



## *Explosion-Proof Servo Motor Technology*

*August 2010*

**Elwood High Performance Motors**

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## *Overview*

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- Definitions
- Hazardous Location Classification
- Servo Motor Ratings
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- Connection Diagrams
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## *Elwood Corporation: Background*

- Privately held
  - Founded: 1973
- Diverse business groups
  - Electronic Products
  - Fluid Power
  - High Performance Motors
  - High Voltage Capacitors
- ISO9001:2000 Certified: **Certificate**
  - ATEX, UL Products
  - AS9102 Products



## *Encompass Partner Products*

- Elwood H-Series Servo Motors
  - Authorized, true drop-in replacements for Rockwell Automation S, H, W, and 1326AS series
  - Website: [Elwood's H-Series Servo Motor Website](#)
  - Brochure: [Elwood's H-Series Brochure](#)
  - Encompass Website:  
[Rockwell Automation's H-Series Encompass Website](#)
  - Pricelist: [Elwood's H-Series Servo Motor Price List](#)



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## *Encompass Partner Products*

- Elwood SX-Series (Explosion Proof) Servo Motors
  - M43x, M44x: Class I, Div. 1 & 2, Groups C & D, T4
  - M46x, M47x: Class I, Div. 1 & 2, Groups C & D, T3C
  - Class II, Div. 1 & 2, Groups E, F, & G, T3C
  - Website: [Elwood's SX-Series Website](#)
  - Brochure: [Elwood's SX-Series Brochure](#)
  - Encompass Website:  
[Rockwell Automation's Encompass Website for SX Series Motors](#)



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## *Enabled Partner*

- SX-Series (Explosion Proof) Servo Motors are a Rockwell Automation Enabled Partner Product.
  - Motors integrate as if they were produced by Rockwell Automation product
  - Motor data files included in Logix database
  - Blob files preloaded for self-recognition (on versions with absolute (Stegmann) feedback)



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## *Definitions (From NEC):*

- **Hazardous Location:** “Where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings.
- **Explosion-Proof (flame proof):** An enclosure designed to contain the explosion of a flammable mixture originating internally without damage and without causing ignition in the external environment.
- **Flame Path:** The joints of a flame proof enclosure designed to contain an internal flame.
- **Increased Safety:** Protection applied to electrical equipment that will not produce arcs and sparks in typical use and specified abnormal conditions.
- **Intrinsic Safety:** Protection where any spark or thermal effect is incapable of causing ignition.

## ***Hazardous Location Classification***

- National Electric Code (NEC) sections 500 – 517 classify and specify installation requirements of Hazardous locations.
- The Occupational Safety and Health Administration has oversight for inspecting/evaluating installations in Hazardous locations.
- Typically, organizations will conduct a risk assessment to determine requirements for specific installations
  - Safety committee
  - Consultants



## ***Class I: Gas Atmospheres***

- From NEC 500.5: Class I locations are those in which flammable gases, flammable liquid-produced vapors, or combustible liquid-produced vapors are or may be present in the air.

## *Class I: Division Classification*

- **Division 1:** Where ignitable concentrations of flammable gases, vapors or liquids can exist all of the time or some of the time under normal operating conditions.
- **Division 2:**  
Where ignitable concentrations of flammable gases, vapors or liquids are not likely to exist under normal operating conditions.

## *Zone Classification*

- Zone Classification is an alternative method to Division Classification from CSA, IEC, and EU Standards
- **Zone 0:** Where ignitable concentrations of flammable gases, vapors or liquids are present continuously or for long periods of time under normal operating conditions.
- **Zone 1:** Where ignitable concentrations of flammable gases, vapors or liquids are likely to exist under normal operating conditions.
- **Zone 2:** Where ignitable concentrations of flammable gases, vapors or liquids are not likely to exist under normal operating conditions.

## *Division – Zone Comparison*

- Division 1 is equated to Zones 0 and Zone 1
- Division 2 is equated to Zone 2
- Zone Classification is the method used by IEC and EU (ATEX)

## *Class I - Groups*

- Groups define the hazardous chemicals present.
- **Division Classification:**
  - Group A: (acetylene)
  - Group B (hydrogen)
  - Group C (ethylene)
  - Group D (propane)
- **Zone Classification:**
  - IIC (acetylene & hydrogen)
  - IIB (ethylene)
  - IIA (propane)



## ***Class II: Dust Atmospheres***

- From NEC 502.1: Class II locations are those in which fire or explosion hazards may exist due to combustible dust

## ***Class II: Divisions, Zones***

- Divisions 1 and 2 for Class II environments are equivalent to Class I
- Zones for Class II environments are equivalent to Class I but preceded by '2'
  - Zone 0 (Class I) ~ Zone 20 (Class II)
  - Zone 1 (Class I) ~ Zone 21 (Class II)
  - Zone 2 (Class I) ~ Zone 22 (Class II)

## *Class II - Groups*

- Groups define the hazardous dust present.
  - Group E (metals - Div. 1 only)
  - Group F (coal)
  - Group G (grain)



## *Temperature Ratings*

- Temperature ratings reflect the maximum surface temperature allowed
- Temperature rating of a device may not exceed the ignition temperature of the hazardous gas, liquid, vapor, dust present.

T1 ----- 450°C

T2 ----- 300°C

T3 ----- 200°C

T3A ----- 180°C

T3B ----- 165°C

T3C ----- 160°C

T4 ----- 135°C

T5 ----- 100°C

T6 ----- 85°C

## *Motor Ratings*

- Division System (Example)

### **Class I Div. 1 Group C T3**

- Class I: Gas Atmosphere
- Div. 1: Division 1 – Continuous presence of hazard
- Group C: Ether type hazard (group)
- T3: Maximum surface temperature - 135°C

- Zone System (Equivalent Example)

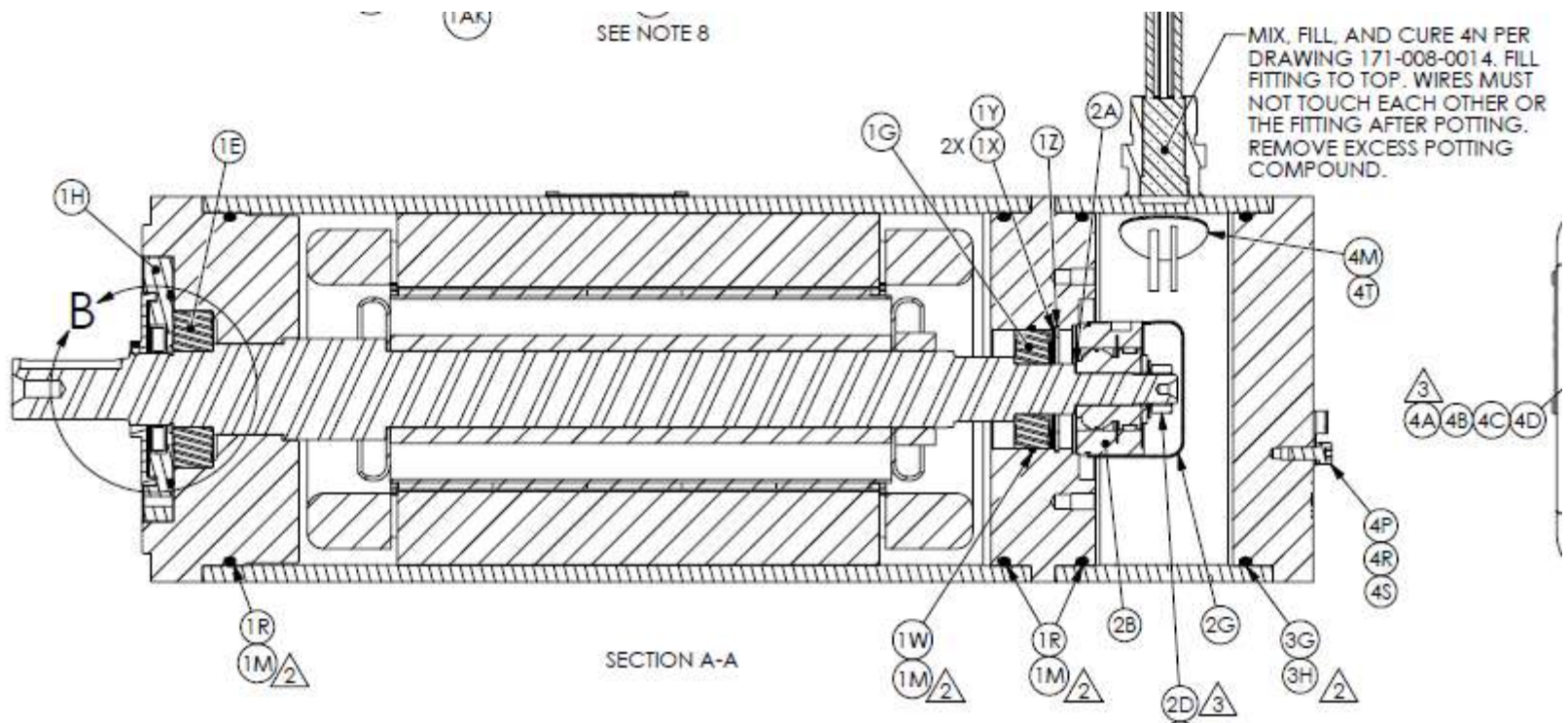
### **Class I Zone 1 A Ex d IIB T3**

- Zone 1: Likely presence of hazard
- A Ex: US Standard, Explosion Proof
- d: Flame proof enclosure
- IIB: Ether type hazard (group)

## *Motor Construction*

- Materials are certified (tensile tested)
- Tie bolts
- Welded conductor standoff
- Potted conductor exits
- Seals are present but not included in flame path
- Assembly fit calculations and records (verification)
- Class II motors incorporate a slinger at the shaft
- Repairs must be conducted at the factory to maintain motor rating/certification

# Motor Construction



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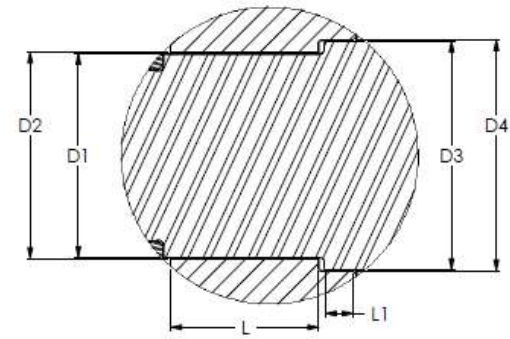
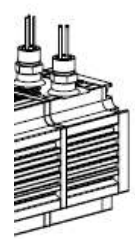
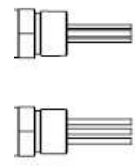
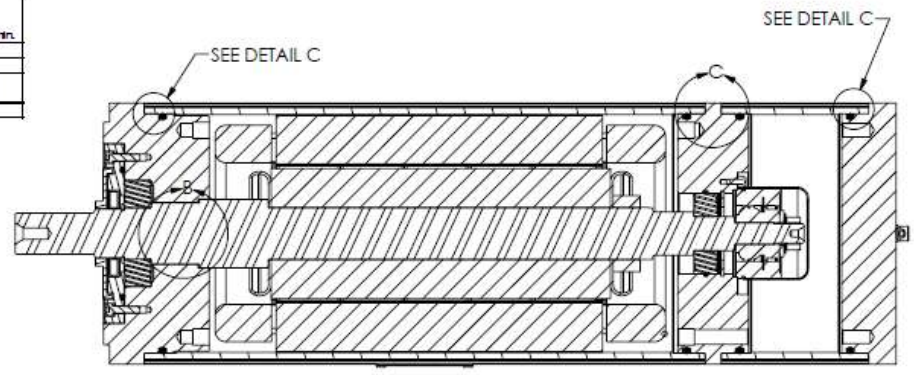
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## Motor Flame Path Fit

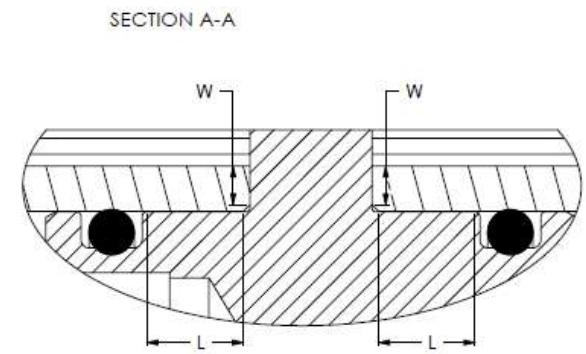
FRONTBELL "L"		FRONTBELL "L1"		FRONTBELL "D2"		SHAFT "D1"		"D2" - "D1"		SHAFT "D3"		FRONTBELL "D4"		"D4" - "D3"	
spec = 1.00 min		spec = .125 min						spec = .021 max						spec = .021 max	
MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
1.010	1.030	0.168	0.223	1.421	1.435	1.404	1.408	0.013	0.021	1.573	1.577	1.550	1.554	0.013	0.021

REVISION			
REV	DESCRIPTION	DATE	APPROVED
A	PRODUCTION RELEASE	04/27/09	DAW

DETAIL C RABBIT JOINT FLAMEPATH					
	FRONTBELL "L"		HOUSING "W"		"L" - "W" spec 3/8 (.375) min.
	MIN	MAX	MIN	MAX	
LENGTH	0.296	0.325	0.081	0.154	0.375
DIA	5.4580	5.4580	5.5000	5.5010	ID-OD spec .003 max. 0.0030



DETAIL B



DETAIL C



FIRST USED	999-000-9970 M465-GNS0-B508	TOLERANCE	UNLESS OTHERWISE SPECIFIED	DRAWN	DAW 04/27/09	MPL APPROVED	
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## *Connection Diagrams*

- Connection Diagram for SX-Series Motors with Resolvers: **Resolver**
- Connection Diagram for SX-Series Motors with Incremental Encoders: **Incremental**
- Connection Diagram for SX-Series Motors with Absolute (Stegmann) Encoders: **Absolute**



## *Additional Resources*

- OSHA's website describing and classifying hazardous locations
- UL: On-site Safety Evaluations
- Adalet: Explosion-Proof Enclosures
- Appleton Electric: Explosion-Proof Enclosures
- Kilark (Hubbell): Explosion-Proof Enclosures
- Expo Technologies: Hazardous Area Solutions

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