

## PFAS Fact Sheet:

# Aqueous Film Forming Foam (AFFF) Systems on Surface Ships

by Maritime DC & PPE Information Center [www.dcfpnavymil.org](http://www.dcfpnavymil.org)

Low-capacity and high-capacity AFFF systems are installed on surface ships to protect machinery spaces, fueled vehicle stowage spaces, helicopter hangars, landing platforms, refueling stations, flight decks, hangar bays, fuel pump rooms and other compartments or areas where flammable liquid fires are likely to occur. AFFF is generated by the following methods:

Balanced pressure proportioner, which proportions the amount of AFFF concentrate depending on the demand instead of injecting a set amount of concentrate. This proportioner is a high-speed capacity system.

Two-speed pumps, which are installed at high-capacity foam stations and inject concentrate depending on which speed is selected (high for sprinkler groups; low for hose lines). Two-speed pumps are high-capacity systems.

FP-180 proportioner, which injects a metered amount of AFFF concentrate for 60 or 180 gallons per minute (gpm). This proportioner is being replaced by balanced pressure proportioners and fixed AFFF eductors. The FP-180 proportioner is a low-capacity system.

Single-speed pumps, which are rated at 12, 27 and 60 gpm and inject their rated capacity of concentrate into the seawater firemain. The 12-gpm single-speed pump is a low-capacity system, while the other two are high-capacity systems.

High-capacity AFFF proportioning systems are installed on ships that require large quantities of AFFF to supply 1 ½-inch and 2 ½-inch hose stations and AFFF sprinkling systems. Hose stations are typically located on flight decks, hangar decks and outside of main engineering spaces. Overhead sprinkler systems are installed in hangars, tank decks, well decks, vehicle cargo holds, weapon elevator pits and fuel pump rooms. Bilge sprinkler systems are installed in machinery spaces.

For more information, see following pages.

- MIL-F-24385 QPL/QPD History for Type 3 AFFF
- MIL-F-24385 QPL/QPD History for Type 6 AFFF
- AFFF Tip 003: Equipment Tech Manual Info



**MIL-F-24385 QPL/QPD History for Type 6 AFFF**

Type	Product Name	Manufacturer	First Date on QPL	Date Removed from QPL
6	FC-196 Light Water	3M	1970_05_15	1971_10_04
6	FC-199 Light Water	3M	1971_10_04	1972_05_05
6	FC-200 Light Water	3M	1972_02_03	1974_05_09
6	Aer-O-Water 6	National Foam	1973_10_24	1978_01_16
6	FC-206 Light Water	3M → Minnesota Mining & Mfg Co	1974_05_09	1978_01_16
6	FC-200 Light Water	3M → Minnesota Mining & Mfg Co	1974_08_08	1977_03_11
<b>**3M changed their company name to Minnesota Mining &amp; Mfg Co. on 27 November 1974**</b>				
6	Ansul AFFF	Ansul	1976_06_03	1978_01_16
6	AFC-2	Ansul	1978_01_16	1982_05_04
6	FC-780	3M	1978_01_16	1979_05_17
6	FC-780B	3M	1979_05_17	1982_05_04
6	AFC-3	Ansul	1979_05_17	1982_05_04
6	AFC-5	Ansul	1982_05_04	1982_09_04
6	FC-206C	3M	1982_05_04	1990_02_20
6	Aer-o-water 6MD	National Foam System, Inc.	1982_05_04	1989_03_22
6	Ansulite 6% AFFF/AFC-5	Ansul	1982_09_04	1990_02_20
6	6% AFFF Type FC-206CE	3M	1984_02_08	1990_02_20
6	Aer-o-water 6MD	CHUBB National Foam, Inc.	1989_03_22	1990_02_20
<b>**AFFF manufactured before February 20, 1990 is not acceptable for current use. Revision D of Mil-F-24385 was instated on this date which included more stringent fire performance requirements.**</b>				
6	6% AFFF Type FC-206CE	3M	1990_12_18	2002_04_24
6	Aer-o-water 6MD	CHUBB National Foam, Inc.	1990_12_18	1997_04_29
6	Ansulite 6% AFFF/AFC-5	Ansul	1990_12_18	2010_08_10
6	FC-206C	3M	1990_12_18	2002_04_24
6	FC-206CF	3M	1991_08_22	2007_01_03
6	Aer-o-water 6-EM	CHUBB National Foam, Inc.	1992_05_21	1997_04_29
6	Aer-o-water 6MD	National Foam, Inc.	1997_04_29	1998_09_30
6	Aer-o-water 6-EM	National Foam, Inc.	1997_04_29	2004_01_02
6	Chemguard 6% AFFF P/NC-601MS	Chemguard	2002_04_24	2014_12_02
6	Aer-o-water 6-EM	Kidde	2004_01_02	2015_12_21
6	Ansulite 6% AFFF/AFC-5	Ansul/Tyco	2010_08_10	2014_11_18
6	Fireade 2000-MIL6 AFFF	Fire Service Plus	2011_05_04	2018_01_22
6	AnsuliteAFC-6MS 6% AFFF	Tyco/Ansul	2015_12_15	ACTIVE
6	Chemguard C606-MS 6% AFFF	Tyco/Chemguard	2015_12_15	ACTIVE
6	Arctic 6% MIL-SPEC AFFF	Amerex/Solberg	2016_03_30	ACTIVE
6	Aer-O-Water 6EM-C6 AFFF	National Foam	2016_05_04	ACTIVE
6	Tridol-C6 M6 AFFF	National Foam	2016_05_04	ACTIVE
6	Phos-Chek 6% Milspec AFFF	ICL	2018_01_08	ACTIVE
6	Fireade MILSPEC 6	Fire Service Plus	2018_01_22	ACTIVE

**MIL-F-24385 QPL/QPD History for Type 3 AFFF**

Type	Product Name	Manufacturer	First Date on QPL	Date Removed from QPL
3	AFC_5A	Ansul	1982_05_04	1982_09_04
3	FC_203C	3M	1982_05_04	1990_02_20
3	Aer-O-Water 3	National Foam System, Inc.	1982_05_04	1989_03_22
3	Ansulite 3% AFFF/AFC-5A	Ansul	1982_09_04	1990_02_20
3	3% AFFF Type 203CE	3M	1984_02_08	1990_02_20
3	Aer-O-Water 3	CHUBB National Foam, Inc.	1989_03_22	1990_02_20
<b>**AFFF manufactured before February 20, 1990 is not acceptable for current use. Revision D of Mil-F-24385 was instated on this date which included more stringent fire performance requirements.**</b>				
3	3% AFFF Type 203CE	3M	1990_12_18	2002_04_24
3	Aer-O-Water 3	CHUBB National Foam, Inc.	1990_12_18	1997_04_29
3	Ansulite 3% AFFF/AFC-5A	Ansul	1990_12_18	2010_08_10
3	FC_203C	3M	1990_12_18	2002_04_24
3	FC_203CF	3M	1991_08_22	2010_08_10
3	Aer-O-Water 3-EM	CHUBB National Foam, Inc.	1992_05_21	1997_04_29
3	Tridol M 3%	Angus Fire	1994_04_21	2010_08_10
3	Aer-O-Water 3	National Foam, Inc.	1997_04_29	1998_09_30
3	Aer-O-Water 3-EM	National Foam, Inc.	1997_04_29	2004_01_02
3	Chemguard 3% AFFF C-301MS	Chemguard	1998_10_30	2017_02_08
3	Buckeye 3% BFC-3MS AFFF	Buckeye	2004_01_02	2015_09_22
3	Aer-O-Water 3-EM	Kidde/National	2004_01_02	2015_12_21
3	Ansulite 3% AFFF/AFC-5A	Ansul/Tyco	2010_08_10	2014_10_23
3	Tridol M 3%	Kidde/National/Angus	2010_08_10	2015_12_21
3	Phos-Chek 3% AFFF MS	ICL Performance Products	2015_11_10	ACTIVE
3	Ansulite AFC-3MS 3% AFFF	Tyco/Ansul	2015_12_15	ACTIVE
3	Chemguard C306-MS 3% AFFF	Tyco/Chemguard	2015_12_15	ACTIVE
3	Arctic 3% MIL-SPEC AFFF	Amerex/Solberg	2016_03_30	ACTIVE
3	Aer-O-Water 3EM-C6 AFFF	National Foam	2016_05_04	ACTIVE
3	Tridol-C6 M3 AFFF	National Foam	2016_05_04	ACTIVE
3	Fomtec AFFF 3%M "SWE"	Dafo Fomtec AB	2017_05_12	ACTIVE
3	Fomtec AFFF 3%M "USA"	Dafo Fomtec AB	2017_05_12	ACTIVE
3	Fireade MILSPEC 3	Fire Service Plus	2018_01_22	ACTIVE



## DEPARTMENT OF THE NAVY

NAVAL SEA SYSTEMS COMMAND  
1333 ISAAC HULL AVE SE  
WASHINGTON NAVY YARD DC 20376-0001

9555  
SER 05P4/023  
27 February 2004

IN REPLY TO

From: Commander, Naval Sea Systems Command (SEA 05P4)  
To: Commander, Naval Surface Force, U.S. Pacific Fleet (N432)  
Subj: AFFF AND COUNTERMEASURE WASHDOWN (CMWD) SYSTEM SOLENOID-OPERATED  
PILOT VALVE (SOPV) COIL PROTECTION MODIFICATION PROCEDURES, REVISION  
OF  
Ref: (a) NAVSEA ltr 9555 Ser 05P4/095 of 8 August 2003  
(b) CNSF N432A1 Telecon of 4 January 2004  
Encl: (1) AFFF SYSTEM SOPV COIL PROTECTION MODS  
(2) CMWD SYSTEM SOPV COIL PROTECTION MODS

1. NAVSEA has completed modifications to the procedures provided by reference (a), as requested by reference (b). Enclosures (1) and (2) supersede the procedures forwarded with reference (a). Note that no changes to the wiring configurations were required.

2. The enclosed procedures include an SOPV data sheet, which is required to be filled out when the modifications are being completed. Copies of these data sheets must be sent to SEA 05P4 for configuration control purposes. The data sheets may be sent via email.

3. NAVSEA POC is Mr. Doug Barylski, NAVSEA 05P4, phone (202) 781-3612, DSN 326-3612, or email barylskidj@navsea.navy.mil.

A handwritten signature in black ink, appearing to read "D. M. McCrory".

D. M. McCrory  
By Direction

Copy to:  
SEA 05P4 file  
COMNAVSURFLANT N4  
COMNAVSURFLANT N7  
COMNAVSURFPAC N7  
PEO-SHIPS FT

## AFFF System SOPV Coil Protection Mods

**This procedure includes generic instructions to isolate the AFFF system piping to prevent inadvertent flow during SOPV tests and SOPV coil protection modifications.**

**This procedure inspects and modifies the SOPV, if possible, so that internal and external wiring utilizes S3 for coil protection and S1 and/or S2 for remote indication.**

### **Safety Precautions.**

1. Forces afloat comply with NAVOSH Program Manual for Forces Afloat, OPNAVINST 5100.19 series.
2. Ensure all tag-out procedures are in accordance with current shipboard instructions.
3. Solenoid operated pilot valves may be supplied by more than one power source. Ensure all electrical circuits are de-energized.
4. Consider all electrical leads to be energized until positively proven they are de-energized.

### **Preliminary.**

1. Deviations on procedures and valve alignment are allowed to suit specific ship configuration.
2. Red "Danger" tags shall be used where tag-outs are required. Yellow "Caution" tags may be installed at the discretion of the Damage Control Assistant (DCA).
3. Comply with ship's regulations before accomplishing any modifications.
4. Obtain permission from DCA prior to removing any fire extinguishing system from the normal readiness condition.
5. Install test cast fittings in sprinkling control valves to prevent sprinkling.

### **Procedure.**

**NOTE 1:** Work center supervisor review procedure and omit steps/add steps to suit specific installations.

**WARNING:** Ensure all tag-out procedures are in accordance with current shipboard instructions.

1. De-energize all electrical circuits to applicable solenoid operated pilot valve(s) and tag "Out of Service".

**WARNING:** Solenoid operated pilot valves may be supplied by more than one power source.

2. Ensure all electrical circuits are de-energized.
3. Remove SOPV cover from baseplate.

**WARNING:** Consider all electrical leads to be energized until positively proven they are de-energized.

4. Test SOPV electrical circuit with AC/DC multimeter to ensure circuits are de-energized.

**NOTE 2:** Improper alignment of micro switch used for coil protection can result in premature loss of voltage to solenoid causing failure of valve to fully cycle.

5. Inspect SOPV wiring. Document on data sheet. If all three switches are used for external indication and control, coil protection is not possible and no work is required. If any one of the three switches is not used for external indication and control perform switch adjustment procedure located on drawing 17312 of Solenoid Operated Pilot Valve Model CSM5M-3A technical manual S6435-B1-MMO-010.
6. Visually inspect each SOPV to ensure that the SOPV linkage is properly lubricated, the SOPV is free of corrosion, dirt and debris, the SOPV does not show evidence of seawater leakage around the T-handle inside the cover or show signs of valve leak-by. If any of these conditions exist the SOPV should be cleaned, inspected and lubricated in accordance with PMS MRC C2EB Y (R-18) or replaced, as necessary.

**NOTE 3:** When installing SOPV cover, ensure wiring is safely stowed away.

7. Re-install SOPV cover.
8. Remove safety tag(s) and energize all electrical circuits to the SOPV.
9. Shut firemain supply cut-out valve to AFFF station.
10. Shut all cut-out valves upstream and downstream of a sprinkling control valve. Where downstream cut-out valves are not installed, ensure that adequate precautions are taken to protect downstream equipment from damage due to residual line drainage.
11. Shut AFFF station loop cut-out valve.
12. Shut AFFF concentrate pump discharge cut-out valve.
13. Ensure AFFF concentrate piping is aligned for recirculation.
14. Ensure AFFF concentrate transfer system cut-out valve is shut, if installed.

**NOTE 4:** Actuation of a sprinkling system will operate a service SOPV and the related AFFF station master SOPV.

15. Test the AFFF system prior to SOPV modification to ensure proper operation:

- a. Man the following locations and test the hose reels/hose racks/sprinkling system:
  1. AFFF station to be tested.
  2. SOPV to be tested.
  3. Hose reel/hose rack/sprinkling system pushbutton to be tested.
- b. Establish communications between locations.

**WARNING:** When operating the AFFF system by remote ON/OFF pushbuttons, do not keep ON or OFF button depressed for more than 3 seconds. In addition, do not cycle the SOPV more than 5 times in 5 minutes. Solenoids are for intermittent duty. Continuous energizing and excessive cycling can cause damage to the solenoid coils.

- c. Notify pushbutton operator to actuate demand.
- d. Observe that SOPV operates smoothly and properly, and related valve(s), pump, and alarms actuate.
- e. If pushbutton is for a sprinkling system, notify the pushbutton operator to secure the sprinkling system and then notify the AFFF station operator to secure the AFFF pump. If pushbutton is for a hose reel/hose rack, notify the AFFF station operator to secure the AFFF pump.
- f. Observe that SOPV operates properly, and related valve(s), pump, and alarms secure.
- g. Record satisfactory operation of each service and master SOPV or any SOPV operational deficiency on the data sheet.

16. Shut firemain supply cut-out valve in control water piping to SOPV.

**WARNING:** Ensure all tag-out procedures are in accordance with current shipboard instructions.

17. De-energize all electrical circuits to solenoid operated pilot valve(s) and tag "Out of Service".

**WARNING:** Solenoid operated pilot valves may be supplied by more than one power source.

18. Ensure all electrical circuits are de-energized.
19. Remove SOPV cover from baseplate.

**WARNING:** Consider all electrical leads to be energized until positively proven they are de-energized.

20. Test SOPV electrical circuit with AC/DC multimeter to ensure circuits are de-energized.



21. Perform SOPV electrical checks and modifications as follows:
  - a. If all three switches are used for external indication and control, coil protection is not possible and no work is required. Document on data sheet.
  - b. Remove any jumpers associated with coil protection.
  - c. Ensure there is no excess cable/wire inside the cover of the SOPV to avoid creation of a shock hazard especially during manual operation of the T-handle, and to avoid interference with movement of the SOPV linkage.
  - d. Install wire markers as wiring is modified to agree with final wiring configuration.
  - e. Relocate any remote indication or control wiring using S3 to S1, or S2 if S1 is used.
  - f. Modify internal and external wiring to concur with Figures 1 and 3 for numbered terminal boards and Figures 2 and 4 for lettered terminal boards.
  - g. For each SOPV, record on data sheet whether S1 and/or S2 provides remote indication.

22. Remove safety tag(s) and energize all electrical circuits to the SOPV.

23. Connect a multimeter between the following points on the applicable SOPV.

- a. On SOPVs with numbered terminal boards between TB 2-7 and TB 2-3 (common).
- b. On SOPVs with lettered terminal boards between 1 on terminal feeding L1-1 and SW3-N.O.

**NOTE 5:** Actuation of a sprinkling system will operate a service SOPV and the related AFFF station master SOPV.

**WARNING:** Keep hands and test leads clear of T-handle during SOPV test.

24. Push any ON pushbutton for the SOPV under test for one second and verify 450 volts on multimeter until the T-handle rotates and power is removed. If SOPV fails to operate, troubleshoot internal and external SOPV wiring and retest.

25. With the SOPV in the Open (actuated) position, move the meter leads as follows:

- a. On SOPVs with numbered terminal boards, move the meter lead connected to TB2-7 to TB2-4 and move the lead from TB2-3 to TB2-1.
- b. On SOPVs with lettered terminal boards, move the meter lead connected to 1 on terminal feeding L1-1 to terminal 2 feeding L2-1 and move SW3-N.O. to SW3-N.C.

**WARNING:** Keep hands and test leads clear of T-handle during SOPV test.

26. Push any OFF pushbutton for the SOPV under test for one second and verify

450 volts on multimeter until the T-handle rotates and power is removed. If SOPV fails to operate, troubleshoot internal and external SOPV wiring and retest.

27. Disconnect multimeter. Secure AFFF pump.

**WARNING:** Ensure all tag-out procedures are in accordance with current shipboard instructions.

28. De-energize all electrical circuits to solenoid operated pilot valve(s) and tag "Out of Service".

**WARNING:** Solenoid operated pilot valves may be supplied by more than one power source.

29. Ensure all electrical circuits are de-energized.

**WARNING:** Consider all electrical leads to be energized until positively proven they are de-energized.

30. Test SOPV electrical circuit with AC/DC multimeter to ensure circuits are de-energized.

**NOTE 6:** When installing SOPV cover, ensure wiring is safely stowed away.

31. Re-install SOPV cover.

32. Remove safety tag(s) and energize all electrical circuits to the SOPV.

33. Open firemain supply cut-out valve in control water piping to SOPV.

34. Test the AFFF system after SOPV modification to ensure proper operation:

**NOTE 7:** Actuation of a sprinkling system will operate a service SOPV and the related AFFF station master SOPV.

a. Man the following locations and test the hose reels/hose racks/sprinkling system:

1. AFFF station to be tested.

2. SOPV to be tested

3. Hose reel/hose rack/sprinkling system pushbutton to be tested.

b. Establish communications between locations.

**WARNING:** When operating the AFFF system by remote ON/OFF pushbuttons, do not keep ON or OFF button depressed for more than 3 seconds. In addition, do not cycle the SOPV more than 5 times in 5 minutes. Solenoids are for

intermittent duty. Continuous energizing and excessive cycling can cause damage to the solenoid coils.

- c. Notify pushbutton operator to actuate demand.
  - d. Observe that SOPV operates smoothly and properly, and related valve(s), pump, and alarms actuate.
  - e. If pushbutton is for a sprinkling system, notify the pushbutton operator to secure the sprinkling system and then notify the AFFF station operator to secure the AFFF pump. If pushbutton is for a hose reel/hose rack, notify the AFFF station operator to secure the AFFF pump.
  - f. Observe that SOPV operates properly, and related valve(s), pump, and alarms secure.
  - g. Record satisfactory operation of each service and master SOPV or any SOPV operational deficiency on the data sheet.
- 
- 35. Open the AFFF concentrate discharge cut-out valve.
  - 36. Ensure AFFF concentrate piping is aligned for normal firefighting service.
  - 37. Open firemain supply cut-out valve to AFFF station.
  - 38. Open the AFFF station loop cut-out valve.
  - 39. Remove test cast fittings from sprinkling control valves.
  - 40. Open all cut-out valves upstream and downstream of a sprinkling control valve.
  - 41. Repeat this procedure including Preliminary steps for each service and master SOPV.
  - 42. Ensure AFFF system is re-aligned for normal firefighting service.
  - 43. Notify Maintenance group supervisor that system is in readiness condition.

## SOPV DATA SHEET

Note: Record data for each SOPV.

SOPV Location and Service	SOPV can receive mod (at least one switch available before mod) (Yes/No)	Operation SAT before mod (Yes/No)	Operation SAT after mod (Yes/No)	SW1 used for indication or other purposes (after mod) (Yes/No)	SW2 used for indication or other purposes (after mod) (Yes/No)	Remarks

SOPV DIAGRAM WITH NUMBERED TERMINAL BOARD INTERNAL WIRES MOVED TO S-3 FOR COIL PROTECTION

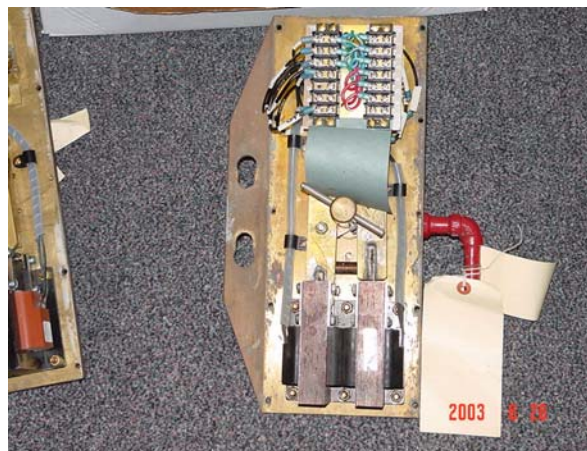
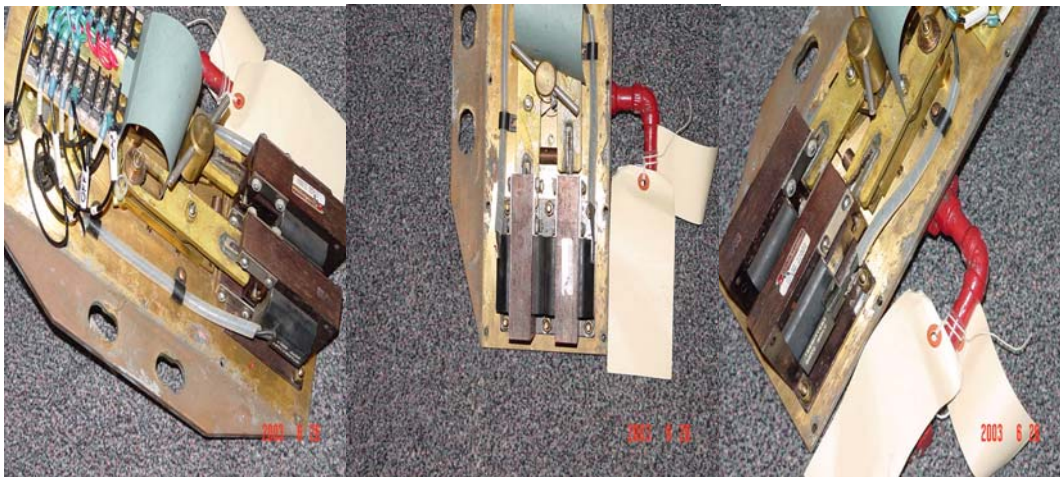
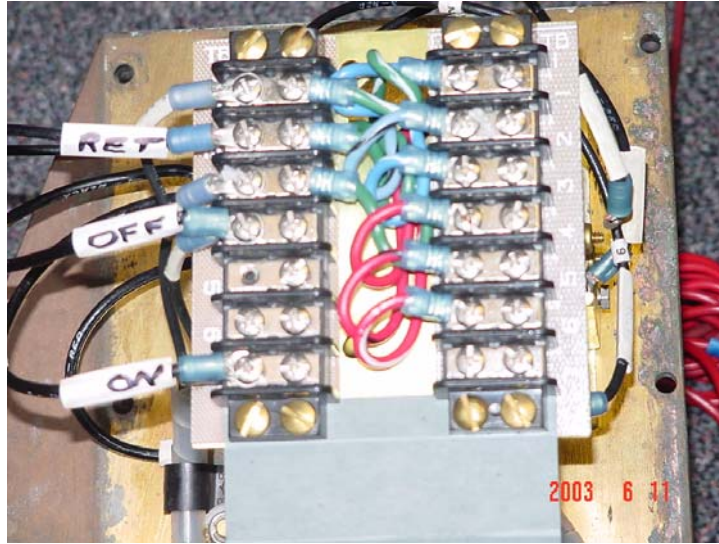


FIGURE 1

SOPV DIAGRAM WITH LETTERED TERMINAL BOARD INTERNAL WIRES MOVED TO S-3 FOR COIL PROTECTION

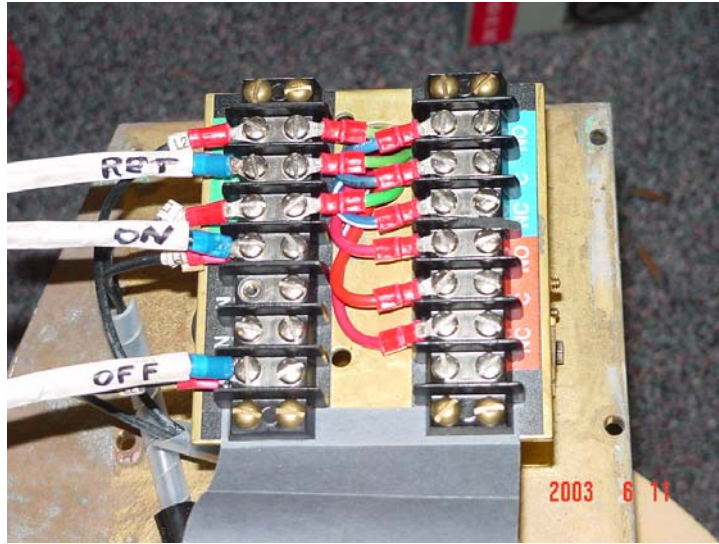
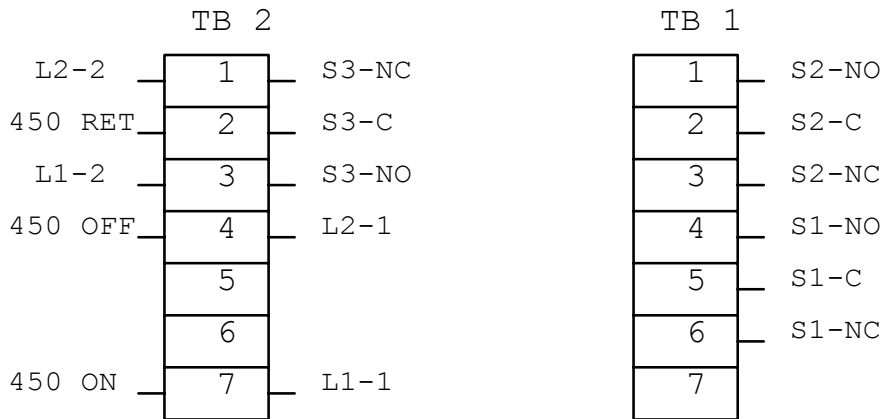
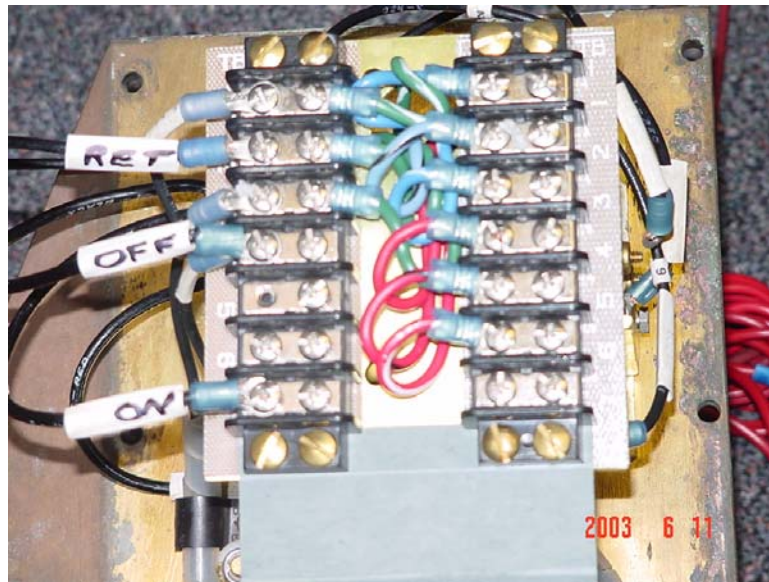
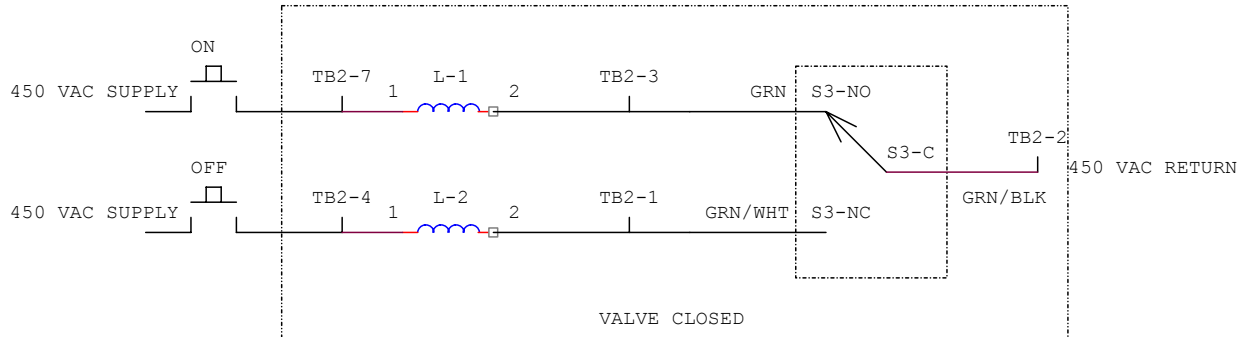


FIGURE 2

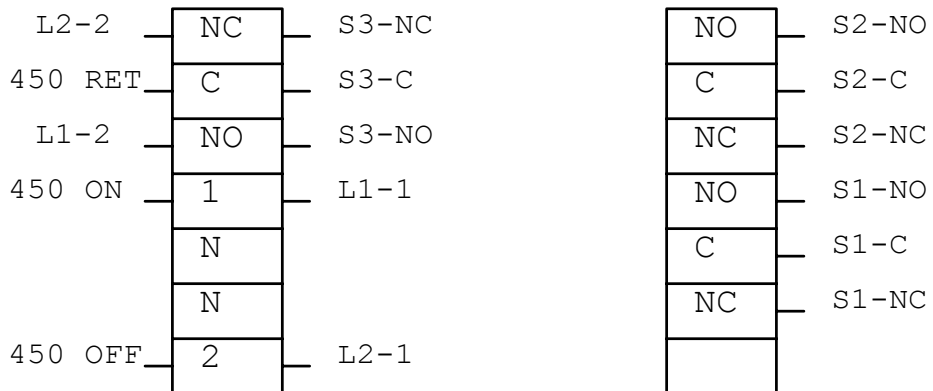
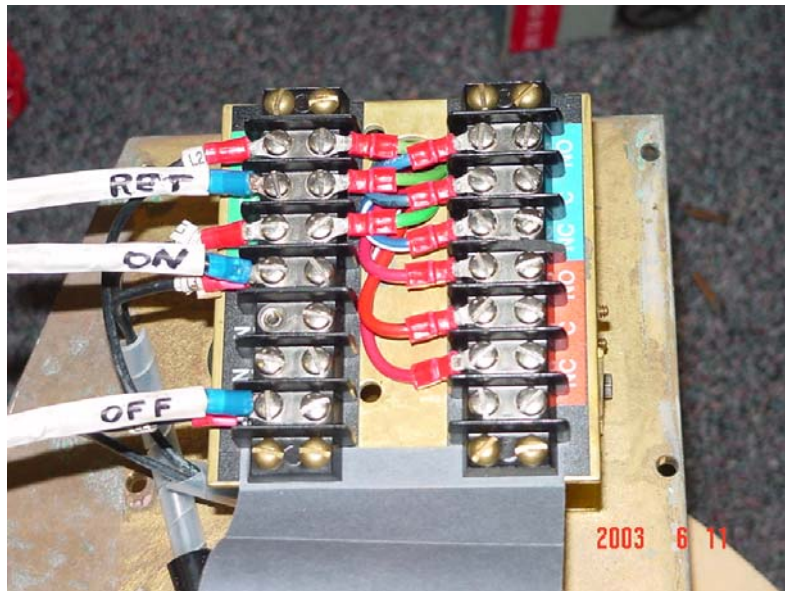
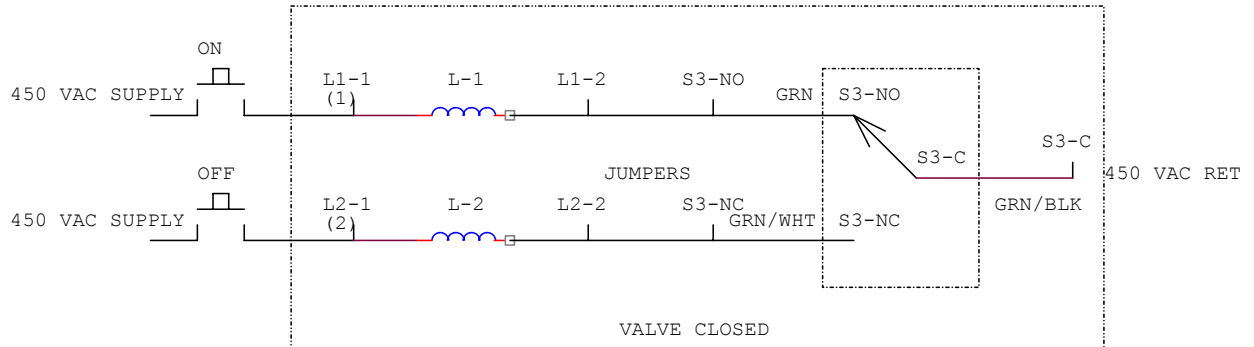
**SOPV DIAGRAM WITH NUMBERED TERMINAL BOARD INTERNAL WIRES MOVED TO S-3 FOR COIL PROTECTION**



The three diagrams above show the electrical connections required for coil protection using switch 3 (green) with internal L1-2 and L2-2 wires relocated to the listed terminals.

FIGURE 3

**SOPV DIAGRAM WITH LETTERED TERMINAL BOARD INTERNAL WIRES MOVED TO S-3 FOR COIL PROTECTION**



The three diagrams above show the electrical connections required for coil protection using switch 3 (green) with internal L1-2 and L2-2 wires relocated to the listed terminals.

FIGURE 4



## CMWD System SOPV Coil Protection Mods

**This procedure includes generic instructions to isolate the CMWD system piping to prevent inadvertent flow during SOPV tests and SOPV coil protection modifications.**

**This procedure inspects and modifies the SOPV, if possible, so that internal and external wiring utilizes S3 for coil protection and S1 and/or S2 for remote indication.**

### **Safety Precautions.**

1. Forces afloat comply with NAVOSH Program Manual for Forces Afloat, OPNAVINST 5100.19 series.
2. Ensure all tag-out procedures are in accordance with current shipboard instructions.
3. Solenoid operated pilot valves may be supplied by more than one power source. Ensure all electrical circuits are de-energized.
4. Consider all electrical leads to be energized until positively proven they are de-energized.

### **Preliminary.**

1. Deviations on procedures and valve alignment are allowed to suit specific ship configuration.
2. Red "Danger" tags shall be used where tag-outs are required. Yellow "Caution" tags may be installed at the discretion of the Damage Control Assistant (DCA).
3. Comply with ship's regulations before accomplishing any modifications.
4. Obtain permission from DCA prior to removing any countermeasure washdown system from the normal readiness condition.
5. Install test cast fittings in sprinkling control valves to prevent sprinkling.

### **Procedure.**

**NOTE 1:** Work center supervisor review procedure and omit steps/add steps to suit specific installations.

**WARNING:** Ensure all tag-out procedures are in accordance with current shipboard instructions.

1. De-energize all electrical circuits to applicable solenoid operated pilot valve(s) and tag "Out of Service".

**WARNING:** Solenoid operated pilot valves may be supplied by more than one power source.

2. Ensure all electrical circuits are de-energized.
3. Remove SOPV cover from baseplate.

**WARNING:** Consider all electrical leads to be energized until positively proven they are de-energized.

5. Test SOPV electrical circuit with AC/DC multimeter to ensure circuits are de-energized.

**NOTE 2:** Improper alignment of micro switch used for coil protection can result in premature loss of voltage to solenoid causing failure of valve to fully cycle.

6. Inspect SOPV wiring. Document on data sheet. If all three switches are used for external indication and control, coil protection is not possible and no work is required. If any one of the three switches is not used for external indication and control perform switch adjustment procedure located on drawing 17312 of Solenoid Operated Pilot Valve Model CSM5M-3A technical manual S6435-B1-MMO-010.
7. Visually inspect each SOPV to ensure that the SOPV linkage is properly lubricated, the SOPV is free of corrosion, dirt and debris, the SOPV does not show evidence of seawater leakage around the T-handle inside the cover or show signs of valve leak-by. If any of these conditions exist the SOPV should be cleaned, inspected and lubricated in accordance with PMS MRC C2EB Y (R-18) or replaced, as necessary.

**NOTE 3:** When installing SOPV cover, ensure wiring is safely stowed away.

8. Re-install SOPV cover.
9. Remove safety tag(s) and energize all electrical circuits to the SOPV.
10. Shut firemain supply cut-out valve to sprinkling control valve.
11. Shut all cut-out valves upstream and downstream of a sprinkling control valve. Where downstream cut-out valves are not installed, ensure that adequate precautions are taken to protect downstream equipment from damage due to residual line drainage.
12. Test the CMWD system prior to SOPV modification to ensure proper operation:
  - a. Man the following locations:
    1. SOPV to be tested.
    2. CMWD system pushbutton to be tested.
  - b. Establish communications between locations.

**WARNING:** When operating the CMWD system by remote ON/OFF pushbuttons, do not keep ON or OFF button depressed for more than 3 seconds. In addition, do not cycle the SOPV more than 5 times in 5 minutes. Solenoids are for intermittent duty. Continuous energizing and excessive cycling can cause damage to the solenoid coils.

- c. Notify pushbutton operator to actuate demand.
- d. Observe that SOPV operates smoothly and properly, and related valve and alarms actuate.
- e. Notify the pushbutton operator to secure the CMWD system.
- f. Observe that SOPV operates smoothly and properly, and related valve and alarms secure.
- g. Record satisfactory operation of each SOPV or any SOPV operational deficiency on the data sheet.

13. Shut firemain supply cut-out valve in control water piping to SOPV.

**WARNING:** Ensure all tag-out procedures are in accordance with current shipboard instructions.

14. De-energize all electrical circuits to solenoid operated pilot valve(s) and tag "Out of Service".

**WARNING:** Solenoid operated pilot valves may be supplied by more than one power source.

15. Ensure all electrical circuits are de-energized.

16. Remove SOPV cover from baseplate.

**WARNING:** Consider all electrical leads to be energized until positively proven they are de-energized.

17. Test SOPV electrical circuit with AC/DC multimeter to ensure circuits are de-energized.

18. Perform SOPV electrical checks and modifications as follows:

- a. If all three switches are used for external indication and control, coil protection is not possible and no work is required. Document on data sheet.
- b. Remove any jumpers associated with coil protection.
- c. Ensure there is no excess cable/wire inside the cover of the SOPV to avoid creation of a shock hazard especially during manual operation of the T-handle, and to avoid interference with movement of the SOPV linkage.
- d. Install wire markers as wiring is modified to agree with final wiring configuration.

- e. Relocate any remote indication or control wiring using S3 to S1, or S2 if S1 is used.
- f. Modify internal and external wiring to concur with Figures 1 and 3 for numbered terminal boards and Figures 2 and 4 for lettered terminal boards.
- g. For each SOPV, record on data sheet whether S1 and/or S2 provides remote indication.

18. Remove safety tag(s) and energize all electrical circuits to the SOPV.

19. Connect a multimeter between the following points on the applicable SOPV.

- a. On SOPVs with numbered terminal boards between TB 2-7 and TB 2-3 (common).
- b. On SOPVs with lettered terminal boards between 1 on terminal feeding L1-1 and SW3-N.O.

**WARNING:** Keep hands and test leads clear of T-handle during SOPV test.

20. Push any ON pushbutton for the SOPV under test for one second and verify 450 volts on multimeter until the T-handle rotates and power is removed. If SOPV fails to operate, troubleshoot internal and external SOPV wiring and retest.

21. With the SOPV in the Open (actuated) position, move the meter leads as follows:

- a. On SOPVs with numbered terminal boards, move the meter lead connected to TB2-7 to TB2-4 and move the lead from TB2-3 to TB2-1.
- b. On SOPVs with lettered terminal boards, move the meter lead connected to 1 on terminal feeding L1-1 to terminal 2 feeding L2-1 and move SW3-N.O. to SW3-N.C.

**WARNING:** Keep hands and test leads clear of T-handle during SOPV test.

22. Push any OFF pushbutton for the SOPV under test for one second and verify 450 volts on multimeter until the T-handle rotates and power is removed. If SOPV fails to operate, troubleshoot internal and external SOPV wiring and retest.

23. Disconnect multimeter.

**WARNING:** Ensure all tag-out procedures are in accordance with current shipboard instructions.

24. De-energize all electrical circuits to solenoid operated pilot valve(s) and tag "Out of Service".

**WARNING:** Solenoid operated pilot valves may be supplied by more than one power source.

25. Ensure all electrical circuits are de-energized.

**WARNING:** Consider all electrical leads to be energized until positively proven they are de-energized.

26. Test SOPV electrical circuit with AC/DC multimeter to ensure circuits are de-energized.

**NOTE 4:** When installing SOPV cover, ensure wiring is safely stowed away.

27. Re-install SOPV cover.

28. Remove safety tag(s) and energize all electrical circuits to the SOPV.

29. Open firemain supply cut-out valve in control water piping to SOPV.

30. Test the CMWD system after SOPV modification to ensure proper operation:

a. Man the following locations:

1. SOPV to be tested

2. CMWD system pushbutton to be tested.

b. Establish communications between locations.

**WARNING:** When operating the CMWD system by remote ON/OFF pushbuttons, do not keep ON or OFF button depressed for more than 3 seconds. In addition, do not cycle the SOPV more than 5 times in 5 minutes. Solenoids are for intermittent duty. Continuous energizing and excessive cycling can cause damage to the solenoid coils.

c. Notify pushbutton operator to actuate demand.

d. Observe that SOPV operates smoothly and properly, and related valve and alarms actuate.

e. Notify the pushbutton operator to secure the CMWD system.

f. Observe that SOPV operates smoothly and properly, and related valve and alarms secure.

g. Record satisfactory operation of each SOPV or any SOPV operational deficiency on the data sheet.

31. Open firemain supply cut-out valve to sprinkling control valve.

32. Remove test cast fittings from sprinkling control valves.

33. Open all cut-out valves upstream and downstream of a sprinkling control valve.

34. Repeat this procedure including Preliminary steps for each SOPV.

35. Ensure CMWD system is re-aligned for normal firefighting service.

36. Notify maintenance group supervisor that system is in readiness condition.

SOPV DIAGRAM WITH NUMBERED TERMINAL BOARD INTERNAL WIRES MOVED TO S-3 FOR COIL PROTECTION

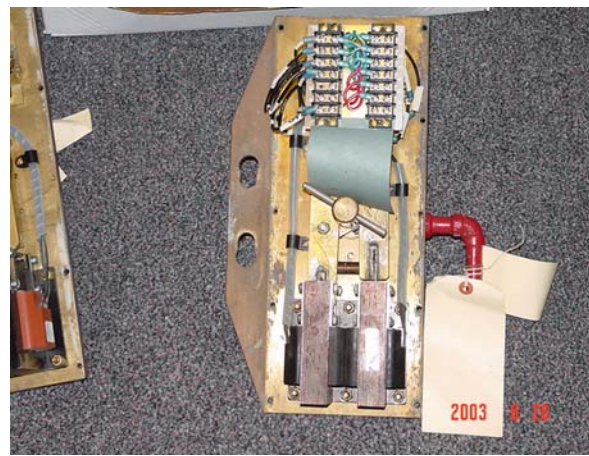
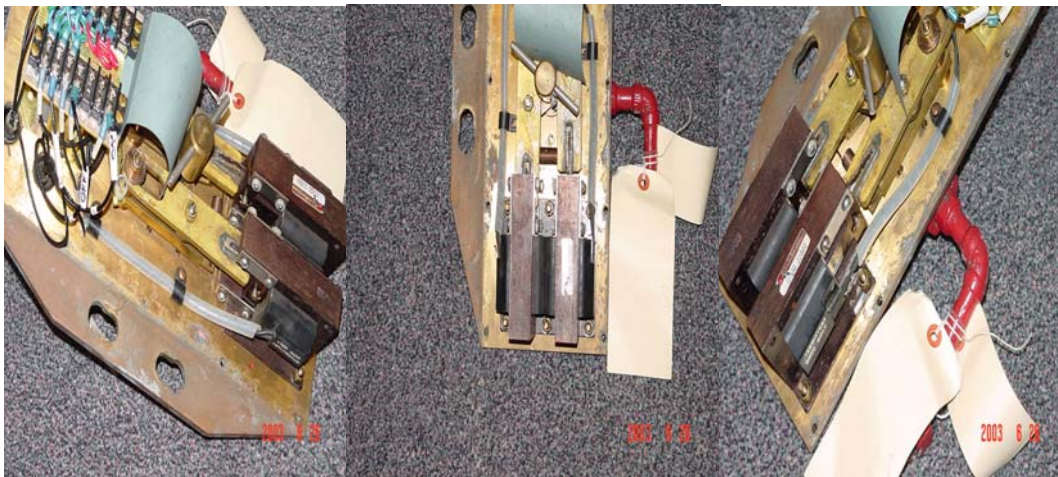
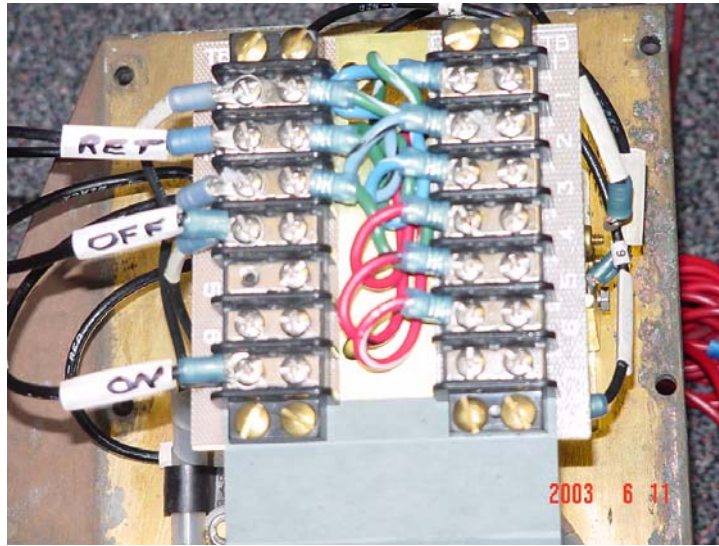


FIGURE 1

SOPV DIAGRAM WITH LETTERED TERMINAL BOARD INTERNAL WIRES MOVED TO S-3 FOR COIL PROTECTION

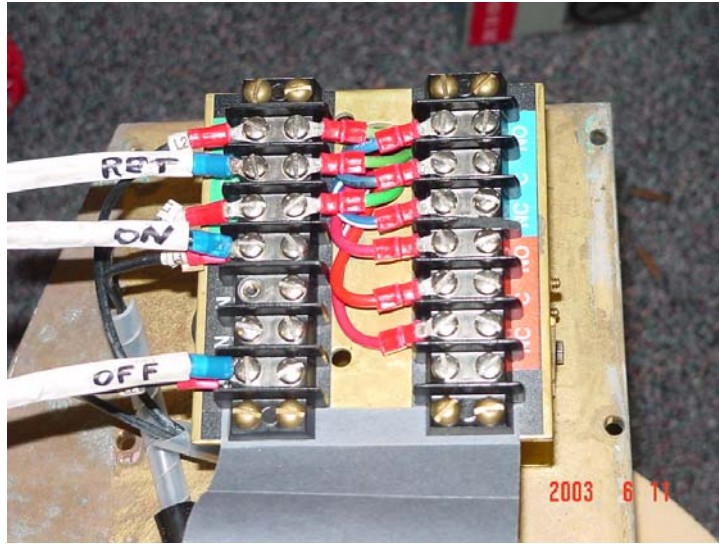
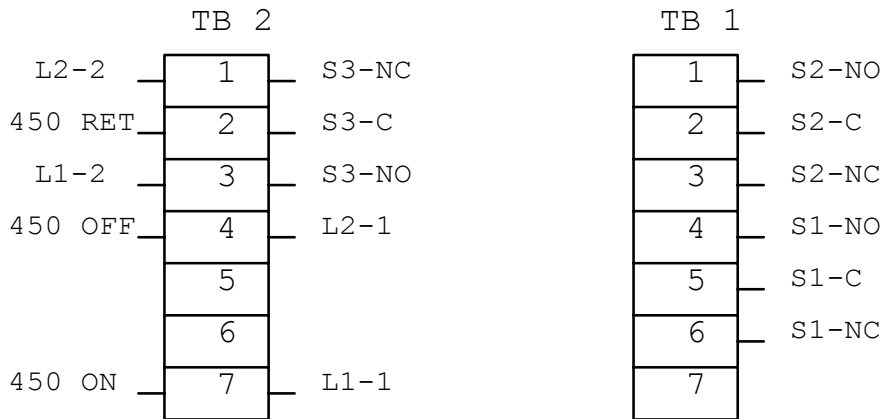
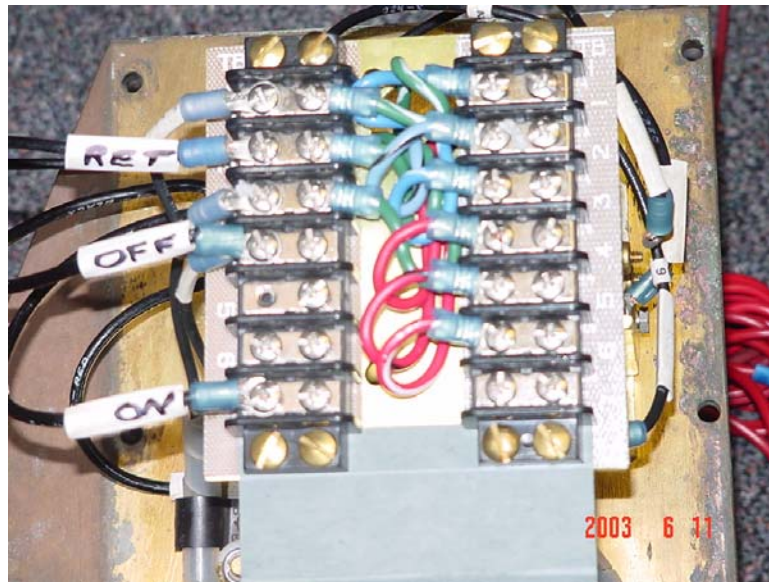
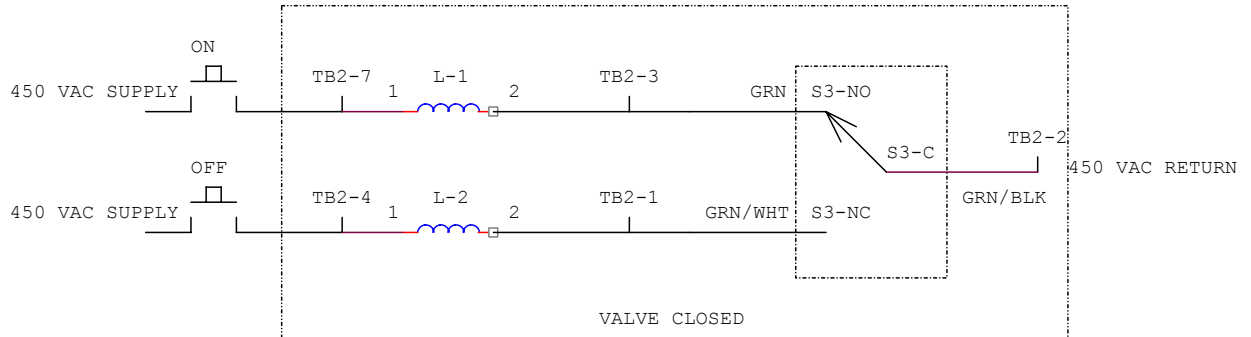


FIGURE 2

**SOPV DIAGRAM WITH NUMBERED TERMINAL BOARD INTERNAL WIRES MOVED TO S-3 FOR COIL PROTECTION**

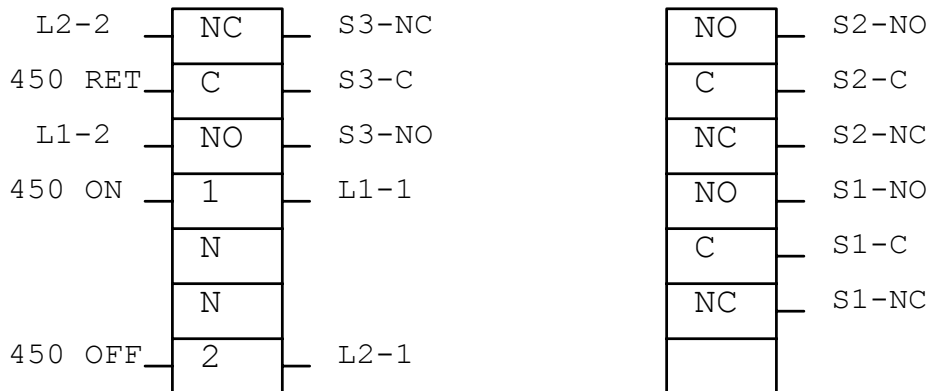
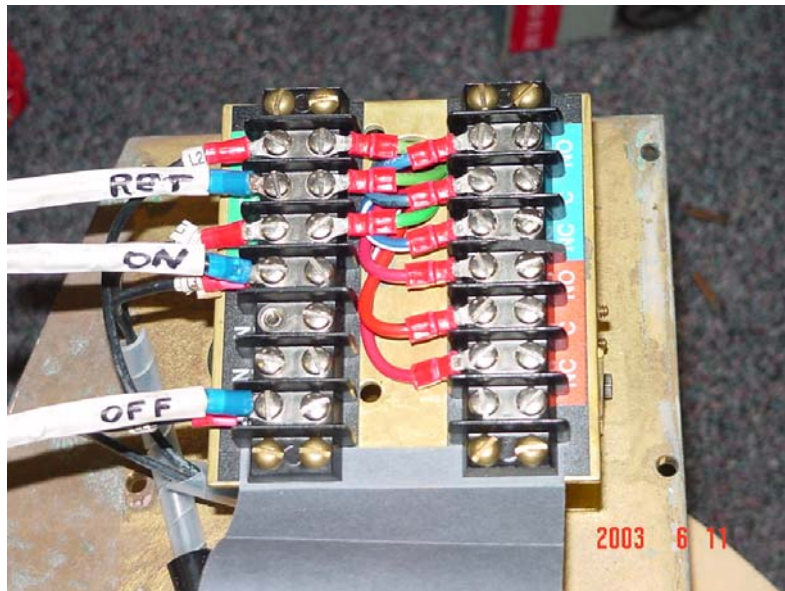
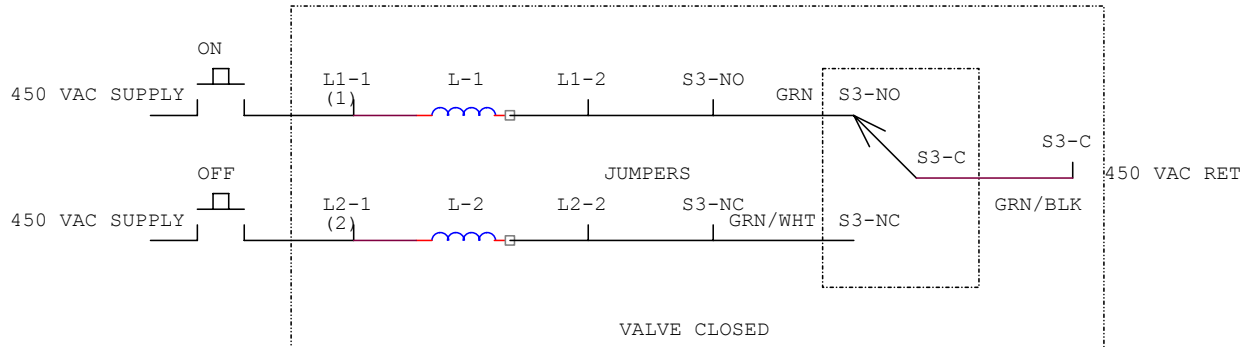


The three diagrams above show the electrical connections required for coil protection using switch 3 (green) with internal L1-2 and L2-2 wires relocated to the listed terminals.

FIGURE 3



**SOPV DIAGRAM WITH LETTERED TERMINAL BOARD INTERNAL WIRES MOVED TO S-3 FOR COIL PROTECTION**



The three diagrams above show the electrical connections required for coil protection using switch 3 (green) with internal L1-2 and L2-2 wires relocated to the listed terminals.

FIGURE 4

**SOPV DATA SHEET**

Note: Record data for each SOPV.

SOPV Location and Service	SOPV can receive mod (at least one switch available before mod) (Yes/No)	Operation SAT before mod (Yes/No)	Operation SAT after mod (Yes/No)	SW1 used for indication or other purposes (after mod) (Yes/No)	SW2 used for indication or other purposes (after mod) (Yes/No)	Remarks