returning the AEC selector to "automatic" position and the manual operating lever to manual stop position.
- 5) Dispose used oil properly.

3.3.3 Changing Oil Filter Cartridge

1. Turn engine off.
2. Put a tray under the filter to retain spilt lubricating oil.
3. Remove the filter with a strap wrench or similar tool. Then dispose of the filter properly (Ref Figure #30).
4. Clean the filter head.
5. Add clean engine lubricating oil to the new filter. Allow the oil enough time to pass through the filter element.
6. Lubricate the top of the filter seal with clean engine lubricating oil.
7. Fit the new filter and tighten it by hand only. Do not use a strap wrench.
8. Ensure that there is lubricating oil in the sump. On turbocharged engines, ensure that the engine will not start and operate the starter motor until oil pressure is obtained.

9. Operate the engine and check for leakage from the filter. When the engine has cooled, check the oil level on the dipstick and put more oil into the sump, if necessary.
10. Return the unit back into service by returning the main pump controller selector to "automatic" position and the manual operating lever to AUTO-OFF position.



Figure #30

3.3.4 Oil Specification

This engine is factory-filled with John Deere Engine Break-in Oil.

Important: Do not add makeup oil until the oil level is BELOW the add mark on the dipstick.

Break-in period is 1 year from engine start-up.

Low Speed engine models (Nameplate RPM is less than or equal to 2600 RPM) are shipped from Clarke with John Deere Break-in oil installed. Break-In Oil (TY22041, 10W30) should be used to make up any oil consumed during the break-in period.

High speed engine models (Nameplate RPM is greater than 2600 RPM) are shipped with CI-4, 15W40 oil. On these models any make up oil should meet the requirements of CF-4, CG-4, CH-4, or CI-4, Viscosity Grade 15W40.

Oil spec to be used after break-in period, all engine models:

API Symbol:

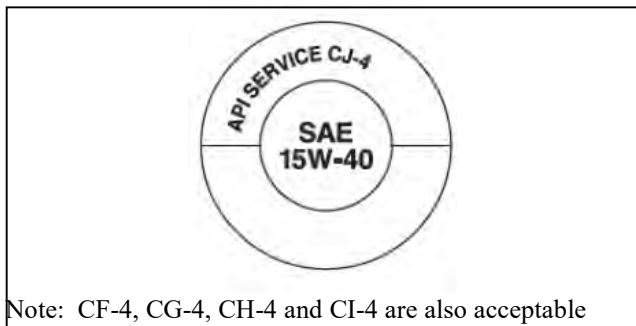


Figure #31

3.3.5 Oil Capacities (Including Filter)

ENGINE MODEL	OIL CAPACITY QUARTS (LITERS)
JU4 – All Models (except JU4H-UF14, UF24, UF34, UF54, JU4R-UF13, UF23, UF53)	15.0 (14.2)
JU4H-UF14, UF24, UF34, UFJ4, UF54, JU4R-UF13, UF23, UF53	16.0 (15.1)
JU6 – All Models (except JU6H-UFAARG, KARG, AAPG, KAPG, AAS0, KAS0, AAQ8, KAQ8, JU6R-UFAARF, KARF, AAPF, KAPF, AAS9, KAS9, AAQ7, KAQ7)	19.7 (18.6)
JU6H-UFAARG, KARG, AAPG, KAPG, AAS0, KAS0, AAQ8, KAQ8, JU6R-UFAARF, KARF, AAPF, KAPF, AAS9, KAS9, AAQ7, KAQ7	32.3 (30.6)
JW6 – All Models	30.1 (28.5)

Figure #32

3.4 COOLING SYSTEM

3.4.1 Intended Engine Operating Temperature

The JU and JW engines are provided with either a heat exchanger or radiator to maintain the engine coolant temperature within recommended operating guidelines.

The JU4H, JU6H, and JW6H have an intended engine operating temperature of 160° F (71°C) to 185° F (85° C). A high coolant temperature switch is provided to indicate a high coolant temperature alarm at 205° F (96° C) for heat exchanger cooled models and 215°F (102° C) for radiator cooled models.

3.4.2 Engine Coolant

The following information is provided as a guide for John Deere Engine users in the selection of a suitable coolant.

The water/ethylene glycol/inhibitor coolant mixture used in John Deere engines must meet the following basic requirements:

- Provide for adequate heat transfer.
- Provide protection from cavitation damage.
- Provide a corrosion/erosion-resistant environment within the cooling system.
- Prevent formation of scale or sludge deposits in the cooling system.
- Be compatible with engine hose and seal materials.
- Provide adequate freeze and boil over protection.

WARNING

A water and anti-freeze solution is required for pump installations. Premixing this solution prior to installing is required. This prevents possible pure anti-freeze chemical reactions to block heater elements which can burnout the element. Please see the I&O section (see Page 5) for proper cooling system capacities of each model.

3.4.3 Water

Water can produce a corrosive environment in the cooling system, and the mineral content may permit scale deposits to form on internal cooling surfaces. Therefore, inhibitors must be added to control corrosion, cavitation, and scale deposits.

Chlorides, sulfates, magnesium and calcium are among the materials which make up dissolved solids that may cause scale deposits, sludge deposits, corrosion or a combination of these. Chlorides and/or sulfates tend to accelerate corrosion, while hardness (percentage of magnesium and calcium salts broadly classified as carbonates) causes deposits of scale. Water within the limits specified in *figure #33* is satisfactory as an engine coolant when properly inhibited. Use of distilled water is preferred.

Materials	Parts per Million	Grains per Gallon
Chloride (Max.)	40	2.5
Sulfates (Max.)	100	5.8
Total Dissolved Solids (Max.)	340	20
Total Hardness (Max.)	170	10

Figure #33

3.4.4 Coolant Capacities

Ethylene Glycol or Propylene Glycol are acceptable:

IMPORTANT:

Do not use cooling system sealing additives or antifreeze that contains sealing additives.

Do not mix ethylene glycol and propylene glycol base coolants.

Do not use coolants that contain nitrites.

Use an ethylene glycol coolant (low silicate formulation) that meets the standard of either the GM 6038-N formulation (GM1899-M performance) or **ASTM D-6210** requirements.

A 50% coolant water solution is recommended. A concentration over 70% is not recommended because of poor heat transfer capability, adverse freeze protection and possible silicate dropout. Concentrations below 30% offer little freeze, boil over or corrosion protection.

IMPORTANT

Never use automotive-type coolants (such as those meeting only ASTM D3306 or ASTM D4656). These coolants do not contain the correct additives to protect heavy-duty diesel engines. They often contain a high concentration of silicates and may damage the engine or cooling system.

ENGINE MODEL	COOLANT CAPACITY QUARTS (LITERS)
JU4H	13.2 (12.5)
JU6H	19.5 (18.5)
JU4R-UF09, 11, 13, 19, 21, 23, UFAEA9, AEE7, AEF1	18.0 (17.0)
JU4R-UF40, 49, 51, 53	20.0 (19.0)
JU6R-UFAAD9, D1, 29, 31, M7, M9, M1, 57, 49, 51, 33, 53	40.7 (38.5)
JU6R-UFAAPF, Q7, RF, 83, 59, 61, S9	43.0 (40.7)
JDFP-06WA/JW6H-UF30,38	22 (21)
JDFP-06WR/JW6H-UF40,48, 50, 58, 60, H8	23 (22)

Figure #34

3.4.5 Coolant Inhibitor

The importance of a properly inhibited coolant cannot be over-emphasized. A coolant which has insufficient or no inhibitors at all, invites the

formation of rust, scale, sludge and mineral deposits. These deposits can greatly reduce the cooling systems efficiency and protection capabilities.

Recommended supplemental coolant inhibitors are a combination of chemical compounds which provide corrosion protection, cavitation suppression, pH controls and prevents scale. These inhibitors are available in various forms, such as liquid packages or integral parts of anti-freeze.

It is imperative that supplemental inhibitors be added to all John Deere engine systems. A pre-charge dosage must be used at the initial fill and the maintenance dosage used at each service interval. Serious damage will occur unless inhibitors are used. Some of the more common corrosion inhibitors are borates, nitrates and silicates.

Inhibitors become depleted through normal operation; additional inhibitors must be added to the coolant as required to maintain original strength levels. Refer *Figure #35* for proper concentrations of inhibitors.

	Min. PPM	Max PPM
Boron (B)	1000	1500
Nitrite (NO ²)	800	2400
Nitrates (NO ³)	1000	2000
Silicon (Si)	50	250
Phosphorous (P)	300	500
PH	8.5	10.5

Figure #35

Do not use soluble oils or chromate inhibitors in John Deere engines. Detrimental effects will occur.

To properly check inhibitor concentrations it may be necessary to contact your local Service/Dealer for assistance. Refer to Parts Information Section to obtain the part number for the factory Coolant Analysis Kit. This kit can be purchased for a nominal fee for analyzing the conditions of the engine's coolant.

3.4.6 Procedure for Filling Engine

Clarke engines ship from the factory filled with coolant unless otherwise requested. Prior to running engine always check for proper coolant level. Checking coolant level and replacing coolant are parts of the standard maintenance routine. For more information on maintenance please see section 4.0 Maintenance Schedule.

During filling of the cooling system, air pockets may form. The system must be purged of air prior to being put in service. This is best accomplished by filling with a pre-mix solution.

Caution: Do not overfill cooling system. A pressurized system needs space for heat expansion without overflowing.

3.4.6.1 Engines without Coolant Recovery Tank (Figure #35A)

Install the pressure cap, start and run engine for approximately 5 minutes in order to purge the air from the engine cavities.

When verifying that the coolant is at a safe operating level, it is best to wait until the engine temperature drops to approximately 120°F (49°C), or lower, before removing the pressure cap.

Remove the pressure cap and refill to the proper fill level. To continue the deaeration process start and run engine until the temperature stabilizes at approximately 160°-200° (71°-93° C) or run engine for 25 minutes, whichever is longer. During this warming process, you may see coolant coming from the overflow tube attached at the pressure cap location. Allow engine to cool, then remove the pressure cap and refill to the proper fill level.

Caution: Do not remove pressure cap while coolant is at normal operating temperatures. Possible personal injury could result from the expulsion of hot coolant.

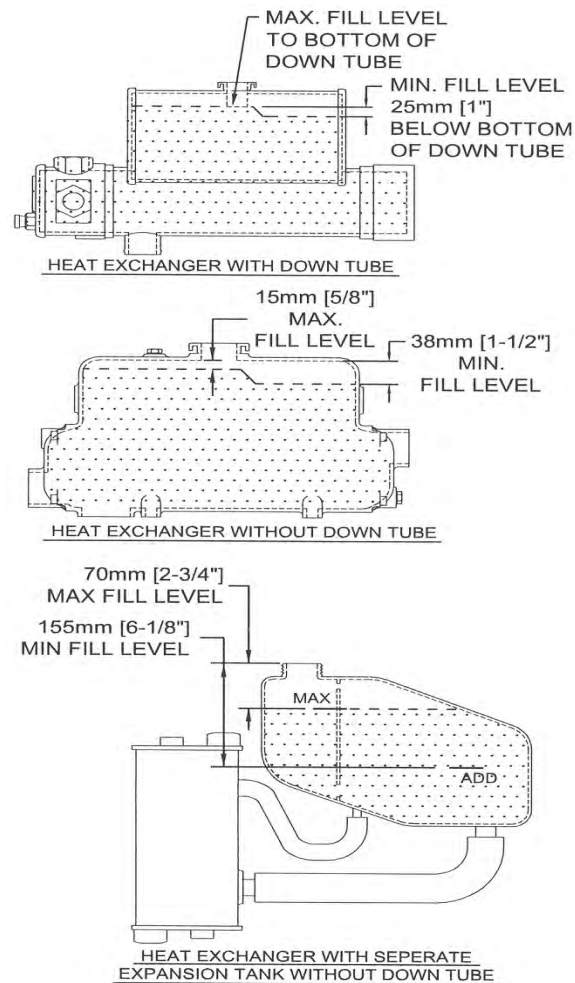
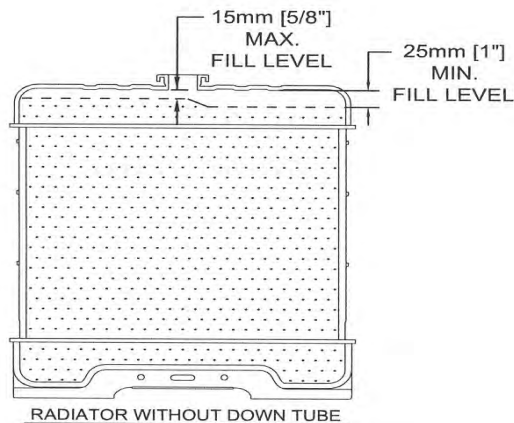


Figure #35A

3.4.6.2 Engines with Coolant Recovery Tank

Remove pressure cap from heat exchanger and fill the cooling system with a 50/50 coolant mixture to pressure cap sealing surface.

Note: Use a fill rate of no more than 10 liters/min (3 gpm). Replace heat exchanger pressure cap.

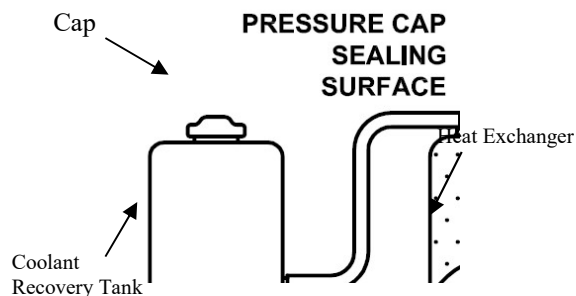


Figure #35B

Remove cap from coolant recovery tank and fill the coolant recovery tank with a 50/50 coolant mixture to

a level of 100mm (4") from bottom of the tank. Replace cap.

Full hot: 4 inches from bottom

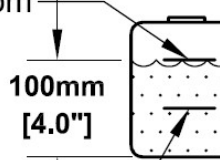


Figure #35C

Start and run engine with fire pump in a no flow or low flow condition. Run engine for approximately 1 minute. Carefully remove heat exchanger pressure cap while engine is running.

Note: Caution should always be taken when removing a cap from a system under pressure.

Refill cooling system to the pressure cap sealing surface. Replace heat exchanger pressure cap.

Complete deaeration will take several warm up/ cool down cycles. Always check appropriate coolant level in coolant recovery bottle.

3.4.7 Providing adequate Raw Water Supply to the Engine Heat Exchanger

3.4.7.1 Raw Water Supply

Most Clarke diesel engine fire pump drivers are heat exchanger cooled and some engines also have a charge air cooler (CAC) that uses raw water to cool the air before entering the intake manifold. If you have a radiator cooled Clarke engine, you can disregard this section. Heat exchanger cooled diesel engine drivers require a clean source of pressurized water from the discharge side of the fire pump in order to keep the engine from overheating by providing a specified minimum amount of raw water flow.

3.4.7.2 Cooling Loop

Note: Engine may include a cooling loop as an optional feature and has not been evaluated by UL as part of a UL Listed fire pump driver.

Figure #35D shows the standard NFPA 20 cooling loop piping arrangement. The cooling loop consists of an Automatic flow line with a 12V or 24V solenoid valve (HSC and ES pump applications only)

that is energized to open anytime the engine is called upon to run from either the fire pump controller or from the engine instrument panel.

NOTE: VT type pumps applications do not require a solenoid valve in the Automatic flow line.

NOTE: With the Mechanical Engine and Alarm Control Board, See section 3.5.5, the solenoid valve will open 15 seconds after engine shutdown and will stay open for 60 seconds. This allows for raw water to flow through the heat exchanger and reduce the heat soak rise caused in the engine.

The second flow line is called the Manual by-pass line and it can be opened at any time if for any reason the engine shows signs of overheating. Each line has two (quarter turn) shutoff values installed and the normal position of the shutoff valve is to remain open in the Automatic flow line and remain closed in the Manual by-pass flow line.

NOTE: Opening up both lines to flow is never a problem should there be some concern of engine overheat, especially if there is an emergency situation. The Manual by-pass line can only be opened by an operator in the pump room.

The shutoff valves are all identified to show which are Normally Open (Automatic flow line) and which are Normally Closed (Manual by-pass flow line). The shutoff valves are also used to isolate water pressure in the event of maintenance to pressure regulators, strainers and solenoid valve. Shutoff valves in the automatic flow line are provided with lockable handles for cooling loops that have been tested to FM requirements. . These valves have been provided with a temporary locking pin to keep them in the open position, see detail A in Figure #25. This temporary retainer needs to be replaced with a 9/32" lock.

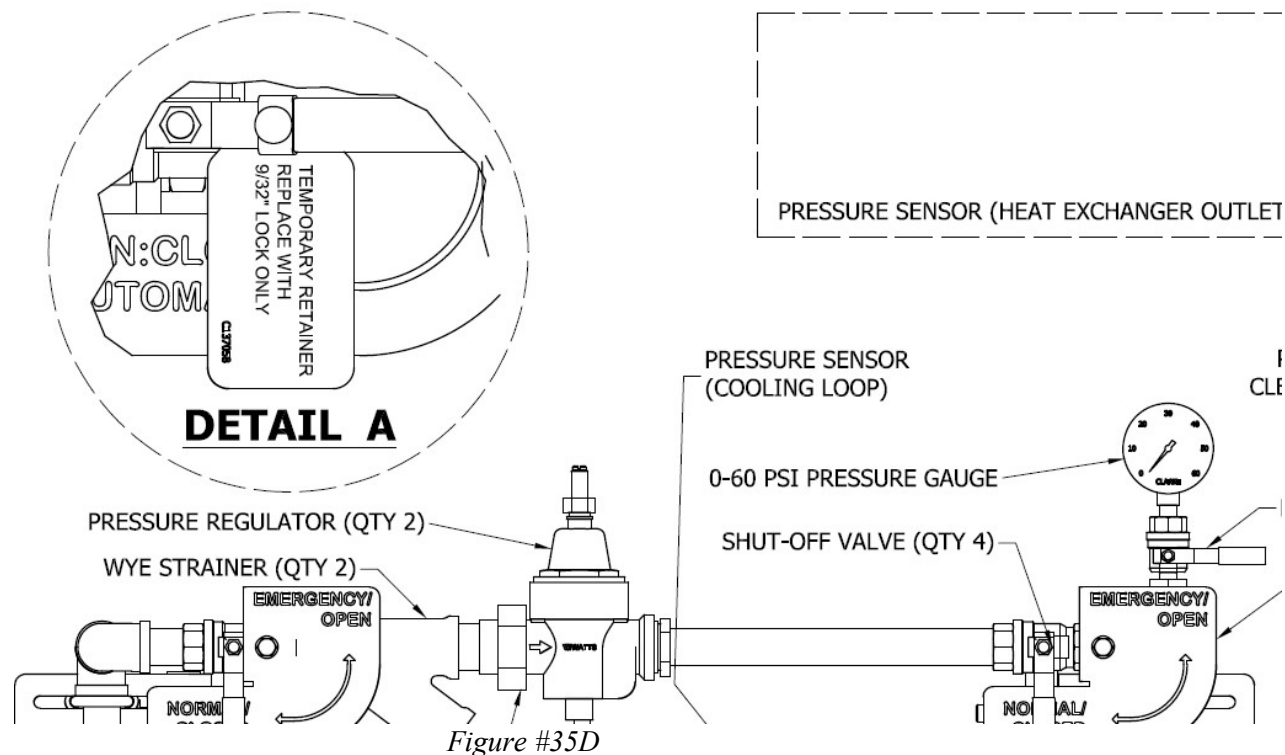
In each flow line there is also a pressure regulator.

Each pressure regulator protects the downstream piping from over-pressurization which includes the tube side of the engine shell & tube heat exchanger (or CAC) and to control raw water flow rate. Typically the pressure regulators are set to limit downstream pressure to 60 psi (4 bar). There is a pressure gauge installed just upstream of the engine heat exchanger (or CAC) and downstream of the pressure regulator. Under normal engine operating conditions with adequate cooling water flowing thru

the heat exchanger (or CAC) this gauge should typically read below 20 psi (1.4 Bar).

Wye strainers are used to remove debris from the raw water supply. One strainer is in the Automatic flow line and the other is in the Manual by-pass flow line.

Note: See section 3.4.7.5 regarding strainer maintenance.



3.4.7.3 Setting Raw Water Flow Rate

The proper amount of raw water flow thru this line is of the utmost importance, and the pressure gauge value does little to indicate if there is sufficient flow. When the engine is exercised weekly, the amount of raw water flow exiting the piping to a floor drain should always be checked to verify it does not appear to have diminished.

During initial commissioning of the engine, it is important to correctly set the raw flow rate going thru the cooling loop. Each Clarke engine model has an Installation and Operation (I&O) Datasheet that provides basic operating conditions of the engine and most values are given based upon engine speed. You will find this datasheet in the Operators Manual that is shipped with the engine for your specific Clarke model. This datasheet must be available during commissioning in order to set the proper minimum raw water flow. You will need to measure the raw water temperature and then find the value for recommended minimum raw water flow at your

measured raw water temperature on the I&O Datasheet and then; with the fire pump flowing 150% of rated flow, and the Automatic flow line open; set minimum flow by using the adjusting screw at the top of the pressure regulator.

NOTE: To increase flow turn the adjusting screw clockwise and to reduce flow turn the adjusting screw counterclockwise.

You will need to capture the flow for a specific amount of time coming out of the heat exchanger and going to a floor drain in order to establish a reasonably accurate flow rate value. Using a container or bucket of known volume, record the time required to fill the container and compare to the gpm or L/min value provided on the I&O datasheet. **THIS IS CRITICAL FOR PROPER ENGINE COOLING AT MAXIMUM PUMP LOAD!** After setting the pressure regulator in the Automatic flowline, open the Manual by-pass line valves, and then close the Automatic flowline valves and repeat the above process in order to set the flowrate going

thru the pressure regulator in the Manual by-pass line. Once this is completed; close the Manual by-pass valves and open the Automatic flowline valves to restore conditions back to normal.

3.4.7.4 Raw Water Outlet

NOTE: NFPA 20 does allow for the heat exchanger outlet flow to be returned to a suction reservoir. This makes it very difficult to measure the flowrate. When discharging to a suction reservoir, NFPA provides additional requirements:

- 1) A visual flow indicator and temperature indicator are installed in the discharge (waste outlet) piping.
- 2) When waste outlet piping is longer than 15ft (4.6m) and / or the outlet discharges are more than 4ft (1.2M) higher than the heat exchanger, the pipe size increased by at least one size.
- 3) Verify that when the correct flow rate is achieved that the inlet pressure to the heat exchanger (or CAC) does not exceed 60psi (4bar)

If you have such an installation, it is recommended that you run the engine for a period of time at firepump 150% flow and confirm the visual flow indicator is showing water flow, the temperature rise is not excessive (usually no more than 40F (4.5C) over ambient raw water temperature) and the engine is showing no signs of overheating.

3.4.7.5 Raw Water Quality, Strainers and Deterioration of Heat Exchanger (or CAC)

Over time, as the heat exchanger (or CAC) begins to plug and foul, this pressure will rise and the flow will diminish which could mean that the heat exchanger (or CAC) may have to be replaced.

It can be not stressed enough how important it is to keep these wye strainers within the cooling loop clean: ***Most engine failures occur due to plugged cooling loop strainers!*** If the raw water supply has

debris in it (leaves, stones, etc) as the strainer accumulates more debris (that will not pass thru it), the flowrate will continue to diminish which will eventually starve the engine of adequate cooling water flow which will lead to engine overheat and catastrophic engine failure. ***When this occurs you have no fire protection!*** Clarke recommends that after the initial engine commissioning and also prior to each weekly exercise of the engine / fire pump set, both strainers be removed and cleaned and then re-installed before starting the engine.

3.4.7.6 Backflow Preventers

NFPA20 allows for the use of backflow preventers in the Automatic and Manual flow line of the cooling loop as required by local code. For specific application information contact factory.

3.4.7.7 Raw Water Outlet Temperature

Certain local codes may not allow you to discharge the waste water outlet from the engine heat exchanger either due to its temperature or it now being considered hazardous waste. It is recommended you always check local codes regarding waste water discharge.

3.4.8 Flow Paths of Engine Cooling System

The engine coolant flows through the shell side of the heat exchanger (or radiator), engine coolant pump, oil cooler, engine block and cylinder head, jacket water heater, thermostat, expansion tank, and coolant recovery tank (if equipped).

On heat exchanger equipped engines raw cooling water flows through the tube side of the charge air cooler, if equipped, and the tube side of the heat exchanger.

Refer to *Figures #35E* for heat exchanger cooled engines and *#35F* for radiator cooled engines for cooling system flow path diagrams.

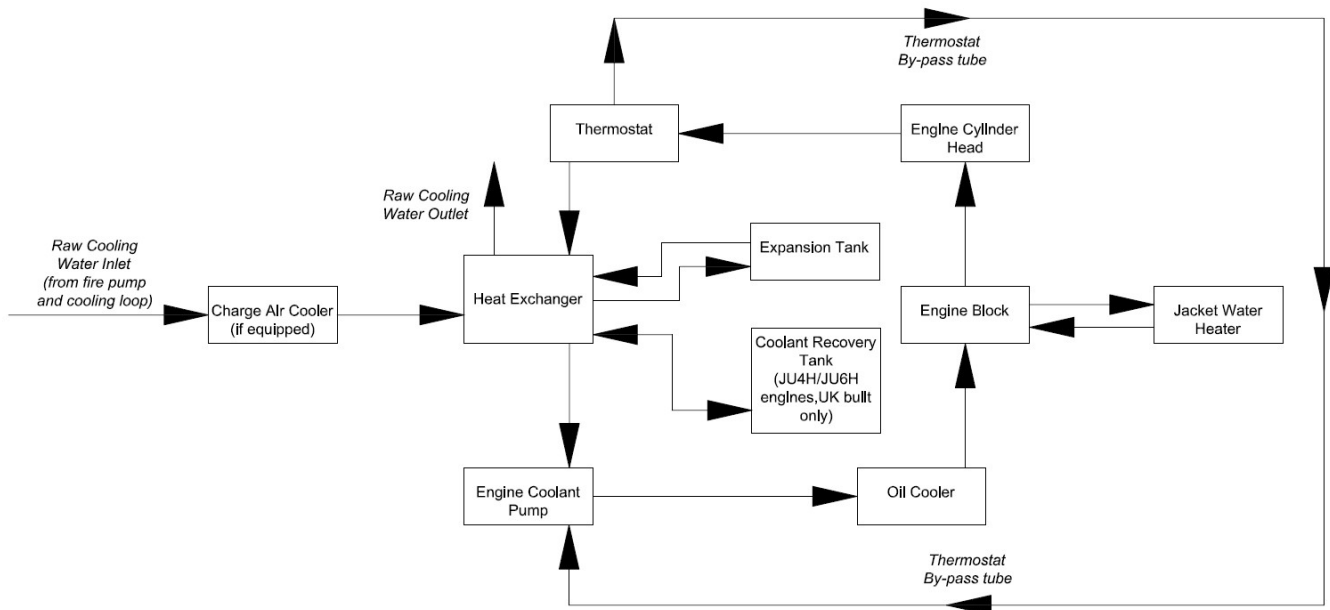


Figure 35E – Heat Exchanger cooled engines – Heat Exchanger cooled engines

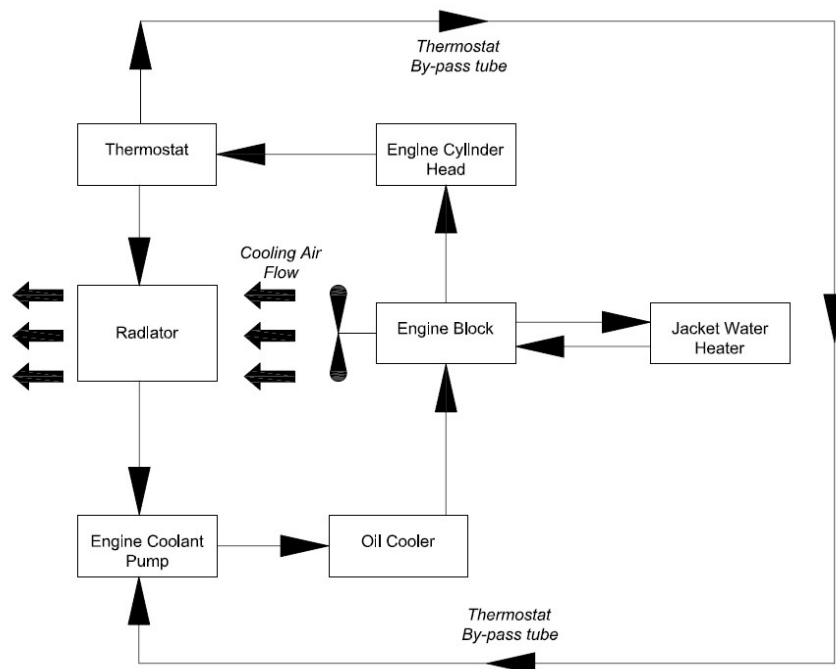


Figure 35F – radiator cooled engines- radiator cooled engines

3.4.9 IMPORTANT SERVICE NOTICE

Any time an engine experiences a high coolant temperature alarm condition the primary cause of the overheat must be determined and the cause corrected to prevent a recurring overheat event. Additionally, if an event of a restricted flow, collapsed hose, insufficient coolant level or failed pressure cap is experienced, further investigation of the cooling

system is required.

- 1) The coolant should be drained (after de-energizing the coolant heater)
- 2) Replace the engine thermostat(s)
- 3) Remove the engine water pump and inspect the impeller and seal for damage, replace as necessary. Reassemble and refill coolant according to the Installation and Operations Instruction Manual.
- 4) Run the engine to verify normal operating

temperature.

3.4.9.1 Water Pump Cavitation

Cavitation is a condition that occurs when bubbles form in the coolant flow in the low pressure areas of the cooling system and implode as they pass to the higher pressure areas of the system. This can result in damage to cooling system components, particularly the water pump impeller and cylinder liners.

Cavitation in an engine can be caused by:

- Improper coolant
- Restricted coolant flow caused by collapsed hose or plugged system
- Coolant fill cap is loose or unable to retain the required pressure
- Insufficient fluid level
- Failure to de-aerate
- Overheat

3.5 ELECTRICAL SYSTEM

3.5.1 Wiring Diagrams (Only with Engine Gauge Panel)

Run/Stop Solenoid	Drawing No.	Description (DC Voltage)	Reference Document
ETR	C07575 (JU4/6)	Mechanical Engines NFPA-20 and UL/FM engine gauge panel (NL Models - Optional)	(Mechanical Engines)
ETR	C071360	Electronic Engine NFPA20 and UL/FM engine gauge panel	JU Electronic Engines JW Electronic Engines
ETR	C07602 (JW6)	NFPA-20 and UL/FM engine gauge panel (NL Models - Optional)	(Mechanical Engines)

ETS	U071056	LPCB Engine Gauge Panel	(Mechanical Engines)
ETR	C071612	UL/FM Front Opening Instrument Panel	(Mechanical Engines)
ETR/ETS	C071590	UL/FM Front Opening Instrument Panel with C071571/ C071963 speed switch	(Mechanical Engines)
ETR	C071299	UL/FM Front Opening Instrument Panel with C071571/ C071963 speed and emergency bypass switch	(Mechanical Engines)

ETR = Energized to Run / ETS = Energize to Stop

Drawing No.	Description (AC Voltage)
C07651 (JU4/6, JW, JX)	NFPA-20, UL/FM, and LPCB Engine Jacket Water Heater (NL Models - Optional)
C07651 (JDFP/JW6)	Optional Engine Jacket Water Heater (NL Models - Optional)

Figure #36

3.5.2 Checking Drive Belt Tension and Adjustment

All drive belts must be adequately tightened to secure that both the engine water pump and battery charging alternator (when fitted) are operating efficiently. Refer to Figure #37.

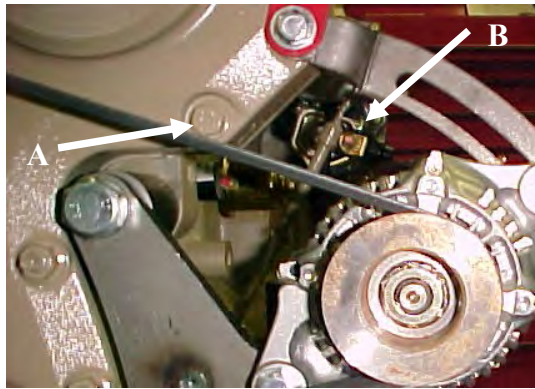


Figure #37

To adjust Belt Tension:

Check belt tension:

- Give at arrow must be .4" - .6" (10-15mm).

To increase tension of the water pump driving belts:

- Loosen alternator or belt tensioner mounting bolts A and B.
- Adjust to proper belt tension.
- Tighten mounting bolts A and B.

3.5.3 Speed Switch (when supplied)

Overspeed is defined as 120% of rated speed for engines rated from 1470 through 2600 rpm, and 110% of rated speed for engines rated from 2800 through 3000 rpm. In the event of an engine overspeed, the speed switch signals the main pump controller and also affects an engine shutdown. A visual overspeed warning lamp will illuminate on the Clarke panel (figure #37A). The OVERSPEED RESET (figure# 9) switch is included on the instrument panel. Should an overspeed condition occur, investigate the cause and make necessary corrections before placing engine back in service. The OVERSPEED RESET must be manually lifted to reset.

NOTE: This reset operation must be completed to allow a restart. If not, the engine will not start thru the main pump controller or manually.

OVERSPEED VERIFICATION

Hold the OVERSPEED VERIFICATION switch in the "up" position. This will provide the main pump controller with an overspeed signal and engine shutdown at 67% of the set overspeed RPM.

Start the engine via the main pump controller; the speed switch will generate an overspeed signal and shutdown protecting both the engine and pump.

EXAMPLE

Rated Speed: 1760 RPM

Overspeed Shutdown: 2112 RPM (120% of 1760 RPM)

Verification Shutdown: 1410 RPM (67% of 2112 RPM)

CAUTION-after verification of overspeed, lift the OVERSPEED RESET switch and reset the main pump controller to re-instate normal operation of the engine and speed switch.

Refer to Engineering Technical Bulletin – ETB003, part number C133407, on the www.clarkefire.com website for adjusting the overspeed setting for range rated engines.

3.5.4 Magnetic Pick-Up (when supplied)

A magnetic pick-up, mounted in the flywheel housing, provides the input signal for the tachometer overspeed switch, and/or the main pump controller. There should be a 0.03" air gap between the top of the ring gear and the center of the magnetic pick-up. With one tooth centered in the magnetic pick-up hole, thread the pickup in until it touches the gear tooth and then back it out 1 turn. Tighten jam nut while holding the pickup in position. Reconnect to wiring harness.

3.5.5 Mechanical Engine Control and Alarm Board (MECAB) Speed Switch Troubleshooting

This engine may be equipped with a speed switch p/n C071571 capable of sensing engine sensor malfunctions and/or electrical over-current(s) on engine alarm circuits and alerting the user via flashing status lamps. This flashing status indication is done so with the red "OVERSPEED SHUTDOWN" lamp on the outside of the Clarke instrument panel (Figure #37A) and a red LED located on the middle of the speed switch inside of the Clarke instrument panel (Figure #37B). In addition to these flashing status lamps, a "Low Engine Coolant Temperature Alarm" is sent via engine / fire pump controller inter-connect circuit #312 as a means to alert the user outside of the engine room.

Note: When first applying battery power to the engine, or after activating the overspeed reset switch, the OVERSPEED SHUTDOWN lamp and red LED on the speed switch will flash several times. This is

an “INITIALIZATION PATTERN” and is normal. This will be referred to in the following troubleshooting section.



Figure #37A

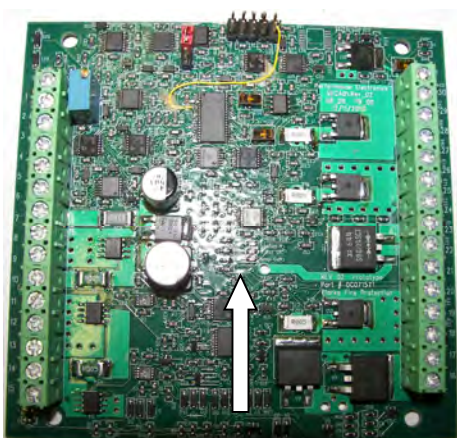


Figure #37B

List of Troubleshooting Malfunctions

Two (2) blinks – Electrical Current Exceeds 10 Amps on Alarm Circuits: Status lamps will flash two times continuously on the Clarke instrument panel and a “Low Engine Coolant Temperature” alarm will be sent to the fire pump controller via circuit #312.

Cause:

Electrical current exceeds 10 amps on one or more engine / fire pump controller inter-connect circuits

- Engine run alarm (#2)
- Engine overspeed alarm (#3)
- Engine low oil pressure alarm (#4)
- Engine high coolant temperature alarm (#5)
- Engine low coolant temperature alarm (#312)

Corrective actions:

Check each of the above circuits to determine which contains the current overload.

Once circuit(s) overload are corrected: On the Clarke instrument panel, operate the “OVERSPEED RESET” switch for two (2) seconds and release (Figure #37C).



Figure #37C

The “INITIALIZATION PATTERN” will flash. This is normal. The continuous two (2) blink flash sequence should turn off at this point.

Three (3) blinks – Engine Coolant Temperature Sensor malfunction: Status lamps will flash three times continuously on the Clarke instrument panel and a “Low Engine Coolant Temperature” alarm will be sent to the fire pump controller via circuit #312.

Cause:

Engine coolant temperature sensor circuit is open or closed

Corrective Actions:

Verify wiring and connector plug at engine coolant temperature sensor are secure. Sensor is located behind engine thermostat housing. On the Clarke instrument panel, operate the “OVERSPEED RESET” switch for two (2) seconds and release. (Refer to Figure #37C).

The “INITIALIZATION PATTERN” will flash. This is normal. The continuous three (3) blink flash sequence should turn off at this point.

If problem still exists, replace engine coolant temperature sensor, Clarke part number C071607

Five (5) blinks on instrument panel – Oil pressure switch or Engine speed sensor (magnetic pick-up) malfunction: Status lamps will flash five times continuously on the Clarke instrument panel and a

“Low Engine Coolant Temperature” alarm will be sent to the fire pump controller via circuit #312.

Cause:

Oil pressure switch failure or magnetic pick-up failure.

Corrective Actions:

Oil Pressure switch check

Verify wiring and connector at engine oil pressure switch are secure. Pressure switch is located on left side of engine (JU models) and right side of engine (JW models)

With engine off, check continuity between the two terminals on the oil pressure switch. Note, do not disconnect wires when performing this task.

If circuit is open, replace oil pressure switch, Clarke part number C072011.

After new switch is replaced: On the Clarke instrument panel, operate the “OVERSPEED RESET” switch for two (2) seconds and release. (Refer to *Figure #37C*)

The “*INITIALIZATION PATTERN*” will flash. This is normal. The continuous five (5) blink flash sequence should turn off at this point.

If circuit is closed, the oil pressure switch is not damaged and is working normally as expected. Proceed to engine speed sensor check, below. Engine speed sensor (magnetic pick-up) check. Verify wiring and connector at engine speed sensor are secure. Magnetic pick-up is located on top of the flywheel housing.

With engine running, verify that the tachometer is functioning normally.

Refer to section 3.5.4 of Engine Operator’s Manual to properly reposition the magnetic pick-up if tachometer is not functioning.

Once magnetic pick-up is repositioned: On the Clarke instrument panel, operate the “OVERSPEED RESET” switch for two (2) seconds and release. (Refer to *Figure #37C*).

“OVERSPEED SHUTDOWN” lamp will flash a sequence of one (1) blink, then four (4) blinks. This is normal. The continuous five (5) blink flash sequence should turn off at this point. If problem still

exists, replace engine speed sensor (magnetic pick-up), Clarke part number C071883.

3.5.6 FIELD SIMULATION OF PUMP CONTROLLER ALARMS

Field simulation of (6) pump controller alarms

- Alarm 1: Over speed Shutdown: Follow over speed verification steps per section 3.5.3.

- Alarm 2: Low Oil Pressure: With the engine running, jumper across two outer terminals with wires attached to the engine mounted Low Oil Pressure switch.

Wait for 15 seconds and controller alarm will activate.

- Alarm 3: High Engine Coolant Temperature: With the engine running, set the High Engine Coolant Temperature DIP switch to “ON” (see *Figure #37D*). Use a fine pick or small screwdriver and slide the white slider to the left. Wait for 30 seconds and controller alarm will activate. Set white DIP switch slider to “OFF” (right) when simulation is complete.

- Alarm 4: Low Engine Coolant Temperature: With the engine not running, set the Low Engine Coolant Temperature DIP switch to “ON” (see *Figure #37D*). Use a fine pick or small screwdriver and slide the white slider to the right. Controller alarm will activate immediately. Set white DIP switch slider to “OFF” (left) when simulation is complete.

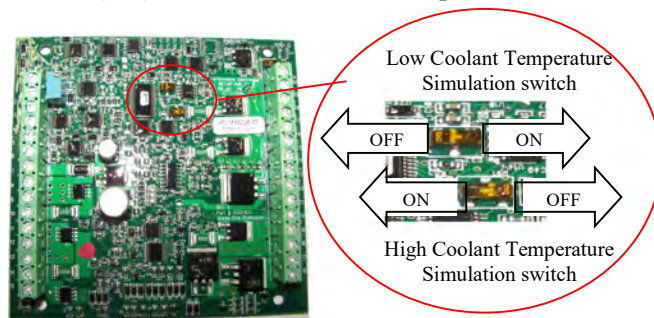


Figure #37D

- Alarm 5: Overcrank: **NEVER** shut off the fuel supply to the engine to prevent it from starting. Shutting off the fuel supply will cause an air lock condition in the fuel system and possibly cause fuel system component damage.

ETR Governor Solenoid: Activate and hold the Overspeed Reset switch while performing the

overcrank test. Switch must be held continuously each time the engine attempts a crank start. This will allow the engine to crank only but will prevent it from running.

ETS Governor Solenoid: Use manual stop override to prevent the engine from starting during the cycle-crank testing. Override must be held continuously each time the engine attempts a crank start. This will allow the engine to crank only but will prevent it from running.

- Alarm 6: High Raw Water Temperature:
With the engine running from the main pump controller, jumper the two terminals of the high raw water temperature switch. The switch is located within the raw water plumbing in between the cooling loop and the inlet of the heat exchanger or charge air cooler (if equipped). Continue jumping the circuit for 30 seconds minimum until the alarm is indicated at the controller at interconnect terminal #310

3.5.7 BATTERY REQUIREMENTS

All Clarke engine models require 8D batteries, as sized per SAE J537 and NFPA20. The battery should meet the following criteria:

Cold Cranking Amps (CCA @ 0°F): 1400

Reserve Capacity (minutes): 430

Refer to Clarke drawing C131885 (see Page 5) for additional information on Clarke supplied batteries.

JU4 and JU6 Non-Listed (NL) and APSAD (AP) engine models may use 4D batteries sized per SAE J537. The battery should meet the following criteria:

Cold Cranking Amps (CCA @ 0°F): 1050

Reserve Capacity (minutes): 290

3.6 ENGINE SPEED ADJUSTMENT

A mechanical governor controls the engine speed. The governor is built into the fuel injection pump. All governors are adjusted to the rated speed at nameplate power or maximum allowed pump load before leaving Clarke. During Start-Up Inspection or when placing reconditioned units into service, some minor speed adjustment may be required. It is recommended that this adjustment be performed by the authorized Service Dealer representative.

To adjust the speed of the engine:

- A. Start the engine by following the “To Start Engine” Procedure in this manual.
- B. Let the engine warm-up. Loosen the jam nut(s) (*Figure #38*).
- C. While observing the instrument panel tach rotate the long adjustor clockwise to lower the RPM and counter clockwise to raise the RPM’s until desired speed is obtained. Ref. *Figure #38A*.
- D. Holding secure the long adjustor with a wrench tighten the jam nut.
- E. Stop engine by following “To Stop Engine” Procedure in this manual.



Figure #38A

If the engine has been designed and tested for range rating, stamp the metal tag titled “FIELD SETTING” with the final adjusted speed, horsepower, and overspeed shutdown setting and keep with the engine. Refer to *Figure #38B*.

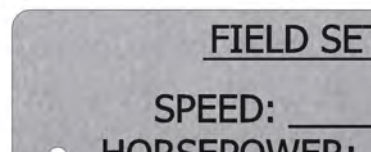


Figure #38B

4.0 MAINTENANCE SCHEDULE

4.1 ROUTINE MAINTENANCE

NOTE: The following Routine Maintenance schedule is based on an engine usage rate not exceeding 2 hours per month. For UL/FM engine models, also refer to NFPA25.

LEGEND:

- Check
- ❖ Clean
- Replace
- Lubricate

WEEKLY

- Air Cleaner
- Battery
- Belts
- Coolant Hoses
- Coolant Leaks

- ☐ Coolant Levels and Condition
- ☐ Cooling Loop Valves Position
- ☐ Cooling Water Solenoid Valve
- ☐ Cooling Water Discharge
- ☐ Exhaust System
- ☐ Fuel Tank
- ☐ General Inspection
- ☐ Governor Run-Stop Control
- ☐ Jacket Water Heater
- ☐ Lubrication Oil Level
- ☐ Operating Gauges
- ☐ Remove Water from Fuel Filter
- ☐ Run Engine
- ☐ Warning Light
- ❖ Cooling Water Strainers
- ❖ Clean Radiator Core Debris (if equipped)

EVERY 6 MONTHS

- ❖ Batteries
- ☐ Battery Charging Alternator
- ☐ Belt tension
- ☐ Coolant Protection Level
- ☐ Driveshaft U-Joints
- ☐ Fuel Lines

EVERY 1 YEAR

- ❖ Air Cleaner
- ☐ Coolant Inhibitor
- ☐ Crankcase Vent System
- Driveshaft U-Joints
 - Fuel & Oil Filters
 - ☐ Heat Exchanger Electrode
 - Lubricating Oil
 - ☐ Mounting Isolators
 - ☐ Wiring System

EVERY 2 YEARS

- Air Cleaner
- Batteries
- Belts
- Coolant Hoses
- Coolant
- Thermostat
- Remove Water Pump to Inspect Impeller and Seal

EVERY 5 YEARS

- Torsional Coupling

IMPORTANT: Set main pump controller to “OFF” while servicing engine. Before turning the main pump controller to the "OFF" position, check with the maintenance and security supervisors to verify that all the departments concerned will be alerted of the temporary interruption of their fire protection equipment for normal maintenance or testing. Also, alert the local fire department in the event that the

main pump controller is connected by silent alarm to headquarters. When servicing is complete, return main pump controller selector to "Automatic" position and the mode selector on the engine to “Automatic” position. Advise the appropriate personnel the engine has been returned to the “Automatic”.

5.0 TROUBLE SHOOTING

Consult Clarke Service Dealer or Factory. Service dealers can be located by going to our website: www.clarkefire.com.

6.0 PARTS INFORMATION

6.1 SPARE PARTS

To ensure best operation and efficiency of all engine components, always use genuine Clarke spare parts.

Orders should specify:

- Engine Model Number - See Engine General
- Engine Serial Number - Specification
- Part Number(s) Refer to Engine Maintenance Parts List section 6.2 or Parts Illustration (see Page 5).

Contact numbers for spare parts:

- www.clarkefire.com
- Phone USA: (513) 771-2200 Ext. 427 (calling within USA)
- Phone UK: (44) 1236 429946 (calling outside USA)
- Fax USA: (513) 771-5375 (calling within USA)
- Fax UK: (44) 1236 427274 (calling outside USA)
- E-Mail USA: parts@clarkefire.com
- E-Mail UK: dmurray@clarkefire.com

6.2 ENGINE MAINTENANCE PARTS LIST

Refer to Appendix “A” at the end of this manual.

ENGINE MODEL	Air Filter Service Kit	Air Filter Oil
All	99-55050	C121157

Figure #39

7.0 OWNER ASSISTANCE

Consult Clarke Service Dealer or Factory. Service Dealers can be located by going to our website: www.clarkefire.com.

8.0 WARRANTY

8.1 GENERAL WARRANTY STATEMENT

The satisfactory performance of Clarke engines and the goodwill of owners / operators of Clarke engines are of primary concern to the Engine Manufacturer, the Engine Service Dealer and Clarke. All provide support of these products after final installation of the complete fire pump and sprinkler system. Warranty responsibility involves both Clarke and the John Deere service organizations worldwide.

The Engine Manufacturer (John Deere) provides Warranty for the basic engine components and Clarke provides warranty on the accessories added to meet the NFPA-20 specifications and FM/UL certification requirements.

8.2 CLARKE WARRANTY

All Clarke warranted components have warranty for a duration of 24 months beginning at the Start-up date of the fire pump system. The warranty coverage includes replacement of the part and reasonable cost of labor for installation. Components failed due to improper engine installation, transportation damage, or misuse is not covered under this warranty. For additional warranty details, see the specific warranty statement "John Deere New Engine Warranty" on the following page. Also contact Clarke direct if you have any questions or require additional information.

Clarke is not responsible for incidental or consequential costs, damage or expenses which the owner may incur as a result of a malfunction or failure covered by this warranty.

8.3 JOHN DEERE WARRANTY

8.3.1 Warranty Duration

Unless otherwise provided in writing, John Deere* makes the following warranty to the first retail purchaser and each subsequent purchaser (if purchase is made prior to expiration of applicable warranty) of each John Deere new off-highway engine marketed as part of a product manufactured by a company other than John Deere or its affiliates:

- 12 months, unlimited hours of use, or

- 24 months and prior to the accumulation of 2000 hours of use; and on each John Deere engine used in an off-highway repower application:
- 12 months, unlimited hours of use.

Note: In the absence of a functional hourmeter, hours of use will be determined on the basis of 12 hours of use per calendar day. (*John Deere" means Deere Power Systems Group with respect to users in the United States, John Deere Limited with respect to users in Canada, and Deere & Company or its subsidiary responsible for marketing John Deere equipment in other countries where the user is located)

8.3.2 Warranty Coverage

This warranty applies to the engine and to integral components and accessories sold by John Deere.

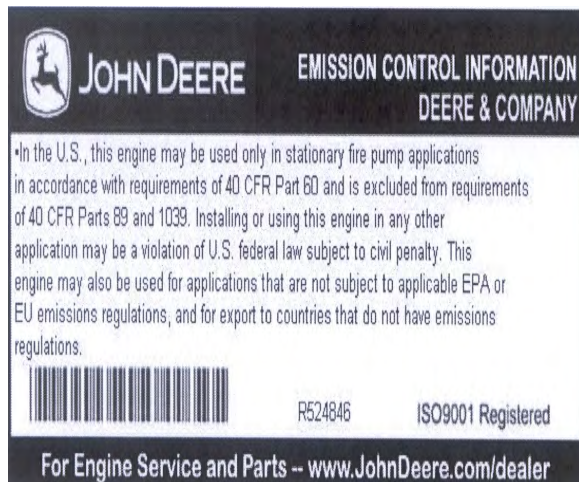
All John Deere-warranted parts and components of John Deere engines which, as delivered to the purchaser, are defective in materials and/or workmanship will be repaired or replaced, as John Deere elects, without charge for parts or engine repair labor, including reasonable costs of labor to remove and reinstall non engine parts or components of the equipment in which the engine is installed, and, when required, reasonable costs of labor for engine removal and reinstallation, if such defect appears within the warranty period as measured from the date of delivery to the first retail purchaser, if the delivery is reported to John Deere within 30 days of the delivery.

8.3.3 Emissions System Warranty (Non-Road Diesel)

EMISSIONS CONTROL SYSTEM CERTIFICATION LABEL

WARNING: Statutes providing severe penalties for tampering with emissions controls may apply at the user's location.

The emissions warranty described below applies only to those engines marketed by John Deere that have been certified by the United States Environmental Protection Agency (EPA) and/or California Air Resources Board (CARB); and used in the United States in equipment. The presence of an emissions label like the one shown signifies that the engine has been certified with the EPA and/or CARB. The EPA and CARB warranties only apply to new engines having the certification label affixed to the engine and sold as stated above in the geographic areas governed by the regulation agencies.



Note: The hp/kW rating on the engine emissions certification label specifies the gross engine hp/kW, which is flywheel power without fan. In most applications this will not be the same rating as the advertised vehicle hp/kW rating.

Stationary engines under the NSPS provisions are also covered, including stationary fire pump ratings. Fire pump ratings labeled under the 40 CFR part 60 (NSPS).

U.S. EMISSIONS CONTROL WARRANTY STATEMENT (UNITED STATES ONLY)

Emissions control-related parts and components are warranted by John Deere for five years or 3000 hours of operation, whichever occurs first. John Deere further warrants that the engine covered by this warranty was designed, built, and equipped so as to conform at the time of sale with all U.S. emissions standards at the time of manufacture, and that it is free of defects in materials and workmanship which would cause it not to meet these standards within the period of five years or 3000 hours of operation, whichever occurs first.

Warranties stated in this manual refer only to emissions-related parts and components of your engine. For complete engine warranty, less emissions related parts and components, ref to 8.3.1.

COVERED EMISSIONS SYSTEMS AND COMPONENTS

System	Sample Sub-Systems and Components
Air induction system	○ Air filter housing ○ Air mass sensor assembly ○ Controlled hot air intake system ○ Heat riser

	○ Intake manifold ○ Intercooler ○ Turbocharger ○ Wastegate control assembly valve
Fuel metering system (fuel system)	○ Aneroid ○ Carburetor ○ Choke mechanism ○ Electronic injection unit ○ Fuel injection assembly ○ Fuel injection nozzle assembly ○ Fuel injection injector ○ Fuel injector nozzle ○ Fuel injection valve assembly ○ Fuel line ○ Gas pressure regulator ○ Pressure relief valve/assembly ○ Air restriction sensor ○ Air temperature sensor ○ Coolant temperature sensor ○ Fuel temperature sensor ○ Mass flow module sensor ○ UEGO sensor ○ Throttle
Ignition control system	○ Distributor assembly ○ Engine control module ○ Glow plugs ○ Ignition coil ○ Ignition control module ○ Ignition sensor ○ Ignition wires ○ Spark plugs
EGR system	○ EGR cooler ○ EGR valve body
Advanced Oxides of Nitrogen (NOx controls)	○ Lean NOx catalysts ○ Nox absorbers ○ Reductant (urea/fuel) containers/dispensing systems
Catalyst or thermal reactor system	○ Catalytic converter ○ Double wall portion of exhaust system ○ Exhaust manifold ○ Exhaust gas recirculation valve
Particulate Controls	○ Control device enclosure and manifolding ○ Regenerators ○ Oxidizers ○ Traps ○ Filters ○ Precipitators ○ Manifold absolute pressure (MAP) sensor
PCV system	○ Oil filler cap ○ PCV solenoid ○ PCV valve ○ Crankcase ventilation filter

	○ Crankcase ventilation valve
Miscellaneous items used in the above systems	○ Electronic control sensors ○ Electronic control units (ECUs) ○ ECU software ○ Pump/valve controllers ○ Wiring harness ○ Coolant temperature sensor ○ Emissions labels ○ Sealing gaskets ○ Thermocouples ○ Thermostats ○ Vacuum-sensitive valve/switches

8.3.4 Obtaining Warranty Service

Warranty service must be requested of the nearest authorized John Deere engine service outlet before the expiration of the warranty. An authorized service outlet is a John Deere engine distributor, a John Deere engine service dealer, or a John Deere equipment dealer selling and servicing equipment with an engine of the type covered by this warranty. Authorized service outlets will use only new or remanufactured parts or components furnished or approved by John Deere.

Authorized service locations and the name of the John Deere division or subsidiary making this warranty are listed in the Parts and Service Directory for John Deere Engines.

At the time of requesting warranty service, the purchaser must be prepared to present evidence of the date of delivery of the engine.

John Deere reimburses authorized service outlets for limited travel expenses incurred in making warranty service repairs in non-John Deere applications when travel is actually performed. The limit, as of the date of publication of this statement, is US \$300.00 or equivalent. If distances and travel times are greater than reimbursed by John Deere, the service outlet may charge the purchaser for the difference.

8.3.5 Warranty Exclusions

John Deere's obligations shall not apply to fuel injection pump and nozzles during the pump and nozzle manufacturer's warranty period on the pump and nozzles, components and accessories which are not furnished or installed by John Deere, nor to failures caused by such items. When the pump manufacturer's warranty is less than the engine warranty, John Deere will reimburse pump repair costs for warrantable-type failures during the remainder of the original engine warranty period,

when so documented by the pump manufacturer's approved service outlet.

8.3.6 Purchaser's Responsibilities

The cost of normal maintenance and depreciation.

Consequences of negligence, misuse, or accident involving the engine, or improper application, installation, or storage of the engine, or improper application, installation, or storage of the engine.

Consequences of service performed by someone other than a party authorized to perform warranty service, if such service, in John Deere's judgment, has adversely affected the performance or reliability of the engine.

Consequences of any modification or alteration of the engine not approved by John Deere, including, but not limited to, tampering with fuel and air delivery systems.

The effects of cooling system neglect as manifested in cylinder liner or block cavitation ("pitting", "erosion", "electrolysis").

Any premium for overtime labor requested by the purchaser.

Costs of transporting the engine or the equipment in which it is installed to and from the location at which the warranty service is performed, if such costs are in excess of the maximum amount payable to the service location were the warranty service performed at the engine's location.

Costs incurred in gaining access to the engine; i.e., overcoming physical barriers such as walls, fences, floors, decks or similar structures impeding access to the engine, rental of cranes or similar, or construction of ramps or lifts or protective structures for engine removal and reinstallation.

Incidental travel costs including tolls, meals, lodging, and similar.

Service outlet costs incurred in solving or attempting to solve non-warrantable problems.

Services performed by a party other than an authorized John Deere engine service dealer, unless required by law.

Charges by dealers for initial engine start-up and inspection, deemed unnecessary by John Deere when operation and maintenance instructions supplied with the engine are followed.

Costs of interpreting or translating services.

8.3.7 No Representations or Implied Warranty

Where permitted by law, neither John Deere nor any company affiliated with it makes any guaranties, warranties, conditions, representations or promises, express or implied, oral or written, as to the nonoccurrence of any defect or the quality or performance of its engines other than those set forth herein, and DOES NOT MAKE ANY IMPLIED WARRANTY OR CONDITIONS OF MERCHANTABILITY OR FITNESS otherwise provided for in the Uniform Commercial Code or required by any Sale of Goods Act or any other statute. This exclusion includes fundamental terms. In no event will a John Deere engine distributor or engine service dealer, John Deere equipment dealer, or John Deere or any company affiliated with John Deere be liable for incidental or consequential damages or injuries including, but not limited to, loss of profits, loss of crops, rental of substitute equipment or other commercial loss, damage to the equipment in which the engine is installed or for damage suffered by purchaser as a result of fundamental breaches of contract or breach of fundamental terms, unless such damages or injuries are caused by the gross negligence or intentional acts of the foregoing parties.

8.3.8 Remedy Limitation

The remedies set forth in this warranty are the purchaser's exclusive remedies in connection with the performance of, or any breach of guaranty, condition, or warranty in respect of new John Deere engines. In the event the above warranty fails to correct purchaser's performance problems caused by defects in workmanship and/or materials, purchaser's exclusive remedy shall be limited to payment by John Deere of actual damages in an amount not to exceed the cost of the engine.

8.3.9 No Seller's Warranty

No person or entity, other than John Deere, who sells the engine or product in which the engine has been installed makes any guaranty or warranty of its own on any engine warranted by John Deere unless it delivers to the purchaser a separate written guaranty certificate specifically guaranteeing the engine, in which case John Deere shall have no obligation to the purchaser. Neither original equipment manufacturers, engine or equipment distributors, engine or

equipment dealers, nor any other person or entity, has any authority to make any representation or promise on behalf of John Deere or to modify the terms or limitations of this warranty in any way.

8.3.10 Additional Information

For additional information concerning the John Deere New Off-Highway Engine Warranty, see booklet Engine Owner's Warranty – Worldwide.

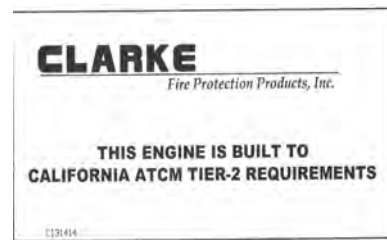
9.0 ATCM CALIFORNIA EMISSIONS REGULATIONS FOR STATIONARY ENGINES

NOTICE AND DISCLAIMER FOR STATIONARY COMPRESSION IGNITION ENGINES INSTALLED IN CALIFORNIA AFTER JANUARY 1, 2005

1. This Notice and Disclaimer is an addendum to, and made a part of, Clarke's Fire Protection Products, Inc.'s ("Clarke") Standard Terms and Conditions of Sale and, in all respects not inconsistent therewith, also applies to all sales of stationary compression ignition engines installed in California after January 1, 2005.
2. Stationary diesel-fueled compression ignition engines installed in California after January 1, 2005 are subject to California's Airborne Toxic Control Measure for Stationary Compression Ignition Engines (the "ATCM"), Cal. Code Regs. Title 17, Section 93115. The California Air Resources Board ("CARB") has reviewed the emissions estimation methodology provided by Clarke Fire Protection Products, Inc. ("Clarke") and has concluded that Clarke has used a valid methodology for estimating the emissions from engines supplied by Clarke and that the engines presumptively comply with the ATCM's emissions standards. Clarke's methodology used existing emissions test data associated with similar engines to estimate the emissions produced by the emergency fire pump engines supplied by Clarke.
3. CARB's determination is not binding on the local air districts, which have primary jurisdiction for implementing and enforcing the ATCM. Actual test data in the field or other information established by the local air

districts or CARB that show actual emissions from an engine supplied by Clarke in excess of the ATCM limitations could indicate a violation of the ATCM and subject the seller, owner and operator of the engine to penalties under California law. Although Clarke believes that the engines supplied by Clarke comply with the ATCM based on the available data and methodology accepted by CARB, for the foregoing reasons, Clarke cannot, and does not, guarantee that its engines will comply with the ATCM emission regulations.

4. CLARKE MAKES NO WARRANTIES OR GUARANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHERWISE, THAT THE ENGINES SUPPLIED BY CLARKE WILL COMPLY WITH THE ATCM. CLARKE ALSO EXPRESSLY DISCLAIMS THAT THE ENGINES SUPPLIED BY CLARKE WILL, IN FACT, COMPLY WITH THE ATCM. IN NO EVENT SHALL CLARKE BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS OR THE ENGINES SUPPLIED BY CLARKE OR FOR INDEMNIFICATION OF BUYER ON ACCOUNT OF ANY CLAIM ASSERTED AGAINST BUYER, OR FOR ANY OTHER DAMAGE OF ANY KIND, WHETHER DIRECT OR INDIRECT, IF THE ENGINES SUPPLIED BY CLARKE DO NOT COMPLY WITH THE ATCM.
5. If Buyer resells any of the goods sold under this Agreement, Buyer shall include language in an enforceable agreement with its buyer that makes the language in this Agreement, including Clarke's disclaimer of warranties and remedies in paragraph 5, binding on its buyer. Buyer shall defend, indemnify and hold Clarke harmless from any claims, causes of action, damages, losses or expenses (including reasonable attorney's fees) that Clarke incurs by reason of Buyer's failure to comply with this paragraph.
6. Each Clarke ATCM Compliant Fire Pump Driver will be affixed with the following ATCM Tier 2 Label:



7. Each Clarke ATCM Compliant Fire Pump Driver will be stamped with new fuel injection pump timing alignment marks. Refer to figure #____. Original 'factory' timing marks will be "X" out.

10.0 INSTALLATION & OPERATION DATA (See clarkefire.com)

11.0 WIRING DIAGRAMS (See clarkefire.com)

12.0 PARTS ILLUSTRATION DRAWING (See clarkefire.com)

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* See clarkefire.com

Appendix “A”

JU4H AND JU4R MODELS

Clarke Engine Models	UF10, 12, 20, 22, AB26 JU4R- 09, 11, 19, 21	UF14, 24 JU4R- UF13, 23	UF28, 30, 32, 40, 42, 50, 52, 58, H0, H2, H8 JU4R- UF40, 49, 51	UF34, J4 UF44, 54 JU4R- UF53	UF84	UFAEA0, E8,F2 JU4R- UFAEA9, E7, F1	UFADHG, J8, J2
Part Description	Part Number (standard items only, optional items not shown)						
Oil Filter	C04440	C04521	C04440	C04521		C04616	
Fuel Filter (Primary)	C02359	C02549	C02359	C02549		C02883	
Fuel Filter (Secondary)	N/A						
Air Filter	C03249						
Alternator	C071047 (12V) or C071048 (24V)						
Fuel Injection Pump	C02896		C02897	C02898	C02899	C02900	C02901
Heat Exchanger	C051128 (USA built) or C051001 (UK built)						
Starter Motor (12V)	RIGHT SIDE-C07888 AND LEFT SIDE-C07889 or RIGHT SIDE C071071 AND LEFT SIDE-C071072						
Starter Motor (24V)	RIGHT SIDE-C071073 AND LEFT SIDE C071074						
Switch, Oil Pressure	C071273 OR C071884						
Switch, Speed	C071001 OR C071571						
Switch, Coolant Temperature	C125678 OR C071881						
Turbocharger	N/A		C061634 OR C061635		C061636	C061637	C061638
Thermostat	C052057	C051275	C052057	C051275		C052057	
Nozzle, Injector	C02360					C02925	

JU6H AND JU6R MODELS

Clarke Engine Models	UF30, UF32,	UF50, UF58, UFD0, UFG8, UFM0, UFM8, UFABL8, UFABL0, UFABL2,	UF52, UFD2, UFM2,	UF60, UF68,	UF62,	UF34, UF44 UF54, UFAB54,	UF74 UF84, UFAB76, UFAB84, UFKAS2, UFAAT8, UFKAT8, UFAAT0, UFKAT0, UFAAT2, UFKAT2, UF94	UFAAQ8, UFKAQ8, UFAARG, UFKARG, UFAAPG, UFKAPG, UFAAS0, UFKAS0,
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Part Description	Part Number (standard items only, optional items not shown)							
Oil Filter	C04440					C04521		C04440
Fuel Filter (Primary)	C02359					C02550		C02359
Fuel Filter (Secondary)	N/A							
Air Filter	C03396							
Alternator	C071047 (12V) or C071048 (24V) OR C071517							
Fuel Injection Pump	C02902 or C02903			C02904		C02905	0C2906	C02907
Heat Exchanger	C051127 (USA built) or C051002 (UK built)							
Starter Motor (12V)	RIGHT SIDE-C07888 AND LEFT SIDE-C07889 or RIGHT SIDE C071071 AND LEFT SIDE-C071072							
Starter Motor (24V)	RIGHT SIDE-C071073 AND LEFT SIDE C071074							
Switch, Oil Pressure	C071273 OR C071884 OR C072011 OR C072013							
Switch, Speed	C071001							
Switch, Coolant Temperature	C125678 OR C071881							
Turbocharger	C061639 or C061640					C061641		C061642
Thermostat	C052057					C051275		C052057
Nozzle, Injector	C02360							

JW6H MODELS

Clarke Engine Models	UF30, UF38	UF40, UF48	UFH8, UF50, UF58, UF60
Part Description	Part Number (standard items only, optional items not shown)		
Oil Filter	C04614		
Fuel Filter (Primary)	C02881		
Fuel Filter (Secondary)	C02882		
Air Filter	C03244		
Alternator	C071047 (12V) or C071048 (24V)		
Fuel Injection Pump	C02908	C02909	C02910
Heat Exchanger	C05804		
Starter Motor (12V)	C071944 or C071072		
Starter Motor (24V)	C071937 or C071074		
Switch, Oil Pressure	C071273 OR C071884		
Switch, Speed	C071001		
Switch, Coolant Temperature	C125678 OR C071881		
Turbocharger	C061643	C061644	C061645
Thermostat	C052059		
Nozzle, Injector	C02894		C02895

Basic Engine Description

Engine Manufacturer	John Deere Co.
Ignition Type	Compression (Diesel)
Number of Cylinders	4
Bore and Stroke - mm (in)	106 (4.19) X 127 (5)
Displacement - L (in ³)	4.5 (275)
Compression Ratio	17.6:1
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)	1-3-4-2
Aspiration	Natural
Charge Air Cooling Type	None
Rotation, viewed from front of engine, Clockwise (CW)	Standard
Engine Crankcase Vent System	Open
Installation Drawing	D525
Weight - kg (lb)	413 (910)

Power Rating

	2350	2600	2800	3000
Gross Power - kW (HP) ¹	45 (60.5)	48.5 (65)	57.5 (77)	58 (78)

Cooling System

	2350	2600	2800	3000
Engine Coolant Heat - kW (Btu/sec)	31.7 (30)	33.8 (32)	35.9 (34)	38 (36)
Engine Radiated Heat - kW (Btu/sec)	7.4 (7)	7.8 (7.4)	8.8 (8.3)	8.9 (8.4)
Heat Exchanger Minimum Flow - [C051001]				
15°C (60°F) Raw H ₂ O - L/min (gal/min)	30.3 (8)	34.1 (9)	37.9 (10)	41.6 (11)
37°C (100°F) Raw H ₂ O - L/min (gal/min)	37.9 (10)	41.6 (11)	45.4 (12)	49.2 (13)
Heat Exchanger Maximum Cooling Raw Water - [C051001]				
Inlet Pressure - bar (psi)	14 (203)			
Flow - L/min (gal/min)	98.4 (26)			
Typical Engine H ₂ O Operating Temp - °C (°F)	76.7 (170) - 87.8 (190)			
Thermostat				
Start to Open - °C (°F)	76.7 (170)			
Fully Opened - °C (°F)	87.8 (190)			
Engine Coolant Capacity - L (qt)	12.5 (13.2)			
Coolant Pressure Cap - kPa (lb/in ²)	68.9 (10)			
Maximum Engine Coolant Temperature - °C (°F)	93.3 (200)			
Minimum Engine Coolant Temperature - °C (°F)	71.1 (160)			
High Coolant Temp Alarm Switch - °C (°F)	96.1 (205)			

Electric System - DC

	Standard		Optional	
System Voltage (Nominal)	12		24	
Battery Capacity for Ambients Above 32°F (0°C)				
Voltage (Nominal)	12	{C07634}	12	{C07634}
Qty. Per Battery Bank	1		2	
SAE size per J537	4D		4D	
CCA @ 18°C (0°F) per J537	1050		1050	
Reserve Capacity - Minutes per J537	290		290	
Battery Cable Circuit, Max Resistance - ohm	0.0012		0.0012	
Battery Cable Minimum Size				
0-3.1m Circuit Length ²	00		00	
3.1m-4.1m Circuit Length ²	000		000	
4.1m-5.1m Circuit Length ²	0000		0000	
Charging Alternator Maximum Output - Amp, ...	40	{C071363}	55	{C071366}
Starter Cranking Amps, Rolling - @15°C (60°F)	350	{C071072}	167	{C071074}

Exhaust System (Single Exhaust Outlet)	2350	2600	2800	3000
Exhaust Flow - m³/min (ft.³/min)	13.3 (469)	15 (531)	16.5 (581)	17.8 (630)
Exhaust Temperature - °C (°F) (corrected to 77°F)	584 (1083)	568 (1055)	556 (1033)	543 (1010)
Maximum Allowable Back Pressure - kPa (in H ₂ O)	7.5 (30)	7.5 (30)	7.5 (30)	7.5 (30)
Minimum Exhaust Pipe Dia. - mm (in) ³	76.2 (3)	76.2 (3)	76.2 (3)	76.2 (3)
Fuel System	2350	2600	2800	3000
Fuel Consumption - L/hr (gal/hr)	11.7 (3.1)	12.9 (3.4)	13.6 (3.6)	14.8 (3.9)
Fuel Return - L/hr (gal/hr)	34.1 (9)	36 (9.5)	37.5 (9.9)	39 (10.3)
Fuel Supply - L/hr (gal/hr)	45.8 (12.1)	48.8 (12.9)	51.1 (13.5)	53.7 (14.2)
Fuel Pressure - kPa (lb/in²)	20.7 (3) - 41.4 (6)			
Minimum Line Size - Supply - in.	.50 Schedule 40 Steel Pipe			
Pipe Outer Diameter - mm (in)	21.5 (0.848)			
Minimum Line Size - Return - in.	.375 Schedule 40 Steel Pipe			
Pipe Outer Diameter - mm (in)	17.1 (0.675)			
Maximum Allowable Fuel Pump Suction Lift				
with clean Filter - mH ₂ O (in H ₂ O)	0.8 (31)			
Maximum Allowable Fuel Head above Fuel pump, Supply or Return - m (ft)	1.4 (4.5)			
Fuel Filter Micron Size	2			
Heater System	Optional			
Engine Coolant Heater				
Wattage (Nominal)	1000		1000	
Voltage - AC, 1 Phase	230 (+5%, -10%)		115 (+5%, -10%)	
Part Number	{C122192}		{C122188}	
Air System	2350	2600	2800	3000
Combustion Air Flow - m³/min (ft.³/min)	4.7 (166)	5.3 (186)	5.7 (202)	6.2 (218)
Air Cleaner	Standard		Optional	
Part Number	{C03249}		{C03327}	
Type	Indoor Service Only, with Shield		Canister, Single-Stage	
Cleaning method	Washable		Disposable	
Air Intake Restriction Maximum Limit				
Dirty Air Cleaner - kPa (in H ₂ O)	2.5 (10)		2.5 (10)	
Clean Air Cleaner - kPa (in H ₂ O)	1.2 (5)		1.2 (5)	
Maximum Allowable Temperature (Air To Engine Inlet) - °C (°F)	54.4 (130)			
Lubrication System				
Oil Pressure - normal - kPa (lb/in²)	345 (50) - 655 (95)			
Low Oil Pressure Alarm Switch - kPa (lb/in²)	138 (20)			
In Pan Oil Temperature - °C (°F)	104 (220) - 118 (245)			
Total Oil Capacity with Filter - L (qt)	15.1 (16)			
Performance	2350	2600	2800	3000
BMEP - kPa (lb/in²)	510 (74)	496 (72)	545 (79)	517 (75)
Piston Speed - m/min (ft/min)	597 (1958)	661 (2167)	711 (2333)	762 (2500)
Mechanical Noise - dB(A) @ 1m	C131547 - Reference Noise data on Engine Page at www.clarkefire.com			
Power Curve	C131979 - Reference Power Curve on Engine Page at www.clarkefire.com			

NOTE: This engine is intended for indoor installation or in a weatherproof enclosure. ¹ Reduce published Gross kW's by 10% to determine maximum pump load. Derate 3% per every 1000ft 304.8m above 300ft 91.4m and derate 1% for every 10°F 5.55°C above 77°F 25°C. ² Positive and Negative Cables Combined Length. ³ Minimum Exhaust Pipe Diameter is based on: 15 feet of pipe, one 90° elbow, and one Industrial silencer. A Back-pressure flow analysis must be performed on the actual field installed exhaust system to assure engine maximum allowable back pressure is not exceeded. See Exhaust Sizing Calculator on www.clarkefire.com. { } indicates component reference part number.