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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>
<thead>
<tr>
<th>Characteristic</th>
<th>060S</th>
<th>060D</th>
<th>090S</th>
<th>090D</th>
<th>115S</th>
<th>115D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total weight (kg)</td>
<td>37</td>
<td>37</td>
<td>50</td>
<td>50</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Cartridge weight (kg)</td>
<td>28</td>
<td>28</td>
<td>35</td>
<td>35</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Rotating mass (kg-m²)</td>
<td>0.048</td>
<td>0.048</td>
<td>0.054</td>
<td>0.054</td>
<td>0.069</td>
<td>0.069</td>
</tr>
<tr>
<td>Center of Gravity x,y,z (mm)</td>
<td>TBD</td>
<td>-128.8, 5.9, 3.2</td>
<td>TBD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling media (ATF)</td>
<td>Dexron VI, 5-15 l/m, op level &gt; 100 mm below shaft center</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling media filter microns</td>
<td>60 maximum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max bus voltage (Vdc)</td>
<td>700</td>
<td>700</td>
<td>700</td>
<td>700</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td>Max current (Arms)</td>
<td>300</td>
<td>600</td>
<td>300</td>
<td>600</td>
<td>300</td>
<td>600</td>
</tr>
<tr>
<td>Peak output (320Vdc, 100C Inlet OIl, 10 l/m, 30 seconds minimum)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed (rpm)</td>
<td>3000</td>
<td>6200</td>
<td>2400</td>
<td>4100</td>
<td>1800</td>
<td>3500</td>
</tr>
<tr>
<td>Torque (N-m)</td>
<td>210</td>
<td>210</td>
<td>310</td>
<td>320</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Power (kW)</td>
<td>70</td>
<td>140</td>
<td>80</td>
<td>140</td>
<td>80</td>
<td>150</td>
</tr>
<tr>
<td>Continuous output (320Vdc, 100C Inlet OIl, 10 l/m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed (rpm)</td>
<td>4000</td>
<td>8400</td>
<td>2600</td>
<td>5700</td>
<td>2000</td>
<td>4400</td>
</tr>
<tr>
<td>Torque (N-m)</td>
<td>110</td>
<td>110</td>
<td>210</td>
<td>160</td>
<td>270</td>
<td>210</td>
</tr>
<tr>
<td>Power (kW)</td>
<td>45</td>
<td>90</td>
<td>60</td>
<td>100</td>
<td>60</td>
<td>100</td>
</tr>
</tbody>
</table>

/1\ See pages 16 & 17 for x, y, z definition
5.2 Temperature Derating
Demagnetization will occur at 180°C.

5.3 Back EMF (BEMF) Coefficients
### 5.4 Thermistor Values

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

<table>
<thead>
<tr>
<th>Temp (Degrees C)</th>
<th>R Nominal (Ohms)</th>
<th>Res. Total %</th>
<th>+/-</th>
<th>Temp ACCY (+/- Degrees C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-.40</td>
<td>965530</td>
<td>9.99</td>
<td></td>
<td>1.53</td>
</tr>
<tr>
<td>-.25</td>
<td>379641</td>
<td>9.24</td>
<td></td>
<td>1.56</td>
</tr>
<tr>
<td>0</td>
<td>96248</td>
<td>6.51</td>
<td></td>
<td>1.3</td>
</tr>
<tr>
<td>25 Test Point</td>
<td>30000</td>
<td>5</td>
<td></td>
<td>1.15</td>
</tr>
<tr>
<td>50</td>
<td>10851</td>
<td>6.42</td>
<td></td>
<td>1.68</td>
</tr>
<tr>
<td>75</td>
<td>4450</td>
<td>7.55</td>
<td></td>
<td>2.27</td>
</tr>
<tr>
<td>100</td>
<td>2036</td>
<td>8.67</td>
<td></td>
<td>2.91</td>
</tr>
<tr>
<td>125</td>
<td>1010</td>
<td>9.37</td>
<td></td>
<td>3.55</td>
</tr>
<tr>
<td>150</td>
<td>541.8</td>
<td>10.22</td>
<td></td>
<td>4.33</td>
</tr>
<tr>
<td>175</td>
<td>309.9</td>
<td>10.68</td>
<td></td>
<td>5.05</td>
</tr>
</tbody>
</table>
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.
5.5.2 HVH250-060D
Typical performance capabilities of the HVH250 – 060D are shown in the following two graphs.
5.5.3 HVH250-090S

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

Typical performance capabilities of the HVH250-090D are shown in the following two graphs.
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
(7.1 Housing and Mounting Plate – continued)
(7.1 Housing and Mounting Plate – continued)
(7.1 Housing and Mounting Plate – continued)
(7.1 Housing and Mounting Plate – continued)

**NOTE**

MOTOR MUST BE ORIENTED WITH SUMP AT BOTTOM

**SAE-8 O-RING BOSS (INLET)**

**VENT**

**ALTERNATE MOUNTS (3)**

**OIL COOL FILL PORT**

**OIL COOL INLET PORT**

**REAR VIEW**

**VENT**

**ALTERNATE MOUNTS (3)**

**OIL COOL FILL PORT**

**OIL COOL INLET PORT**

**NOTE**

MOTOR MUST BE ORIENTED WITH SUMP AT BOTTOM
(7.1 Housing and Mounting Plate – continued)

REAR/SIDE VIEW

FRONT/SIDE VIEW

ALTERNATE OIL COOL INLET PORT

LOW VOLTAGE CONNECTOR

WIRING COMPARTMENT COVER

GEARBOX MOUNTING POINTS (24)

OIL OUTLET PORT
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)       | 22.69            |
| 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:

FROM HVH250
- Resolver excitation
- Resolver excitation
- Resolver signal
- Resolver signal
- Resolver signal
- Temperature sensor #1
- Temperature sensor #1
- Safety switch #1
- Safety switch #2

PROVIDED ON SOME MODELS

To INVERTER
- RED
- BLK
- WHI
- RED
- BLK
- YEL
- RED
- BLK
- YEL
- ORG
- GRY
- GRY
- ORG
- GRA
- YLD

Amphenol 038999/20F015PN Connector on HVH250 Motor
Unused positions M thru R filled with uncrimped terminals

Amphenol 038999/25F015SN Connector with MB5049/38-15N Cable Clamp on one end of 3-meter, Belden 9074 Cable. Unused positions P & R filled with uncrimped terminals.
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
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 LOCK WASHER

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
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)

7. ADD COOLANT OIL
Complete connections to cooling system per instructions for Model UCS250 Motor Oil Cooling System.

11. RE-ASSEMBLE WIRING COMPARTMENT COVER PLATE. TORQUE SCREWS TO 3.7 – 4.3 N·m
(8. ADD COOLANT OIL – continued)

Fill cooling system with ATF per following illustrations.

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.

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