Remy HVH250 Application Manual

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1. INTRODUCTION

This document provides an overview and instructions for installation of HVH250 motors.

2. SYSTEM OVERVIEW

Remy HVH250 machines are high performance electric motor/generator units designed for a wide variety of applications including vehicle traction motors, parallel hybrid generators, boost motors for IC (Internal Combustion) engines, starting motors for IC engines, industrial motors/generators where high performance, high power density, and excellent reliability and durability are required.

2.1 Installation Overview

Typical installations require:

- A power source – normally from line power, batteries, or generated power from another source.
- Inverter to convert power from the source to 3-phase controlled output at appropriate voltage and current levels to power the HVH250. If generating capability is required, the inverter should be capable of returning electrical power from the HVH250 to the power source.
- Controls system – capable of commanding the inverter modes of operation based on operator input or system requirements.
- HVH250 motor – specified to match the system parameters for:
    - Mechanical power, torque output, and duty cycle
    - Electrical current and voltage input
    - Operating speed range
    - Coolant capability
    - Mechanical interface and packaging, shaft design, and mounting
    - Electrical interface
- Mechanical output interface – ranging from vehicle transmissions, pumps, drive shafts or other mechanical devices receiving or transmitting power to/ from the HVH250 motor.

2.2 Motor Overview

Remy HVH250 motors consist of a variety of components that make up a complete motor.

- Stator
- Rotor
- Resolver
- High Voltage Connections
- Low Voltage Connections
- Cooling
- Temperature Sensing
- Rotor Support / Bearings
- Cartridge
- Housing

3. HVH MOTOR TYPICAL APPLICATIONS

The HVH250 motors provide a design flexibility to cover a wide range of performance requirements. The selection of a motor to match a specific application requires a study of the performance expectations, application details, duty cycle, voltage and current available, inverter selection, gearing, durability expectations, cooling capability and a wide variety of other parameters.

Typical applications for the HVH250 motors:

- Light automotive traction motor / generators
- Medium and heavy duty automotive traction, power assist, and power generation
- On-vehicle power generation and IC engine-off power for accessories
- Commercial drives and generators
- Industrial drives
- Wind and hydro-electric power generation

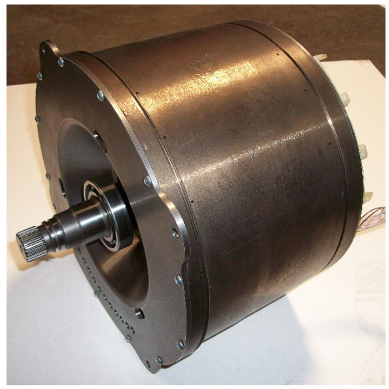
4. MOTOR DESIGN PHYSICAL CONTENT

The HVH250 motors include a variety of custom engineered components to provide a high performing motor in the most compact packaging for the best cost. Components that make up an HVH250 motor are:

- Cartridge
- Stator
  - High Voltage Hairpins (HVHs)
  - Lamination Stack
  - 3-phase connections
  - Temperature sensors
- Rotor
  - Lamination Stack
  - Permanent Magnets
  - Rotor Hub
- Resolver
- Housing
  - Low Voltage Connector
  - High Voltage Connector
- Mounting Plate
- Output Shaft

4.1 Cartridge

Motor components are contained in a cartridge that maintains alignment of the bearings, rotor, stator, and resolver for mounting inside an exterior housing. The cartridge is a close-tolerance part that ensures magnetic air gap – a critical design parameter – is maintained within tolerances under all operating conditions. It does not provide any sealing, electrical protection or other features provided by the exterior housing.



4.2 Stator

Remy HVH250 stator "High Voltage Hairpin" (HVH) design provides a copper fill advantage over round wire configurations to reduce magnetic flux losses and maximize thermal transfer to the lamination stack.

HVH250 stator design advantages:

- Allows high current within windings while operating at voltages provided by modern inverter systems
- Robust and lightweight for excellent power density and thermal performance
- 10-pole with either series or parallel windings to optimize performance for specific applications
- Contains temperature sensors to signal inverter control system to limit power and prevent excessive temperatures.

4.3 Rotor

The HVH250 rotors provide maximized magnetic performance derived from extensive computer modeling of the magnetic flux to optimize magnet positioning, motor/generator power density, and minimize weight and rotational inertia. The rotor has also been finite-element analyzed and tested for structural integrity at over-speed well above the maximum operating speed of the motor. The rotor is mounted in ball bearings capable of supporting the rotor mass and gyroscopic forces applied to the rotor at speeds well in excess of the maximum rated speeds.

4.4 Resolver

The resolver provides extremely accurate position information to the inverter via the low voltage connection. The resolver receives field coil excitation from, and returns sensor coil signals to the inverter to provide precision rotor position information for accurate synchronization of the signals supplied by the inverter.

4.5 Housing

The external HVH250 housing provides necessary features for mechanical integration in a wide variety of applications. In addition, the housing provides high and low voltage connections, lubrication, and integrated cooling loop through and around the motor, and sufficient protection for most installations. Internal forced and splash cooling maintains stator temperatures within class H insulation limits and prevents demagnetization.

The included wiring compartment contains high voltage (HV) and low voltage (LV) connections. Three HV leads, one for each phase, and a LV cable for resolver and temperature signals are required between the motor and resolver. HV connections are typically 2, 1 or 1/0 awg copper wiring suitable for the expected system voltage and current levels.

4.6 Mounting Plate

The mounting plate provides a 24-hole VS215 mounting circle for 15-degree clocking.

4.7 Output Shaft

The 24-tooth external spline shaft provides connection to standard interfaces such as the Borg Warner 31-03 transmission. The shaft load is supported by ball-bearings mounted in the HVH250 Housing and Mounting Plate.

5. HVH250 MOTOR SPECIFICATIONS

5.1 Motor Ratings

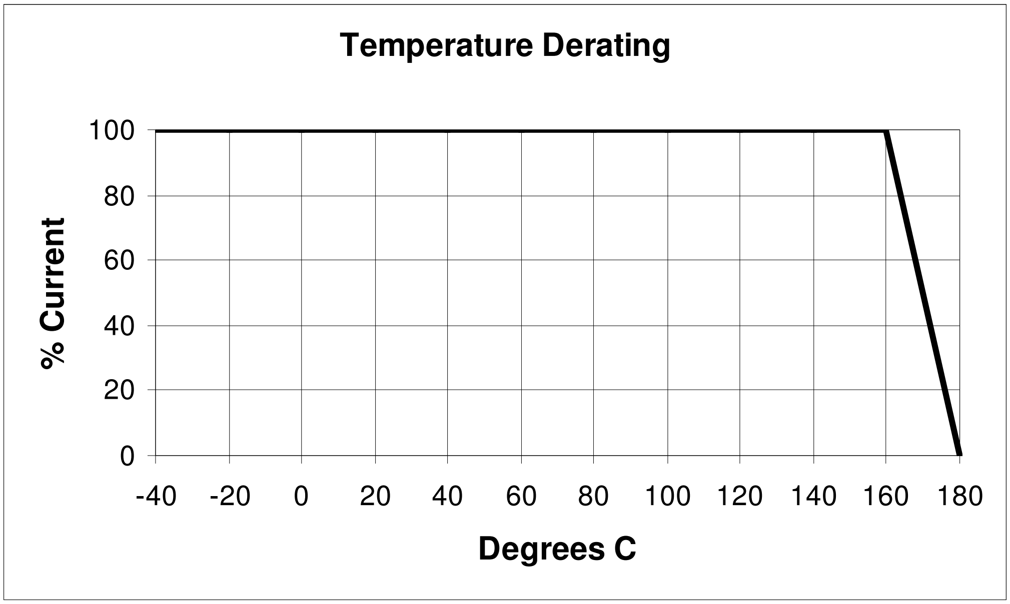
TABLE 1. TYPICAL RATINGS

Characteristic		**060S**	**060D**	**090S**	**090D**	**115S**	**115D**
Total weight	**(kg)**	37	37	50	50	57	57
Cartridge weight	**(kg)**	28	28	35	35	42	42
Rotating mass	**(kg-m^2)**	0.048	0.048	0.054	0.054	0.069	0.069
Center of Gravity /1	**x,y,z (mm)**	TBD		-128.8, 5.9, 3.2		TBD	
Cooling media	**(ATF)**	Dexron VI, 5-15 l/m, op level $\geq$ 100 mm below shaft center					
Cooling media filter	**microns**	60 maximum					
Max bus voltage	**(Vdc)**	700	700	700	700	700	700
Max current	**(Arms)**	300	600	300	600	300	600
Peak output (320Vdc, 100C Inlet Oil, 10 l/m, 30 seconds minimum							
Speed	**(rpm)**	3000	6200	2400	4100	1800	3500
Torque	**(N-m)**	210	210	310	320	400	400
Power	**(kW)**	70	140	80	140	80	150
Continuous output (320Vdc, 100C Inlet Oil, 10 l/m							
Speed	**(rpm)**	4000	8400	2600	5700	2000	4400
Torque	**(N-m)**	110	110	210	160	270	210
Power	**(kW)**	45	90	60	100	60	100

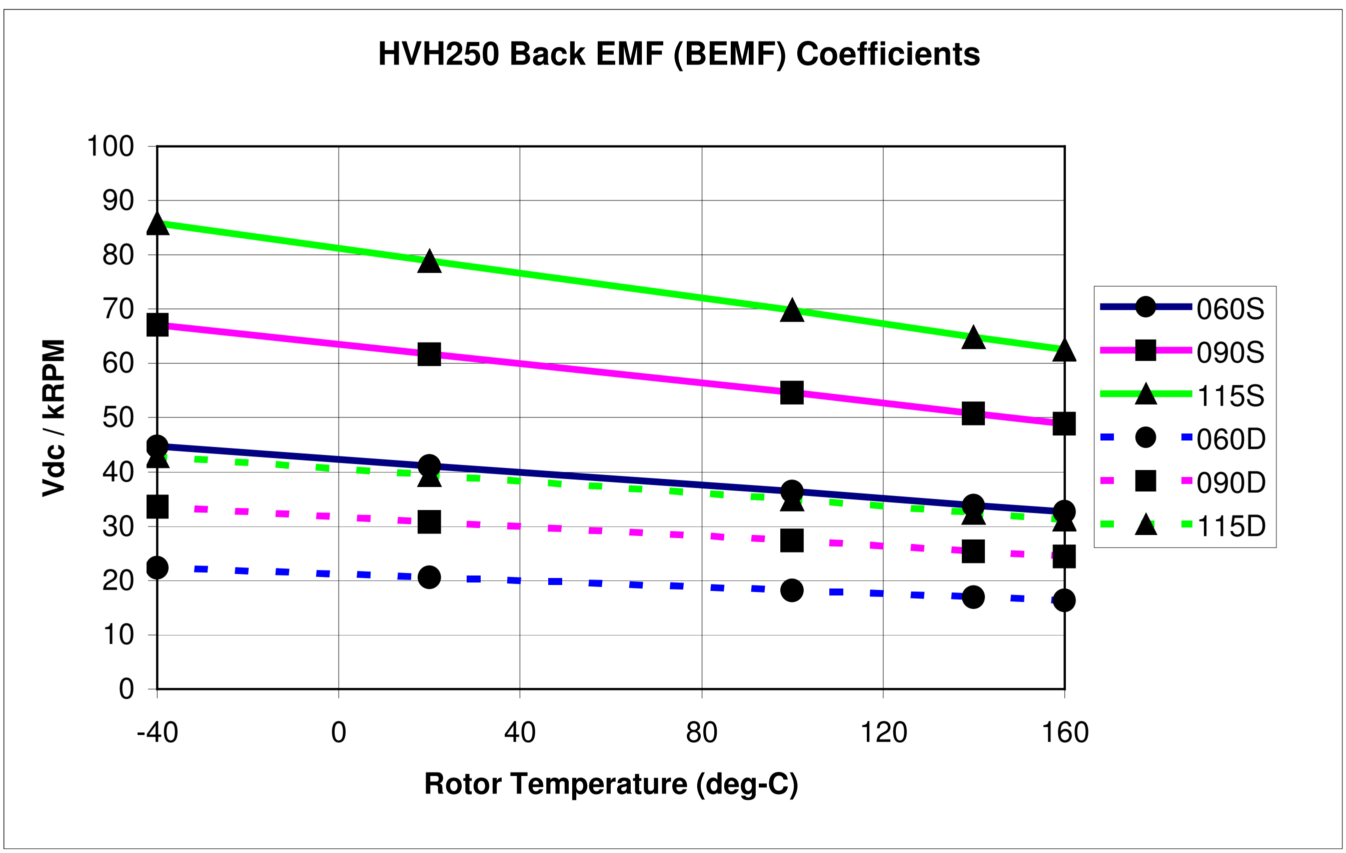
/1\ See pages 16 & 17 for x, y, z definition

5.2 Temperature Derating

Demagnetization will occur at 180C.



5.3 Back EMF (BEMF) Coefficients



5.4 Thermistor Values

Stator thermistor resistance vs temperature values are shown in Table 2.

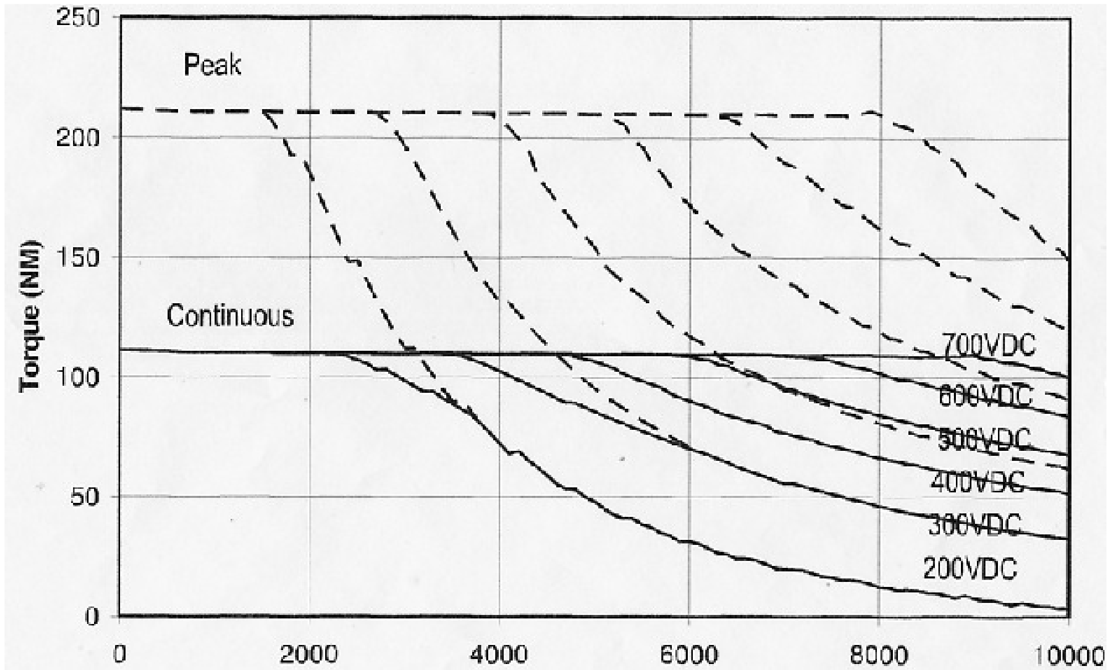
TABLE 2. TYPICAL THERMISTOR VALUES

Temp (Degrees C)	R Nominal (Ohms)	Res. Total +/- %	Temp ACCY (+/- Degrees C)
-40	965530	9.99	1.53
-25	379641	9.24	1.56
0	96248	6.51	1.3
25 Test Point	30000	5	1.15
50	10851	6.42	1.68
75	4450	7.55	2.27
100	2036	8.67	2.91
125	1010	9.37	3.55
150	541.8	10.22	4.33
175	309.9	10.68	5.05

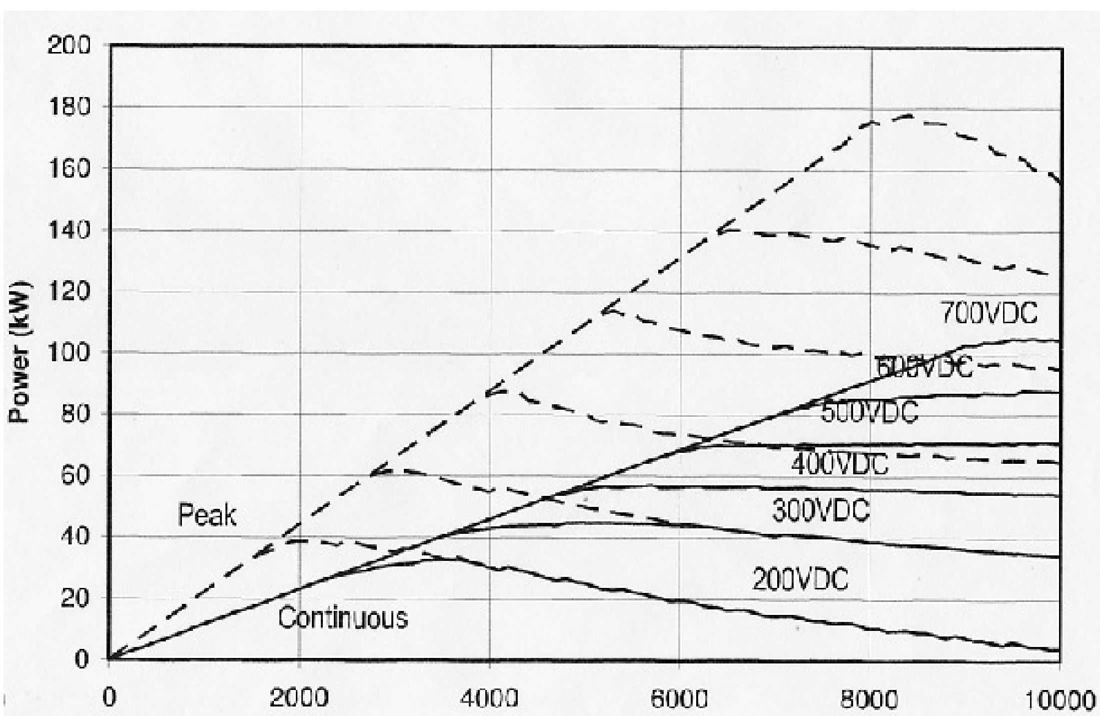
5.5 HVH250 Performance Curves

5.5.1 HVH 250-060S

Typical performance capabilities of the HVH250 – 060S are shown in the following two graphs.



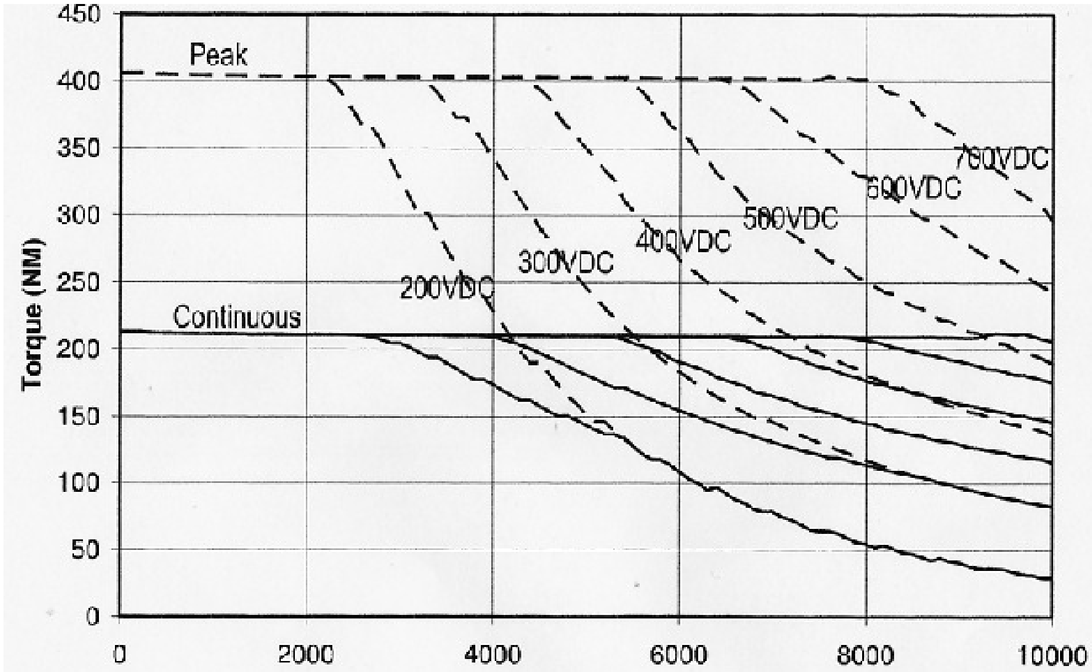
RPM



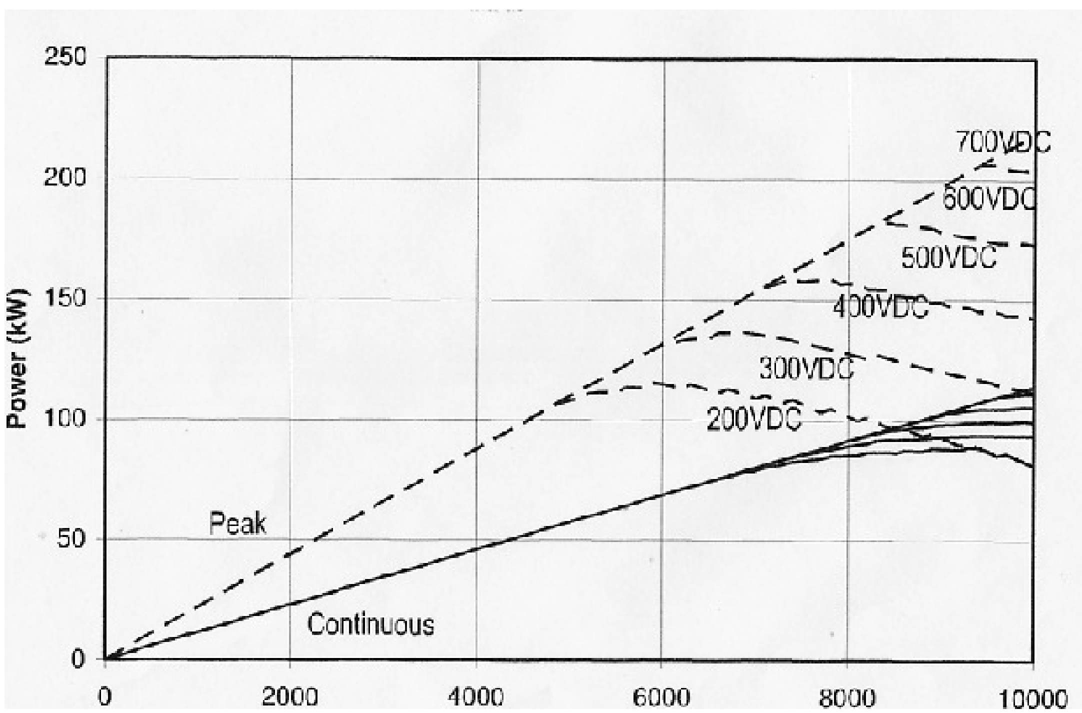
RPM

5.5.2 HVH250-060D

Typical performance capabilities of the HVH250 – 060D are shown in the following two graphs.



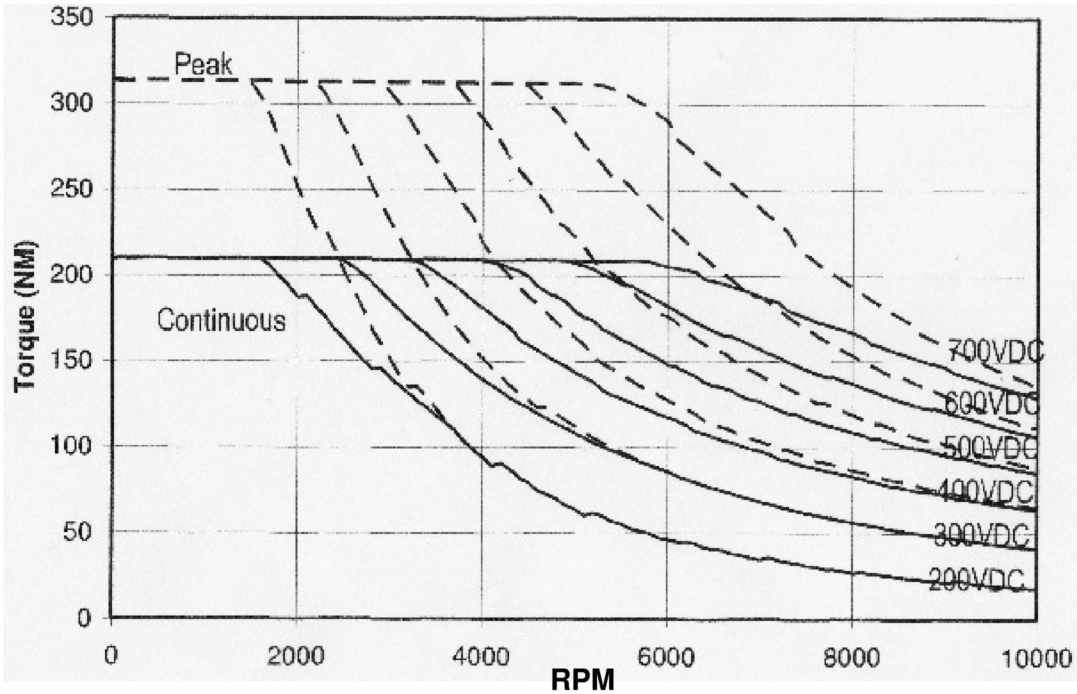
RPM



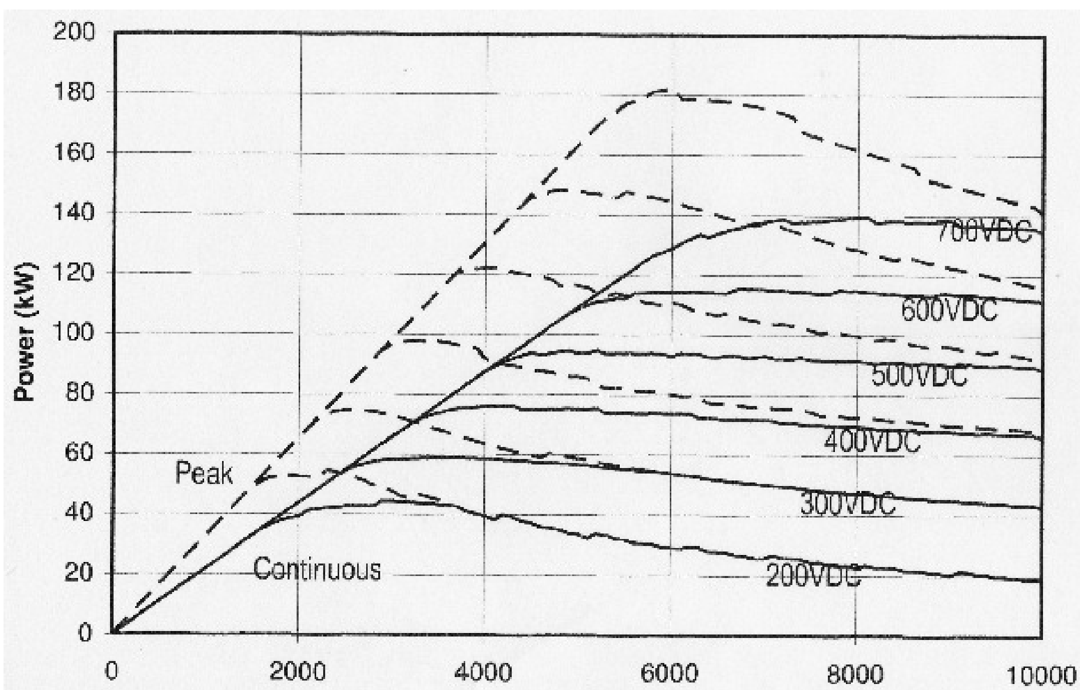
RPM

5.5.3 HVH250-090S

Typical performance capabilities of the HVH250 – 090S are shown in the following two graphs.



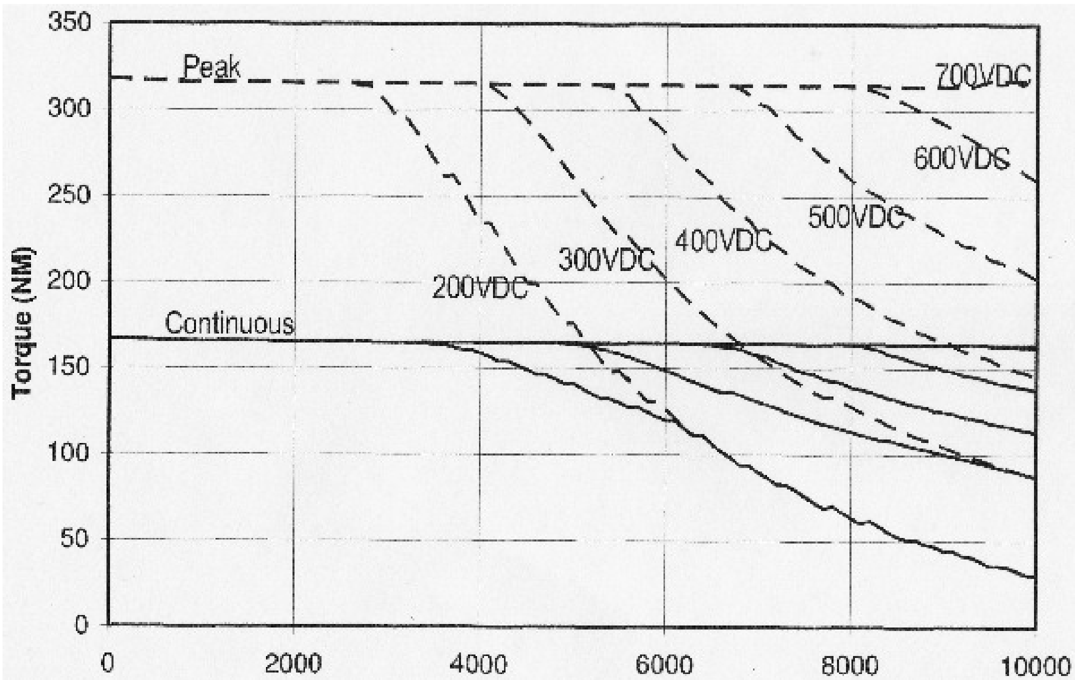
RPM



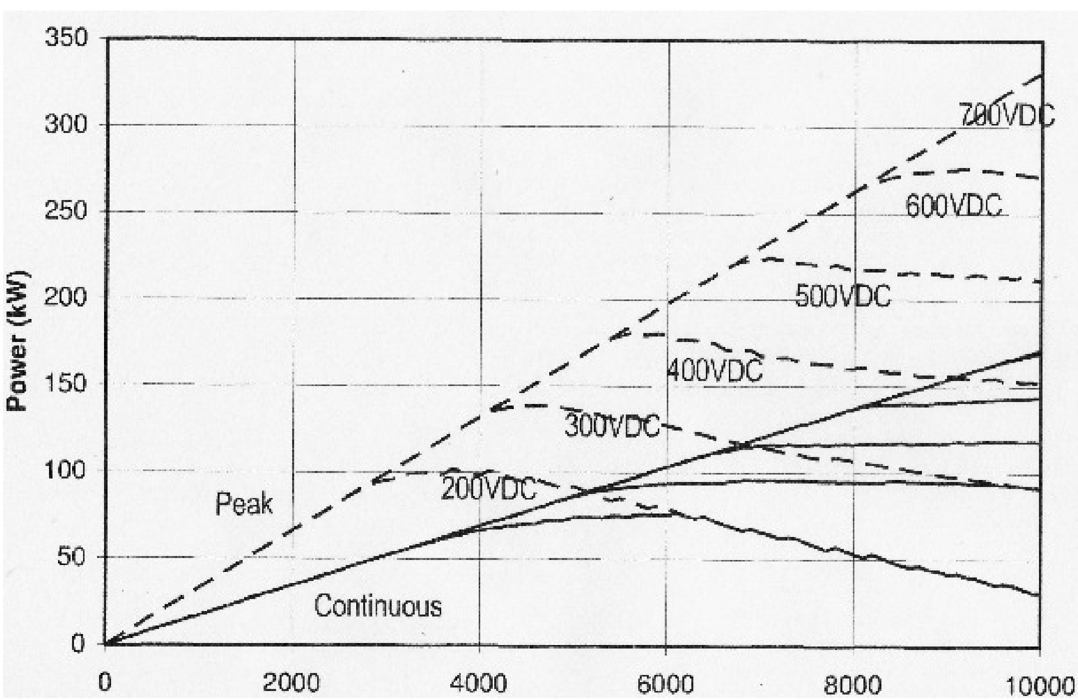
RPM

5.5.4 HVH250-090D

Typical performance capabilities of the HVH250-090D are shown in the following two graphs.



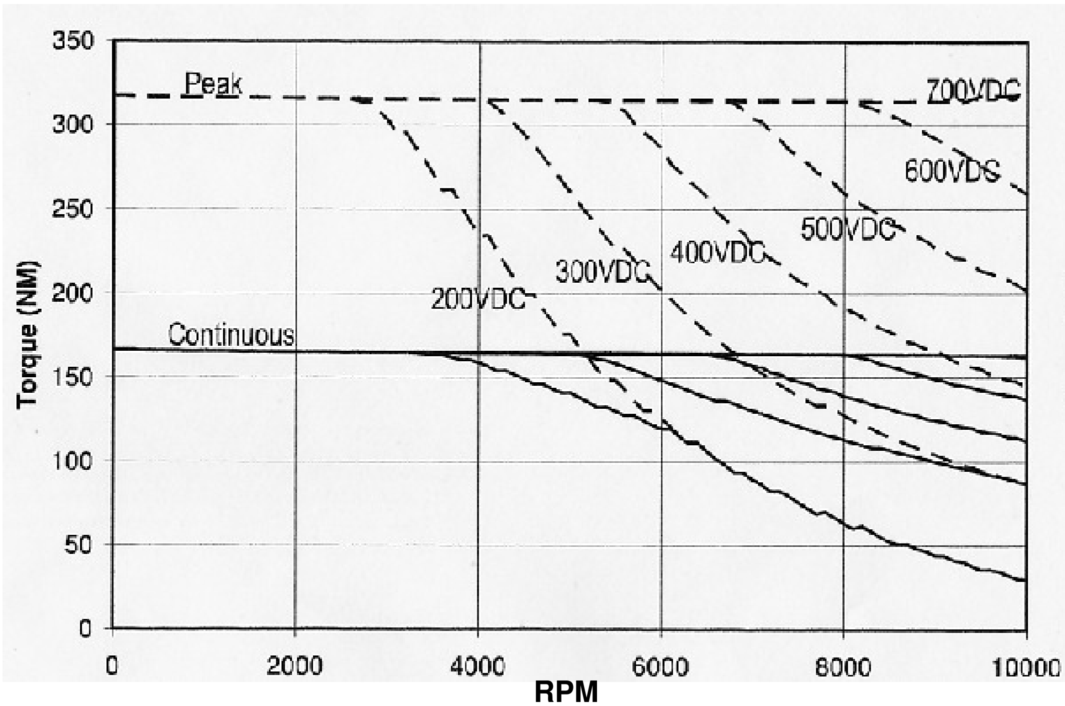
RPM

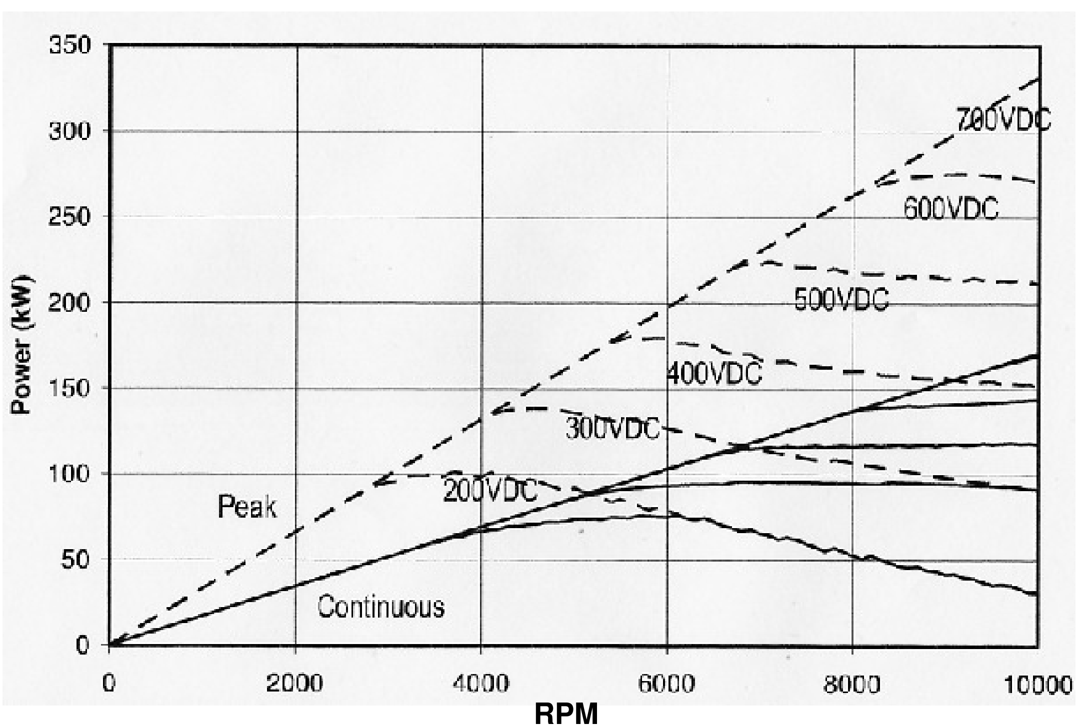


RPM

5.5.5 HVH250-115S

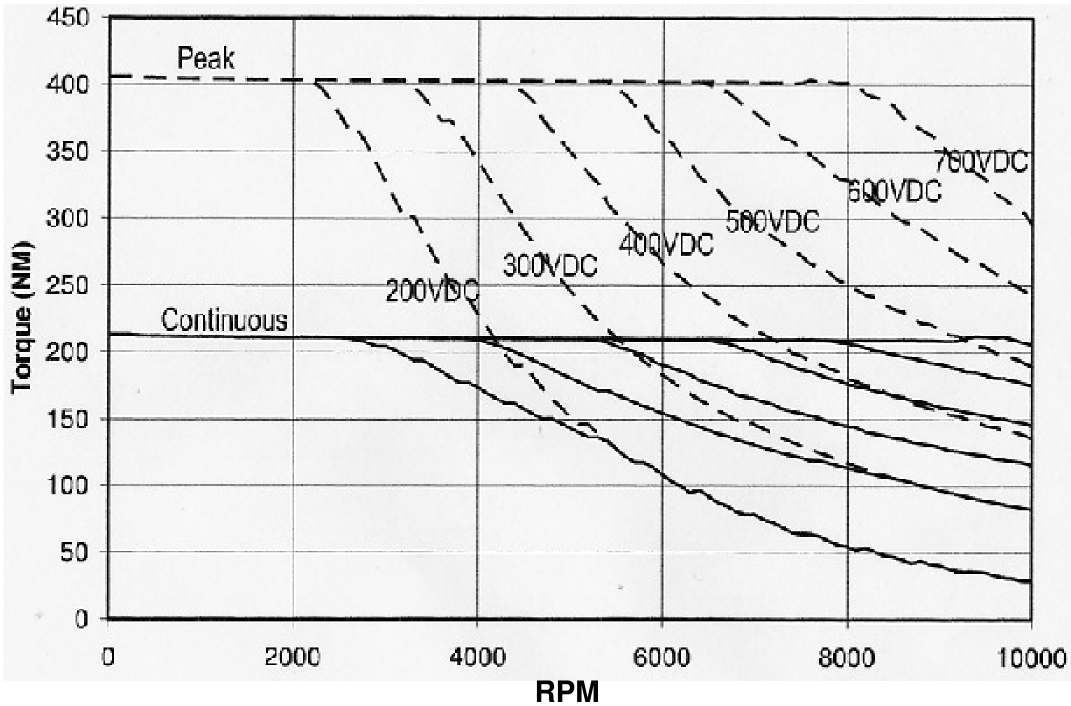
Typical performance capabilities of the HVH250-115S are shown in the following two graphs.

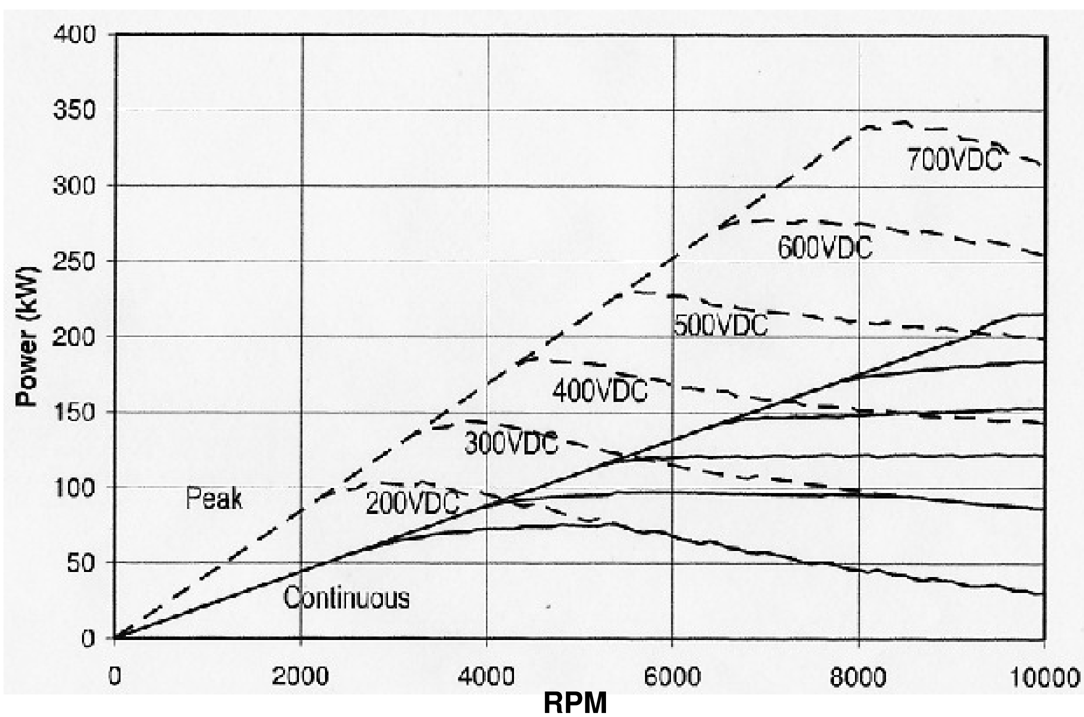




5.5.6 HVH250-115D

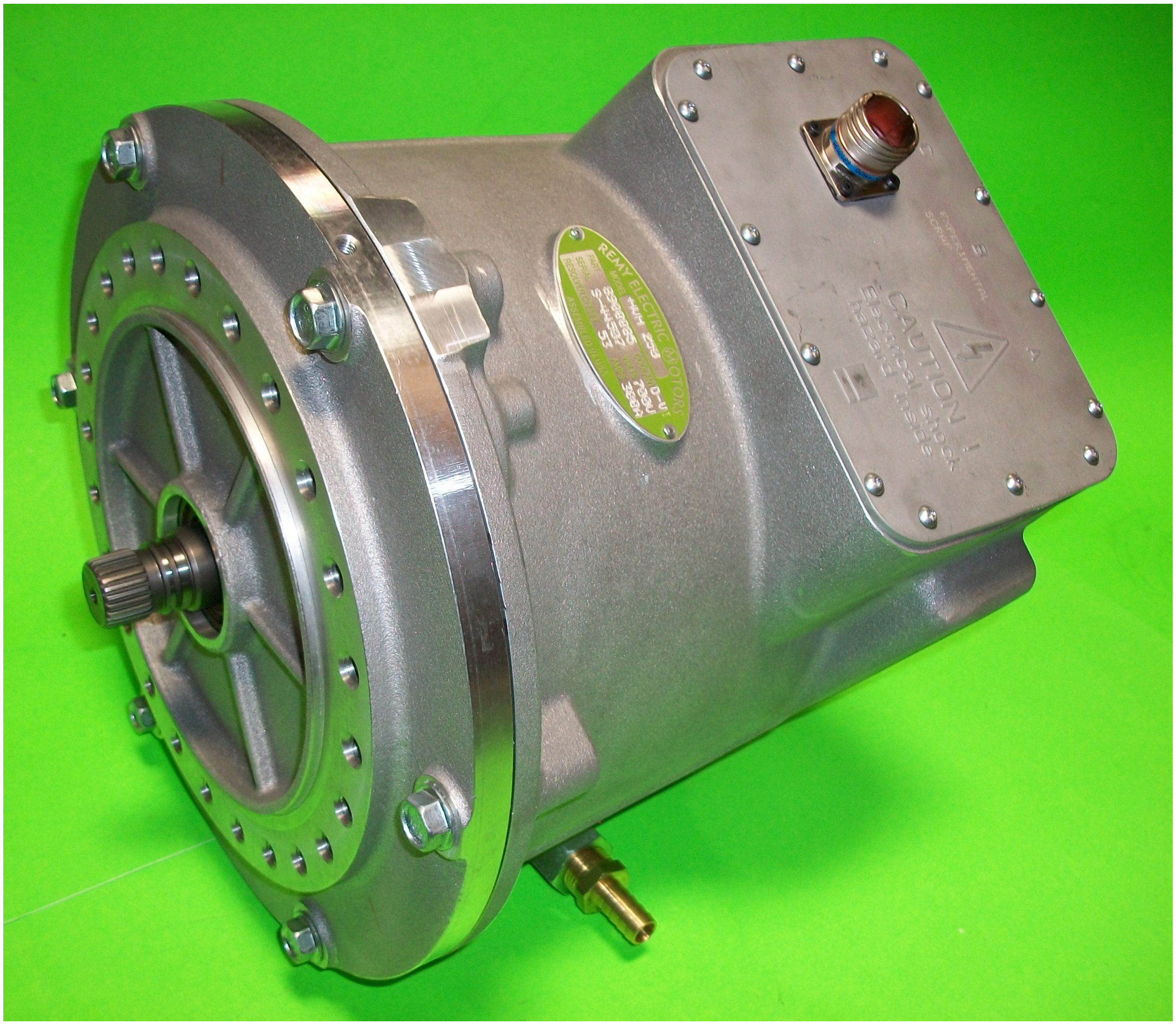
Typical performance capabilities of the HVH250 – 115D are shown in the following two graphs.

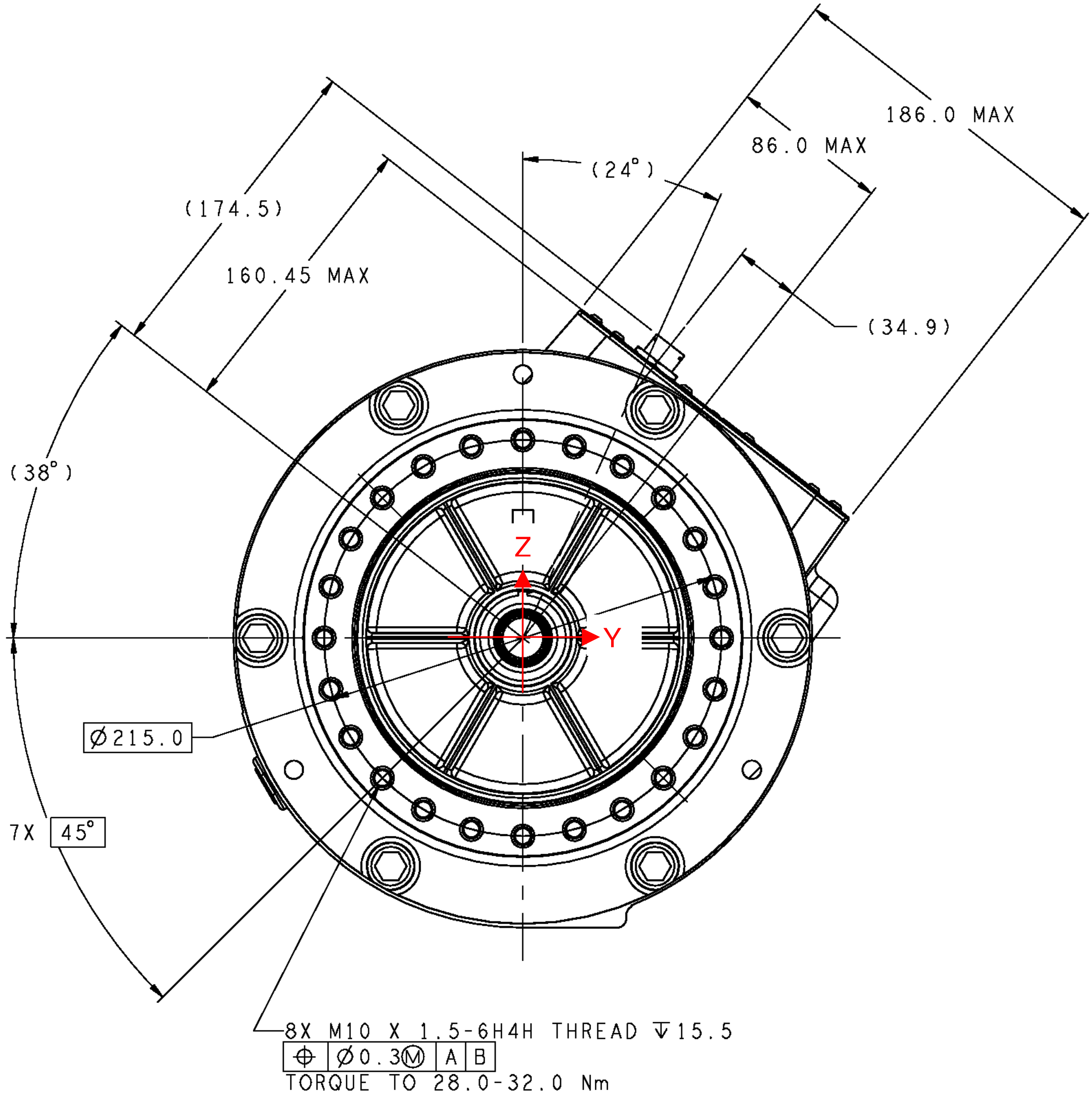




6. INSTALLATION DETAILS

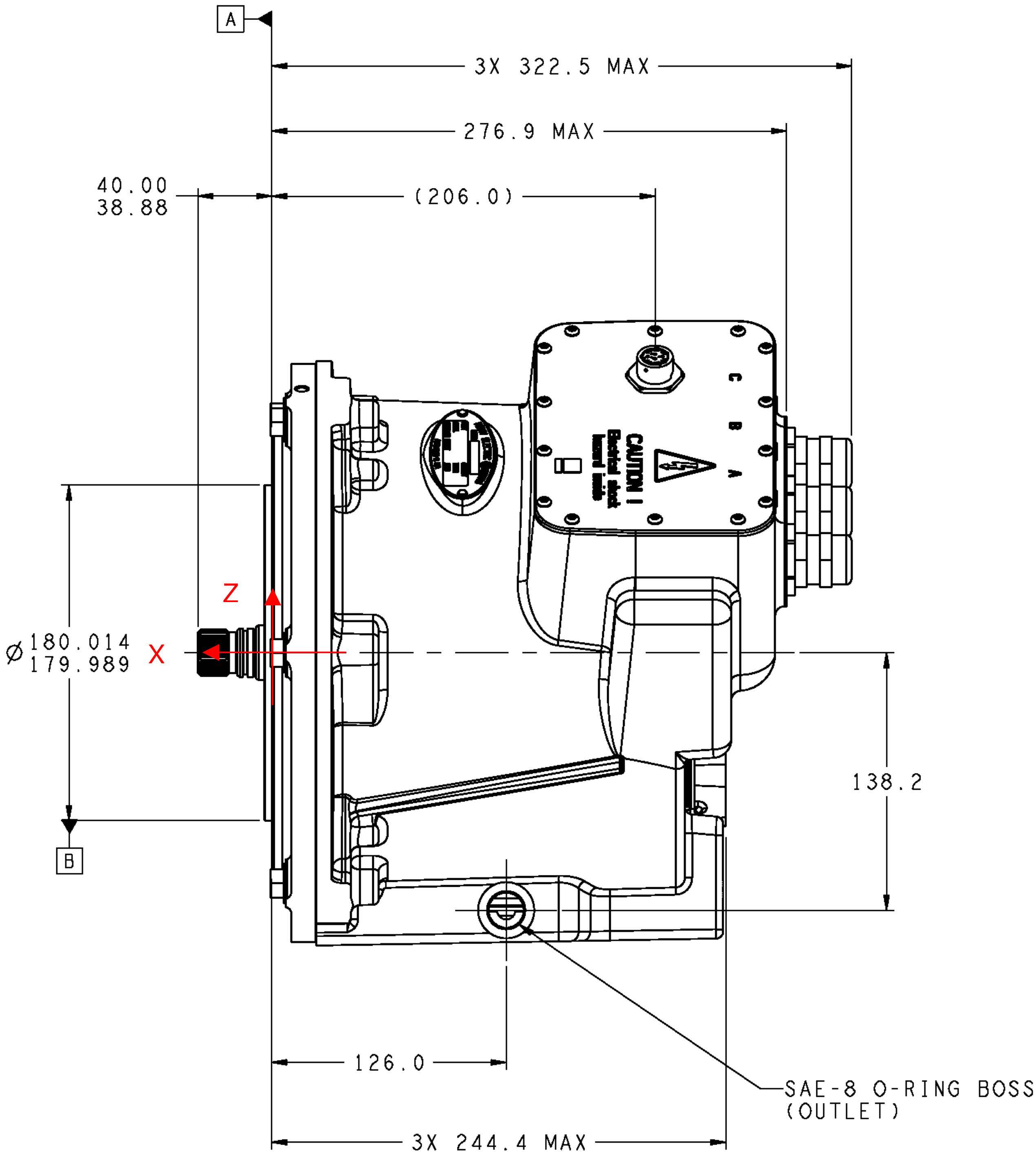
6.1 Housing and Mounting Plate



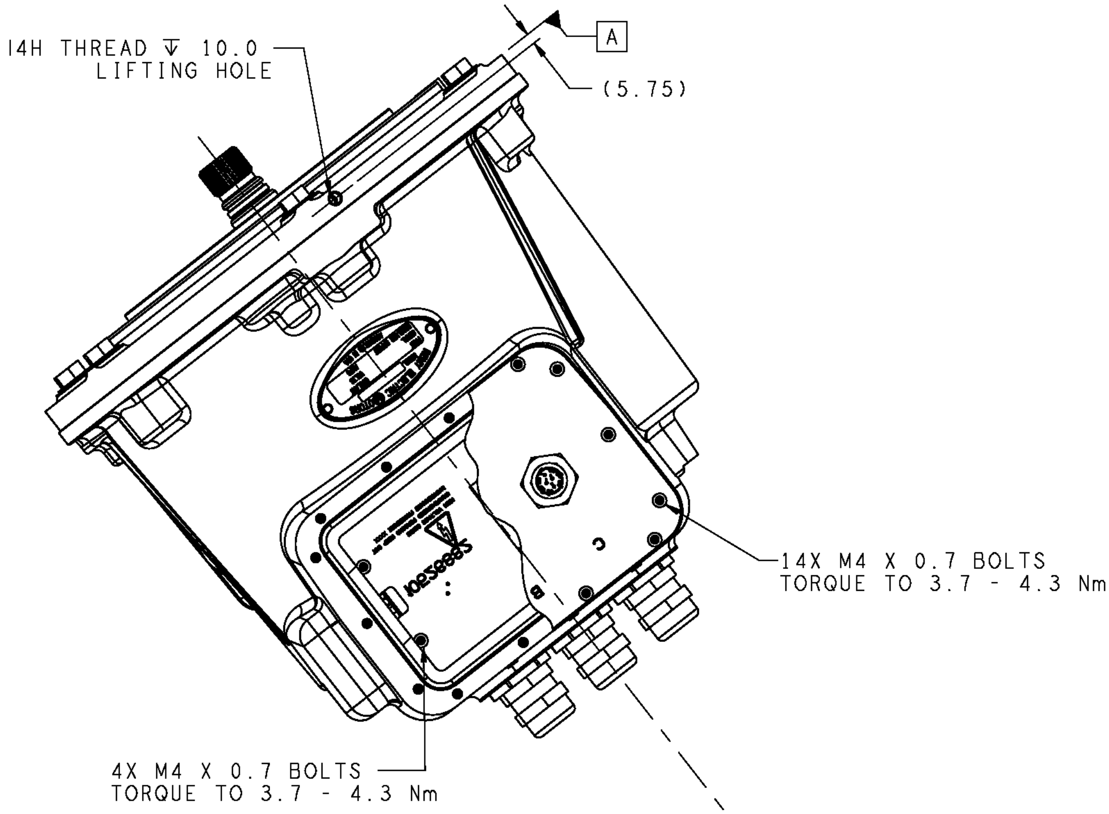


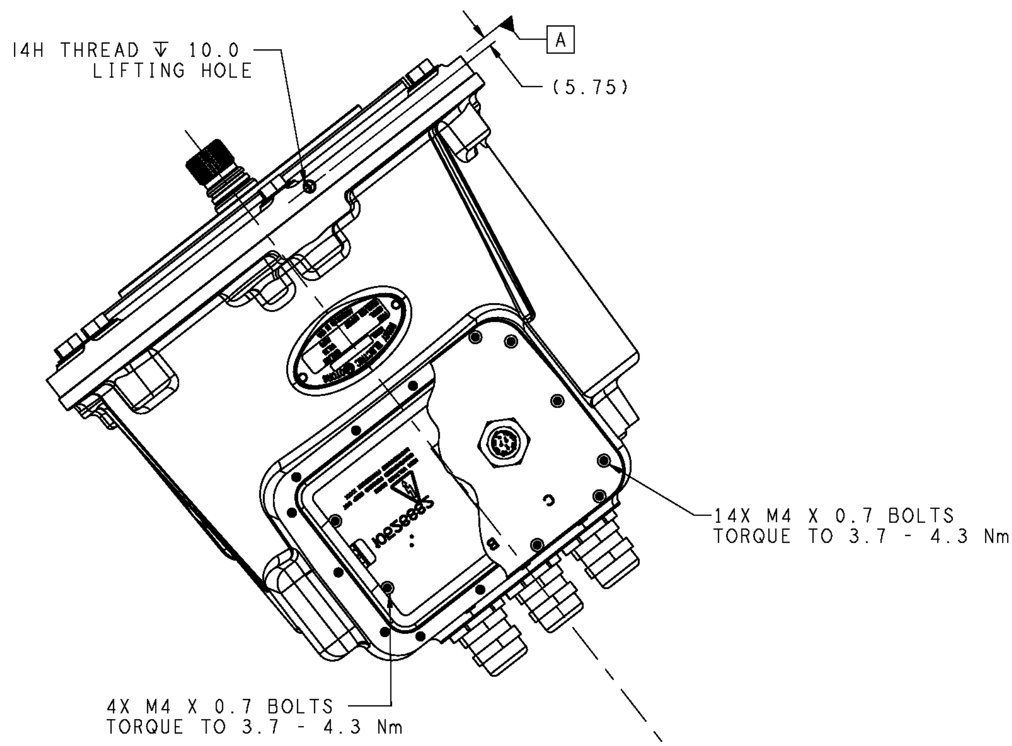
186.0 MAX
86.0 MAX
(24°)
(174.5)
160.45 MAX
(34.9)
(38°)
Z
Y
Ø215.0
7X 45°
8X M10 X 1.5-6H4H THREAD ↧15.5
⌖ Ø0.3Ⓜ A B
TORQUE TO 28.0-32.0 Nm

(7.1 Housing and Mounting Plate – continued**)**

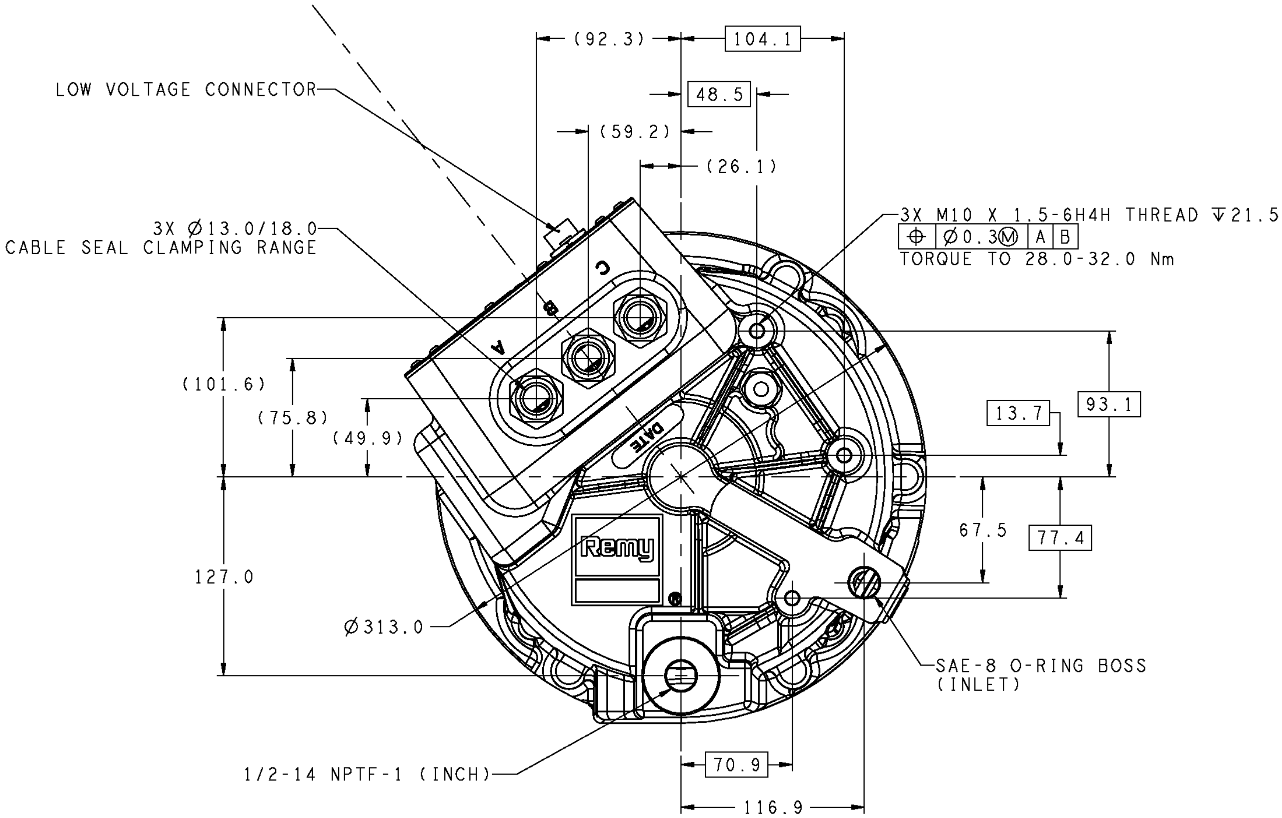


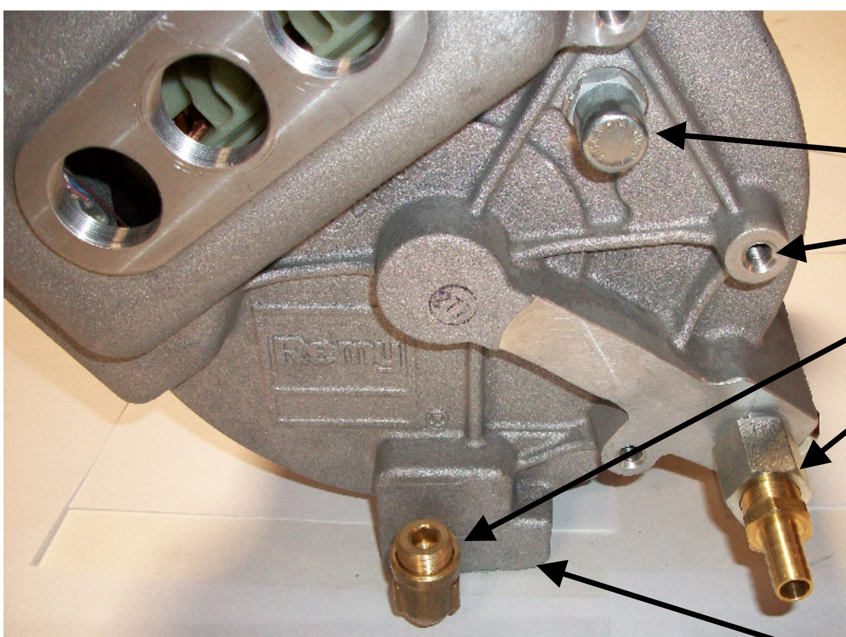
(7.1 **Housing and Mounting Plate** – continued**)**



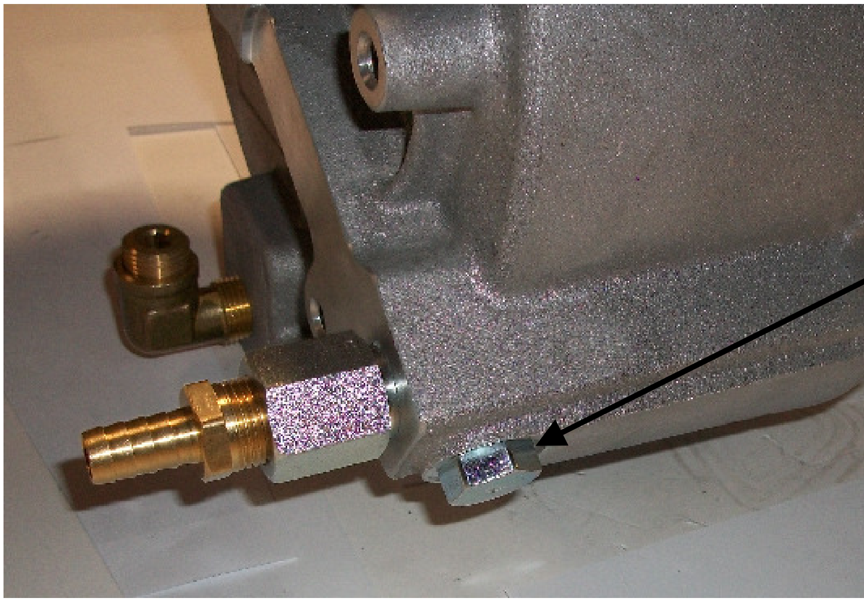


(7.1 Housing and Mounting Plate – continued)

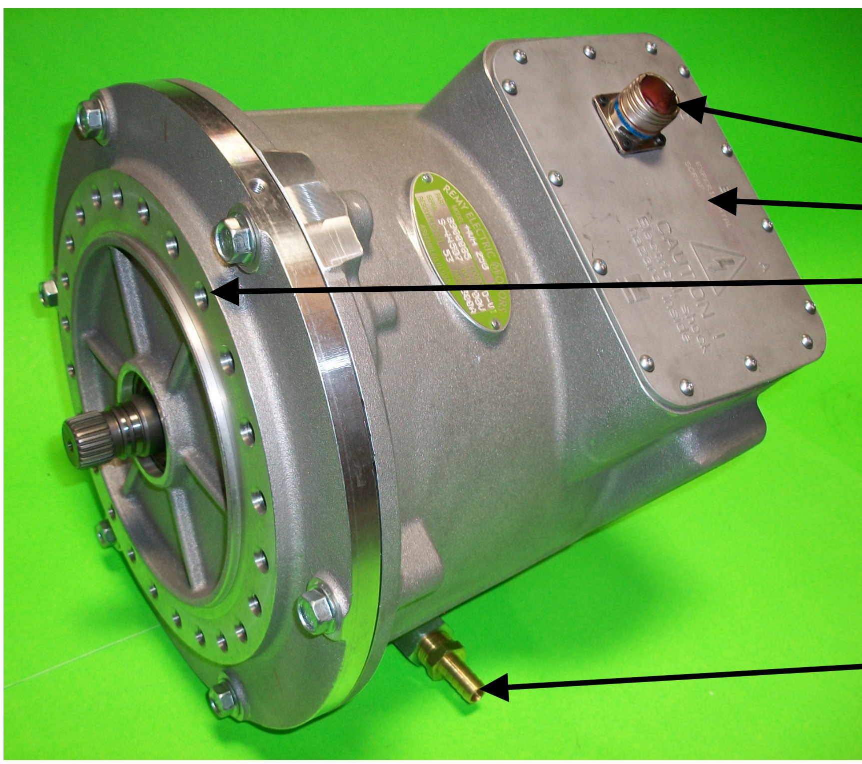




REAR VIEW

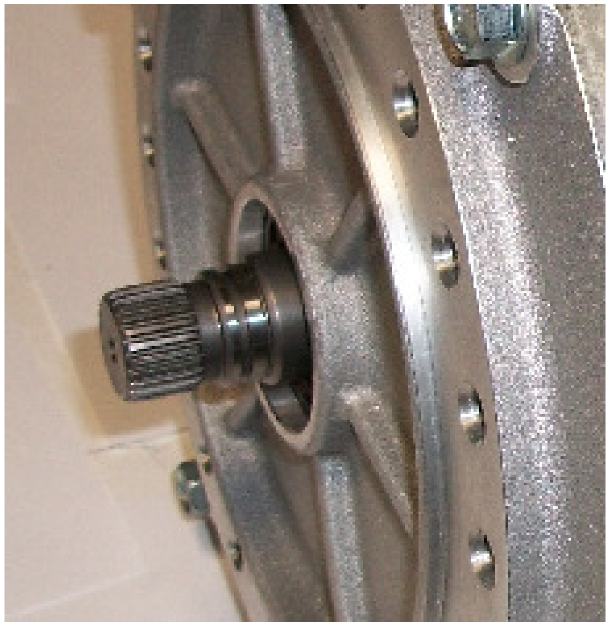


REAR/SIDE VIEW



FRONT/SIDE VIEW

6.2 Output Shaft

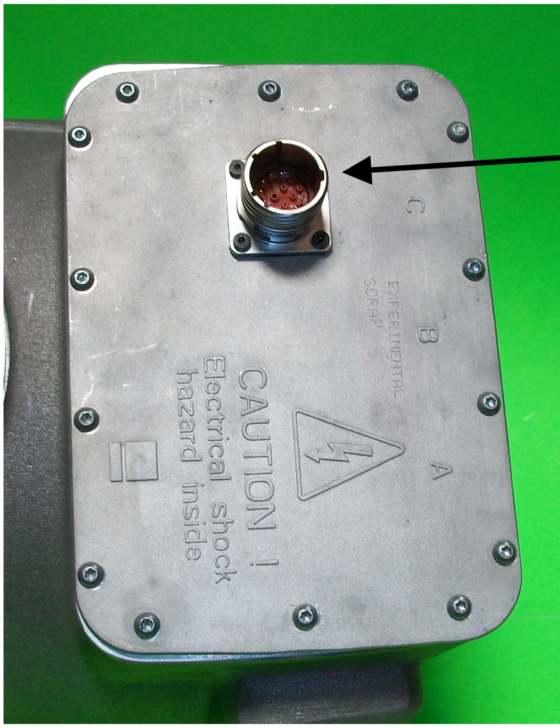


OUTPUT SHAFT EXTERNAL INVOLUTE SPLINE DATA

FLAT ROOT SIDE FIT	
TOLERANCE CLASS - 6H	
NUMBER OF TEETH	24
MODULE	1.000
PRESSURE ANGLE	30.0
PITCH DIAMETER (REF)	24.00
BASE DIAMETER	20.785
MAJOR DIAMETER	24.75-25.00
MINOR DIAMETER	22.26-22.50
FORM DIAMETER (MAX)	22.89
CIRCULAR TOOTH WIDTH AT PITCH DIAMETER	
MAX EFFECTIVE	1.571
MIN ACTUAL	1.485
PIN DIAMETER	2.120
MEASUREMENT OVER PINS (REF)	27.399-27.479

6.3 Low Voltage Connections

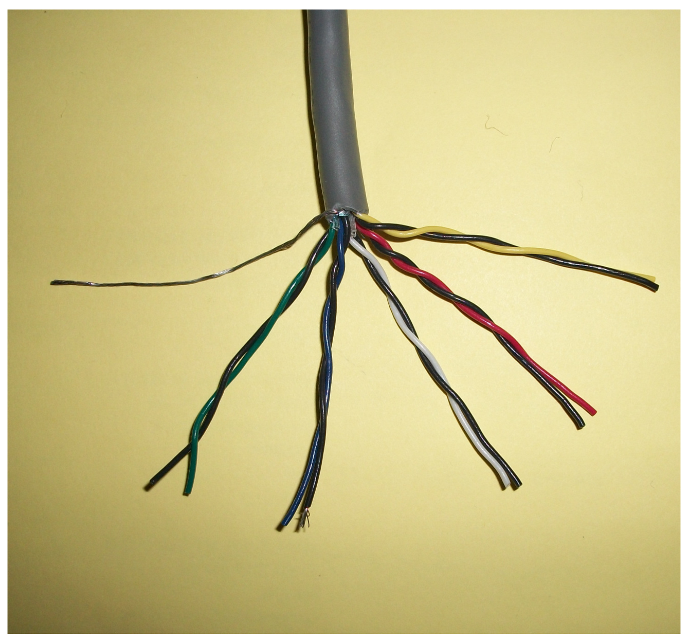
Low voltage connector at HVH250 motor:



D38999/20FD15PN LOW VOLTAGE CONNECTOR

WIRING COMPARTMENT COVER PLATE

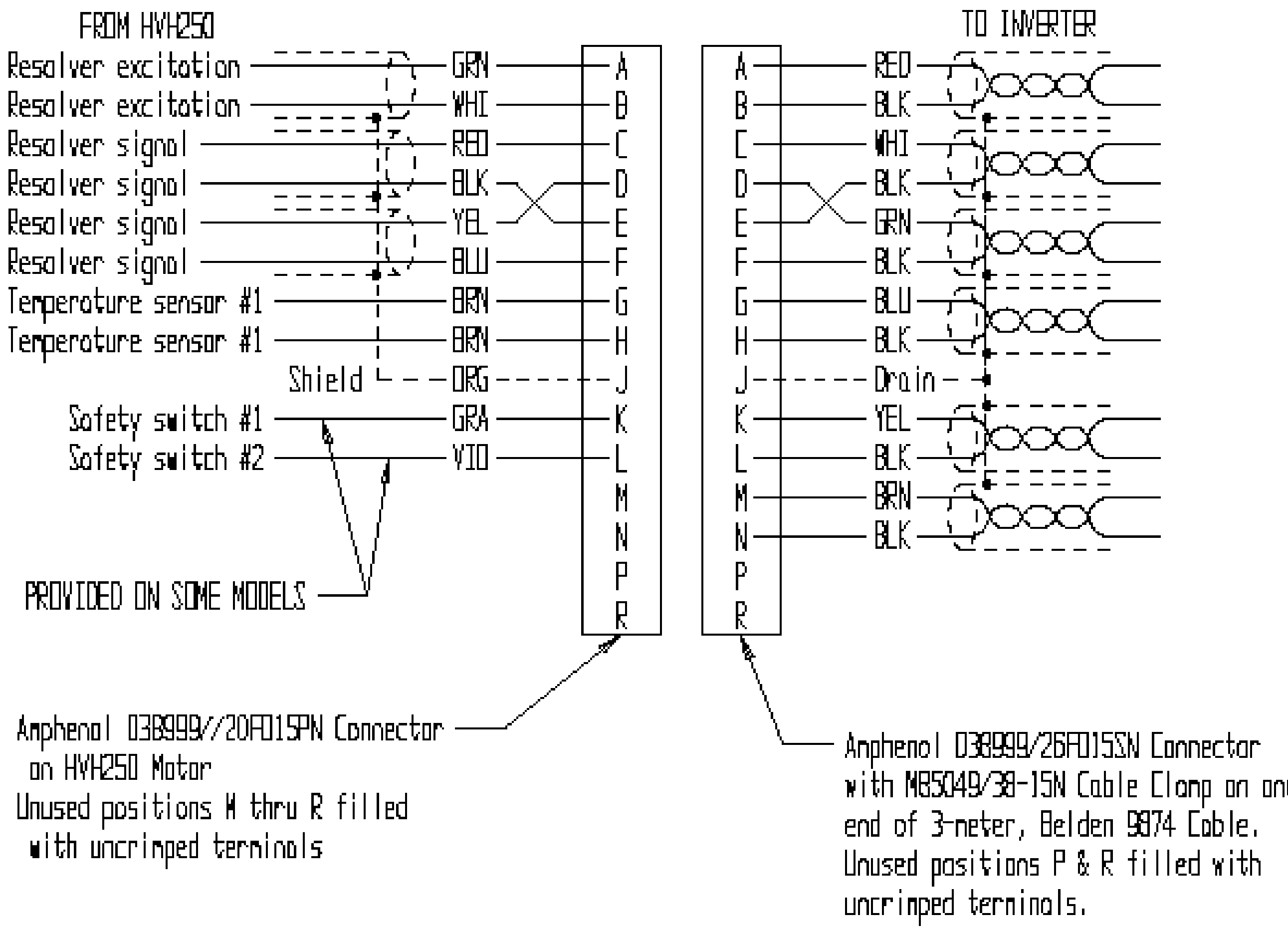
LOW VOLTAGE CABLE WITH MATING D38999/26FD15SN CABLE CONNECTOR



5-TWISTED-PAIR, INDIVIDUALLY SHIELDED, CABLE TO INVERTER

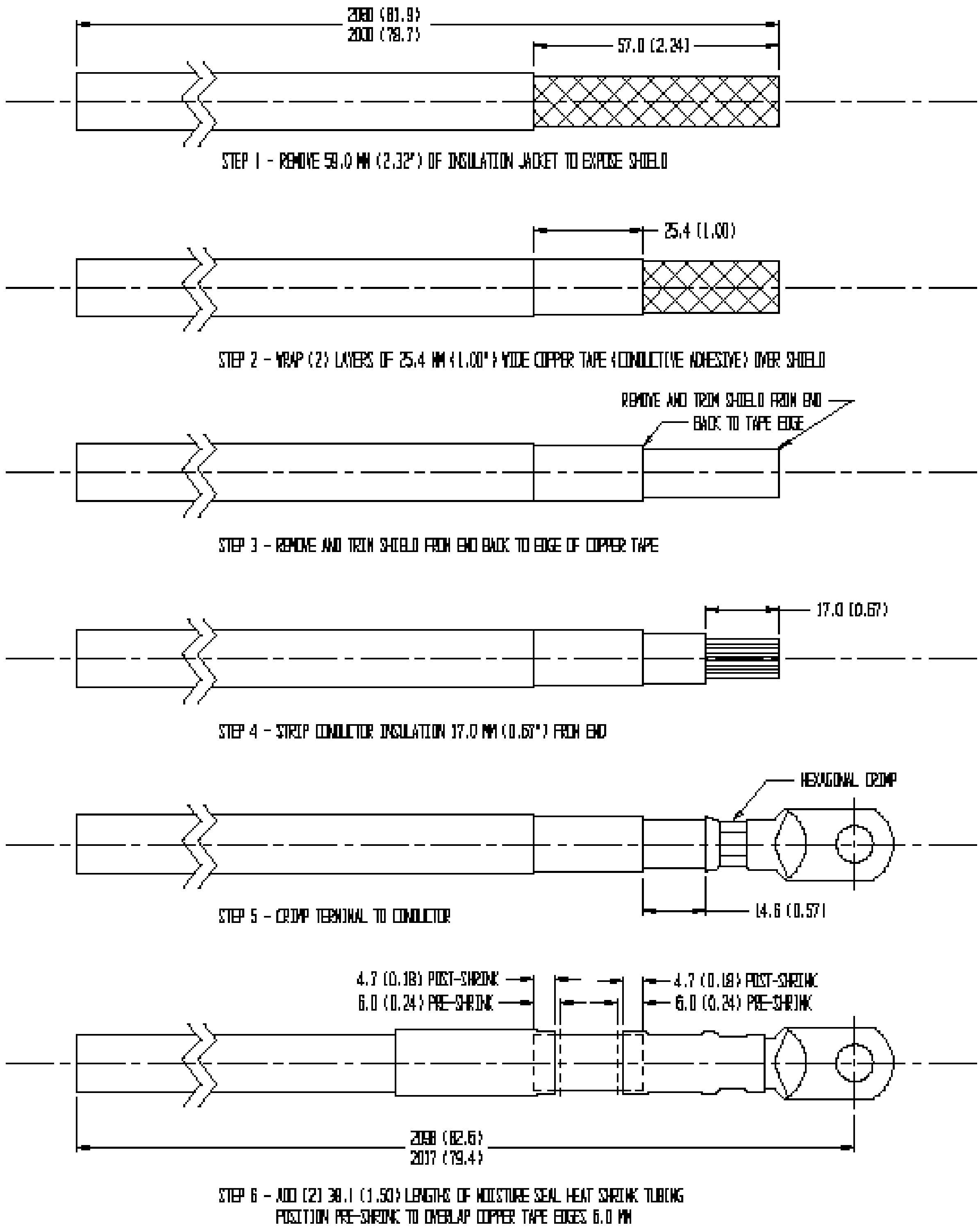
(7.3 **Low Voltage Connections** – continued**)**

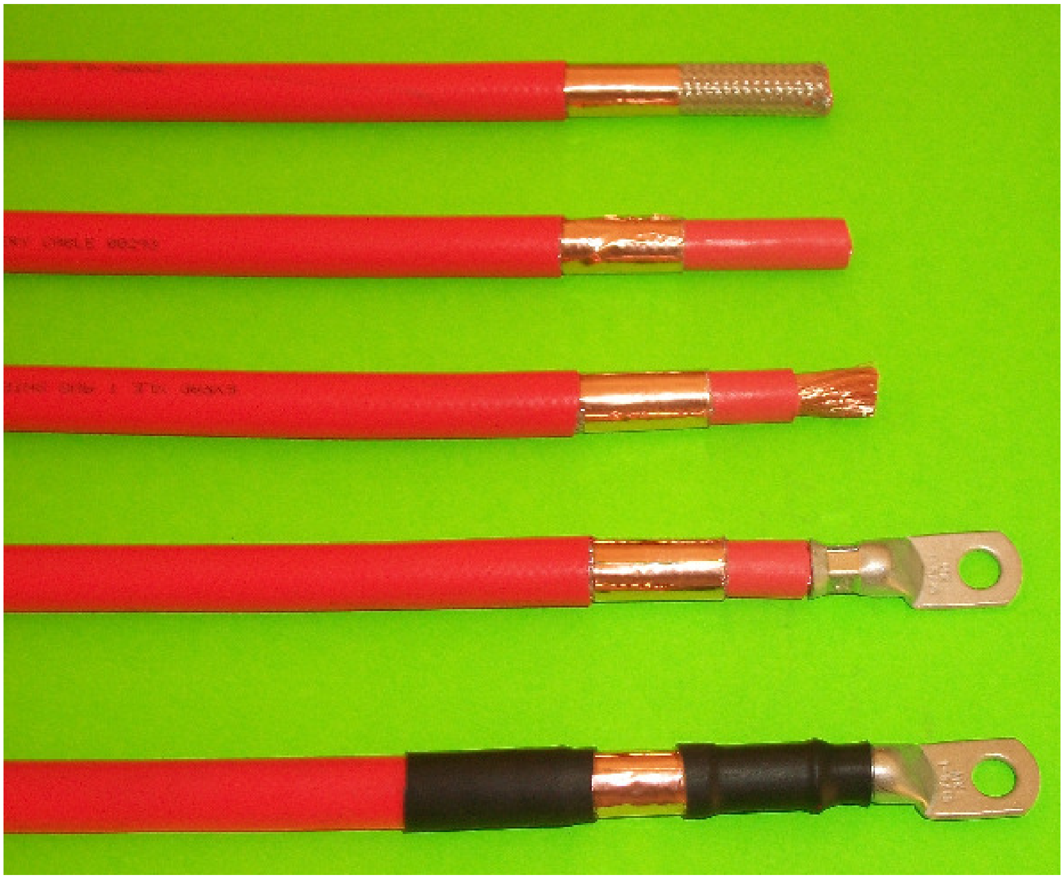
Connection diagram:



6.4 High Voltage Connections

Unless provided, prepare high voltage 1 awg cables for assembly to motor per steps 1 - 6 of the following illustration.





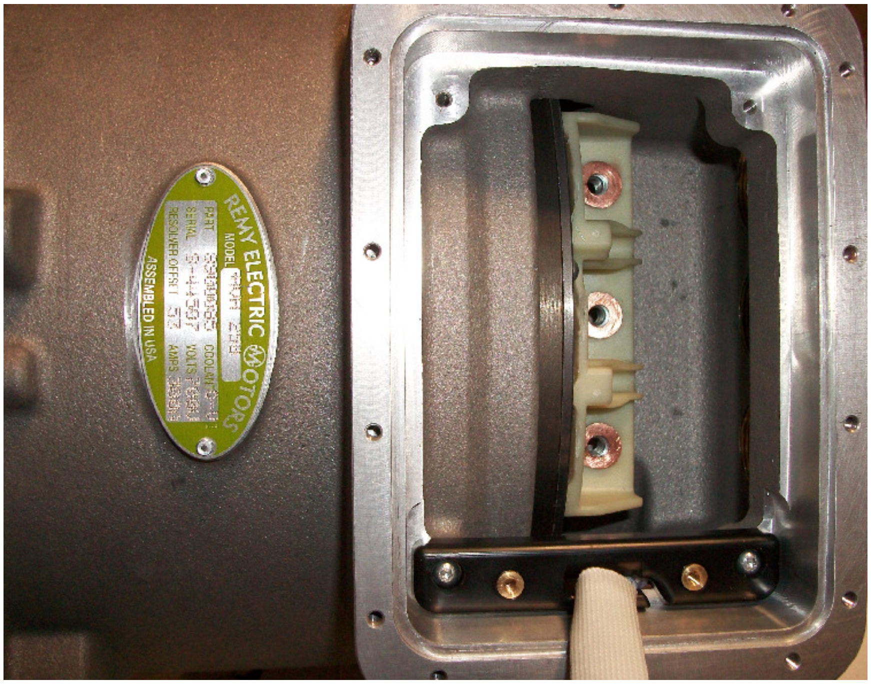
6.5 Assembly of High Voltage (HV) Cables to Terminals

Assemble high voltage cables to motor terminals per 1 - 11 of following illustrations.

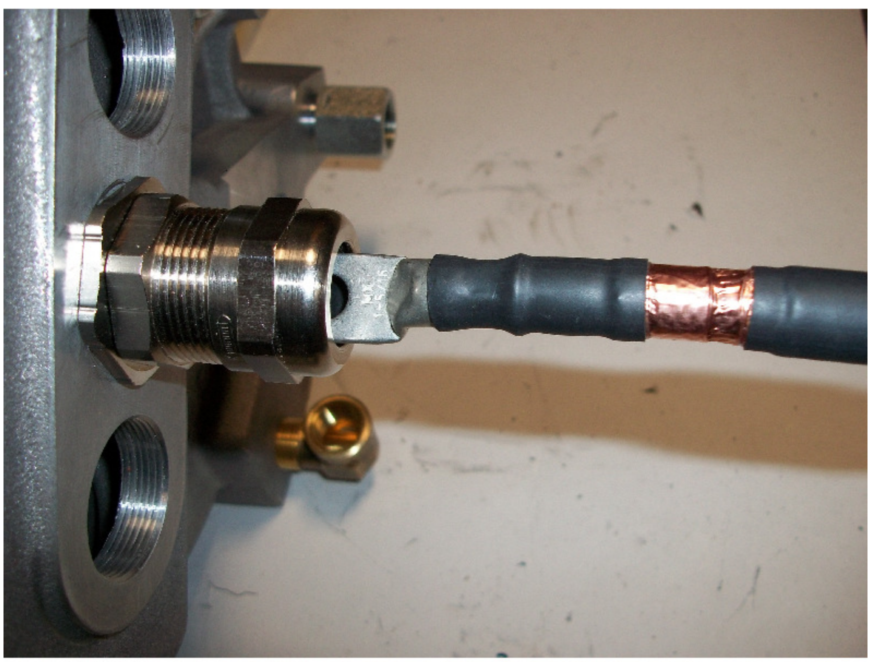
1. REMOVE WIRING COMPARTMENT COVER PLATE

SAFETY COVER PLATE

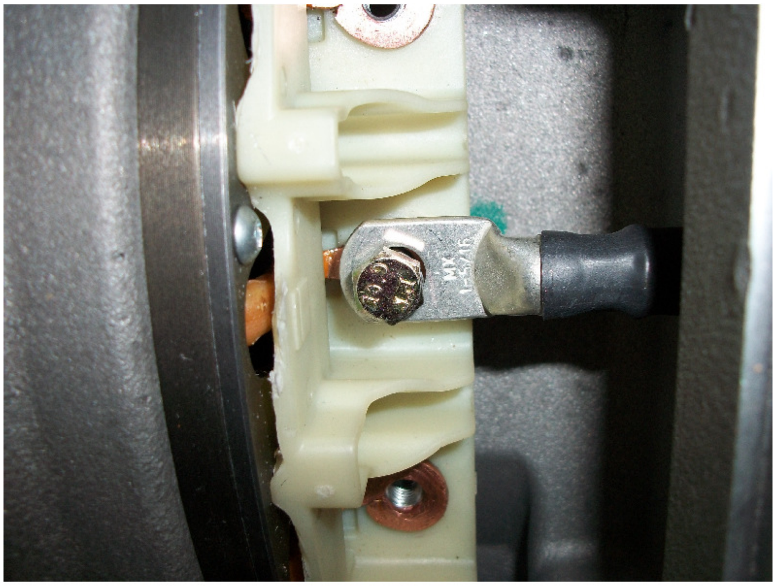
(7.5 Assembly of High Voltage (HV) Cables to Terminals – continued**)**



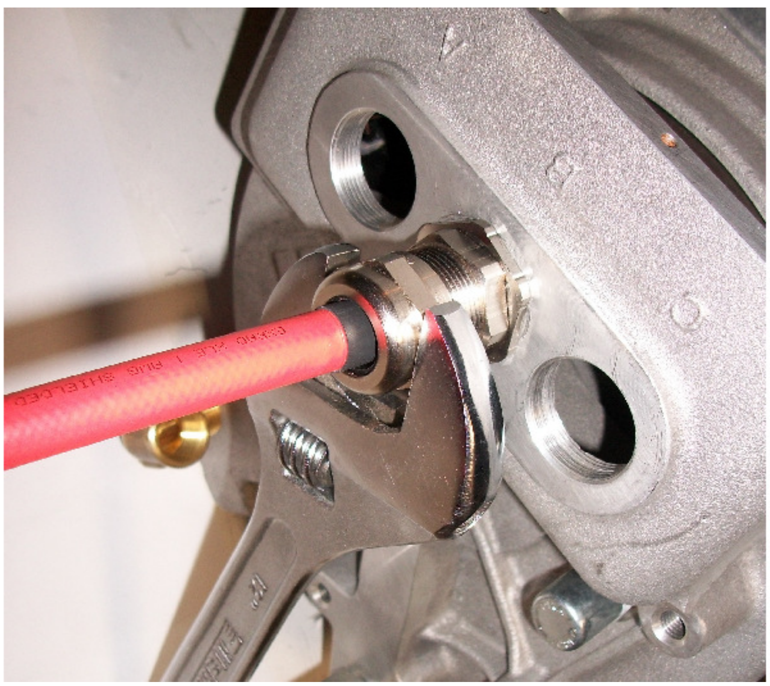
2. **REMOVE SAFETY COVER PLATE**



3. **INSERT HV CABLE THROUGH CABLE STRAIN RELIEF INTO TERMINAL COMPARTMENT**

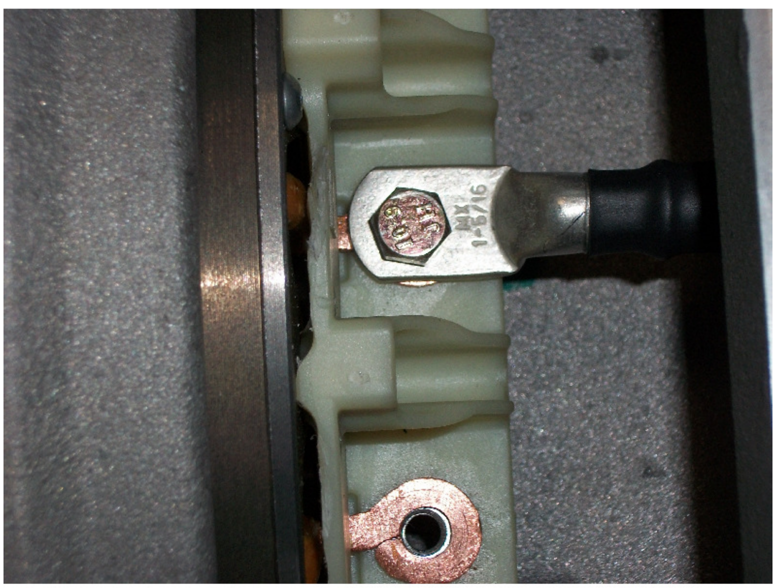


4. **LOOSELY CONNECT CABLE TO HVH250 TERMINAL WITH SCREW AND LOCKWASHER**



5. **TIGHTEN CABLE STRAIN RELIEF NUT**

6. **VERIFY CONTACT OF CABLE STRAIN RELIEF EMI/RFI FINGERS TO COPPER-TAPED AREA OF CABLE**



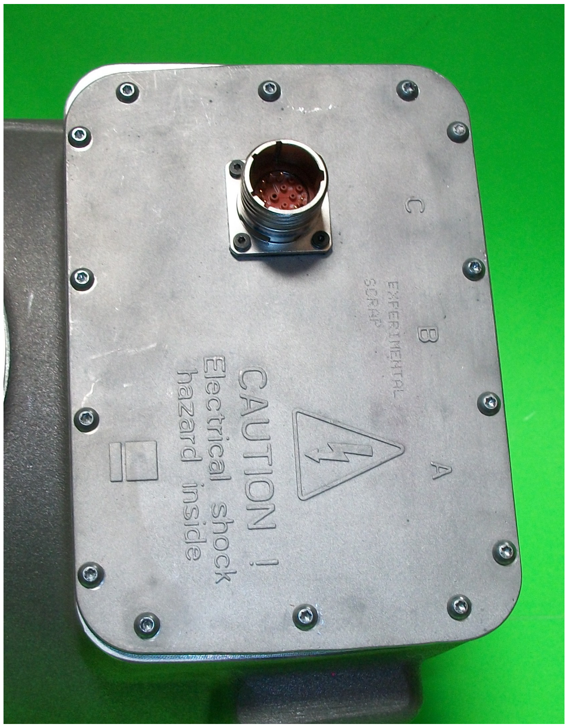
8. **TIGHTEN TERMINAL SCREW. REPEAT STEPS 1-8 FOR REMAINING TWO CABLES**

(7.5 Assembly of High Voltage (HV) Cables to Terminals – continued)

9. **RE-ASSEMBLE SAFETY COVER PLATE. TORQUE SCREWS 3.7 – 4.3 N-m**

10. **CHECK O-RING POSITION AND ADD LUBRICATION AS NEEDED (PETROLEUM JELLY OR EQUIVALENT)**

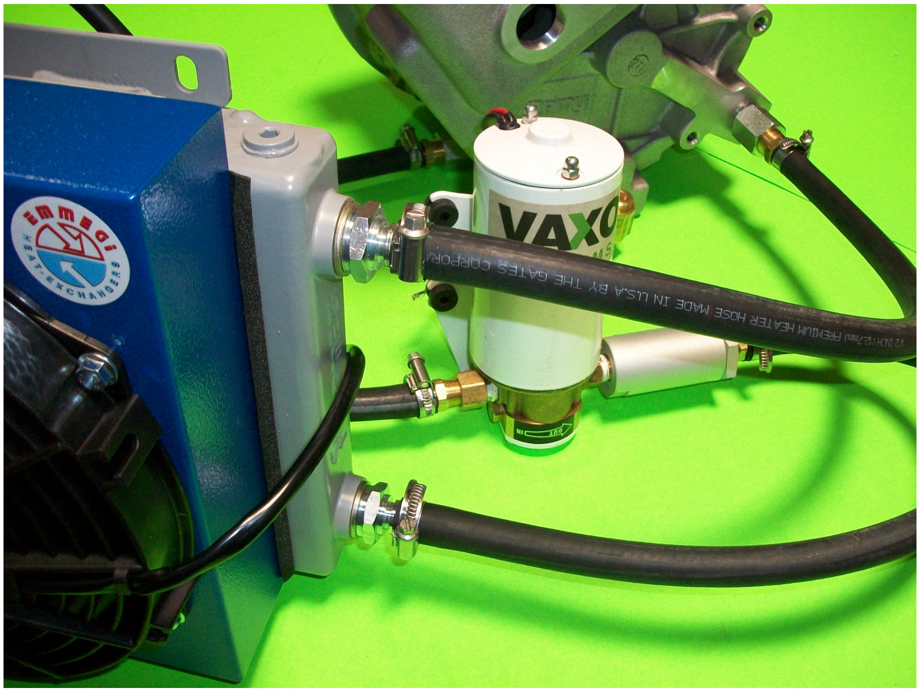
(7.5 Assembly of High Voltage (HV) Cables to Terminals – continued**)**



11. RE-ASSEMBLE WIRING COMPARTMENT COVER PLATE. TORQUE SCREWS TO 3.7 – 4.3 N-m

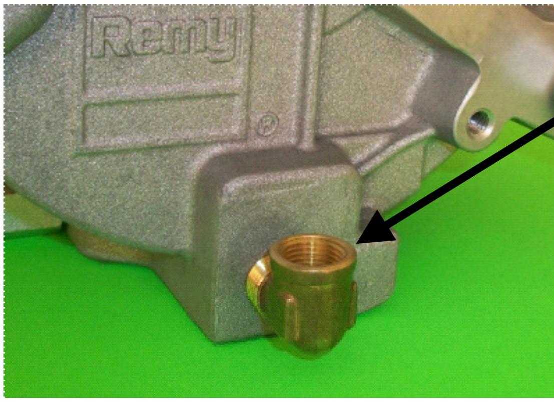
7. ADD COOLANT OIL

Complete connections to cooling system per instructions for Model UCS250 Motor Oil Cooling System.



(8. ADD COOLANT OIL – continued**)**

Fill cooling system with ATF per following illustrations.

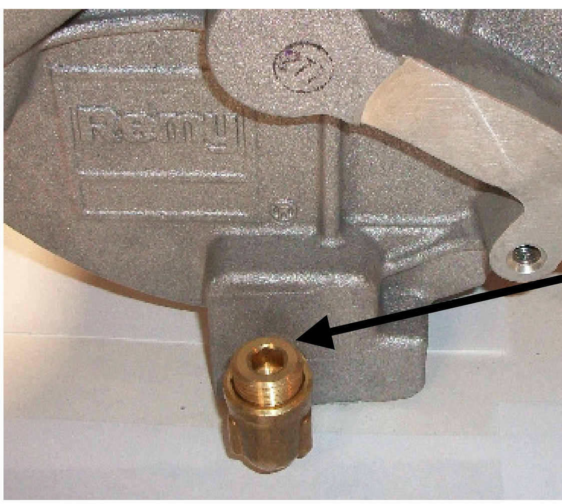


FILL PORT

1. **ADD ATF TO BRING FLUID LEVEL TO TOP OF FILL PORT WHEN COLD AND BEFORE POWERING OIL PUMP.**

2. **START OIL PUMP AND IMMEDIATELY CONTINUE TO ADD ATF UNTIL SYSTEM REMAINS FILLED TO TOP OF FILL PORT. ADD AND TIGHTEN FILL PLUG.**

CHECKING FLUID LEVEL WHEN HOT MAY CAUSE ATF TO OVERFLOW THE FILL PORT.



FILL PORT PLUG

Amount of ATF volume required to fill cooling system will vary depending on length of cooling lines, capacity of heat exchanger, and inverter model. Fill, check level, and add ATF as needed until ATF level is to the top of filler tube. Check system for leaks during initial operation.

8. TROUBLESHOOTING TIPS

TBD