FAULT FINDING GUIDE

● LIGHT ON ○ LIGHT OFF ✸ LIGHT FLASHING

Technical Assistance: nist@nistcontrol.com

MOTORSCOPE
THE RELIABLE ELECTRIC MOTOR GUARD

Technical Assistance: 074 587 2152/61

Red Yellow Green	Symptom or Reason	Remedy
○ ○ ○	• Motor does not start. • The *Motorscope* unit does not switch on. (no indication lights)	**On single phase units:** ☞ Measure the AC voltage between live and earth. This should be between 190 and 250 volts. ☞ Measure the AC voltage between neutral and earth. This must not be more than 5 volts. ☞ Disconnect the power and then measure the resistance of the primary winding of the transformer on the *Motorscope* unit. (±1.5kΩ) ☞ If the above steps does not reveal the source of the problem, try to switch the live and neutral wires. **On three phase units:** ☞ Measure the AC voltage between each one of the phases and earth. This should be ±220 volts. ☞ Disconnect the power and then measure the resistance of the primary winding of the transformer on the *Motorscope* unit. (±5kΩ) **On Panels:** ☞ Make sure that the on/off switch is working, by measuring its continuity.
● ✸ ✸	**Motor can not start error** (Motor wires swopped)	**On single phase units only:** ☞ See the *Motorscope* unit's installation instructions for the *Run, Start and Common wire definitions.*
● ● ○	**Phase sequence error** • Phase sequence incorrect • Phase failure	**On three phase units only:** ☞ Swop two incoming phase wires at the isolator.
✸ ✸ ○	**Voltage error** • The supply voltage differs more than 15% from the rated operating voltage.	**On single phase units:** ☞ Measure the AC voltage between live and earth. This should be between 190 and 250 volts. ⓘ To improve the voltage measurement of the *Motorscope* unit, the earth wire must be removed and the neutral and earth terminals of the *Motorscope* unit must be bridged. **On three phase units:** ☞ Measure the AC voltage between each one of the phases and earth. This should be ±220 volts. ⓘ If all of the phase measurements to earth is ±220 volts, the voltage measurement of the *Motorscope* unit can be improved by placing a bridge between the earth and COM terminals of the *Motorscope* unit. **NOTE:** ● When the supply voltage recovers and stays within the safe limits for 15 min, normal operation resumes.
○ ✸ ○	**Underload** (restart timer enabled) (***Default***)	☞ A run-dry condition has occurred and the *Motorscope* unit will **automatically** attempt to restart the motor after the underload timer has run out. The timer may be adjusted on the *Motorscope* unit.

FAULT FINDING GUIDE

● LIGHT ON ○ LIGHT OFF ✸ LIGHT FLASHING

Red	Yellow	Green	Symptom or Reason	Remedy
○	●	○	**Underload** (restart timer disabled) • Broken shaft or belt • Blocked pump inlet or outlet	☞ A run-dry condition has occurred and the *Motorscope* unit will only restart after a **manual** reset (by switching the power off and then on). The *Motorscope* unit can be restarted automatically if the underload restart timer is enabled. ☞ If the *Motorscope* unit continues to trip in an *Underload*, even when the bore-hole's water level is restored, the pump should be pulled out and inspected.
●	✸	○	**Over current** • The motor has drawn 40% more current than the calibrated	**On single phase units:** ☞ Verify that the correct size motor is fitted to the controller. There are different controllers for different motor sizes depending on the amount of current which is drawn under normal running conditions (as specified by the motor manufacturers). **On three phase units:** ☞ Verify that the resistance over the external current transformer is correct (refer to the ***External C.T. Resistor***
●	○	○	**Overload** (The phase angle is too small) • Jammed pump • Damaged motor bearing • A wire to the motor is loose • A wire to the motor is broken • A starter contact is burned	☞ The phase angle may be viewed with the *Optimizer* . A phase angle lower than 27 degrees indicates an overloading motor, or a low voltage at the motor. Verify the current, if that is correct then verify the wire diameters. Refer to the ***Cable Diameter Tables*** on the last page of this guide. ☞ Measure the current in each one of the wires going to the motor, while the pump is running. If any one of the currents exceeds the motor's rated current, it is usually an indication of ☞ Verify that all the wires to and from the contactor are securely fastened. ☞ Disconnect the motor's wires from the contactor. Number them 1, 2 and 3. Measure the resistance between 1 and 2, 2 and 3, 1 and 3. If any of these measurements exceeded 300Ω, one of the cables is broken or most probably has a dry- ☞ Disconnect the power cables from the starter contactor. Push the contactor in and measure the continuity from L1 to T1, L2 to T2 and L3 to T3. If any of these measurements are open-circuit, it is an indication that the contact is burned.
●	○	✸	**Overload Restart Delay** (Any one of the above reasons for an overload.)	☞ Wait for the overload delay timer to run out. The *Motorscope* will automatically attempt to restart the motor after 30 min. However, if three consecutive overload errors occurred, it will not attempt to restart the motor again and an overload error will be indicated.
○	○	✸	**Auxiliary trip** • The state of a peripheral device (e.g. float switch, pressure switch, etc.) connected on the AUX port of the controller changed (from open-circuit to closed-circuit or vice-versa) and thus caused a trip.	☞ Verify that the peripheral device is active. If so, the *Motorscope* unit is functioning correctly. The *Motorscope* unit should automatically restart the motor once the peripheral device returns to its previous state. If the trip occurred during the wrong state of the peripheral device, the *Optimizer* may be used to alter the passive state of the peripheral device from "normally closed" to "normally open" or vice-versa. ☞ Verify that the wires at the AUX and COM connections are securely fastened. ⓘ The functionality of the auxiliary input may be tested by placing a bridge between the AUX and COM terminals of the *Motorscope* unit.

FAULT FINDING GUIDE

● LIGHT ON ○ LIGHT OFF ✸ LIGHT FLASHING

Red	Yellow	Green	Symptom or Reason	Remedy
○	✸	✸	**Motor restart delay** • According to the motor manufacturers, a certain period of time has to pass between two motor starts to prevent the motor from over-heating.	☞ Wait for the T_{Temp} timer to run out. The default time is determined by the following formula: T_{Temp} = (CT ratio) x 2 minutes. The T_{temp} timer may be changed with the *Optimizer.* The T_{Temp} timer may also be disabled, but in doing so you will forfeit all rights on warranty claims, as the motor could then be used outside of its safe operating conditions.
○	○	●	**No Current** • No current is measured. • The current transformer is connected in the wrong phase	☞ Verify that the wires from the *Motorscope* unit to the motor are properly connected. ☞ Verify that the contactor pulls in. If the contactor does not pull in, verify that two different phases are connected over the coil of the contactor. **On three phase units with an external current transformer (C.T.):** ☞ Ensure that L3 runs through the current transformer.

USEFUL TABLES

EXTERNAL C.T. RESISTOR TABLE

Current Range:	1 - 12 Amp	8 - 24 Amp	20 - 48 Amp	40 - 96 Amp	70 - 192 Amp
Resistor Value:	32 Ohm	16 Ohm	8 Ohm	4 Ohm	2 Ohm
CT Ratio:	1	2	4	8	16

CT RESISTOR TABLE

Current Range	Resistor Value	CT Ratio
1 - 12 Amp	= 32 Ohm	= 1
8 - 24 Amp	= 16 Ohm	= 2
20 - 48 Amp	= 8 Ohm	= 4
40 - 96 Amp	= 4 Ohm	= 8
70 - 192 Amp	= 2 Ohm	= 16

Cable Selection 400V 50Hz

3 Wires 3 Phase 400V

Motor Ratings		Metric Cable Size, Square Millimeter. Maximum length in meter										
Volts	KW	1,5	2,5	4	6	10	16	25	35	50	70	95
400V	0,37	810	1350	2160	3240	5500	8530	-	-	-	-	-
400V	0.55	550	920	1480	2230	3780	5860	8890	-	-	-	-
400V	0,75	410	680	1090	1640	2780	4330	6570	9010	-	-	-
400V	1,1	300	500	810	1210	2060	3200	4850	6640	9220	-	-
400V	1,5	220	370	590	880	1500	2340	3560	4890	6830	9230	-
400V	2,2	150	250	400	600	1030	1600	2440	3350	4680	6340	7990
400V	3	110	190	310	460	790	1230	1880	2590	3630	4930	6230
400V	3,7	90	150	240	370	630	980	1490	2050	2870	3900	4920
400V	4	80	140	230	340	590	920	1390	1910	2670	3600	4520
400V	5,5	-	110	170	260	440	690	1060	1450	2030	2750	3460
400V	7,5	-	80	130	200	340	530	810	1110	1560	2120	2680
400V	11	-	-	90	130	230	360	550	750	1060	1440	1820
400V	15	-	-	-	100	170	270	410	570	800	1080	1370
400V	18,5	-	-	-	80	140	210	330	450	630	860	1090
400V	22	-	-	-	-	120	180	280	380	540	740	930
400V	30	-	-	-	-	-	130	210	280	400	540	680
400V	37	-	-	-	-	-	-	170	230	320	440	550
400V	45	-	-	-	-	-	-	-	180	270	360	460

Maximum submersible copper cable lengths in meters from **Power Source to the Motor**.

This table is intended as a guide only.

Final values must be confirmed with the cable manufacturer.

All lead out cables must be submerged.

Information was obtained from ***Franklin Electric*** spreadsheet.

Cable Selection 230V 50Hz

Single-Phase Motor Maximum Length Copper Cable

Motor Ratings		Metric Cable Size, Square Millimeter									
Volts	KW	2,5	4	6	10	16	25	35	50	70	96
230V	0,25	280	450	670	1130	1750	2640	3590	4940	6560	8110
230V	0,37	200	320	480	810	1260	1900	2590	3580	4770	5920
230V	0,56	130	220	320	550	850	1290	1760	2430	3230	4000
230V	0,75	100	170	250	430	670	1010	1380	1910	2550	3160
230V	1,1	70	120	180	300	470	710	980	1360	1850	2320
230V	1,5	60	90	130	230	360	550	760	1060	1440	1820
230V	2,2	-	60	90	150	230	350	490	680	920	1160

Maximum submersible copper cable lengths in meters from **Power Source to the Motor**.

Cables for submersible motors must be suitable for submerged operation and of adequate size.

Final values must be confirmed with the cable manufacturer.

Information was obtained from ***Franklin Electric*** spreadsheet.

ⓘ THE CABLE DIAMETER TABLES ARE ONLY GUIDELINES