



# TORNATECH

LISTEN DEVELOP LEAD

**INSTALLATION AND MAINTENANCE MANUAL FOR  
ELECTRIC FIRE PUMP CONTROLLERS  
MODEL VPx**





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# GENERAL DESCRIPTION

Model VPx electric fire pump controllers are designed to automatically start an electric driven fire pump upon detection of a pressure drop in the fire protection system. It is intended to control 3-phase squirrel cage induction motors and is arranged for electrical or manual starting and stopping

and for automatic start, controlled by the pressure sensor. The combination automatic/non-automatic option provides a 10-minute automatic stop after automatic start but only after all starting causes have returned to normal

## 1. TYPES OF ELECTRIC FIRE PUMP CONTROLLERS

FIRE PUMP CATALOGUE NUMBER				
MODEL n° EXAMPLE: VPA - 208 / 50 / 3 / 60				
VPA	208	50	3	60
Model prefix	Voltage	HP rating	Phase	Frequency

### 1.1. ACROSS-THE-LINE STARTER

#### 1.1.1. MODEL VPA:

This model is intended to be used where the local utility or the capacity of the power source permits across-the-line starting. Upon a start command, the controller connects the variable speed frequency drive to the motor. The motor ramps up and adjusts its speed. When the variable speed drive is bypassed, full voltage is applied to the motor as soon as the controller receives a start command.

Upon a start command, the controller connects the variable speed frequency drive to the motor. The motor ramps up and adjusts its speed. With any starting method, and when the variable speed drive is bypassed, an autotransformer is used to start the motor at reduced voltage. After a time delay, the autotransformer is shunted out and the motor is connected to full voltage by a closed transition switching sequence.

### 1.2. REDUCED VOLTAGE STARTER

These models are intended to be used where the local utility or the capacity of the power source does not permit full voltage starting.

#### 1.2.1. MODEL VPR: AUTOTRANSFORMER STARTER

The manual "EMERGENCY RUN" device will initiate across-the-line starting.

#### 1.2.2. MODEL VPS: SOLID STATE STARTER

The manual "EMERGENCY RUN" device will initiate across-the-line starting. Upon a start command, the controller connects the variable speed frequency drive to the motor. The motor ramps up and adjusts its speed. With any starting method, and when the variable speed drive is bypassed, a soft starter is used to supply a ramp-up voltage to the motor until the motor reaches its full speed. If the soft starter fails, an across-the-line starting will be initiated.

## **2. METHODS OF STARTING / STOPPING**

The controllers are available as combination automatic / non-automatic with provision for manual or automatic shutdown (automatic shutdown only possible after automatic start)

### **2.1. METHODS OF STARTING**

#### **2.1.1. AUTOMATIC START**

The controller will start automatically on low pressure detection by the pressure sensor when pressure drops below cut-in threshold. The controller must be in automatic mode (Remove jumper IJ2 to disable automatic start).

#### **2.1.2. MANUAL START**

The motor can be started by depressing the START push button whatever the system pressure.

#### **2.1.3. REMOTE MANUAL START**

The motor can be started from a remote location by momentarily closing a contact of a manual push button.

#### **2.1.4. EMERGENCY START**

The motor can be started manually by using the emergency handle. This handle can be maintained in a closed position.

Important: to avoid damaging the contactor, it is recommended to start the motor in the manor:

- 1) shutdown the main power by using the main disconnect means,
- 2) pull the emergency handle and lock it in closed position,
- 3) turn the power back on by using the main disconnect means.

#### **2.1.5. SEQUENTIAL START**

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

#### **2.1.6. WEEKLY START**

The motor can be started (and stopped) automatically at the preprogrammed time.

### **2.2. METHODS OF STOPPING**

#### **2.2.1. MANUAL STOP**

Manual stop is done by depressing the INSTANT STOP or DELAYED STOP push button.

Note : All start conditions must be disappeared to stop the pump.

#### **2.2.2. AUTOMATIC STOP**

The automatic stop is possible only after an automatic start, and this function must be activated. When this function is enabled, the motor is automatically stopped 10 minutes (factory setting) after the restoration of the pressure (above the cut-out threshold).

#### **2.2.3. EMERGENCY STOP**

The emergency stop is always possible in any starting conditions and is done by using the main disconnecting means located on the door.

## **3. VARIABLE SPEED PRESSURE LIMITING CONTROL**

### **3.1. GENERAL**

The variable speed pressure limiting control is enabled if the speed selector switch is in 'VARIABLE' or 'PRESET' position.

While in 'VARIABLE' position, the motor speed varies depending of the pump flow in order to maintain the pressure at constant value.

While in 'PRESET' position, the motor runs at a predetermined constant speed.

The variable speed pressure limiting control is disabled either if the speed selector switch is in 'BYPASS' mode, either if the emergency start handle is used to start the motor, or if the variable speed pressure limiting system failed. In those cases, the motor is directly connected to the main power source and motor runs at its maximum speed.

The speed selector switch is located behind a breakable and lockable window.

### **3.2. VARIABLE SPEED MODE**

This mode is the normal mode of the controller and permits the system to work at its full capability.

The speed selector switch must be in 'VARIABLE' position. Upon a start demand (pressure drops below the PRS pressure threshold, manual start, remote start), the variable speed drive is energized and the motor speed ramps up to its minimal speed in several seconds. Then, the motor speed is automatically adjusted depending of the system pressure.

This mode is automatically replaced by the bypass mode if failure occurs in the variable speed drive path or if emergency handle is activated or if the pressure stays below the PRS pressure threshold for more than 15 seconds.

### **3.3. PRESET SPEED MODE**

In this mode, the speed of the motor is constant

The speed selector switch must be in 'PRESET' position. Upon a start demand (pressure drops below the PSR threshold, manual start, remote start), the variable speed drive is energized and the motor speed ramps up to the predetermined speed in several seconds. The speed is constant and is independent of the system pressure. This mode is automatically replaced by the bypass mode if failure occurs in the variable speed drive path or if emergency handle is activated.

### **3.4. BYPASS MODE**

This mode is activated when the speed selector switch is in 'BYPASS' position. Upon a start demand (pressure drops below the PSR threshold, manual start, remote start), the variable speed drive is disconnected and the bypass contactor is activated to connect the motor to the main power supply.

This mode is also activated, even if the selector switch is in variable or preset position in case of drive failure or emergency start.

### **3.5. STOP PUSH BUTTONS**

In 'VARIABLE' or 'PRESET' position the motor stop can be progressive by depressing the DELAYED STOP push button. It can be instantaneous too, by depressing the INSTANT STOP push button.

Note : In BYPASS mode , the motor can only be stopped instantaneously, no matter what push button is used. All start conditions must be disappeared to stop the pump.



## 4. FRONT PANEL

### 4.1. GENERALS

A display located on the left side is used to monitor the electrical parameters of the incoming power and to set the automatic start pressure threshold. See PRS display and PRS annunciators. Some others annunciators are located on the flange of the controller.

### 4.2. PRS DISPLAY

The first line shows the power source status. The three line-to-line voltages and the frequency of the normal source are displayed. The last two digits are reserved to write a status symbol.

The status symbol "W" indicates the source is in wrong phase sequence.

The status symbol "n" indicates the source is not acceptable. This non-acceptability occurs when :

any line voltage drops below 85%,  
the frequency is too high or too low,  
an unbalance occurs between the three phases.

The third line is dedicated for the motor and trouble status. When no trouble, the three line currents are shown followed by the elapse time meter of the motor. The elapse time meter is expressed in hours and tenths of hours.

If trouble occurs, the two last digits of the elapse time meter are replaced by a status symbol. The symbol can be :

P for Pump starting failure (see below)

O for Overcurrent problem (see below)

U for Undercurrent (see below)

T for Transducer problem (see below)

The fourth line is dedicated for the pressure system status. The first section shows the cut-out threshold, the second section shows the cut-in threshold, the third section shows the system pressure.

'O' means cut-Out which is the value where the pump has to stop,

'I' means cut-In which is the value where the pump has to start.

Those values are adjustable on the field by removing the adjustment cover plate with a

Philips screwdriver. When removed, it is possible to have access to small switch. The pressure unit (PSI or kPa) can be selected on the field.

### 4.3. PRS ANNUNCIATORS

#### 4.3.1. POWER AVAILABLE

This LED indicates power acceptable on all 3 phases and phase sequence is correct for the power source.

#### 4.3.2. SYSTEM TROUBLE

This LED indicates unexpected situation occurring. This LED is flashing and a flashing symbol appears on the last digit of the third line. To help the user, the trouble legend is written on the display (See troubleshooting hint).

- **P** for pump starting failure. This trouble occurs when the low system pressure is detected but the current did not reach 10% of the nominal current after 20 seconds.
- **O** indicates an over current. This trouble occurs when the current is over 130% of the nominal current for more than 20 seconds.
- **U** indicates an undercurrent. This trouble occurs when the detected current is under 30% of the nominal current for more than 20 seconds.
- **T** indicates a pressure transducer problem (PT1 only).

This can occur if :

- the pressure transducer is not connected (atmospheric pressure)
- the transducer does not send a correct signal
- a wire to the transducer is cut.

The last trouble is recorded and displayed. To clear the symbol and the LED, the Reset Push button must be depressed.

Note : this LED is not activated under drive failure condition.

#### 4.3.3. PHASE REVERSAL

This LED indicates phase reversal of the power source.

#### **4.3.4.LOW SYSTEM PRESSURE**

This LED indicates that pressure drops below the lowest threshold.

### **4.4.FLANGE ANNUNCIATORS**

#### **4.4.1.BYPASS MODE**

This pilot light indicates when the selector switch is in bypass mode or when the bypass contactor is activated.

#### **4.4.2.VFD FAILURE**

This pilot light indicates when the drive failed. This pilot light is reset if the VFD is reset. To reset the VFD failure, press the Reset/Silence push button.

A drive failure is initiated by one of the following conditions :

- If the variable speed drive fails for overload, over-temperature, or other internal failure;
- Within the first 30 seconds of powering on the controller;
- If the variable speed drive is not in 'ready' condition in the first 5 seconds after power up;
- If the system pressure has not been recovered after 15 seconds;

### **4.5.AUDIBLE ALARM**

The audible alarm is triggered when the bypass mode light or when the VFD failure light is activated. The alarm can be silenced by the SILENCE push button. If the alarm is present more than 24 hours, the audible alarm will restart sounding.

The audible alarm is also activated when sequential module is in STOP mode. In this case, there is no possibility of silencing the buzzer. The sequential module must be restarted in RUN mode.

## 5. ALARM CONTACTS

The following alarm contacts are available on all controllers:

- motor run
- power available (loss of phase)
- phase reversal
- motor trouble
- bypass mode
- VFD failure

## 6. INSTALLATION

The VPx electric fire pump controller is listed cULus and is intended to be installed in accordance with the Standard of the

National Fire Protection Association for the Installation of Centrifugal Fire Pumps, NFPA n°20-2007 (Centrifugal Fire Pumps) and

in USA	National Electrical Code NFPA 70
in Canada	Canadian Electrical Code, Part 1
others *	Local Electrical Codes *

- Only American and Canadian applicable codes have been considered during the design of the controllers and the selection of components.

## 7. LOCATION

Controller shall be located as close as practical to the motor it controls and shall be within sight of the motor.

Controller shall be so located or so protected that it will not be damaged by water escaping from pump or pump connections.

Working clearances around controller shall comply with NFPA 70, National Electrical Code, Article 110 or C22.1, Canadian Electrical Code, Article 26.302 or other local codes.

Controller shall be 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 41°F (5°C) and 104°F (40°C).

The standard controller enclosure is rated NEMA 2. It is the installer's responsibility to assure that either the standard enclosure meets the ambient conditions or that an enclosure with an appropriate rating has been provided.

Controllers shall be located in a building; they are not designed for outside location. The paint color may change if controller is exposed to Ultraviolet rays during long period of time.

## 8. MOUNTING

### 8.1. WALL MOUNTING

The fire pump controller shall be mounted in a substantial manner on a single noncombustible supporting structure.

Wall mounted controller shall be attached to the structure or wall using all mounting ears provided on the controller with hardware designed to support the weight of the controller at a height not less than 12 in. above floor level.

### 8.2. FLOOR MOUNTING

Floor mounted controller shall be attached to the floor using all holes provided on the mounting brackets with hardware designed to support the weight of the controller. A concrete slab is recommended to avoid water accumulation on the controller's feet.

## 9. CONNECTIONS

### 9.1. WATER CONNECTIONS

The pipe connection for the pressure sensor is 1/2". The pressure sensor connection is located on the side of the controller.

The pump start - stop pressure sensor shall be connected to the system as per NFPA 20-2007, Chapter 10-5.2.1.6 (b) and (c) and figure A-10-5.2.1 (a) and (b).

### 9.2. ELECTRICAL CONNECTIONS

#### 9.2.1. ELECTRICAL WIRING

The electrical wiring between the power source and the fire pump controller shall meet the NFPA 20-2007, Chapter 9-3, NFPA 70 National Electrical Code Article 695 or C22.1 Canadian Electrical Code, Section 32-200 or other local codes. Electrical wiring shall be typically sized to carry at least 125% of the full load current of the fire pump motor.

Incoming power terminals on the controller are suitable to accept wire based on that selection with insulation not less than 60°C. (Refer to terminal diagram for terminal sizes.)

The electrical wiring between the fire pump controller and the pump motor shall be in rigid, intermediate, or liquid tight flexible metal conduit or Type MI cable and meet the requirements of NFPA 70 National Electrical Code or C22.1 Canadian Electrical Code or other local codes.

The number of conductors required varies depending on the model of starter:

- 3-wires plus ground sized at 125% of full load current for models VPA, VPR, VPS.

#### 9.2.2. ENCLOSURE DRILLING

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 NEMA rating of the cabinet.

The installer is responsible for adequate protection of 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.

#### 9.2.3. INCOMING POWER CONNECTIONS

Incoming normal power is to be connected to terminals identified L1-L2 and L3 located on the disconnecting means IS.

The electronic board is phase sensitive, thus the incoming power leads must be connected in the correct phase order.

#### 9.2.4. MOTOR CONNECTIONS

Motor connections are connected to terminals identified by:

- T1-T2 and T3 located on main contactor (1R) for models VPA, VPR, VPS

It is the responsibility of the installer to obtain connection information on the motor and to assure that the motor is connected as per motor manufacturer recommendations. Failure to do so may cause injuries to personnel, damage the motor and/or the controller and subsequently void warranty on both items.

#### 9.2.5. ALARM CONTACT CONNECTION

Since these alarm connections are derived from control relays or motor contactor auxiliary contacts located inside a metallic enclosure with wiring that can pick up induction from the line voltage, an induced voltage can be present at the terminal connections. It is the responsibility of the alarm contractor to evaluate the potential danger for their equipment. A remote alarm panel Type APE with interface relays may be required if induced voltages cause problems to electronic equipment.

(NOTE: This induction problem is more likely to occur in 600 V. models.)

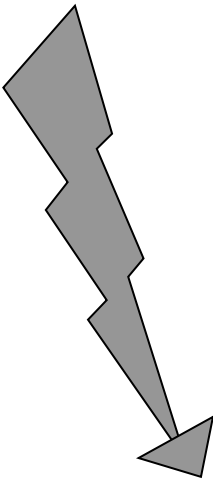
**9.2.6.CONNECTION TO  
EXTERNAL DEVICE**

**REMOTE MANUAL START SIGNAL**

Each electric fire pump controller has provision for connection to a manual remote

start station (manually operated). This remote start contact must be normally open. Change of state of this contact will initiate a manual start of the pump.

## 10. START-UP AND TEST PROCEDURES

	<b>DANGER</b>
	<b><u>HAZARDOUS VOLTAGE IS PRESENT IN THE ENCLOSURE WHICH WILL CAUSE SEVERE PERSONAL INJURY OR DEATH.</u></b>
	<b>MAINTENANCE OR START UP SHOULD BE PERFORMED ONLY BY EXPERIENCED LICENSED ELECTRICIANS.</b>
	<b>ONLY QUALIFIED PERSONNEL SHOULD WORK ON OR AROUND THIS EQUIPMENT.</b>

### 10.1. VERIFICATIONS

#### 10.1.1. ELECTRICAL INSTALLATION

A representative for the electrical contractor responsible for the installation shall be available on-site to assist during the verification of the following points and the actual start-up.

All electrical label ratings meet incoming power voltage and frequency as well as motor voltage, HP and frequency.

All electrical connections in controller are tight. Retighten if necessary.

All electrical connections are properly completed and power is available.

#### 10.1.2. PIPING INSTALLATION

A representative for the sprinkler contractor responsible for the installation shall be available on-site to assist during the

verification of the following points and the actual start-up.

All water connections are properly completed; water is available and free of dirt and/or contamination.

NOTE: Standard controllers have pressure sensor rated for fresh water only. If other conditions exist, make sure that the controller pressure sensor is compatible.

### **WARNING**

Water lines must be flushed before connecting pressure switch or pressure transducer. Failure to do so will void warranty.

## 10.2. SETTINGS ON THE ELECTRONIC BOARDS

ATS99 is the name of the internal circuit board located on the controller (left side).  
 PRS99 is the name of the electronic circuit board located on the controller door (left side)  
 Sequential module (SM1) is the name of the control unit located on the controller (left side)

	<b>10.3. <u>DIPSWITCH</u></b>	Required	N/A																								
	<p>The Dipswitch S2 is located on the middle top of the electronic board. Select the appropriate dipswitch for the setting that needs to be changed. Use a small screwdriver or a pencil to change the position of the dipswitch. The factory setting is shown in figure 1.</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 10px auto;"> <table style="border-collapse: collapse;"> <tr><td style="padding: 2px 5px;"><input checked="" type="checkbox"/></td><td style="padding: 2px 5px;"><input type="checkbox"/></td><td style="padding: 2px 5px;">Ph Rev</td></tr> <tr><td style="padding: 2px 5px;"><input checked="" type="checkbox"/></td><td style="padding: 2px 5px;"><input type="checkbox"/></td><td style="padding: 2px 5px;">RPT</td></tr> <tr><td style="padding: 2px 5px;"><input checked="" type="checkbox"/></td><td style="padding: 2px 5px;"><input type="checkbox"/></td><td style="padding: 2px 5px;">Seq</td></tr> <tr><td style="padding: 2px 5px;"><input checked="" type="checkbox"/></td><td style="padding: 2px 5px;"><input type="checkbox"/></td><td style="padding: 2px 5px;">Timer</td></tr> <tr><td style="padding: 2px 5px;"><input checked="" type="checkbox"/></td><td style="padding: 2px 5px;"><input type="checkbox"/></td><td style="padding: 2px 5px;">Test</td></tr> <tr><td style="padding: 2px 5px;"><input type="checkbox"/></td><td style="padding: 2px 5px;"><input checked="" type="checkbox"/></td><td style="padding: 2px 5px;">Pr Unit</td></tr> <tr><td style="padding: 2px 5px;"><input checked="" type="checkbox"/></td><td style="padding: 2px 5px;"><input type="checkbox"/></td><td style="padding: 2px 5px;">Serial</td></tr> <tr><td style="padding: 2px 5px;"><input type="checkbox"/></td><td style="padding: 2px 5px;"><input checked="" type="checkbox"/></td><td style="padding: 2px 5px;">Serial</td></tr> </table> </div> <p>Figure 1</p> <p><b>10.3.1. <u>PHASE REVERSAL (PH REV)</u></b>          The S2-1 dip switch is used to change the reference phase sequence (see page 19 – “Check wrong phase rotation indication”).</p> <p><b>10.3.2. <u>RUN PERIOD TIMER (RPT)</u></b>          The S2-2 dip switch must be set to the left. The run period timer is set in the sequential module (SM1) if necessary.</p> <p><b>10.3.3. <u>SEQUENTIAL START TIMER (SEQ TIMER)</u></b>          The S2-3 &amp; S2-4 dip switches must be set to the left. Sequential start timer is set in the sequential module (SM1) if necessary.</p> <p><b>10.3.4. <u>TEST (TEST)</u></b>          This Dip switch (S2-5) is used by factory and must be set to the left.</p> <p><b>10.3.5. <u>PRESSURE UNIT (PR UNIT)</u></b>          The S2-6 dipswitch is set to the right if PSI is required as pressure unit.          The S2-6 dipswitch is set to the left if kPa (kilo Pascal) is required as pressure unit.</p> <p><b>10.3.6. <u>SERIAL (SERIAL)</u></b>          The S2-7 and S2-8 dipswitches are used by factory. S2-7 must be set to the left, S2-8 must be set to the right.</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Ph Rev	<input checked="" type="checkbox"/>	<input type="checkbox"/>	RPT	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seq	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Timer	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Pr Unit	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Serial	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Serial		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Ph Rev																									
<input checked="" type="checkbox"/>	<input type="checkbox"/>	RPT																									
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Seq																									
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	<b>10.4. PRS</b>	Required	N/A
<b>DANGER.</b> Hazardous voltage is present in the enclosure and will cause severe personal injury or cause death	<b>10.4.1. PRESSURE ADJUSTMENT</b> Set the cut-out and cut-in threshold on the PRS board. It is recommended to set the cut-out threshold 5 psi above the cut-in threshold. If the cut-out threshold is set above the maximum pump pressure, it is impossible to stop the pump with 'stop' push button.		

### **10.5. SETTINGS ON THE SEQUENTIAL MODULE (SM1)**

The chapter 15 provides the instructions to adjust the Sequential module parameters. The adjustments can only be done when the power is on and the door is open.

**DANGER** : Hazardous voltage is present in the enclosure and will cause severe personal injury or cause death.

	<b>10.6. TIMERS</b>	Requis	N/D
	<b>10.6.1. T1 : SEQUENTIAL START TIMER</b> The sequential start can be adjusted with T1 timer. The value is in seconds. (ex : 002.5 = 2 sec ½). <b>10.6.2. T2 : MINIMUM RUN PERIOD TIMER</b> The minimum run period timer can be adjusted with T2 timer. The value is in minutes and seconds ( ex : 12 :30 = 12 minutes 30 seconds). Timer is set at 10 minutes by factory.		

# 11. VARIABLE SPEED DRIVE (VFD) SETTINGS

	<p align="center"><b>11.1. <u>NON-CRITICAL PARAMETERS</u></b></p>	Required	N/A
	<p>The Variable speed drive (VFD) is factory set to start the system. Some adjustments must be done on the field to improve the performance of the system.            A list of all VFD parameters is attached on the inside of the enclosure. The non-critical parameters can be adjusted on the field by the Tornatech technician. Critical parameters shall not be changed.</p> <p align="center"><b>11.1.1. <u>VFD POWER UP / SHUTDOWN</u></b></p> <p>On the sequential module (SM1), press any gray key to energize the VFD. Note, the VFD will be automatically de-energized after 15 minutes. The VFD can also be shut down before the expiration of the 15 minutes delay by depressing a second time any gray key on SM1.</p> <p align="center"><b>11.1.2. <u>MINIMUM SPEED</u></b></p> <p>To adjust the minimum speed,</p> <ul style="list-style-type: none"> <li>- start the controller with manual start push button - main switch in 'preset' position,</li> <li>- create a very small water flow (almost 0 gpm flow) by opening a valve,- shutdown jockey pump.</li> <li>- select on VFD the "Minimum Speed" parameter and adjust it until the pressure is at requested value.</li> </ul> <p align="center"><b>11.1.3. <u>PRESET SPEED</u></b></p> <p>The preset speed is expressed in percentage of motor speed.            To adjust the preset speed,</p> <ul style="list-style-type: none"> <li>- start the controller with manual start push button - main switch in 'preset' position,</li> <li>- select on VFD parameter "Fixed speed setpoint" and adjust it until the preset speed is at requested value.</li> </ul> <p>Note : preset speed must be greater than minimum speed.</p>		

	<p style="text-align: center;"><b>11.1.4. <u>PRESSURE SETPOINT</u></b></p> <p>The pressure setpoint is expressed in percentage of 300 psi. To adjust the pressure setpoint,</p> <ul style="list-style-type: none"> <li>- start the controller with manual start push button - main switch in 'variable' position,</li> <li>- create a flow demand by opening a valve,- shutdown jockey pump.</li> <li>- select on VFD parameter "Technology controller fixed value" and adjust it until the pressure is at requested value. Important : the pressure may stabilize after several seconds (or minutes) - this stabilization time is set by gain and integral parameter - see below.</li> </ul> <p style="text-align: center;"><b>11.1.5. <u>GAIN</u></b></p> <p>The gain is parameter "Proportional gain setting". By incrementing the value, the drive will react faster due to a flow change in order to maintain the pressure at constant level. By decrementing this value, the drive will react slowly.</p> <p>It is recommended to start by a low value and increase the value slowly (by step of 0.2) in order to have a decent speed change when changing the flow.</p> <p style="text-align: center;"><b>11.1.6. <u>INTEGRAL TIME</u></b></p> <p>The integral time is parameter "Integral time setting". By incrementing the value, the drive will adjust the speed to stabilize the pressure at its requested value but it will also reduce time of reaction.</p> <p>It is recommended to start by a low value and increase the value slowly (by step of 0.2) in order to have a decent speed change when changing the flow.</p>		
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## 12. ACTUAL START-UP

	<p style="text-align: center;"><b>12.1. <u>CHECK MOTOR ROTATION</u></b></p>	Required	N/A
<p><b>DANGER.</b> Hazardous voltage is present in the enclosure and will cause severe personal injury or cause death.</p> <p>Only experienced licensed electricians should perform start up. Only qualified personnel should work on or around this equipment.</p>	<ul style="list-style-type: none"> <li>◆ Turn the speed selector switch to BYPASS position Note : the buzzer will sound when the controller will be powered up. The buzzer can be silenced by depressing silence push button</li> <li>◆ Turn circuit breaker handle to the ON position.               <ul style="list-style-type: none"> <li>• If the system pressure is above the cut out pressure setting (pressurized system), the motor will not start right away. If motor does not start, press the START pushbutton.</li> </ul> </li> <li>◆ Turn the circuit breaker handle to the OFF position as soon as motor starts to stop motor.</li> <li>◆ Check the motor rotation.               <ul style="list-style-type: none"> <li>• If the motor rotation is correct, no further adjustment is required, move to the next section.</li> </ul> </li> <li>◆ Correct the motor rotation.               <ul style="list-style-type: none"> <li>• Motor rotation can be changed by swapping any two motor wires either at the motor junction box or on the motor connection terminals inside the controller. In both cases, the operator shall assure that the power is disconnected before proceeding. NOTE : Under no circumstances shall the internal wiring of the controller be tampered with. Failure to comply will void warranty, may cause injuries and damage the controller. Only the wires directly feeding the motor can be reversed.</li> </ul> </li> <li>◆ Turn circuit breaker handle to the ON position.</li> <li>◆ Check the motor rotation once more.</li> </ul>		
	<p style="text-align: center;"><b>12.2. <u>CHECK WRONG PHASE ROTATION INDICATION</u></b></p>	Required	N/A
	<ul style="list-style-type: none"> <li>◆ Turn circuit breaker handle to the ON position.               <ul style="list-style-type: none"> <li>• If the display does not show a 'W' symbol on the right side of the first line, feeders are in the right phase sequence. No further adjustment is required, move to the next section.</li> <li>• If the display shows a 'W' symbol on the right side of the first line, feeders and electronic module do not have the same sequence and the electronic needs to be adjusted.                   <ul style="list-style-type: none"> <li>- Turn circuit breaker handle to the OFF position.</li> <li>- Open control panel door.</li> <li>- Locate the S2 dipswitch on the middle top of the electronic board.</li> <li>- With a small screwdriver or pencil, change S2-1 (Ph rev) dipswitch from left to right.</li> <li>- Close controller panel door.</li> <li>- Turn circuit breaker to the ON position.</li> </ul> </li> </ul> </li> </ul> <p>Verify that display does not show 'W' symbol on the first line. No further adjustment is required.</p>		

## 13. PUMP START TEST

Note in this section, all starting causes will be tested. The pump will run at preset speed.

		Required	N/A
	<b>13.1. <u>START FROM START PUSHBUTTON PB1</u></b>		
	<ul style="list-style-type: none"> <li>◆ Turn the speed selector switch to PRESET position</li> <li>◆ Press the START pushbutton on the controller, pump motor will start regardless of the system pressure and continues to run at preset speed. (No possibility of automatic stop.)</li> <li>◆ Press STOP pushbutton on the controller, pump motor will stop.</li> </ul>		
	<b>13.2. <u>START FROM REMOTE START STATION</u></b>		
	<ul style="list-style-type: none"> <li>◆ Turn the speed selector switch to PRESET position</li> <li>◆ If the remote start circuit consists of a momentary pushbutton or contact :               <ul style="list-style-type: none"> <li>• Press the remote START pushbutton or initiate closure of the remote start contact, the pump motor will start regardless of the system pressure and continues to run at preset speed. (No possibility of automatic stop.)</li> <li>• Press STOP pushbutton on the controller, pump motor will stop.</li> </ul> </li> <li>◆ If the remote start circuit consists of a maintained contact :               <ul style="list-style-type: none"> <li>• Initiate closure of the remote start contact, the pump motor will start regardless of the system pressure and continues to run at preset speed. (No possibility of automatic stop.)</li> <li>• Initiate opening of the remote contact. (No possibility of automatic or manual stop if contact remains closed unless the circuit breaker is turned off.)</li> <li>• Press STOP pushbutton on the controller, pump motor will stop.</li> </ul> </li> </ul>		
	<b>13.3. <u>WATER PRESSURE CONTROL</u></b>		
<p><b>DANGER</b> Hazardous voltage is present in the enclosure and will cause severe personal injury or cause death.</p> <p>Only</p>	<p><b>IMPORTANT :</b> If the cut-in and cut-out values are set to 0, the pump will not start in automatic mode.</p> <p style="text-align: center;"><b>13.3.1. <u>MANUAL SHUTDOWN MODE</u></b></p> <ul style="list-style-type: none"> <li>◆ Check that the controller is set for a manual shutdown only (Jumper IJ1 closed).</li> <li>◆ Turn the speed selector switch to PRESET position</li> <li>◆ Simulate a pressure drop in the system by draining water off the pressure sensing line.</li> <li>◆ The pressure transducer automatically starts the pump motor when the pressure falls below the cut-in setting.</li> </ul>		

<p>experienced licensed electricians should perform start up. Only qualified personnel should work on or around this equipment.</p>	<ul style="list-style-type: none"> <li>◆ Verify that the pump motor starts at the desired pressure.</li> <li>◆ Verify the speed reference is adjusted properly to build the pressure above the desired cut out pressure. Let the pump build up pressure until it reaches cut-out.</li> <li>◆ Press “STOP” push button.</li> </ul> <p style="text-align: center;"><b>13.3.2. <u>AUTOMATIC SHUTDOWN MODE</u></b></p> <p>NFPA20-2003 §10-5-4-B-2 : <i>'Automatic shutdown shall not be permitted where the pump constitutes the sole supply of a fire sprinkler or standpipe system or where the authority having jurisdiction has required manual shutdown'</i></p> <ul style="list-style-type: none"> <li>◆ Check that the controller is set for an automatic shutdown (Jumper IJ1 opened).</li> <li>◆ Turn the speed selector switch to PRESET position</li> <li>◆ Simulate a pressure drop in the system by draining water off the pressure sensing line. The pressure transducer automatically starts the pump motor when the pressure falls below the cut-in setting.</li> <li>◆ Verify that the pump motor starts at the desired pressure.</li> <li>◆ Let the pump build up pressure.</li> </ul> <p>Verify the speed reference is adjusted properly to build the pressure above the desired cut out pressure.</p> <ul style="list-style-type: none"> <li>◆ 10 minutes after the pressure has reached the cut out setting, the pump motor will automatically stop.</li> </ul> <p>The pump motor can be stopped before the expiration of the run period delay by pressing the Instant STOP or Progressive STOP push button if the pressure is higher than the cut out setting.</p>		
	<p><b>13.4. <u>START FROM EMERGENCY START HANDLE</u></b></p>		
	<p><b><u>BE CAREFUL</u></b></p> <ul style="list-style-type: none"> <li>◆ Verify that the pump is not running and main circuit breaker in ON position</li> <li>◆ Slowly pull the EMERGENCY START handle out of less than 1 inch (2cm), the pump motor will start ACROSS THE LINE and AT FULL SPEED.</li> <li>◆ Release the handle</li> <li>◆ Press STOP pushbutton on the controller, pump motor will stop.</li> </ul>		

## 14. SEQUENTIAL MODULE PROGRAMMING INSTRUCTIONS

### 14.1. HOW TO ADJUST DATE

The date and time are factory set for North America Eastern time. The date and time are saved even without any power. If the controller is installed in other time zone, the date and time may need to be adjusted.

<u>Action</u>	<u>Display</u>
Press Menu/Ok	a word is flashing
Press ▼ several time until CHANGE D/H	CHANGE D/H is flashing
Press Menu/Ok	the day is flashing – new key function appears
Press ► to move the cursor on value to be changed	value flashing
Press ▲ or ▼ to change value	value flashing
Press Menu/Ok	CHANGE D/H is flashing
Press ◀ to return to main screen	main screen

### 14.2. HOW TO PROGRAM A WEEKLY TEST

The weekly test is designated by in the sequential module SM1

The weekly test is disabled if ON time and OFF time are identical, otherwise the weekly test is enabled.

The pump will start at ON time and will stop at OFF time.

Proceed with the following sequence to adjust ON and OFF time

<u>Action</u>	<u>Display</u>
Press Menu/Ok	a word is flashing
Press ▼ until "PARAMETER"	PARAMETER is flashing
Press Menu/Ok	a parameter is flashing – new key function appears
Press ▲ several time until H1	H1 is flashing
Press ► to move the cursor on the line	first digit of the line is flashing Note : first digit (-/0) for Monday, last digit (-/6) for Sunday ‘-’ indicates no test on that day number indicates test will be activated on that day
Press ▲ or ▼ to activate test on that day	number value appear (0 for Monday, ..., 6 for Sunday)
Press ► to move the cursor to ON time	ON time value is flashing
Press ▲ or ▼ to change ON time value	new ON time value is flashing
Press ► to move the cursor to OFF time	OFF time value is flashing
Press ▲ or ▼ to change OFF time value	new OFF time value is flashing
Press Menu/Ok	CONFIRM CHANGES, YES is flashing
Press Menu/Ok to confirm	new values
Press Menu/Ok to return to main screen	main screen

### 14.3. HOW TO SET SM1 IN RUN MODE

Note : The controller is shipped from factory to be operational at power up. The sequential module should stay always in RUN mode (RUN symbol appears on the bottom right of the screen). If the sequential module is in STOP mode, the alarm buzzer is activated with no possibility of silencing.

<u>Action</u>	<u>Display</u>
Press Menu/Ok	a word is flashing
Press ▼ until	RUN/STOP is flashing
Press Menu/Ok	RUN/STOP YES is flashing
Press Menu/Ok	Main screen

### 14.4. HOW TO SET RUN PERIOD TIMER

Note : The run period timer is adjusted with parameter **T2**. This value is in minutes : seconds. The factory set is 10 minutes.

Proceed with the same sequence as weekly test adjustment choosing parameter T2.

### 14.5. HOW TO SET SEQUENTIAL START TIMER

Note : The sequential start timer is adjusted with parameter **T1**. This value is in seconds. The factory set is 0 seconds.

Proceed with the same sequence as weekly test adjustment choosing parameter T1.



# 15. PRS99 PROGRAMMING INSTRUCTIONS

## 15.1. HOW TO READ THE DISPLAY

	L1-L2	L2-L3	L3-L1		
Power	600	598	599	60	V / Hz
Current / TT	126	128	129	12.4	Amps / Hr
Pressure	O:225	I:20	P:219PSI		
		5			

### 15.1.1. TOP LINE

The top line displays normal power supply data.

Voltage	Voltage	Voltage	Frequenc y	Status
---------	---------	---------	---------------	--------

The first group displays the voltage between phase L1 and phase L2.

The second group displays the voltage between Phase L2 and L3.

The third group displays the voltage between Phase L3 and L1.

The fourth group displays the frequency of the source (in Hz).

The fifth group displays the status of the normal power supply :

“Wn” indicates power supply is in Wrong phase (i.e. phase reversal)

“n” indicates power supply is not available, which includes:

- voltage has dropped to less than 85%
- frequency is too high or too low
- there is an unbalance between the three phases

### 15.1.2. SECOND LINE

The second line is dedicated for the alternate source. It stays blank when the controller is supplied without transfer switch

or if the voltage of the second source is not present. It has the same readout of the top line (See above).

### 15.1.3. THIRD LINE

The third line displays the electric motor status :

Amps	Amps	Amps	TT.T
------	------	------	------

The first group displays the current of phase L1.

The second group displays the current of phase L2.

The third group displays the current of phase L3.

The fourth group displays the elapsed motor run time in hours and tenths of hours (e.g. 12.4)

### 15.1.4. FOURTH LINE

The fourth line displays the system pressure status :

O:xxx	I:xxx	P:xxx PSI
-------	-------	-----------

The first group “O:xxx” displays the fire pump cut-out pressure setting (the pump stop pressure)

The second group “I:xxx” displays the fire pump cut-in pressure setting (the pump start pressure)

The third group “P:xxxPSI” displays the pressure sensed by the transducer (the pressure in the main to the sprinkler/standpipe system). This pressure can be shown in psi or kPa (kilo Pascal)

## 15.2. HOW TO ADJUST THE CUT IN / CUT OUT PRESSURE

The pressure settings must be entered in the field, after installation, field wiring and pressure connection to the transducer have been completed.

The aluminum cover plate located between the annunciator panel and the three white push-buttons covers two small multi-turn potentiometers. With a small Philips screwdriver, loosen the plate securing screws and flip the plate counterclockwise so that it hangs from the left securing screw.

Insert the small screwdriver into the hole to reach the potentiometer. The same small Philips screwdriver may be used to make the adjustments. The left potentiometer dial sets the desired cut-out pressure. The right potentiometer dial sets the desired cut-in pressure. Turn the dial carefully, until the desired readings appear on the fourth line of the display. Return the aluminum cover plate to its normal position and tighten the securing screws.

If the cut-in pressure has been set higher than the cut-out pressure, display line flashes on and off, to signal an improper

setting. Re-set the settings to ensure that the cut-out pressure setting is higher than the cut-in pressure setting.

### **15.3. WHAT IS THE FLASHING SYMBOL ON THE SECOND LINE**

The flashing symbol alerts the operator that a trouble occurred on the controller. The most recent flashing letter symbol is retained on the display and recorded. To clear the letter symbol from the display, after the fault has been corrected, press the RESET push button.

occurs when the power supply current (amps) is more than 130% of nominal. Flashing Symbol U indicates the pump absorbed an abnormally low current. It occurs when the power supply current (amps) is less than 30% of nominal.

Flashing Symbol P indicates the pump did not run although there was a pump demand. It occurs when the Low System Pressure LED is lit and the motor did not absorb any current.

Flashing Symbol T indicates a pressure transducer problem. It occurs to indicate either the pressure transducer is not connected (is sensing less than 5 psi) or the pressure transducer is transmitting a signal that is out of the factory range setting or a wire to the pressure transducer is cut.

Flashing Symbol O indicates the pump absorbed an abnormally high current. It

See troubleshooting hint to verify if the system is correct.

### **15.4. WHY 'LOW SYSTEM PRESSURE' LED IS FLASHING**

In VPx controller, the 'low system pressure' LED must not flash at any time. If it is flashing, either the S2-2 or S2-3 or S2-4 is

not adjusted properly. All of those must be set to the left.

### **15.5. HOW TO ADJUST THE DATE AND TIME**

To adjust date, time, the PRS99 must be set in setup mode. To enter in the setup mode, press and hold the "Print" button until normal default display is replaced by set-up menu display.

Change the value of the setting displayed by repeated pressing and releasing of the RESET button.

Release the "Print" push-button. The set-up menu display is:

Utilizing these functions, set the present day, date, year and time.

Day	Date	Year	Hr:Min
Compatible system : N			
WT	START	STOP	
Day	Hr:Min	Hr:Min	OFF

Finally, press and hold PRINT push-button until set-up menu display is replaced by normal display to store all changes or modifications.

Scroll through the menu set-up system by repeated pressing and releasing of the PRINT button.

If above step does not occur within 60 seconds, the display will revert to the default normal mode. Any changes or modifications will not be saved.

## 15.6. HOW TO PRINT REPORTS

Be sure that paper is in the printer. The PAPER FEED push-button allows the paper roll motor to advance the paper.

The PRINT button activates the printer mounted below the trouble legend. No reports can be printed, unless this button is pushed. Two reports may be obtained (printed).

A seven-day record of the controller activity with one press of the PRINT button.

To obtain a read-out of all pressure fluctuations for the previous seven days, press the PRINT button a second time, within 60 seconds. The report will print until all data accumulated is shown. The complete print-out could require a lot of paper. To conserve paper consumption, a stop feature is provided during this function:

if, while the printing is in progress, PRINT is pressed, the printing will stop after few seconds. (Note, the printer has to send all its memory before stopping, this can last 10 seconds, do not press the PRINT button twice otherwise the printing will continue). If a continuation of the printing operation is desired, pressing PRINT will initiate a resumption of the printing from point where it was stopped. There is a 15 minute time window, factory programmed, for this print resumption feature. This is particularly useful when it is observed that the paper roll is about to run out before the report is finished. The printing can be paused, as described, the paper roll replaced, and then resumed on the paper fed from the new paper roll.

## 15.7. HOW TO REPLACE THE PAPER

To replace the paper, the operator must open the main door. **Only authorized and qualified personnel can perform opening the main door.**

**Danger, hazardous voltage is present in the enclosure and will cause severe personal injury or cause death.**

Cut the power of the alternate source if present, then cut the power of the normal source and open the main door.

Remove the empty roll by removing the screw, set a new paper roll. Cut the paper end at a 45° angle. Introduce and force paper in the printer slot until the paper appears throughout the front slot. Close the main door, restore the power and advance the paper by pressing paper feed. Realign the paper is necessary.

## 15.8. HOW TO REPLACE THE RIBBON

The ribbon has a small area where it is marked 'pull'. Remove the actual ribbon by pulling carefully the ribbon with finger. Advance the paper several inches, place the

paper in the ribbon and fix the new ribbon by pressing it carefully. Verify the ink tape is correctly in place.

## 15.9. HOW TO RETRIEVE PRESSURE DATA'S FROM RS232 PORT

### 1. Connection between laptop computer and Tornatech Fire Pump Controller.

- a. Verify that your laptop computer has a RS232/DB9 communication port
- b. Connect your laptop computer communication port to the Tornatech Fire Pump Controller using a DB9 male/female cable.

### 2. Opening the Hyper Terminal

To communicate with the Fire Pump Controller, communication software is required. The latest versions of Windows come standard with Hyper Terminal software.

- a. Select from the Windows Toolbar : Start – Program – Accessories- (Communication) – Hyper Terminal
- b. If Hyper Terminal software has not been configured, double click on hypertrm.exe.  
*Note : This procedure might not be available on certain versions of this software*
- c. If Hyper Terminal software has already been configured to communicate with a Fire Pump Controller, select this configuration and go to step 4. (In case you are experiencing problems, go to step 7)

### 3. Communication Configuration

To be able to communicate with the Fire Pump Controller, the communication parameters between the Fire Pump Controller and your laptop computer must be identical.

- a. In the « New Connection » window, enter a connection name. Ex : "FPx Controller"
- b. Click on « OK » to validate
- c. The «Connect to» window will open and a communication port must be chosen. (*Usually Com 1*)
- d. Click on « OK » to validate
- e. The "port setting" window will open for the selection of the communication parameters
- f. Select : bits per second: 9600 - data bits: 8 - parity: none - stop bits: 1 - flow control: hardware
- g. Click « OK » to validate

### 4. Capturing the Information

In this step, the data contained in the Fire Pump Controller will be copied to a file in laptop computer

- a. Select Transfer – Capture Text –
- b. A window will open so that you can select a file. With the help of the Browse function, enter the name of the

file that you will designate to receive the data.

- c. It is good practice to save the data with a name incorporating the date. Ex : my documents\021024.txt ( for October 24,2002)  
(In case you are experiencing problems, go to step 7)
- d. If the « Select Capture File » window is open, click on « Open » (available on certain HyperTerminal version only)
- e. Click on « Start » to begin capturing, or downloading, the controller's data

*Note : The data will not start downloading to your laptop computer until the « Print » button is pressed on the Fire Pump Controller display.*

*The data required for the creation of the pressure graph are both the 7-day résumé and the pressure readings. To obtain the 7-day résumé, the "Print" button must be pressed once. To obtain the pressure readings, the "Print" button must be pressed once again within 60 seconds of the first time it was pressed for the 7-day résumé. This data will be saved in the file chosen in step 4C*

- f. If the data that appears on your screen is not legible, please go to step 7d for the troubleshooting information on data transmission problems.

## 5. Closing the Hyper Terminal Session

Once the data has downloaded, the HyperTerminal session can be disconnected.

- a. Click on File, select Exit
- b. Click on « YES » to disconnect

*Note : Upon closing the session, the Hyper Terminal software will ask if you want to save the session ( see step 3a ).*

*If you want to save the session, the data will be saved and an icon will appear the next time the Hyper Terminal will be open.*

*If you decide not to save the session, step 3 will have to be repeated the next time the Hyper Terminal software is opened*

## 6. Reading and Printing of the Data

The downloaded data is saved in the file created in step 3a. This file is a .TXT file that can be read by "Notepad", "Word", "Lotus" and "Excel" and other software's.

Upon opening this file, for it to show in the file list, the ".TXT" file type needs to be selected.

The data can be saved and printed using Word, Excell, Notepad.....

## 7. Troubleshooting

- a. Communication icon does not appear (step 2C)  
In certain versions of Hyper Terminal, the icon is hidden because the program has never been used. You must go to the end of the menu to have the icon appear.
- b. In step 4c, an error message appears indicating that the file cannot be found. In certain versions of Hyper Terminal, an empty .TXT file must be created so that it can be designated as the destination file  
While keeping the HyperTerminal session open, open Word. Select File - Save As and create the destination file for the downloaded data to be saved into (Ex : 021024). Important : this file must be a .TXT file only.
- c. When the file is opened in Word, Excel, or any other software, the saved document does not appear in the file list.  
The saved file is a .TXT file. Make sure the correct file type (.TXT or \*.\* ) is chosen
- d. In the destination file, the data is not formatted and the text is illegible. In the save file, the data is not formatted because the communication parameters are not adequate. In Hyper Terminal, click on File – Properties – Settings – ASCII Setup and verify ASCII receiving. Append line feeds to incoming line ends : ON; Force incoming data to 7-bit ASCII : OFF; Wrap lines that exceed terminal width : ON
- e. No data appears on the laptop computer screen when the "Print" button is pressed

Press the "Print" button firmly for approximately 1 second. Communication has not been established. Select Call-Call and verify if the "connected" status appears at the bottom left of the screen. Communication is not in capture mode. Select Transfer-Capture Text - select the appropriate file. Verify if the "Capture" status appears at the bottom right of the screen.

- f. The data is downloaded on the screen but the destination file remains empty. Communication is not in capture mode. Select Transfer-Capture Text - select the appropriate file. Verify if the "Capture" status appears at the bottom right of the screen.

### 15.10. PREVENTIVE AND MAINTENANCE TEST

Fire pump controllers are an important part of your fire protection system. They require a minimum preventive maintenance but must be periodically inspected and their operation simulated to assure constant performance.

**NOTE : : Qualified and authorized personnel only must do this maintenance.**

<b>15.11. <u>VISUAL INSPECTION</u></b>	OK	N/A
Inspect cleanliness of controller.		
Remove any object from the top of controller. Dust and clean the controller		
Inspect controller for any evidence of corrosion outside and inside		
Check for leaks in pressure transducer and piping.		
Inspect door for proper alignment and function of door locks		
Inspect flange handle for proper operation		
Inspect flange handle for interlock with door		
Inspect emergency start handle operation		
Verify operation of limit switch on emergency start handle		
Inspect tightness of all connections		
Inspect tightness of all terminal jumpers		
Inspect controller grounding		
Inspect harness mechanical attachment		
Inspect relays, contactors, and timers for any evidence of damage.		
Inspect motor contactor power contacts.		
Inspect tightness of all mounting nuts and screws.		
Check VFD fuses		

<b>15.12. <u>OPERATIONAL INSPECTION</u></b>	OK	N/A
Check wrong phase rotation indication.		
Check motor rotation.		
Start from start push button		
Start from emergency start handle.		
Start from remote start station. (If connected.)		
Start from weekly test by programming the SM1		
Start from water pressure control.		
Start from start push button in bypass mode		
Verify speed selection		

## 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



[www.tornatech.com](http://www.tornatech.com)