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## MCK and MCK-5

*MCK flame-retardant motor connection kits for 1/C low-voltage poly cable (1000 V) and MCK-5 motor connection kits for 1/C poly cable (5/8.7 kV)*

### Type V

The Type V kit is designed to splice the stub or butt configuration that is commonly used where there is insufficient room to make in-line connections.

### Type L

The Type L kit is used, where space permits, to splice in-line connections.

MCK is qualified to ANSI-C119.1-1986 and rated to ICEA electrical withstand test for 1000 V.

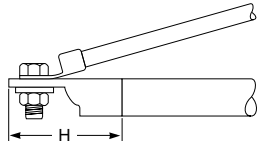
MCK-5 is rated to the general electrical requirements of the IEEE-48 withstand tests.

For use as an in-line or stub splice between 1/C poly feeder cable and motor leads.

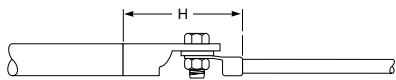
Tyco Electronics' motor connection kit provides excellent insulation sealing—and resistance to abrasion—in motor connections.

### Selection information (dimensions in inches/millimeters)

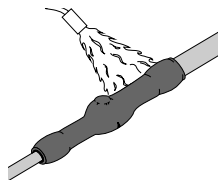
Catalog number	Motor feeder size (AWG/kcmil)	Bolt length (max.)	Connection length (max.) H	Length (nominal)
<b>MCK (1000 V)</b>				
<b>Type V (stub)</b>				<b>Cap</b>
MCK-1V	#14-#10	5/8	2.0 (51)	2.5 (64)
MCK-2V	#12-#4	3/4	2.5 (64)	3.4 (86)
MCK-3V	#2-4/0	1	3.5 (89)	4.5 (114)
MCK-4V	250-500	1 1/2	5.5 (140)	6.5 (165)
<b>Type L (in-line)</b>				<b>Sleeve</b>
MCK-1L	#8-4/0	1 1/4	5.0 (127)	9.0 (229)
MCK-2L	250-1000	1 1/2	8.0 (203)	12.0 (305)
<b>*MCK (5/8.7 kV)</b>				
<b>Type V (stub)</b>				<b>Cap</b>
MCK-5-1V	#8-#2	1	5.0 (127)	7.5 (191)
MCK-5-2V	#1-250	1 1/2	6.0 (152)	8.5 (216)
MCK-5-3V	300-750	1 1/2	7.0 (178)	9.5 (241)
<b>*Type L (in-line)</b>				<b>Sleeve</b>
MCK-5-1L	#8-250	1	6.0 (152)	12.0 (305)
MCK-5-2L	300-1000	1 1/2	7.0 (178)	14.0 (356)



Type V  
Stub configuration



Type L  
In-line configuration



### Ordering information

- Select appropriate catalog number based on the motor feeder cable. Motor pigtail leads of the same size or smaller are suitable. MCK selections are based on the typical dimensions of low-voltage insulated cable. MCK-5 selections are based on the typical dimensions of 100%-insulated cables manufactured in accordance with the data contained in AEIC CS5-1987 and AEIC CS6-1987, as well as the dimensions of commonly used connectors. Nominal insulation thickness (100%): 90 mils. For cables manufactured to other specifications, confirm selection with cable and connector dimensions.
- \* Shielded cable must be terminated before installing MCK-5 (use Tyco Electronics HVT-80-G/SG terminations from page 101).
- MCK and MCK-5 kits are designed for single-hole connectors and include caps and sealant strips for three connections. Kits do not contain connectors.
- Standard package:  
MCK: 5 kits/box.  
MCK-5: 1 kit/box.
- Related test reports:  
MCK: [EDR-5110](#)  
MCK-5: [EDR-5010](#)

Related installation instructions  
[MCK-xV](#) [MCK-5-xL](#) [MCK-5-xV](#)  
[MCK-L](#)



### MCK-5-xL 5-8kV Class

## Motor (In-line) Connection Kits for 1/C Medium-Voltage Power Cable

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### General Instructions

#### Suggested Installation Equipment (not supplied with kit)

- Cable preparation tools
- Raychem P42 cable preparation kit or cable manufacturer approved solvent
- Clean, lint-free cloths
- Lug(s) and installation tools
- Raychem recommended torch

#### Recommended Raychem Torches

Install heat-shrinkable cable accessories with a "clean burning" torch, i.e., a propane torch that does not deposit conductive contaminants on the product.

Clean burning torches include the Raychem FH-2609, FH-2629 (uses refillable propane cylinders) and FH-2616A1 (uses disposable cylinder).

#### Safety Instructions

**Warning:** When installing electrical power system accessories, failure to follow applicable personal safety requirements and written installation instructions could result in fire or explosion and serious or fatal injuries.

To avoid risk of accidental fire or explosion when using gas torches, always check all connections for leaks before igniting the torch and follow the torch manufacturer's safety instructions.

To minimize any effect of fumes produced during installation, always provide good ventilation of confined work spaces.

#### Adjusting the Torch

Adjust regulator and torch as required to provide an overall 12- inch bushy flame.

The FH-2629 will be all blue, the other torches will have a 3- to 4-inch yellow tip. Use the yellow tip for shrinking.

#### Regulator Pressure

FH-2616A1	Full pressure
FH-2609	5 psig
FH-2629	15 psig

#### General Shrinking Instructions

- Apply outer 3- to 4-inch tip of the flame to heat-shrinkable material with a rapid brushing motion.
- Keep flame moving to avoid scorching.
- Unless otherwise instructed, start shrinking tube at center, working flame around all sides of the tube to apply uniform heat.

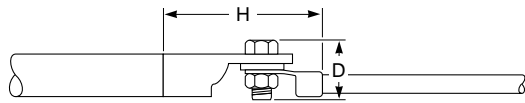
To determine if a tube has completely recovered, look for the following, especially on the back and underside of the tube:

1. Uniform wall thickness.
2. Conformance to substrate.
3. No flat spots or chill marks.
4. Visible sealant flow if the tube is coated.

## 1. Product selection.

Check kit selection with cable dimensions in Table 1.

**Note:** The Raychem MCK-5 Motor Connection Kit is designed for use with shielded or unshielded feeder cables. When shielded cables are used, a Raychem HVT termination kit is recommended to terminate the feeder cable prior to installation of the MCK-5.



**Table 1**

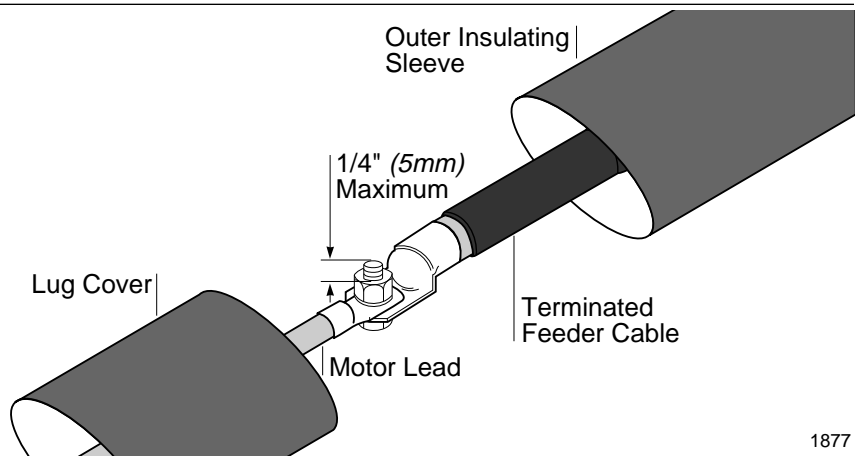
Kit	Motor Feeder Conductor Size	Bolt Length Max (D)	Connection Length Max (H)
MCK-5-1L	#8-250 kcmil	1" (25mm)	6.0" (150mm)
MCK-5-2L	300-1000 kcmil	1-1/2" (40mm)	7.0" (175mm)

## 2. Position tubes; install lugs.

After completing phase rotation check, align motor lead with appropriate feeder cable.

Remove all fiber braid (if any) from the cables and clean for 6" (150mm) beyond each lug. Place the tubes over the cables as shown.

Install lugs on feeder cables and motor leads. Bolt connections tight. Insert bolt through tang of largest lug first. Bolt must not extend through nut more than 1/4" (5mm).



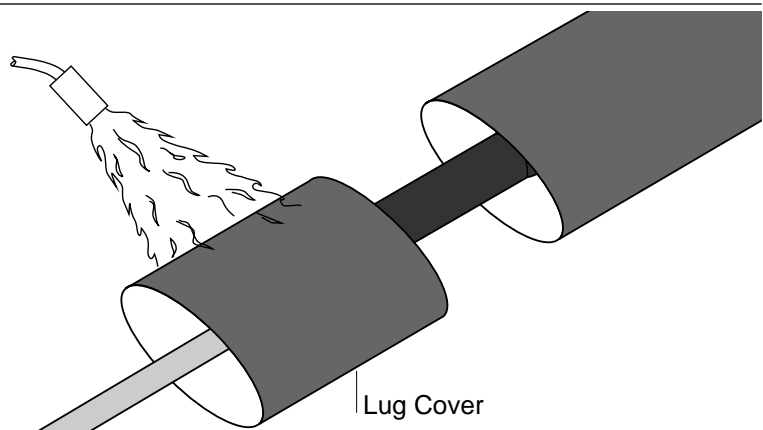
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**Note:** MCK insulating caps are designed to accommodate the largest lugs normally used. However, many installations require shorter caps due to space limitations. MCK can be trimmed to any desired length as long as the following rules are observed.

- The cuts must be clean with no jagged edges.
- The cap length must be sufficient to completely cover the mastic strips – approximately 1-1/2" (40mm) beyond the end of the longest lug barrel.
- If the cap is trimmed, an equal length should be trimmed from the lug cover sleeve.

## 3. Install lug cover.

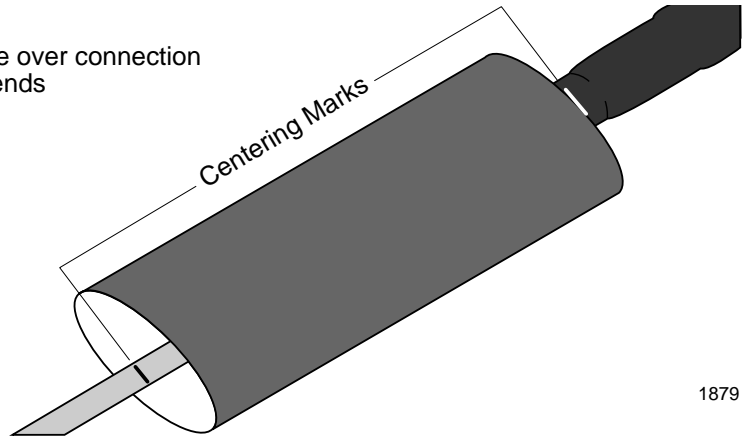
Center the lug cover sleeve over the bolted connection and shrink in place.



## 4. Mark cables.

Center the outer insulating sleeve over the connection area and mark its end positions on the cables.

Center tube over connection and mark ends

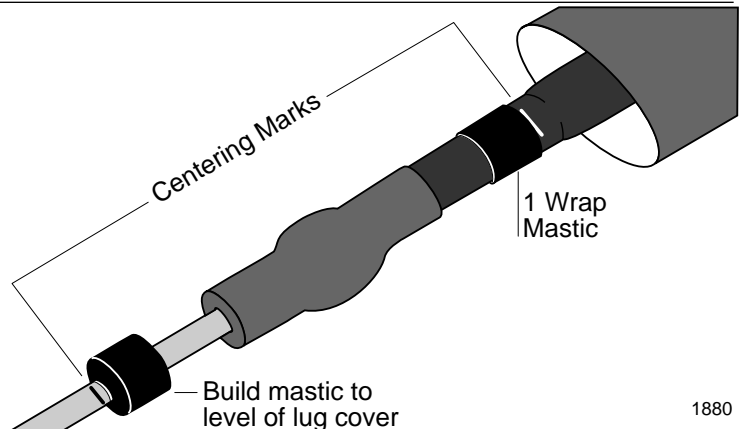


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## 5. Apply mastic.

Remove release papers from mastic strip. Make one complete wrap of mastic around the feeder cable, just inside the mark made in Step 4.

Wrap mastic around the motor lead (just inside mark made in Step 4). Make as many wraps as necessary to build the motor lead up to the diameter of the lug cover sleeve. Discard excess mastic.



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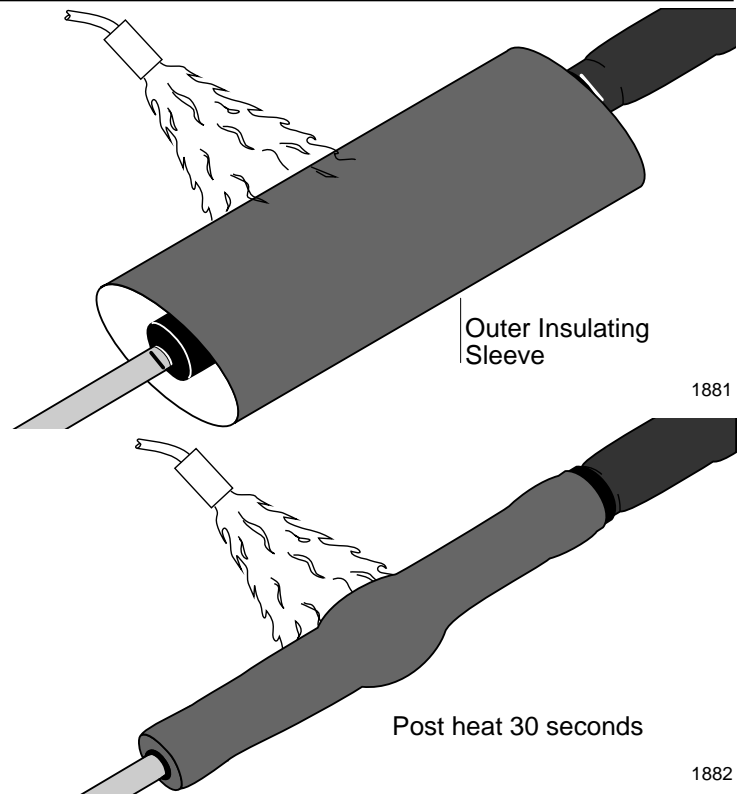
## 6. Position tube; shrink in place.

Center the outer sleeve over the connection area, covering the mastic wraps. Begin shrinking at the center, working the torch with a smooth, brushing motion around all sides of the sleeve.

Continue to each end as the sleeve shrinks and conforms to the cable contours. Post heat sleeve for approximately 30 seconds after sleeve has fully shrunk.

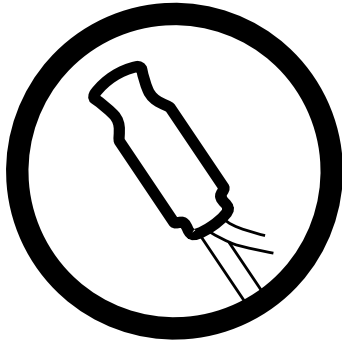
Allow to cool enough to touch before replacing in motor terminal box.

**Installation is complete.**



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## MCK-5-xV 5-8kV Class

### Motor (Stub) Connection Kits for 1/C Medium-Voltage Power Cable

#### General Instructions

##### Suggested Installation Equipment (not supplied with kit)

- Raychem P63 cable preparation kit or cable manufacturer approved solvent
- Cable preparation tools
- Lug(s) and installation tools
- Clean, lint-free cloths

##### Recommended Raychem Torches

Install heat-shrinkable cable accessories with a "clean burning" torch, i.e., a propane torch that does not deposit conductive contaminants on the product.

Clean burning torches include the Raychem FH-2609, FH-2629 (uses refillable propane cylinders) and FH-2616A1 (uses disposable cylinder).

##### Safety Instructions

**Warning:** When installing electrical power system accessories, failure to follow applicable personal safety requirements and written installation instructions could result in fire or explosion and serious or fatal injuries.

To avoid risk of accidental fire or explosion when using gas torches, always check all connections for leaks before igniting the torch and follow the torch manufacturer's safety instructions.

To minimize any effect of fumes produced during installation, always provide good ventilation of confined work spaces.

*As Raychem has no control over field conditions which influence product installation, it is understood that the user must take this into account and apply his own experience and expertise when installing product.*

##### Adjusting the Torch

Adjust regulator and torch as required to provide an overall 12- inch bushy flame. The FH-2629 will be all blue, the other

torches will have a 3- to 4-inch yellow tip. Use the yellow tip for shrinking.

##### Regulator Pressure

FH-2616A1	Full pressure
FH-2609	5 psig
FH-2629	15 psig

##### Cleaning the Cable

Use an approved solvent, such as the one supplied in the P63 Cable Prep Kit, to clean the cable. Be sure to follow the manufacturer's instructions. Failure to follow these instructions could lead to product failure.

Some newer solvents do not evaporate quickly and need to be removed with a clean, lint-free cloth. Failure to do so could change the volume resistivity of the substrate or leave a residue on the surface.

Please follow the manufacturer's instructions carefully.

##### General Shrinking Instructions

- Apply outer 3- to 4-inch tip of the flame to heat-shrinkable material with a rapid brushing motion.
- Keep flame moving to avoid scorching.
- Unless otherwise instructed, start shrinking tube at center, working flame around all sides of the tube to apply uniform heat.

To determine if a tube has completely recovered, look for the following, especially on the back and underside of the tube:

1. Uniform wall thickness.
2. Conformance to substrate.
3. No flat spots or chill marks.
4. Visible sealant flow if the tube is coated.

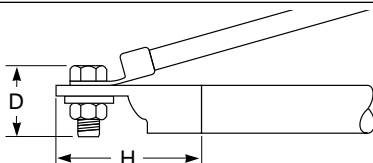
**Note:** When installing multiple tubes, make sure that the surface of the last tube is still warm before positioning and shrinking the next tube. If installed tube has cooled, re-heat the entire surface.

#### Installation Instructions

##### 1. Product selection.

Check kit selection with cable dimensions in Table 1.

**Note:** The Raychem MCK-5 Motor Connection Kit is designed for use with shielded or unshielded feeder cables. When shielded cables are used, a Raychem HVT termination kit is recommended to terminate the feeder cable prior to installation of the MCK-5.

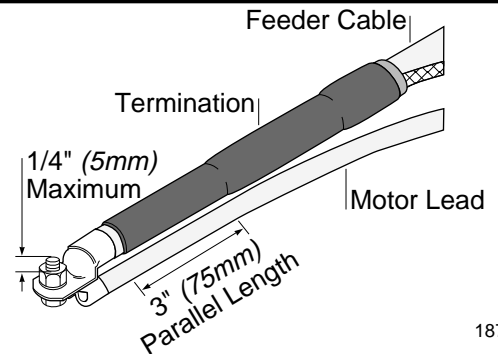


**Table 1**

Kit	Motor Feeder Conductor Size	Bolt Length Max (D)	Connection Length Max (H)
MCK-5-1V	#8-#2 AWG	1" (25mm)	5.0" (156mm)
MCK-5-2V	#1-250 kcmil	1-1/2" (40mm)	6.0" (150mm)
MCK-5-3V	300-750 kcmil	1-1/2" (40mm)	7.0" (175mm)

**2. Install lugs.**

After completing phase rotation check, align motor lead with appropriate feeder cable. Leads must be parallel for a minimum of 3" (75mm) beyond the end of the longest lug. Remove all fiber braid (if any) from the motor lead. Clean both cables with approved solvent. Install lugs on feeder cables and motor leads. Bolt connections tight. Insert bolt through tang of smallest lug first. Bolt must not extend through nut more than 1/4" (5mm).



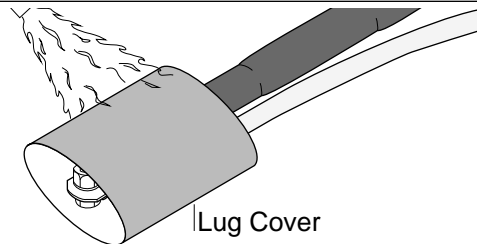
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**Note:** MCK insulating caps are designed to accommodate the largest lugs normally used. However, many installations require shorter caps due to space limitations. MCK can be trimmed to any desired length as long as the following rules are observed.

- The cuts must be clean with no jagged edges.
- The cap length must be sufficient to completely cover the mastic strips – approximately 1-1/2" (40mm) beyond the end of the longest lug barrel.
- If the cap is trimmed, an equal length should be trimmed from the lug cover sleeve.

**3. Install lug cover.**

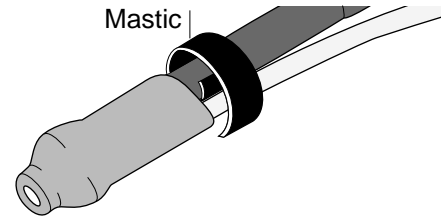
Place the lug cover sleeve over the bolted connection and shrink in place.



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**4. Apply mastic.**

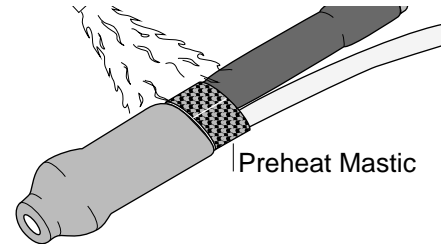
Remove release papers from mastic strip. Insert one end between the leads of one phase just beyond the end of the lug cover sleeve. Make one complete wrap of mastic around both cables. Discard excess mastic.



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**5. Preheat mastic.**

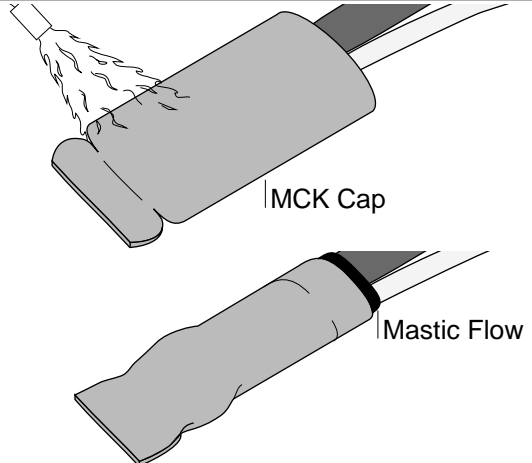
Heat the mastic with a brushing motion for approximately 15 seconds or until surface foaming occurs.



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**6. Position cap; shrink in place.**

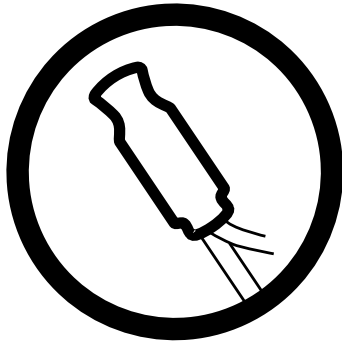
Place the cap over the connection as far as possible. Begin shrinking at the closed end, working the torch with a smooth, brushing motion around all sides of the cap. Continue to the open end as the cap shrinks and conforms to the cable contours. Post heat mastic area approximately 30 seconds after cap has fully shrunk. With gloved hand or cloth, compress the mastic area to knead the sealant between the leads. Allow to cool enough to touch before replacing in motor terminal box. Repeat Steps 2-6 for remaining phases.



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**Installation is complete.**



## MCK-5-xV 5-8kV Kit de Conexión de Motores Conexiones de Punta (Tipo V)

### Instrucciones Generales

#### Equipo Sugerido de Instalación (no se suministra con el equipo)

- Herramientas de preparación de cables
- Trapos limpios libres de peluzas
- Soplete recomendado por Raychem
- Equipo de preparación de cables Raychem p63 o solvente aprobado por el fabricante
- Cinta de electricista
- Tela o papel abrasivo, no-conductivo, de fineza 120 o más fina
- Conector(es) y herramientas de instalación

#### Sopletes Recomendados por Raychem

Instale los accesorios termocontráctiles con un soplete de flama limpia, ejemplo: un soplete de propano que no deposite

contaminantes conductivos en el producto. Los sopletes de flama limpia incluyen al Raychem FH-2609, Fh-2629 (usa cilindros de propano recargables) y FH-2616Al (usa cilindros desechables).

#### Instrucciones de seguridad

**Advertencia:** Cuando se instalen los accesorios del sistema de energía eléctrica, el no seguir los requerimientos personales de seguridad y las instrucciones escritas referente a la instalación, podría dar como resultado un incendio o una explosión y causar serios o fatales perjuicios. Para evitar riesgo de fuego accidental o

de explosión, cuando se utilicen sopletes de gas, siempre revise todas las conexiones por fugas, antes de encender el soplete y siga las instrucciones de seguridad del soplete. Para minimizar cualquier efecto de humo producido durante la instalación, provéase siempre de una buena ventilación en el lugar de trabajo.

*Como Raychem no controla todas las condiciones que pueden influir en la instalación del producto en campo, queda entendido que el usuario debe tomar esto en cuenta y aplicar su propia experiencia y práctica cuando instale el producto.*

#### Ajustando el soplete

Ajuste el regulador y el soplete como se requiere, para así proporcionar una flama espesa de un total de 12 pulgadas.

En el FH-2629 la flama será toda azul, los otros sopletes tendrán un extremo amarillo de 3 a 4 pulgadas. Use el extremo amarillo para la termocontracción.

#### Presión del regulador

FH-2616A1	Presión completa
FH-2609	5 psig
FH-2629	15 psig

#### Limpieza del Cable

Use un solvente adecuado como el provisto en el kit P63. Asegúrese de seguir las instrucciones del producto. Un descuido puede provocar que el producto falle.

Algunos solventes nuevos no se evaporan rápidamente y necesitan ser removidos con un paño limpio y libre de peluzas. De no ser así, pueden provocarse cambios en la

resistividad volumétrica del sustrato o dejar residuos en la superficie. Siga cuidadosamente las instrucciones del fabricante.

#### Instrucciones Generales de Termocontracción

- Aplique el extremo exterior de 3 a 4 pulgadas de la flama, al material termocontráctil al calor con un suave movimiento de cepillado.
- Mantenga la flama moviéndose para obtener una termocontracción uniforme y evitar el chamusqueo.

A menos que se le instruya de hacerlo distinto, comience a termocontraer el tubo desde el centro, trabajando la flama alrededor de todas las partes del tubo para aplicar un calor uniforme. Para determinar si el tubo se ha instalado correctamente obsérvelo especialmente en la parte de atrás:

- 1.-Grosor uniforme de las paredes.
- 2.-Confomación de los substratos.
- 3.-Sin puntos planos o marcas frías.
- 4.-Flujo sellador visible si el tubo esta cubierto.

**Nota:** Cuando se instalen tubos múltiples, asegúrese de que la superficie del último esté todavía caliente, antes de acoplar y encoger el siguiente tubo. Si instala el tubo en frío, recaliente la superficie entera.

## Instructivo de Instalación

### 1. Selección del Producto.

Verifique la selección del kit con las dimensiones del cable en la Tabla 1.

**Nota:** El Kit Raychem MCK-5 para Conexión de Motor, está diseñado para usarse con cables alimentadores con o sin pantalla. Cuando se use en cables con pantalla, se recomienda utilizar una terminal Raychem HVT en el cable alimentador antes de instalar el MCK-5.

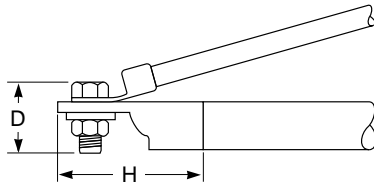


Tabla 1

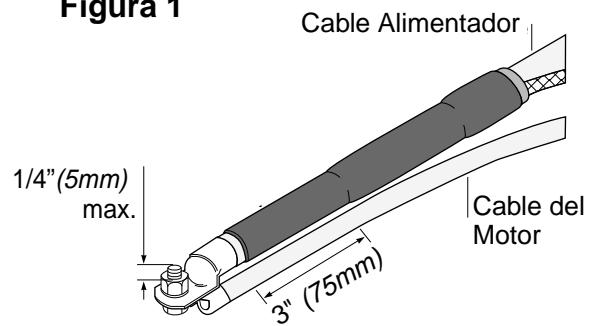
Kit	Calibre Alimentador	Longitud tornillo Max (D)	Longitud de la Conexión Max (H)
MCK-5-1V	#8-#2 AWG	1" (25mm)	5.0" (156mm)
MCK-5-2V	#1-250 kcmil	1-1/2" (40mm)	6.0" (150mm)
MCK-5-3V	300-750 kcmil	1-1/2" (40mm)	7.0" (175mm)

2. Después de completar el chequeo de la fase de rotación, alinee el cable del motor con el cable alimentador apropiado. Asegurese que el cable alimentador y el cable del motor estén paralelos dentro de una distancia mínima de 3 pulg. a partir del extremo del conector del cable del motor, como se muestra en la Fig. 1 .

3. Remueva todo el trenzado (si lo hay) del cable del motor. Limpie ambos cables con un solvente apropiado.

4. Realice la conexión de los cables. En caso de utilizár tornillo en la conexión, asegurese que el alto de la rosca a través de la tuerca no sobresalga mas de 1/4 de pulg. (Fig. 1).

Figura 1



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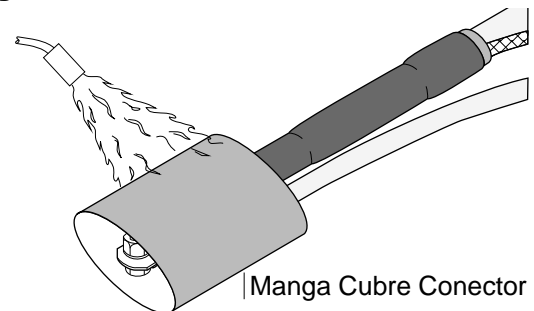
5. Cubra la conexión con la manga y contraigala en el lugar\* (Fig. 2).

**\*NOTA:** Las mangas de aislamiento MCK-5, están diseñadas para cubrir al conector más grande normalmente utilizado. Sin embargo, algunas instalaciones requieren mangas más cortas debido a las limitaciones de espacio. El MCK-5 puede acondicionarse a la longitud deseada siempre y cuando se observen las siguientes-reglas:

- El corte debe ser limpio sin bordes dentados.
- El capuchón debe ser lo suficientemente largo para cubrir completamente la tira de adhesivo inclusive hasta 1 1/2 pulgadas más allá del borde del conector.
- Si se acondiciona el capuchón a una longitud requerida también debe acondicionarse la manga que cubre la conexión.

6. Continúe calentando por espacio de unos 15 segundos adicionales, justo debajo de la manga que cubre la conexión (Fig. 2).

Figura 2



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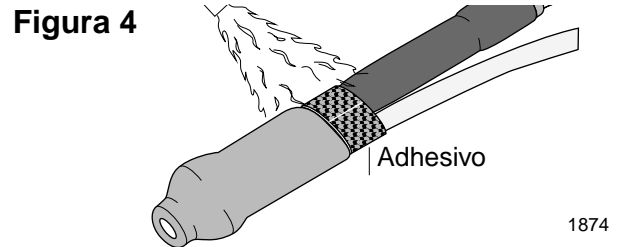


## Instructivo de Instalación

7. Remueva la tira de papel protector del adhesivo. Introduzca una punta de la tira de adhesivo entre los cables justo al final de la manga que cubre la conexión.

8. Con la tira de adhesivo dele una vuelta completa alrededor de ambos cables.

9. Caliente el adhesivo con movimientos continuos por espacio de 15 segundos o hasta que la superficie se torne espumosa. (Fig. 4).



10. Introduzca la conexión hasta el extremo del capuchón. Comience a contraer el capuchón desde el extremo cerrado hacia el extremo abierto, moviendo continuamente la flama.

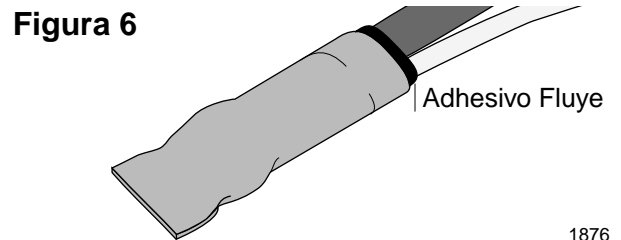
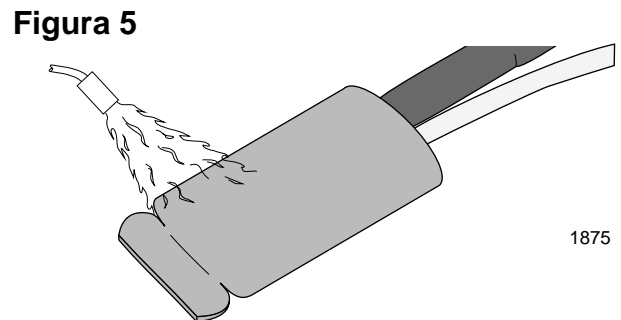
**\*NOTA:** Si el capuchón es muy largo refiérase a los pasos para el acondicionamiento en el Punto 5.

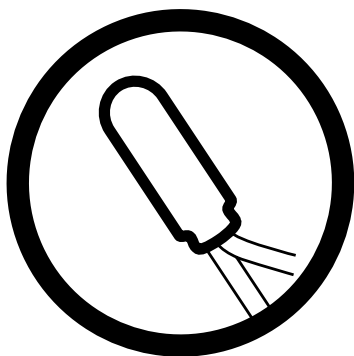
11. Una vez contraído completamente el capuchón, continúe calentando por espacio de unos 30 segundos el área sobre la cual colocó el adhesivo.

12. Con la mano protegida por un guante o paño, comprima el área donde aplicó el adhesivo para conformar el sello entre los cables. Una vez completado este paso puede darse por concluida la conexión.

13. Repita los pasos para las otras fases.

14. Todas las conexiones deben estar suficientemente frías al tacto para introducirlas en la caja terminal del motor.





# MCK-xV

## 1000V Flame-Retarded Motor (Stub) Connection Kits for 1/C Low-Voltage Power Cable

### General Instructions

#### Suggested Installation Equipment (not supplied with kit)

- Raychem P63 cable preparation kit or cable manufacturer approved solvent
- Cable preparation tools
- Lug(s) and installation tools
- Clean, lint-free cloths

#### Recommended Raychem Torches

Install heat-shrinkable cable accessories with a "clean burning" torch, i.e., a propane torch that does not deposit conductive contaminants on the product.

Clean burning torches include the Raychem FH-2629 (uses refillable propane cylinders) and FH-2618A1 (uses disposable cylinder).

#### Safety Instructions

**Warning:** When installing electrical power system accessories, failure to follow applicable personal safety requirements and written installation instructions could result in fire or explosion and serious or fatal injuries.

To avoid risk of accidental fire or explosion when using gas torches, always check all connections for leaks before igniting the torch and follow the torch manufacturer's safety instructions.

To minimize any effect of fumes produced during installation, always provide good ventilation of confined work spaces.

*As Raychem has no control over field conditions which influence product installation, it is understood that the user must take this into account and apply his own experience and expertise when installing product.*

#### Adjusting the Torch

Adjust regulator and torch as required to provide an overall 12- inch bushy flame. The FH-2629 will be all blue, the other

torches will have a 3- to 4-inch yellow tip. Use the yellow tip for shrinking.

#### Regulator Pressure

FH-2618A1	Full pressure
FH-2629	15 psig

#### Cleaning the Cable

Use an approved solvent, such as the one supplied in the P63 Cable Prep Kit, to clean the cable. Be sure to follow the manufacturer's instructions. Failure to follow these instructions could lead to product failure.

Some newer solvents do not evaporate quickly and need to be removed with a clean, lint-free cloth. Failure to do so could change the volume resistivity of the substrate or leave a residue on the surface.

Please follow the manufacturer's instructions carefully.

#### General Shrinking Instructions

- Apply outer 3- to 4-inch tip of the flame to heat-shrinkable material with a rapid brushing motion.
- Keep flame moving to avoid scorching.
- Unless otherwise instructed, start shrinking tube at center, working flame around all sides of the tube to apply uniform heat.

To determine if a tube has completely recovered, look for the following, especially on the back and underside of the tube:

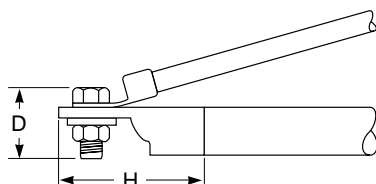
1. Uniform wall thickness.
2. Conformance to substrate.
3. No flat spots or chill marks.
4. Visible sealant flow if the tube is coated.

**Note:** When installing multiple tubes, make sure that the surface of the last tube is still warm before positioning and shrinking the next tube. If installed tube has cooled, re-heat the entire surface.

### Installation Instructions

#### 1. Product selection.

Check kit selection with cable dimensions in Table 1.

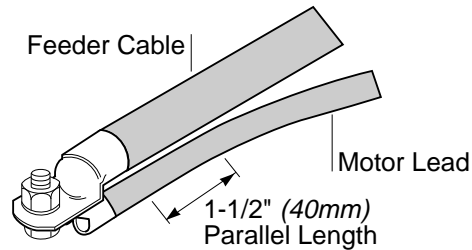


**Table 1**

Kit	Motor Feeder Conductor Size	Bolt Length Max (D)	Connection Length Max (H)
MCK-1V	#14-#10 AWG	5/8" (15mm)	2.0" (50mm)
MCK-2V	#12-#4 AWG	3/4" (20mm)	2.5" (65mm)
MCK-3V	#2-4/0 AWG	1" (25mm)	3.5" (89mm)
MCK-4V	250-500 kcmil	1-1/2" (35mm)	5.5" (140mm)

## 2. Install lugs.

Install lugs on feeder cables and motor leads. Bolt connections tight. Bolts should be inserted through the tang of the smallest lug first. Leads must be parallel for a minimum of 1-1/2" (40mm) beyond the end of the longest lug.

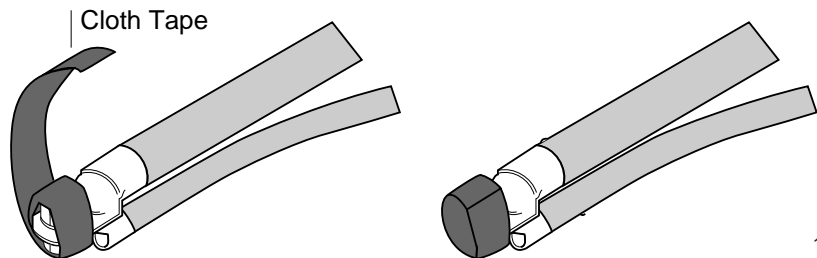


1863

**Note:** If a rotation check is desired, place caps over the connection area to provide temporary insulation while bumping the motor. **Do not shrink.** After check, remove caps and proceed to next step.

## 3. Apply cloth tape to lug.

Wrap the bolt area with a cloth tape strip to keep the hardware clean.

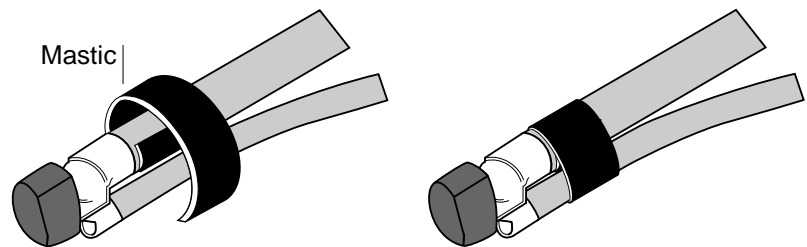


1864

## 4. Apply mastic to cable jacket.

Remove release papers from mastic strip. Insert one end between the leads of one phase just beyond the end of the lug barrel.

Make one complete wrap of mastic around both cables. Discard excess mastic.

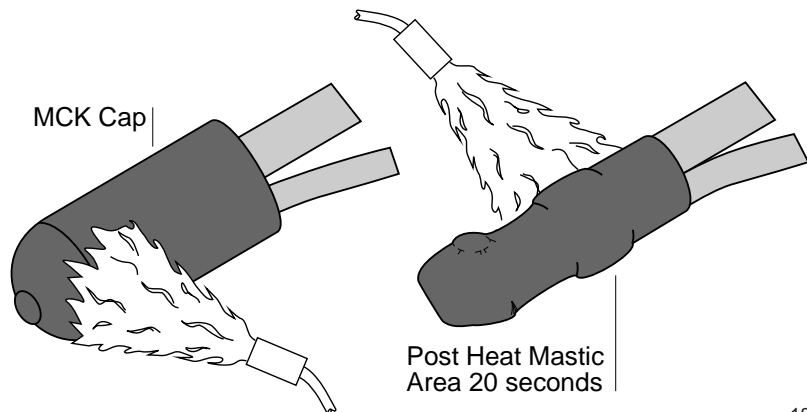


1865

## 5. Position cap; shrink in place.

Place the cap over the connection as far as possible. Begin shrinking at the closed end, working the torch with a smooth, brushing motion around all sides of the cap.

Continue to the open end as the cap shrinks and conforms to the cable contours. Post heat mastic area approximately 20 seconds after cap has fully shrunk.

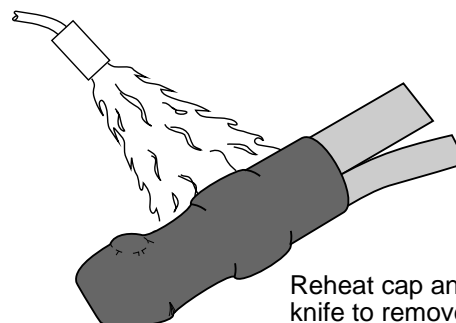


1866

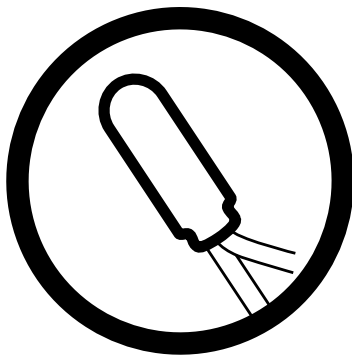
**Installation is complete.**

## 6. Removal.

To remove, reheat cap and score with a knife. Peel the cap off with pliers. Remove cloth tape to expose clean bolted connection.



1867



# MCK-xV

## Kit para Conexión de Motor 1000V Retardada a la Flama para Cable de Energía de Bajo Tensión 1/C

### Instrucciones Generales

#### Equipo Sugerido de Instalación (no se suministra con el equipo)

- Herramientas de preparación de cables
- Trapos limpios libres de peluzas
- Soplete recomendado por Raychem
- Equipo de preparación de cables Raychem P63 o solvente aprobado por el fabricante
- Cinta de electricista
- Tela o papel abrasivo, no-conductivo, de fineza 120 o más fina
- Conector(es) y herramientas de instalación

#### Sopletes Recomendados por Raychem

Instale los accesorios termocontráctiles con un soplete de flama limpia, ejemplo: un soplete de propano que no deposite

contaminantes conductivos en el producto. Los sopletes de flama limpia incluyen al Raychem Fh-2629 (usa cilindros de propano recargables) y FH-2618Al (usa cilindros desechables).

#### Instrucciones de seguridad

**Advertencia:** Cuando se instalen los accesorios del sistema de energía eléctrica, el no seguir los requerimientos personales de seguridad y las instrucciones escritas referente a la instalación, podría dar como resultado un incendio o una explosión y causar serios o fatales perjuicios. Para evitar riesgo de fuego accidental o

de explosión, cuando se utilicen sopletes de gas, siempre revise todas las conexiones por fugas, antes de encender el soplete y siga las instrucciones de seguridad del soplete. Para minimizar cualquier efecto de humo producido durante la instalación, provéase siempre de una buena ventilación en el lugar de trabajo.

*Como Raychem no controla todas las condiciones que pueden influir en la instalación del producto en campo, queda entendido que el usuario debe tomar esto en cuenta y aplicar su propia experiencia y práctica cuando instale el producto.*

#### Ajustando el soplete

Ajuste el regulador y el soplete como se requiere, para así proporcionar una flama espesa de un total de 12 pulgadas.

En el FH-2629 la flama será toda azul, los otros sopletes tendrán un extremo amarillo de 3 a 4 pulgadas. Use el extremo amarillo para la termocontracción.

#### Presión del regulador

FH-2618A1	Presión completa
FH-2629	15 psig

#### Limpieza del Cable

Use un solvente adecuado como el provisto en el kit P63. Asegúrese de seguir las instrucciones del producto. Un descuido puede provocar que el producto falle.

Algunos solventes nuevos no se evaporan rápidamente y necesitan ser removidos con un paño limpio y libre de peluzas. De no ser así, pueden provocarse cambios en la

resistividad volumétrica del sustrato o dejar residuos en la superficie. Siga cuidadosamente las instrucciones del fabricante.

#### Instrucciones Generales de Termocontracción

- Aplique el extremo exterior de 3 a 4 pulgadas de la flama, al material termocontráctil al calor con un suave movimiento de cepillado.
- Mantenga la flama moviéndose para obtener una termocontracción uniforme y evitar el chamusqueo.

A menos que se le instruya de hacerlo distinto, comience a termocontraer el tubo desde el centro, trabajando la flama alrededor de todas las partes del tubo para aplicar un calor uniforme. Para determinar si el tubo se ha instalado correctamente obsérvelo especialmente en la parte de atrás:

- 1.-Grosor uniforme de las paredes.
- 2.-Confomación de los substratos.
- 3.-Sin puntos planos o marcas frías.
- 4.-Flujo sellador visible si el tubo esta cubierto.

**Nota:** Cuando se instalen tubos múltiples, asegúrese de que la superficie del último esté todavía caliente, antes de acoplar y encoger el siguiente tubo. Si instala el tubo en frío, recaliente la superfiie entera.

## 1. Selección del Producto.

Verifique la selección del kit con las dimensiones del cable en la Tabla 1.

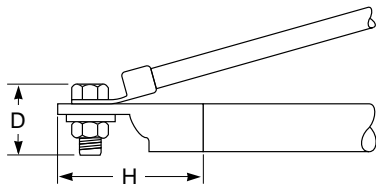
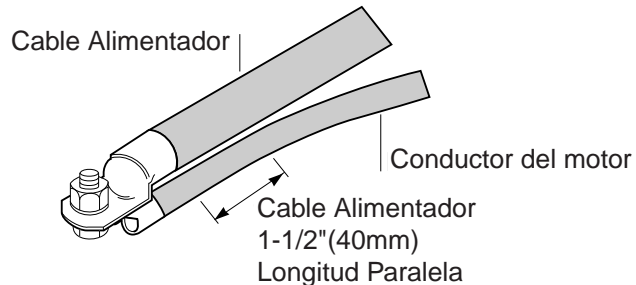


Tabla 1

Kit	Calibre Alimentador	Longitud tornillo Max (D)	Longitud de la Conexión Max (H)
MCK-1V	#14-#10 AWG	5/8" (15mm)	2.0" (50mm)
MCK-2V	#12-#4 AWG	3/4" (20mm)	2.5" (65mm)
MCK-3V	#2-4/0 AWG	1" (25mm)	3.5" (89mm)
MCK-4V	250-500 kcmil	1-1/2" (35mm)	5.5" (140mm)

## 2. Instale zapata.

Instale las zapatas sobre los cables alimentadores y los conductores del motor. Emperne las conexiones ajustadas. Los pernos se deben insertar a través de los orificios de la zapata más pequeña primero. Los conductores deberán estar paralelos en un mínimo de 1-1/2" (40mm) más allá del extremo de la zapata más larga.

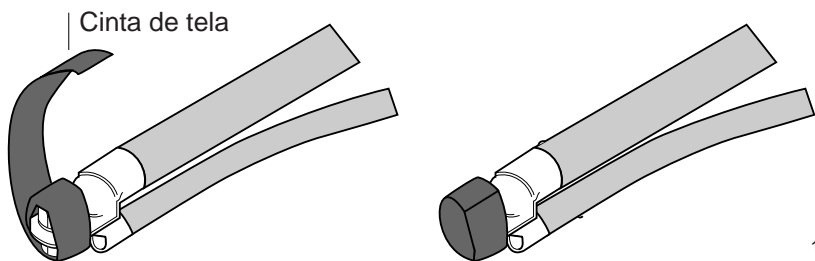


1863

**Nota:** Si se desea una verificación de rotación, coloque las tapas sobre el área de conexión para suministrar un aislamiento temporal al mismo tiempo que se prueba el motor. **No termocontraiga.** Después de la verificación, remueva las tapas y proceda al siguiente paso.

## 3. Aplique una cinta de trapo a la zapata.

Envuelva el área del perno con una tira de cinta de trapo para mantener limpias las zapatas.

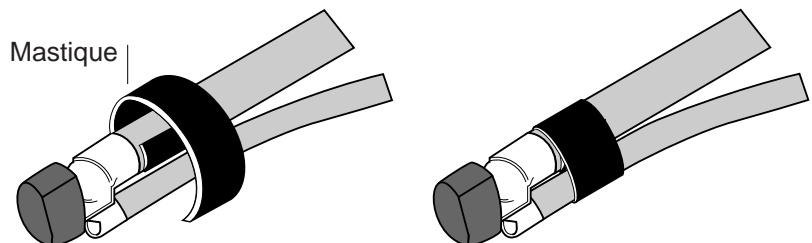


1864

## 4. Aplique mastique a la cubierta de cable.

Remueva el papel de protección de la tira del mastique. Inserte un extremo entre los conductores de una fase un poco más allá del extremo del barril de la zapata.

Haga una envoltura completa de mastique alrededor de ambos cables. Deseche el mastique excedente.



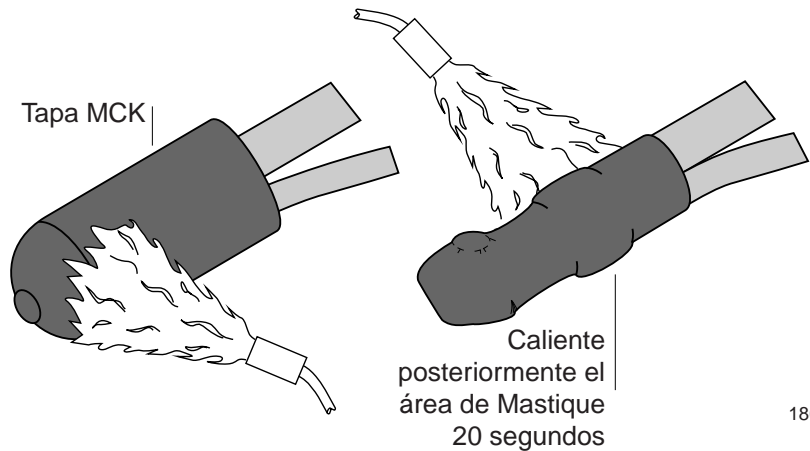
1865

### 5. Posicione el capuchón; termocontraiga en su lugar.

Coloque el capuchón sobre la conexión tan lejos como sea posible. Inicie la termocontracción en el extremo cerrado, trabajando el soplete con un movimiento tipo cepillado suave alrededor de todos los extremos de el capuchón .

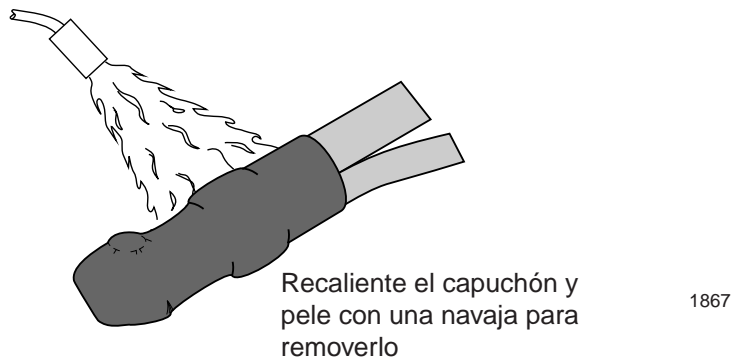
Continúe hacia el extremo abierto hasta que el capuchón se termocontraiga y se conforme a los contornos del cable. Caliente posteriormente en área de calentamiento aproximadamente 20 segundos después de que el capuchón se ha termocontraído completamente.

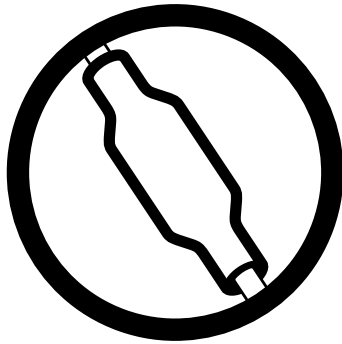
**La instalación está completa.**



### 6. Remoción

Para remover, remueva el capuchón y márquela con una navaja. Pele el capuchón con unas pinzas. Remueva la cinta de tela para exponer la conexión empalrnada limpia.





## MCK-L

# 1000V Flame-Retarded Motor (In-line) Connection Kits for 1/C Low-Voltage Power Cable

### General Instructions

#### Suggested Installation Equipment (not supplied with kit)

- Cable preparation tools
- Raychem P42 cable preparation kit or cable manufacturer approved solvent
- Clean, lint-free cloths
- Lug(s) and installation tools
- Raychem recommended torch

#### Recommended Raychem Torches

Install heat-shrinkable cable accessories with a "clean burning" torch, i.e., a propane torch that does not deposit conductive contaminants on the product.

Clean burning torches include the Raychem FH-2609, FH-2629 (uses refillable propane cylinders) and FH-2616A1 (uses disposable cylinder).

#### Safety Instructions

**Warning:** When installing electrical power system accessories, failure to follow applicable personal safety requirements and written installation instructions could result in fire or explosion and serious or fatal injuries.

To avoid risk of accidental fire or explosion when using gas torches, always check all connections for leaks before igniting the torch and follow the torch manufacturer's safety instructions.

To minimize any effect of fumes produced during installation, always provide good ventilation of confined work spaces.

#### Adjusting the Torch

Adjust regulator and torch as required to provide an overall 12- inch bushy flame. The FH-2629 will be all blue, the

other torches will have a 3- to 4-inch yellow tip. Use the yellow tip for shrinking.

#### Regulator Pressure

FH-2616A1	Full pressure
FH-2609	5 psig
FH-2629	15 psig

#### General Shrinking Instructions

- Apply outer 3- to 4-inch tip of the flame to heat-shrinkable material with a rapid brushing motion.
- Keep flame moving to avoid scorching.
- Unless otherwise instructed, start shrinking tube at center, working flame around all sides of the tube to apply uniform heat.

To determine if a tube has completely recovered, look for the following, especially on the back and underside of the tube:

1. Uniform wall thickness.
2. Conformance to substrate.
3. No flat spots or chill marks.
4. Visible sealant flow if the tube is coated.

### Installation Instructions

#### 1. Product selection.

Check kit selection with cable diameter dimensions in Table 1.

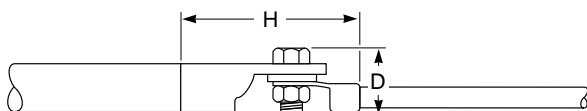


Table 1

Kit	Motor Feeder Conductor Size	Bolt Length Max (D)	Connection Length Max (H)
MCK-1L	#8-4/0 AWG	1-1/4" (30mm)	5.0" (125mm)
MCK-2L	250-1000 kcmil	1-1/2" (35mm)	8.0" (205mm)

## Installation Instructions

**Note:** MCK insulating sleeves are designed to accommodate the largest lugs normally used. However, many installations require shorter sleeves due to space limitations. MCK can be trimmed to any desired length as long as the following rules are observed.

- The cuts must be clean with no jagged edges.
- The sleeve length must be sufficient to completely cover the mastic strips – approximately 1-1/2" (40mm) beyond the end of each lug barrel.

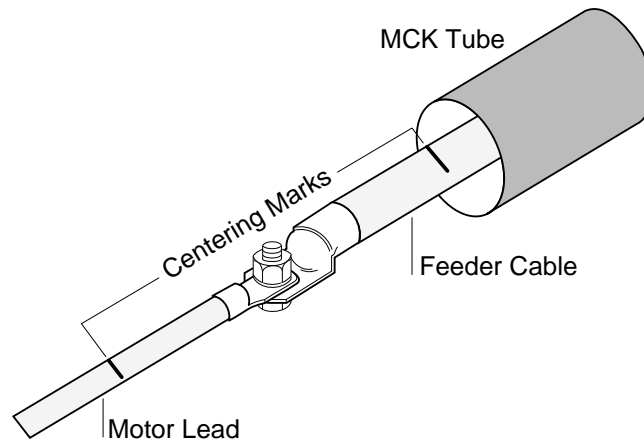
### 2. Position tube; install lugs; mark cable.

Slide tube over feeder cable.

Install lug on feeder cable and motor lead. Bolt connection tight. Bolts should be inserted through the tang of the largest lug first.

Center tube over connection area and mark end positions on the cables.

Move tube back over feeder cable.



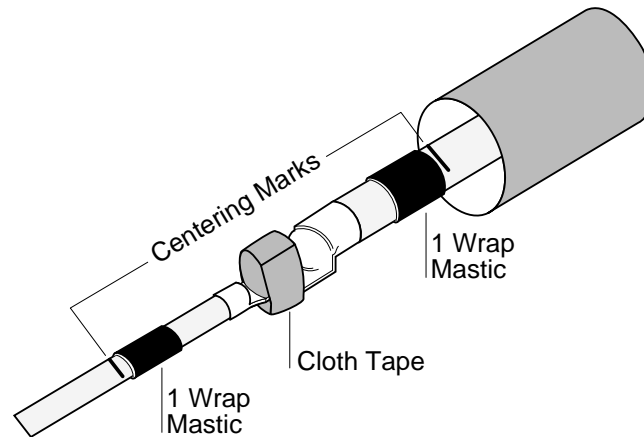
1868

**Note:** If a rotation check is desired, place tube over the connection area to provide temporary insulation while bumping the motor. **Do not shrink.** After check, slide tube back over feeder cable and proceed to next step.

### 3. Apply cloth tape to lug; apply mastic to cable jackets.

Wrap the bolt area with a cloth tape strip to keep the hardware clean.

Remove release papers from mastic strip. Make one complete wrap at the end of each lug barrel, just inside the marks made in Step 2.



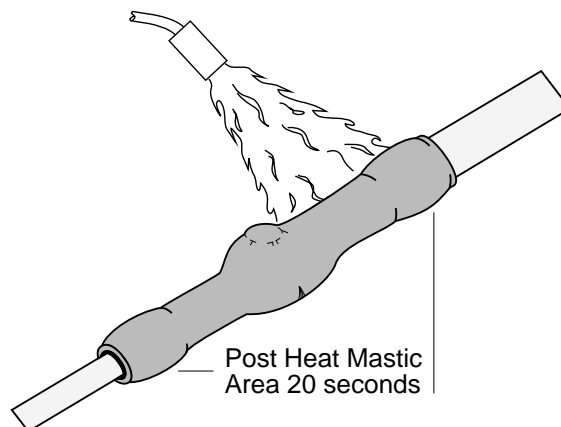
1869

### 4. Position tube; shrink in place.

Center tube over connection area. Begin shrinking in center of tube, working torch with a smooth, brushing motion around all sides of tube. Continue to each end as the tube shrinks and conforms to the cable contours.

Post heat mastic area approximately 20 seconds after cap has fully shrunk.

**Installation is complete.**



1870



# Raychem Energy Division

# Report

Title	PERFORMANCE TEST ON RAYCHEM MCK II STUB TYPE MOTOR CONNECTION SYSTEM FOR CABLES RATED UP TO 2kV	Pages: 5	Enclosures: 5		
Report Number:	EDR-5110	Date:	April 12, 1984		
Tested by:	Alan Rehder	Signature:	<i>Alan Rehder</i>	Date:	4-12-84
Prepared by:	Mike Stine	Signature:	<i>Mike Stine</i>	Date:	4-12-84
Approved by:	John Kuster for Product Management	Signature:	<i>John Kuster</i>	Date:	4-12-84
Approved by:	John Bramfitt for Technical Operations Raychem Corporation Energy Division	Signature:	<i>J. Bramfitt</i>	Date:	12 <sup>th</sup> March 84

## I. OBJECTIVE

To subject the Raychem MCK II design to severe environmental, mechanical and electrical extremes in order to evaluate its performance and prove its suitability for use as an environmentally sealed motor connection system.

## II. SUMMARY

The test set consisted of twelve (12) samples. The test samples were subject to immersion, oven heat conditioning, thermal cycling, A.C. voltage withstands, insulation resistance measurements, D.C. voltage withstands and A.C. leakage current measurements.

The applicable specifications include ANSI C119.1 for sealing tests and ICEA S-66-524 for final A.C. and D.C. voltage withstand levels.

All samples passed design test criterion.

## III. CONCLUSION

The performance evaluation of the MCK II design concludes that the MCK II product is suitable for use as an environmentally sealed system for stub type connections of motor leads and feeder cables rated up to 2kV with continuous maximum operating temperature ratings of 90°C.

#### IV. SAMPLE PREPARATION

All motor connection test assemblies were connected in a stub type configuration. The cable sizes and corresponding Raychem MCK kit used for the evaluation are listed below. For test purposes the feeder cable and motor leads were identical.

##### MCK KITS INSTALLED PER APPENDIX V

<u>SAMPLE</u>	<u>CABLE DESCRIPTION</u>	<u>Raychem Kit DESIGNATION</u>
#1	Capwire 10 AWG Type Use of RHW or RHH 600 Volt	MCK 1V
#2	Capwire 10 AWG Type Use of RHW or RHH 600 Volt	MCK 1V
#3	Capwire 10 AWG Type Use of RHW or RHH 600 Volt	MCK 1V
#4	Anaconda 14 AWG Durasheath Ep Type RHH or RHW VW-1 600 Volt	MCK 1V
#5	Anaconda 14 AWG Durasheath Ep Type RHH or RHW VW-1 600 Volt	MCK 1V
#6	Anaconda 14 AWG Durasheath Ep Type RHH or RHW VW-1 600 Volt	MCK 1V
#7	Anaconda 4/0 AWG Unicon-Frep Type Use or RHH or RHW VW-1 600 Volt	MCK 3V
#8	Anaconda 4/0 AWG Unicon-Frep Type Use or RHH or RHW VW-1 600 Volt	MCK 3V
#9	Anaconda 4/0 AWG Unicon-Frep Type Use or RHH or RHW VW-1 600 Volt	MCK 3V
#10	Anaconda 2 AWG S Type XHHW 600 Volt	MCK 3V
#11	Anaconda 2 AWG S Type XHHW 600 Volt	MCK 3V
#12	Anaconda 2 AWG S Type XHHW 600 Volt	MCK 3V

Polyvinyl Chloride (PVC) insulated cables were not evaluated because their continuous maximum operating temperature rating is well below the temperatures achieved during Test Sequence 4 and 7.

## V. TESTING

### A. Test Sequence

#### 1. Immersion

The test samples were immersed for 24 hours so that the entire motor connection area was submerged under a minimum one foot head of tap water having an ambient temperature of  $23\text{ C} \pm 3\text{ C}$ .

#### 2. Insulation Resistance - After Immersion

Insulation Resistance was measured after 24 hours immersion by applying 500 volts D.C. between each conductor and the grounded water bath for one minute.

Requirement:  $2.5 \times 10^6$  ohms minimum.

Results: All samples passed. Values are recorded in Appendix I.

#### 3. A.C. Withstand - After Immersion

Following the Insulation Resistance Measurement, an A.C. Voltage (60 hertz) of 2.2kV was applied between each conductor and the grounded water bath for one minute.

Requirement: No breakdown or flashover.

Results: All samples passed.

#### 4. Heat Conditioning

The test samples were placed in an air circulating oven at a temperature of  $90^{\circ}\text{C}$  for a period of 72 hours.

#### 5. Insulation Resistance - After Heat Conditioning

Insulation Resistance was measured after Heat Conditioning as described in Test Sequence 2.

Requirement:  $2.5 \times 10^6$  ohms minimum.

Results: All samples passed. Values are recorded in Appendix II.

#### 6. A.C. Withstand - After Heat Conditioning

An A.C. Voltage of 2.2kV was applied between each conductor and the grounded water bath for one minute following the Insulation Resistance Measurements.

Requirement: No breakdown or flashover.

Results: All samples passed.

#### 7. Thermal Cycling

The test assemblies were subjected to 50 cycles of current heating followed by immersion. One cycle is defined as applying sufficient current to the assemblies to achieve a conductor temperature of 90°C for one hour, then de-energizing the samples and within three minutes immersing the motor connection portion of the assemblies under a minimum one foot head of tap water having an ambient temperature of 23°C ± 3°C for 30 minutes.

#### 8. Insulation Resistance-After 25th and 50th Thermal Cycles

Insulation Resistance was measured after the 25th and 50th thermal cycles as described in Test Sequence 2.

Requirement: 2.5 x 10<sup>6</sup> ohms minimum.

Results: All samples passed. Values are recorded in Appendix III.

#### 9. A.C. Withstand-After 25th and 50th Thermal Cycles

Each assembly was subjected to an A.C. Voltage Withstand after the 25th and 50th Thermal Cycles as described in Test Sequence 3.

Requirement: No breakdown or flashover.

Results: All samples passed.

#### 10. A.C. Leakage Current Measurement

Leakage current was measured by applying an A.C. Voltage of 600 volts between each conductor and the grounded water bath for one minute while immersed per Test Sequence 1.

Requirement: 2.5mA maximum.

Results: All samples passed. Values are recorded in Appendix IV.

#### 11. A.C. Withstand - Final

The motor connection assemblies were subjected to a final A.C. Withstand which consisted of applying an A.C. voltage of 9.5kV between each conductor and the ground water bath for 15 minutes while immersed per Test Sequence 1.

Requirement: No breakdown or flashover.

Results: All samples passed.

#### 12. D.C. Withstand

Each sample was subjected to a D.C. Withstand by applying a D.C. Voltage of 34.5kV between each conductor and grounded water bath for five minutes while immersed per Test Sequence 1.

Requirement: No breakdown or flashover.

Results: All samples passed.

## APPENDIX I

### INSULATION RESISTANCE MEASUREMENTS-500 VOLTS D.C AFTER INITIAL IMMERSION

Requirement:  $2.5 \times 10^6$  ohms minimum.

<u>SAMPLE NO.</u>	<u>INSULATION RESISTANCE (Ohms)</u>
1	$3.0 \times 10^{13}$
2	$2.0 \times 10^{13}$
3	$2.8 \times 10^{13}$
4	$5.0 \times 10^{12}$
5	$5.0 \times 10^{12}$
6	$5.8 \times 10^{12}$
7	$4.0 \times 10^{12}$
8	$2.0 \times 10^{12}$
9	$1.0 \times 10^{12}$
10	$2.0 \times 10^{12}$
11	$5.0 \times 10^{12}$
12	$2.0 \times 10^{12}$

## APPENDIX II

### INSULATION RESISTANCE-500 D.C AFTER HEATING CONDITIONING

Requirement:  $2.5 \times 10^6$  ohms minimum.

<u>SAMPLE NO.</u>	<u>INSULATION RESISTANCE (Ohms)</u>
1	$2.2 \times 10^{13}$
2	$2.0 \times 10^{13}$
3	$2.4 \times 10^{13}$
4	$1.0 \times 10^{13}$
5	$7.0 \times 10^{12}$
6	$4.5 \times 10^{12}$
7	$4.0 \times 10^{12}$
8	$4.5 \times 10^{12}$
9	$5.6 \times 10^{12}$
10	$7.0 \times 10^{12}$
11	$6.2 \times 10^{12}$
12	$9.0 \times 10^{12}$



APPENDIX III

INSULATION RESISTANCE-500 VOLTS D.C  
AFTER 25TH AND 50TH THERMAL CYCLES

Requirement:  $2.5 \times 10^6$  ohms minimum.

<u>SAMPLE NO.</u>	<u>25TH CYCLE</u>	<u>50TH CYCLE</u>
1	$2.0 \times 10^{14}$	$2.0 \times 10^{13}$
2	$2.0 \times 10^{14}$	$1.1 \times 10^{13}$
3	$5.0 \times 10^{13}$	$9.2 \times 10^{12}$
4	$4.5 \times 10^{12}$	$5.2 \times 10^{12}$
5	$4.0 \times 10^{12}$	$4.5 \times 10^{12}$
6	$4.5 \times 10^{12}$	$4.5 \times 10^{12}$
7	$1.3 \times 10^{12}$	$1.9 \times 10^{12}$
8	$1.5 \times 10^{12}$	$3.0 \times 10^{12}$
9	$1.8 \times 10^{12}$	$3.0 \times 10^{12}$
10	$6.8 \times 10^{12}$	$1.8 \times 10^{12}$
11	$4.2 \times 10^{12}$	$3.4 \times 10^{12}$
12	$4.5 \times 10^{12}$	$4.0 \times 10^{12}$

## APPENDIX IV

### A.C. LEAKAGE CURRENT MEASUREMENTS

Requirement: 2.5mA maximum.

<u>SAMPLE NO.</u>	<u>A.C. LEAKAGE CURRENT</u>
1	.038mA
2	.039mA
3	.036mA
4	.036mA
5	.035mA
6	.037mA
7	.120mA
8	.130mA
9	.150mA
10	.150mA
11	.150mA
12	.165mA

## Stub Connection (Type V) Installation Instructions

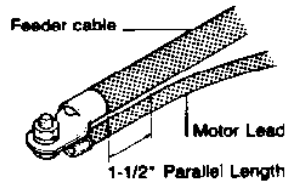
1. Install lugs on feeder cables and motor leads (Figure 1). Bolt connections tight. Bolts should be inserted through the tang of the smallest lug first. Leads must be parallel for a minimum of 1-1/2" beyond end of the longest lug.

**Note:**  
If a rotation check is desired, place caps over the connection area to provide temporary insulation while bumping motor. Do not shrink. After check, remove caps and proceed to next step.

**Max Bolt Lengths:**

MCK 1V	5/8"
MCK 2V	3/4"
MCK 3V	1"
MCK 4V	1-1/2"

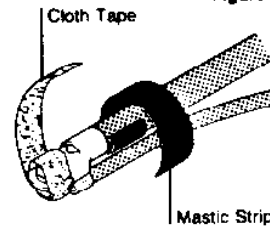
Figure 1



2. Wrap the bolt area with a cloth tape strip to cover sharp edges (Figure 2).

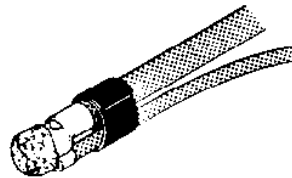
3. Remove release papers from mastic strip. Insert one end between the leads of one phase just beyond the end of the lug barrel (Figure 2).

Figure 2



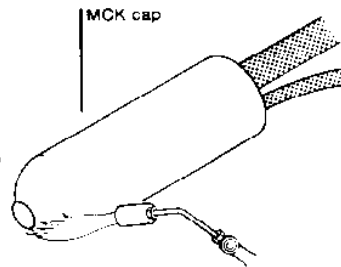
4. Make one complete wrap of mastic around both cables (Figure 3). Remove excess mastic.

Figure 3



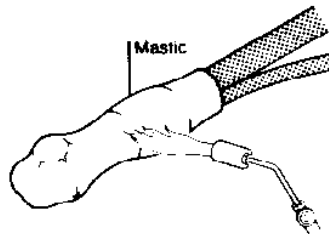
5. Place cap over connection as far as possible. For best shrinking results, use either the Raychem FH-2616A or FH-2609 torch. Adjust torch to obtain a 12" flame with a 3-4" yellow tip. Only the yellow tip should be in contact with cap. Apply heat with a brushing motion working all around cap. Begin at closed end (Figure 4) and continue to the open end as cap shrinks and conforms to cable contours.

Figure 4



6. Post heat mastic area approximately 20 seconds after cap has fully shrunk (Figure 5).

Figure 5



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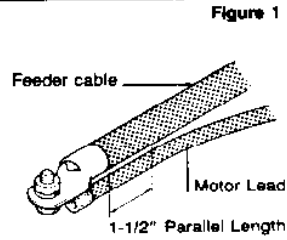
## Stub Connection (Type V) Installation Instructions

1. Install lugs on feeder cables and motor leads (Figure 1). Bolt connections tight. Bolts should be inserted through the tang of the smallest lug first. Leads must be parallel for a minimum of 1-1/2" beyond end of the longest lug.

**Note:**  
If a rotation check is desired, place caps over the connection area to provide temporary insulation while bumping motor. **Do not shrink.** After check, remove caps and proceed to next step.

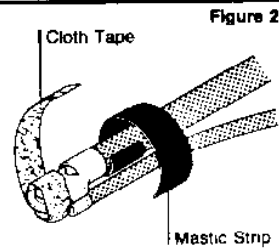
**Max Bolt Lengths:**

MCK 1V	5/8"
MCK 2V	3/4"
MCK 3V	1"
MCK 4V	1-1/2"

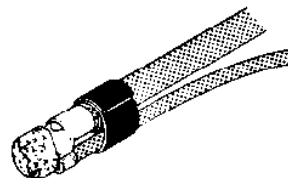


2. Wrap the bolt area with a cloth tape strip to cover sharp edges (Figure 2).

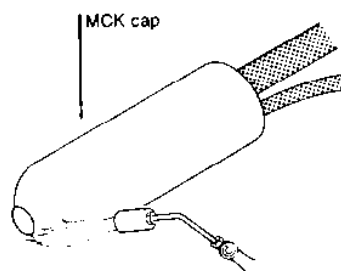
3. Remove release papers from mastic strip. Insert one end between the leads of one phase just beyond the end of the lug barrel (Figure 2).



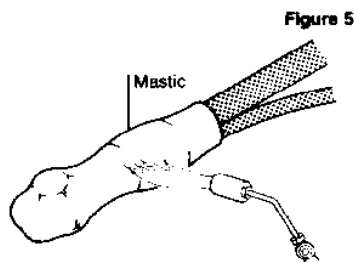
4. Make one complete wrap of mastic around both cables (Figure 3). Remove excess mastic.



5. Place cap over connection as far as possible. For best shrinking results, use either the Raychem FH-2616A or FH-2609 torch. Adjust torch to obtain a 12" flame with a 3-4" yellow tip. Only the yellow tip should be in contact with cap. Apply heat with a brushing motion working all around cap. Begin at closed end (Figure 4) and continue to the open end as cap shrinks and conforms to cable contours.




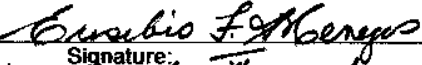

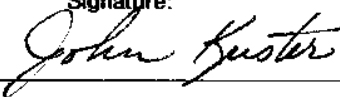
6. Post heat mastic area approximately 20 seconds after cap has fully shrunk (Figure 5).



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# Raychem Energy Division

# Report

<b>Title</b>		<b>Pages:</b>
PERFORMANCE TEST ON STUB AND IN LINE TYPE MOTOR CONNECTION SPLICES TYPE MCK-5		10
<b>Report Number:</b>		<b>Enclosures:</b>
EDR 5010		
<b>Tested by:</b>	<b>Signature:</b>	<b>Date:</b>
Rudolf Pokojny		2/21/80
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<b>for Technical Operations</b>		
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John Kuster		2/22/80
<b>for Product Management</b>		
<b>Raychem Corporation</b> <b>Energy Division</b>		

## 1.0 OBJECTIVE

To evaluate the performance of Raychem type MCK-5 heat shrinkable stub and in-line splices in terminal boxes of motors rated through 8.7kV.

A total of eighteen MCK-5 samples were evaluated. The first group of twelve test samples went through a series of electrical voltage withstands followed by a long-term overvoltage test. The second group of six test samples went through a similar series of electrical voltage withstands followed by a thermal and water immersion cycling test.

All kits were subjected to rated ampacities per the National Electric Code, Article 310-38 for 90°C continuous rated feeder cables.

All samples passed the designed test criteria. The test results are summarized in Table I.

## 3.0 CONCLUSION

The test program results indicate that the MCK-5 performed successfully as an environmentally sealed insulation system for application on motor-feeder cables rated up to 8.7kV AC.

TABLE I  
SUMMARY OF TEST RESULTS

Tests	Test Requirements	GROUP I		GROUP II	
		Test Sequence	Typical Results	Test Sequence	Typical Results
1. Discharge Extinction Voltage	at 7.5kV less than 5pc	●	Passed	●	Passed
2. Dry DC Withstand	35kV for 15 minutes	●	Passed	●	Passed
3. Impulse Withstand	95kV, 3 consecutive shots at each polarity	●	Passed	●	Passed
4. 6-Hour Dry Withstand	23kV AC for 6 hours	●	Passed	●	Passed
5. Overvoltage Testing	17.3kV AC for 32 days	●	Passed	●	Passed
6. Immersion and Other Tests		●		●	
6.1 Water Immersion	Samples under 12-inch head of water at 23°C±3°C for 24 hours	●		●	Passed
6.2 Insulation Resistance	Greater than 2.5x10 <sup>6</sup> ohms measured at 500V DC	●		●	>10 <sup>11</sup> ohms
6.3 Current Cycling	Conductor current cycled with specified amperes for 1 hour in air followed by water immersion of samples for one-half hour. Total 50 cycles.	●		●	Passed

#### 4.0 SAMPLE DESCRIPTION

##### 4.1 Cables and Connections

Feeder cables were chosen for electrical tests on the basis of nominal diameter and in such a manner that when connected to a sample motor lead would represent the largest cross-section for which the MCK-5 was designed (Group I samples).

Immersion test samples were chosen such that feeder and motor leads were the same size to allow for maximum heat generation in the butted connection (Group II samples).

All medium voltage cables were terminated using the Raychem HVT termination system.

Connectors used were of the compression type, short barrel, single bolt, as manufactured by either Penn-Union (Series TLU) or by Burndy Corporation (Series YA).

Connection hardware was either 3/8 or 1/2 inch, as appropriate, with bolt lengths chosen not to extend through the nut by more than 1/4-inch.

##### 4.2 Sample Preparation

The MCK-5 samples were assembled in accordance with the standard installation instructions as provided in each kit. The test sample matrix used in the evaluation is given in Table II.



TABLE II  
SAMPLE MATRIX

Sample No.	Test Group	"Feeder" Size	"Feeder" Cable Voltage	"Motor" Size	"Motor" Lead Voltage	Test	Kit Cat. No.
1	I	750kcm	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-3V-00
2	I	750kcm	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-3V-00
3	I	250kcm	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-2V-00
4	I	250kcm	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-2V-00
5	I	2AWG	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-1V-00
6	I	2AWG	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-1V-00
7	I	750kcm	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-2L-00
8	I	750kcm	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-2L-00
9	I	250kcm	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-1L-00
10	I	250kcm	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-1L-00
11	I	2AWG	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-1L-00
12	I	2AWG	5kV	2AWG	5kV	Elec/Overvolt.	MCK-5-1L-00
13	II	2/OAWG	5kV	2/OAWG	5kV	Elec/Immersion	MCK-5-2V-00
14	II	2/OAWG	5kV	2/OAWG	5kV	Elec/Immersion	MCK-5-2V-00
15	II	2/OAWG	5kV	2/OAWG	5kV	Elec/Immersion	MCK-5-2V-00
16	II	2/OAWG	5kV	2/OAWG	5kV	Elec/Immersion	MCK-5-2L-00
17	II	2/OAWG	5kV	2/OAWG	5kV	Elec/Immersion	MCK-5-2L-00
18	II	2/OAWG	5kV	2/OAWG	5kV	Elec/Immersion	MCK-5-2L-00

## 5.0 TESTING

All eighteen MCK-5 samples were first subjected to a test sequence consisting of applicable sections of IEE-404, 1977, "IEEE Standard for Power Cable Joints". The tests included Discharge Extinction Voltage, AC and DC Voltage Withstand, and Impulse Voltage Withstand. The samples were then divided into two groups. Group I consisting of twelve samples underwent long-term overvoltage tests. Group II consisting of six samples were immersion cycled. The cycling consisted of one hour heating in air by current induction, followed by immersion for one-half hour under two feet of water at  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ .

The current used was the specified allowable ampacity for  $90^{\circ}\text{C}$  continuous rated insulated single copper conductor isolated in air (NEC Article 310-38). For the 2/0 copper conductor the current was 350 amperes, calculated for an ambient air temperature of  $25^{\circ}\text{C}$ . The alternating heating and cooling of the samples was performed in accordance with Section 3.3.10 "Current Cycle and Water Submersion Test" of ANSI CII9.1, 1974 for "Sealed Insulated Underground Connector Systems".

## 6.0 TEST RESULTS

All samples went through the following sequence of tests.

### 6.1 Discharge Extinction Voltage

Test voltages were raised above their recommended values (IEEE-404-1977) and then lowered until discharges below 5pc were observed.

Result: All samples passed or exceeded test requirements of 7.5kV discharge free operation (less than 1/2pc) with a minimum ground plane separation of one-half inch. (For MCK's in intimate contact with ground plane, refer to Notes, Section 7.1)

### 6.2 15-Minute Dry DC Withstand (per IEEE-404-1977)

A DC voltage of 35kV was applied for 15 minutes between conductor and a copper gauze ground plane which was wrapped tightly around the sample, see Figure I.

Result: All samples passed with no breakdown or flashover.

### 6.3 Impulse Voltage Withstand(per IEEE-404-1977)

A nominal 1.2x50  $\mu$ s wave of 95kV was applied between conductor and the copper gauze ground plane. The samples were required to pass 3 consecutive shots of each polarity.

Result: All samples passed with no flashover or breakdown.

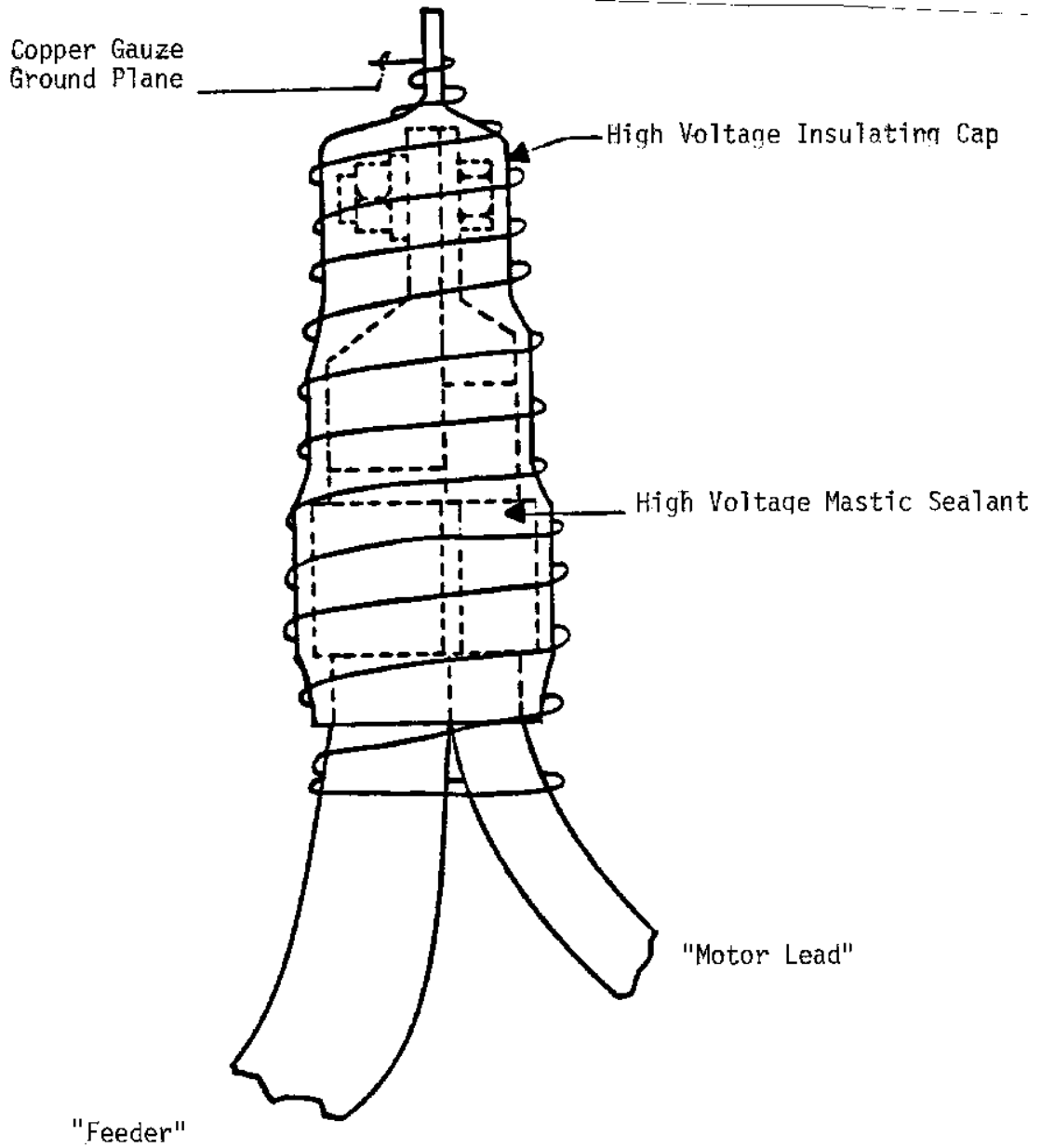


FIGURE I  
SAMPLE CONSTRUCTION  
FOR ELECTRICAL TESTING

6.4 6-Hour Dry Withstand (per IEEE-404-1977)

A 60-hertz voltage of 23kV was applied for 6 hours between conductor and the copper gauze ground plane.

Result: All samples passed with no flashover or breakdown.

6.5 Long-Term Overvoltage Tests

A 60-hertz voltage of 17.3kV was applied for 32 days between conductor and the copper gauze ground plane. The voltage of 17.3kV represents 3.5 times normal operating voltage to ground, and by operating for over 32 days gives an extrapolated equivalent service life at rated voltage of over 40 years.

Result: All twelve Group I samples passed with no flashover or breakdown occurring.

6.6 Immersion Test (per ANSI CII9.1, 1974, Sect. 3.3.10)

All six Group II samples were then connected in series and subjected to the following sequence of tests:

6.6.1 Spliced samples were immersed under a 12-inch head of tap water at  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$  for 24 hours.

6.6.2 Insulation resistance measurements were taken on immersed samples between conductor and the grounded water bath using a megohmmeter set at 500V DC.

Result: Nominal value of 8 samples:  $8 \times 10^{11}$  ohms.

6.6.3 The samples were current cycled for one hour with 350 amperes and then immersed for one-half hour in 23°C + 3°C tap water. The samples went through a total of 50 cycles.

6.6.4 Insulation resistance measurements were taken after the 25th and 50th cycle.

Results: Nominal value of 8 samples:  $7 \times 10^{11}$  ohms.

6.6.5 After completion of the 50 current cycles, the Group II samples were further subjected to a 6-hour withstand test at 23kV AC.

Results: All samples passed without flashover or breakdown.

## 7.0 NOTES

### 7.1 Discharge Extinction Voltage

Experiments were conducted using various air gaps between the MCK-5 and ground to determine the minimum required clearance so that the 5-8kV shielded power cable connection exhibited a maximum of 5 picocoulombs of discharge at 1.5 times operating voltage (in this case 7.5kV). It was determined that with a ground clearance of 1/2 inch, the connection would operate discharge-free at over 1.5 times rated voltage.

Since, in practice, it is not possible to guarantee clearances between all points on a stub splice and all points in the interior of a motor conduit box, long-term overvoltage tests were conducted which showed that the continuous presence of discharges did not have any deleterious effects on the performance of the Raychem MCK-5, even when in intimate contact with ground.