Installation & Operation Manual

Nederman

Stationary Filters

Bag Filter Dust Collector

S-SERIES ELECTRICAL

Installation, Wiring, and Troubleshooting

WARNING End-user is responsible for following NEC Codes and Guidelines

Original Installation and Service Manual

Rev.1 10/23

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Section 1.0 – Preface

Nederman S-Filters utilize high-efficiency induction motors that have a high startup current, known as "Inrush Current", that lasts for a brief period, usually less-than 10 seconds. When the motor first starts, it will experience up to 8x the FLA of the motor current. This will decrease rapidly until the motor reaches steady state. If the motor is not turning over or drive shaft not rotating, please see Section 4.0 Troubleshooting.

There are specific NEC electrical codes and standards outlined within this manual that need to be employed when making the electrical connections.

WARNING All work must be completed by certified industrial electrican.

WARNING Failure to follow guidelines could result in fire, damage to equipment and injury to personnel.

WARNING End user is responsible to follow NFPA 70 to all local, state and federal codes and guidelines.

WARNING Failure to adhere to the procedures outlined in this document VOIDS Nederman's product warranty.

WARNING Twist on connectors (wire nuts) are prohibited by NEC and void warranty.

NFPA 79-2007 Clause 13.5.9.2 Electrical Connections

NEC 70HB-2014 695.6 Power Wiring.

Section 2.0 – Circuit Sizing

Refer to Table 1 and 2 (*1 and 3-Phase S-Filter Motor Circuit Sizing Tables*) to appropriately size the branch circuit conductors and circuit breaker size. The data in these tables is based on the 2020 NEC and is to be used as *recommendations only* and <u>final discretion is the responsibility of the licensed electrician, local codes, regulations, and the AHJ.</u>

Due to the inrush current, the fusing/breaker must be sized larger to protect the wiring in the event of a short-circuit. The motor-overload, not the breaker, provides the motor protection and should be set as close to the FLA (Full-Load Amperage) of the motor as possible to maximize motor protection.

The minimum conductor size listed in the table is calculated based on 75 °C (167 °F) wire. If using a different type of wire or the dust collector is located a significant distance from the main panel, the wire size must be adjusted accordingly.

Note: AWG #12 is the minimum acceptable wire size

TABLE 1 - 1 Phase S-Filter Motor Circuit Sizing Table[8]

Service Factor 1.0		Motor FLA[1]		Conductor Size[2,7]		Inverse Time Breaker Size[3]		Time Delay Fuse[4]		Non-Time Delay Fuse[5]		O/L Setting[6]	
S-500	208 V	22.8	A	8	AWG	80	A	60	A	100	A	26	A
	230 V	20.2	A	8	AWG	70	A	50	A	90	A	23	A
S-750	208 V	35	A	6	AWG	110	A	80	A	150	A	40	A
	230 V	30	A	8	AWG	100	A	70	A	125	A	35	A

Section 2.0 – Circuit Sizing

TABLE 2 - 3-Phase S-Filter Circuit Sizing Table[8]

Service Factor 1.25		Motor FLA[1]		Conductor Size[2,7]		Inverse Time Breaker Size[3]		Dual Element / Time Delay Fuse[4]		Non-Time Delay Fuse[5]		O/L Setting[6]	
S-500	208V	13.2	A	10	AWG	45	A	30	A	50	A	17	A
	230V	12.4	A	12	AWG	40	A	30	A	50	A	16	A
	460V	6.18	A	12	AWG	20	A	15	A	25	A	8	A
	575V	4.94	A	12	AWG	20	A	15	A	20	A	6	A
S-750	208V	19.2	A	10	AWG	70	A	45	A	80	A	24	A
	230V	17.7	A	10	AWG	60	A	40	A	70	A	22	A
	460V	8.6	A	12	AWG	30	A	20	A	35	A	11	A
	575V	7.08	A	12	AWG	25	A	20	A	30	A	9	A
S-1000	208V	26.3	A	8	AWG	80	A	60	A	100	A	33	A
	230V	23.9	A	8	AWG	70	A	50	A	90	A	30	A
	460V	12	A	12	AWG	35	A	25	A	45	A	15	A
	575V	9.55	A	12	AWG	30	A	20	A	30	A	12	A

1 Motor nameplate full-load amps (Used for setting O/L, overload, only).

2 Minimum size based on 75 °C (167 °F) insulation and copper wire, such as RHW, THHW, THW, THWN, XHHW, XHWN, USE, ZW. Verify with table 310.16. Conductor size may need to be increased based on wire type used.

3 Branch circuit protection to be sized at 250% of motor FLC for Inverse Time circuit breaker based on tables 430.52, 430.248, and 430.250. Based on 2020 NEC 70 Article 430 and best-practice.

4 Branch circuit protection to be sized at 175% motor FLC for Dual Element/Time-Delay Fuse based on tables 430.52, 430.248, and 430.250. Based on 2020 NEC 70 Article 430 and best-practice.

5 Branch circuit protection to be sized at 300% motor FLC for Non-time Delay Fuse (Class CC fuses) on tables 430.52, 430.248, and 430.250. Based on 2020 NEC 70 Article 430 and best-practice.

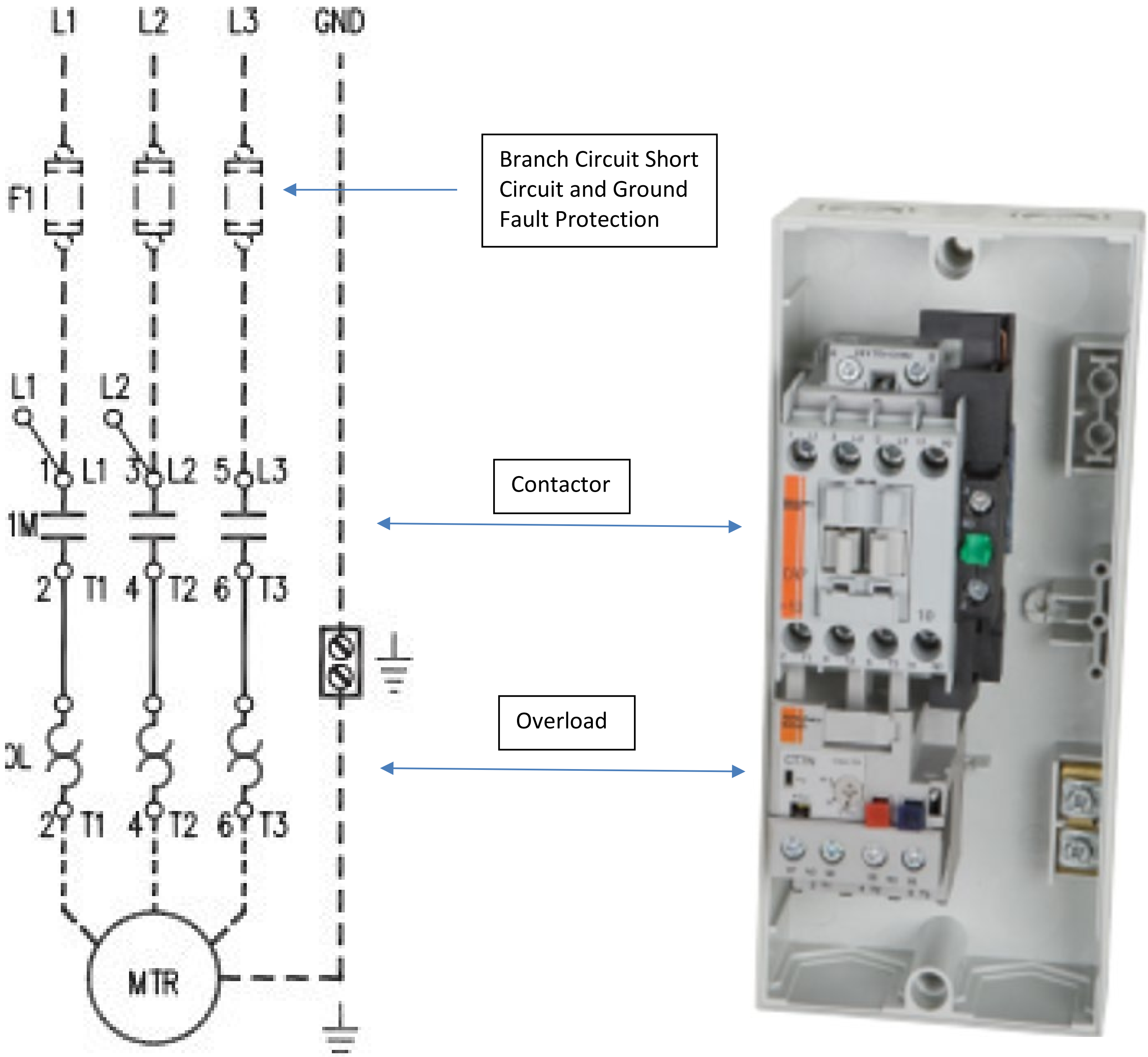
6 Recommended O/L (overload) setting on Nederman Push Button Starters based on motor nameplate FLA multiplied by the service factor.

7 Wire-nuts or soldering are ***NOT*** acceptable means to connect motor leads per NFPA 79, 13.5.9. Use appropriate components to make motor connections such as split bolts, crimp-connections and eye-bolts.

8 It is the end-user's responsibility to follow State and Local Codes. Chart is provided as a helpful resource only and the use of a qualified and licensed industrial electrician is required for proper installation.

Section 2.0 – Circuit Sizing

Product Owner/End-user shall provide branch circuit protection. Refer to the Motor Circuit Sizing Tables on previous pages for max breaker and fuse sizes.



Section 3.0 – Motor Connections

It is important to incorporate the correct junction box motor connections.

Under no circumstances shall wire-nuts/marrettes be used to make motor connections! (*see Figure 1*)

Per NFPA 79, 13.5.9, wire-nuts and soldering motor leads are unacceptable connection methods for motors as they greatly increase the risk of fire and hazards to machinery and personnel.

- **The use of wire-nuts on Nederman motors VOIDS THE WARRANTY!**

WARNING

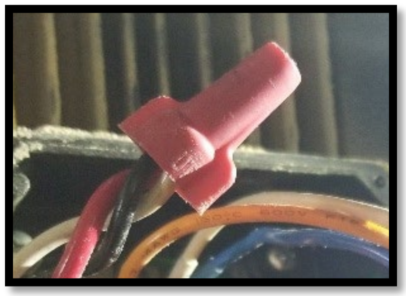


Figure 1 – Unacceptable Connector

Acceptable alternatives include the use of Split-Bolts, Crimp-Connectors, Eye-Bolts with Screws, or other approved motor connection terminals. (*See Figure 2)*

Figure 2 - Acceptable Connectors Split Bolt Insulated Multitap Crimp

<u>Product Owner/End User:</u>

1) Must ensure that you are using dust-tight connections on the motor junction box. The cord-grip used should tightly secure the flexible conduit or cord being used. The motor junction box cover should be secured to the motor so that no dust or water can enter the junction box.
2) Must refer to the wiring diagram for correct motor voltage configuration.
   This diagram is located on the cover of the junction box.
3) Must use appropriate connection components (Ex: split bolts, eye-bolts crimps)
4) Is responsible for following all local, state and federal codes and regulations.

User can use the free access to the standard by going to www.nfpa.org/79

Section 3.0 – Motor Connections

Motor manufacturer recommendations:

Motor Lead Termination for Flying Leads without Terminal Block Low Voltage Motors (1Kv and less)

1) Properly size crimp style terminals
2) Ensure all strands of wire are inserted into the lug
3) Use appropriate sized crimping device for the lug and crimp the lug onto the wire
4) Connect the lugs using properly sized bolts, washers on both sides and locking washers.

   (Do not drill out ring terminals and do not use Loc-Tite)
5) Tape the connection using 2 layers of cambric tape with adhesive side up.
6) Tape the cambric layer with 130 C rubber tape with 4 half lapped layers stretched to 1/3 of the original width.
7) Tape final layer with 33 Plus electrical tape. 2 Half lapped layers extended 2 tape widths beyond the rubber tape. Pull with tension to compress the runner tape.
8) Ensure no wire is exposed on any of the leads

⚠ **WARNING** Twist on connectors (wire nuts) are prohibited by NEC and void warranty.

NFPA 79-2007 Clause 13.5.9.2 Electrical Connections

NEC 70HB-2014 695.6 Power Wiring.

⚠ **WARNING** All work must be completed by certified industrial electrican.

⚠ **WARNING** Failure to follow guidelines could result in fire, damage to equipment and injury to personnel.

⚠ **WARNING** End user is responsible to follow NFPA 70 to all local, state and federal codes and guidelines.

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Section 4.0 – Troubleshooting

1) Are wire-nuts used in the motor junction box?
Remove and dispose of the wire-nut as they (and soldered connections) are prohibited for motor connections per NFPA 79, 13.5.9.2. Crimp connections, lugs & split-bolts, Polaris connectors, or some other acceptable connection method must be used.

2) Motor starts but will not turn over/spin?
Set the O/L (overload) adjustment dial as close to the O/L Setting in the Motor Circuit Sizing Tables for the respective series of filter and voltage. Move trip class up incrementally until O/L does not trip on start. This is different than the overload adjustment. (These are 10, 20, and 30)

3) Is the circuit breaker or fuse sized according to the 1/3-Phase Motor Circuit Sizing Table?
Ensure the circuit protection is sized appropriately per section 2.0 for the filter model.

4) Are the supply conductors the correct size according to the 1/3-Phase Motor Circuit Sizing Table?
Please confirm correct sizing. If the length between the starter and the motor exceeds 150-feet, consider upsizing the conductors 1 size to account for voltage drop in the conductors. Consult your Licensed Electrician about the voltage drop.

5) Is the contactor not moving, "chattering" or making an odd sound?
Verify the contactor voltage (look on top of the contactor for the A1 & A2 connection block).
The voltage label will be 200-240 V (for 208, 230, & 240 V) or 440-480 V (for 460 V and 480 V)

6) Does the motor spin freely by hand?
If not, the motor is defective. Contact a Nederman representative to order a replacement.

7) Is ductwork connected?
Ensure that all ductwork is connected to the fan. If not, block the fan intake by 1/2. It is important to introduce static resistance to the airflow. Otherwise, the motor will over-amp & potentially fault.

Note: Continue to the next page if none of these options correct the problem.

Section 4.0 – Troubleshooting

Please follow these steps to verify motor condition. If it is a brand new motor, please contact Nederman.

1) Separate the individual motor leads and check the resistance if each winding with an ohmmeter. A standard multi-meter is limited in checking issues with motors, but can still provide some valuable information.

2) For the 9-wire motors, note the resistance values below:
   a. T1 to T4 =
   b. T2 to T5 =
   c. T3 to T6 =
   d. T7 to T8 =
   e. T8 to T9 =
   f. T7 to T9 =

3) Next, check each value to ground, or the chassis.
   a. T1 to GND =
   b. T2 to GND =
   c. T3 to GND =
   d. T4 to GND =
   e. T5 to GND =
   f. T6 to GND =
   g. T7 to GND =
   h. T8 to GND =
   i. T9 to GND =

4) While the motor is disconnected and the circuit breaker turned off, measure the resistance of the supply leads to ground to ensure there is not a direct short from one of the supply leads.
   a. L1 to GND =
   b. L2 to GND =
   c. L3 to GND =

5) If you have access to a MEGGER, perform an Insulation test from each lead to ground (motor frame):
   a. T1 to GND =
   b. T2 to GND =
   c. T3 to GND =
   d. T4 to GND =
   e. T5 to GND =
   f. T6 to GND =
   g. T7 to GND =
   h. T8 to GND =
   i. T9 to GND =

6) Reconnect leads, following the proper wiring pattern shown on the motor wiring label. Before proceeding, remove any wire-nuts from the motor. Wire nuts & soldered connections are prohibited for motor connections per NFPA 79, 13.5.9.2. Use crimp connections, lugs & split-bolts, Polaris connectors, or some other acceptable connection method

7) Start the dust collector and measure the running current after the motor reaches full-speed.
   a. L1 Amps =
   b. L2 Amps =
   c. L3 Amps =

Section 5.0 – Inrush

When an AC induction motor starts, the supply voltage creates a magnetic field in the stator that induces a magnetic field in the rotor. The interaction of these two magnetic fields produces torque turning the motor. The creation of the magnetic field causes an induced voltage that opposes the supply voltage known as "back EMF" that also limits the amount of current in the motor.

The amount of "back EMF" produced is directly proportional to the speed of the motor so at startup, when the motor speed is near zero, there is very little "back EMF" and high "inrush" current is allowed to flow. The highest level of inrush current occurs during the first half-cycle of motor operation and can be more than 10 times the motor's FLA (full-load amperage). As the motor turns, the current decreases to the level of the motor's locked rotor current, which is often six to eight times the motor's normal operating current. As the motor speed and "back EMF" increases, the current further decreases, until normal operating speed and current are reached.

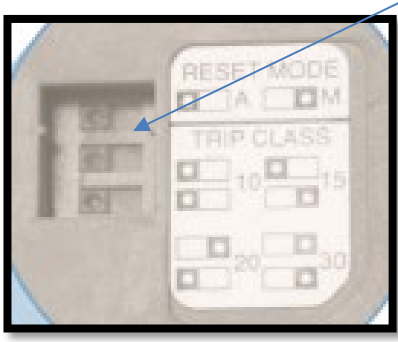
High inrush current can:

- Cause nuisance tripping of protective devices or motor damage.
- Cause voltage dips in the supply line (which can affect other equipment).
- Prevent the motor from properly starting.
- Cause high torque production, exceeding motor ratings, causing sudden and severe acceleration damaging mechanical loads.

Tip for Inrush:

Use the overload adjustable trip class function that increases the time that the overload experiences the locked rotor current and motor reaches steady state. This will be evident as the motor will try to start and trip the overload. Below is an example of an adjustable trip class. Below you will see two different locations for the trip class settings.

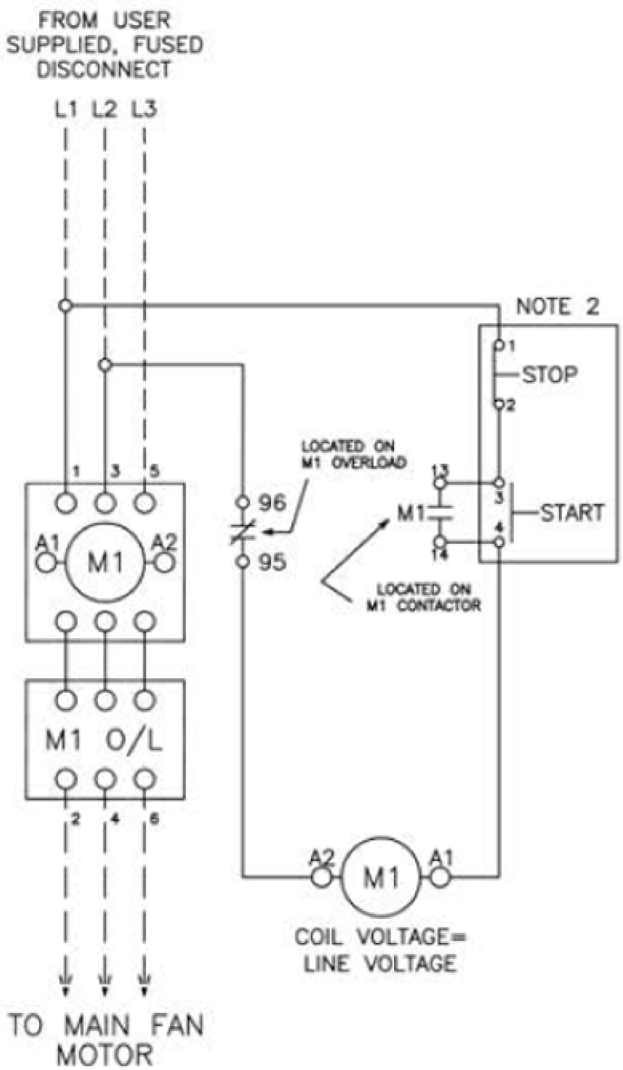
Dip Switch on side (Option)



Trip Class	
10	$2 < Ti \geq 10$
15	$4 < Ti \geq 10$
20	$6 < Ti \geq 20$
30	$0.5 < Ti \geq 30$

Dial on Front (Option)

Section 6.0 Wiring Diagrams



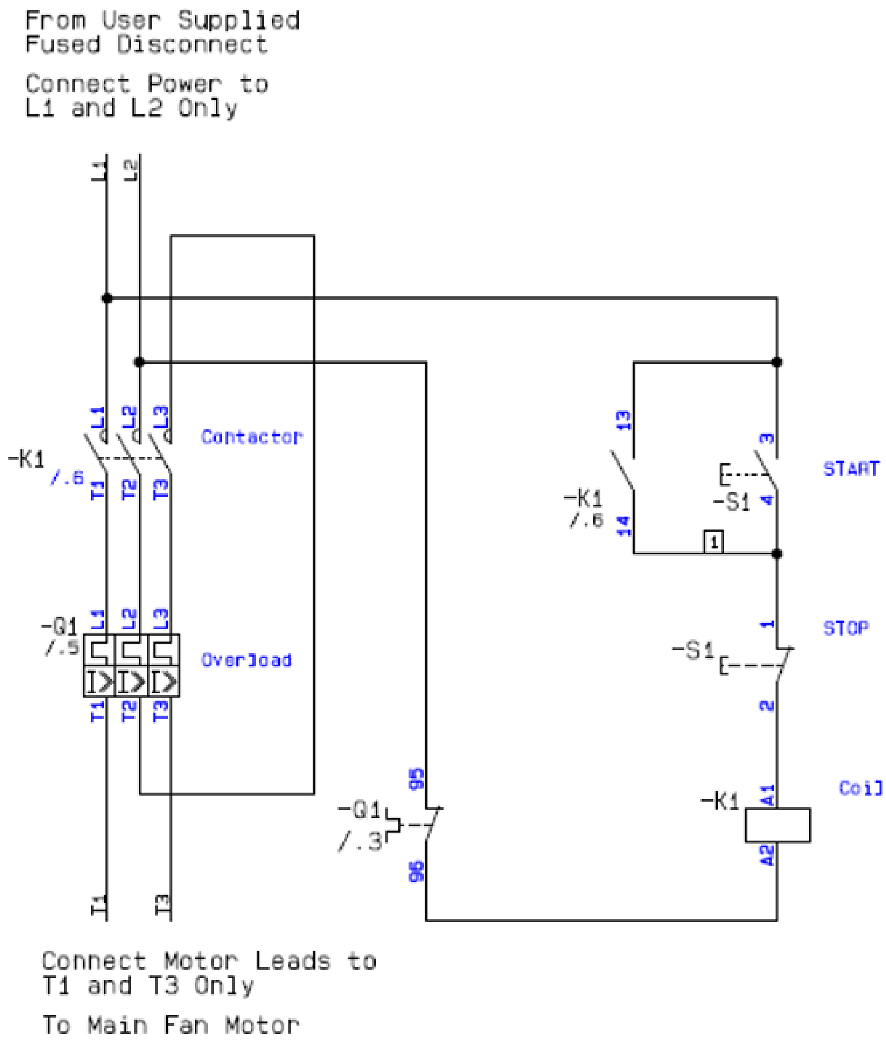
NOTE:
1. DASHED LINES ARE CUSTOMER SUPPLIED WIRING.

2. START/STOP CONTROLS MAY BE DUAL STYLE OR INDIVIDUAL PUSHBUTTONS.

3 Phase Wiring Diagram

208/230/460/575VAC

Section 6.0 Wiring Diagrams



1 Phase Wiring Diagram

208/230VAC

Section 7.0 Definitions

AWG	**American Wire Gauge** - Standard way to denote wire size. *(The larger the number the smaller the diameter the wire and vice versa.)*
Back EMF	**Back Electromotive Force** – Electromotive force that occurs as brushless motor turns. Acts as a generator creating electromotive resistance within the motor. It is proportional to the motor speed which enables the determination of motor speed.
Dual Element or Time Delay Fuse	Allows a surge in electricity during a short time before overloading or shorting out. Protects equipment from overload and allows for greater starting amperage.
FLA	**Full Load Amperage** – A motor's "rated current" at rated load and voltage. It is the amount of current (amps) the motor will draw when producing its rated output horsepower and is found on nameplate Also referred to as running amps and rated amps.
FLC	**Full Load Current** – Theoretical current (amps) drawn by a motor while operating at full load and rated voltage. Can be found in NEC and is Used to size conductors, branch circuit short circuit and ground fault protection.
GND	**Ground** – A backup pathway that provides an alternating route for the current to flow back to the ground if there is a fault in the wiring system.
Inrush Current	The instantaneous high input current drawn by electrical motor at "turn-on". Arises from the initial currents (amps) required to charge the capacitors and or inductors. Also known as switch-on surge and input surge current.

Inverse Time Breaker also known as thermal-magnetic circuit breakers.

The time to trip is inverse to the rate of rise in current. As current increases, trip time decreases and vice versa.

Megger	Instrument used to measure electrical resistance to current flow.
MTR	Motor
NEC Code	The National Electrical Code, or NFPA 70, is a regionally adoptable standard for the safe installation of electrical wiring and equipment in the USA. [National Electrical Code - Wikipedia]
Overload (O/L)	Too much current passes through electrical wires or equipment. Motor overload occurs when the motor is under excessive load which includes excessive current draw, insufficient torque and overheating.

Section 7.0 Definitions

Non Time Delay Fuse	Protects equipment from overload. Does not allow short surges at start up.
Single Phase	The flow of electricity is through a single conductor. Motor contains 2 wires, hot (phase) and neutral. Used for smaller loads and equipment. Voltage varies and constant power isn't delivered. Also known as "residential voltage".
(Three) 3 Phase	The flow of electricity is through 3 separate conductors. Motor contains three-conductor wires and a neutral wire. Voltage is constant and used to accommodate higher loads.
Trip Class	Specifies the length of time for the relay to open in an overload condition. - A trip class of 10 will trip in 10 seconds or less and 20 in 20 seconds or less, etc.
NEC	National Electrical Code www.nfpa.org/79
NFPA	National Fire Protection Association www.nfpa.org

Section 8.0 FAQs

Q1: "Why does the overload keep tripping when trying to start the motor".

A: Make sure that the overload is set to the "O/L Setting" in Table 1 and 2 from the "S-Series Electrical IOM – 09-19-2022".

A: Verify adjustable trip class is set to 20 and try starting the motor again. If motor fails again, set adjustable trip class to 30 and try again. Location to find adjustable trip class: usually on right or left side of the overload.

A: Customer has received the wrong contactor and the appropriate "O/L Setting" in Table 1 and 2 from the "S-Series Electrical IOM – 09-19-2022", is not selectable. Another starter with the correct overload must be sent.

A: Customer has received a starter without an adjustable trip class and a different starter must be sent.

Q2: "Why does the Main Breaker trip when trying to start the motor"

A: Make sure that the wiring is correct, check the "S-series Electrical IOM-09-19-2022" manual for 3PH or 1PH wiring. Remove and dispose of the wire-nut as they (and soldered connections) are prohibited for motor connections per NFPA 79, 13.5.9.2. Crimp connections, lugs & split-bolts, Polaris connectors, or some other acceptable connection method must be used.

A: Motor Branch Short Circuit and Ground Fault protection (Inverse Time Breaker, Time delay fuse or Non time delayed fuse) are sized to Table 1 and 2 from the "S-Series Electrical IOM - 09-19-2022".

Q3: "My motor is pulling really high Amperage when turned on. Is this Normal?"

A: Yes, this is normal. You should see approximately 8 x FLA initially at startup and see the amperage drop drastically as the motor makes it past locked rotor to steady state.

Q4: "Why is the breaker sized so high for the Motor?"

A: This is sized in accordance with NFPA 70, Table 430.52 (Rating or Setting for Individual Motor Circuit). This is merely a recommendation and is the maximum rating or setting of Motor Branch Short Circuit and Ground Fault protection devices. Must be sized to not trip under locked rotor current. See Section 2 Circuit Sizing

Q5: "Why is the wire sized low for the Short Circuit and Ground Fault Protection?"

A: This is merely a cost saving recommendation and wire size is calculated using the FLC charts and ampacities in accordance with NFPA 70. See section 2 Circuit Sizing

Nederman

The Nederman Group is one of the World's leading suppliers of products and solutions within the environmental technology sector focusing on industrial air filtration and recycling. These products and solutions reduce the environmental impact of industrial production and create safe and clean working environments while boosting production efficiency.

The group's offering covers the design stage through installation, commissioning and servicing with subsidiaries in 29 countries and agents and distributors in over 30 countries.

Nederman is ISO 9001 and 14001 certified and develops and produces in its own manufacturing and assembly facilities in Europe, North America and Asia.

Nederman Service Capabilities

Nederman has certified service partners trained extensively in servicing our machinery. Make sure to choose a certified technician to service your Nederman equipment as they have the correct tools and knowledge to solve any machinery issues and improve its performance. Be sure to ask if your technician is certified by Nederman.

Our services for dust collection systems are customized to your particular needs. We work with you to understand your needs, then develop a program to meet your specific needs. Our services include: (*not all services available in all locations*)

- Bag Change-outs
- Bag Selection Recommendations
- Collector Re-builds
- Dye Testing for Leakage
- Electrical Tests - Current, Voltage
- Emergency Call-outs
- Filter Media Analysis
- Mechanical Survey and Repair
- Multi-year Contracts
- New Collector Start-up Service
- On-going Technical Support
- Preventative Maintenance
- Repair and Replace Gauges/Times/Valves
- Stack Emissions Testing
- Training Programs
- Troubleshooting / Auditing
- Velocity, Pressure and Temperature Tests
- Written Service Reports

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