
INSTALLER TRAINING JOB AID

Ocal[®] PVC-coated systems

Installation practices for PVC-coated conduit and fittings

Ocal[®]



Ocal® PVC-coated conduit recommended installation procedures

PVC-coated conduit is installed in much the same manner as conventional rigid galvanized steel conduit; however, certain precautions must be taken to assure satisfactory results. Installers should follow these guidelines and use the proper tooling to help achieve a damage-free installation.

Specification of Ocal PVC-coated conduit requires that the total run shall be PVC-coated. There are no exceptions to this rule. This means from the beginning of the run to its completion and all in between, no exposed metal shall be allowed.

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Ocal installation certification training

Proper installation procedures for PVC-coated conduit systems

Training description

How do you reduce installation costs; save time and material, reduce the risk of installation damage to PVC-coated conduit systems and help provide end users a high-quality installation of PVC-coated conduit systems designed to deliver years of trouble-free service? Become a Certified Ocal Installer! Attend our hands-on training, demonstrating best practices and installation methods: cutting, threading, bending, assembly, patching and more!

Who benefits from this training?

- Electrical contractors
- Project managers
- Electrical engineers
- End users

Benefits of completing this training

- Successful completion of the Ocal Installation Training will earn you the designation of Certified Ocal Installer, which is valid for two years. This designation will be recorded in the ABB database.
- ABB extends its Ocal limited warranty for defects in materials and workmanship from two (2) years from the date of purchase to five (5) years from the date of purchase when installed by a Certified Ocal Installer.

Learning outcomes

- The proper techniques for installing PVC-coated conduit systems:
 - Clamping
 - Cutting
 - Threading
 - Bending
 - Assembly
- Understanding of the special tools used to install PVC-coated conduit systems and their proper use
- How to avoid damaging the PVC and conduit systems' layers of corrosion protection
- The best ways to help protect the threads of the PVC-coated conduit system for each application
- The proper installation of PVC-coated conduit sleeves and fittings
- When and how to patch the PVC coating



Clamping

- 01 Yoke-style vise
- 02 Ocal jaw vise adapters (JAWS23)

Clamping

The first step is the correct clamping of the PVC-coated conduit. Use of a yoke-style vise is recommended.

When using a yoke-style vise, you should replace the upper and lower jaw inserts with the specially designed Ocal jaw vise adapters. These adapters provide greater clamping force and will help prevent the pipe from spinning during the threading operation.



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Product code	Description	Weight (lbs.)	Weight (kg)
JAWS23	Use with RIDGID No. 23 and 40A yoke vises	2.80	1.27

Clamping

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01 Chain-style vise

Use of a chain-style vise may result in the chain and jaw inserts tearing the conduit's PVC coating during threading.

To prevent damage to the PVC coating, protective "shells" may be fabricated from lengths of standard rigid steel conduit that fit over the PVC-coated conduit, preventing the chain from coming into direct contact with the PVC coating. The steps to make the shells are outlined below:



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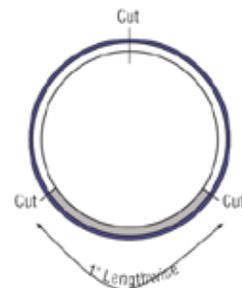
- 1 Use a 6" to 8" length of rigid conduit that is one size larger than the PVC-coated conduit. For example, if the PVC-coated conduit is 1½" trade size, use 2" trade size rigid conduit for the nipples, or shells.



- 2 Remove a 1" piece lengthwise from the cut conduit section.



- 3 Cut the conduit section in half lengthwise, creating two shells.



- 4 Grind and brush the edges smooth.



- 5 Score interior of shells lengthwise with a band saw.



Clamping

- 01 Chain-style vise
- 02 Without using protective shells, the chain will damage the PVC coating
- 03 Mounting the shells

To clamp with a chain, place a shell on top of the lower jaws, then rest the conduit on top of the bottom shell. Place the second shell on top of the conduit. Now, you are ready to clamp the chain to secure the conduit.



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Operations such as threading and cutting can now be performed without risk of the chain and jaws damaging the PVC coating.

Cutting

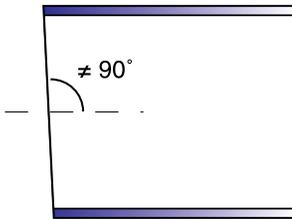
Band saw cutter

Cutting PVC-coated conduit with a band saw will leave the PVC coating flush with the end of the conduit. When PVC material is left flush at the end of the conduit, the threading process cannot begin because the threader die teeth are unable to bite into the steel.

To prepare the conduct for threading, approximately 1/4" of the PVC coating must be removed. Using a knife, whittle in a pencil-sharpening style, cutting 1/4" of the coating from the conduit. A wire brush may also be used to remove PVC coating.

A band saw may not cut the conduit at a "perfect" 90° angle (the accuracy of the cut depends on operator skill).

- 01 Band saw
- 02 Removal of PVC required after band saw cutting
- 03 Roller cutter
- 04 Roller cutter in use
- 05 Beveled edge as a result of using roller cutter



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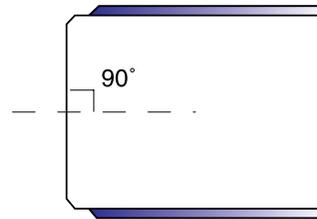


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Roller-style cutter

Although many personnel in the field prefer a band saw, a roller-style cutter is the recommended tool for cutting Ocal PVC-coated conduit.

A roller-style cutter cuts the edge of the conduit at a bevel and removes 1/4" of the coating at the same time, so no additional removal of PVC coating is necessary to prepare for threading. In addition, the roller cutter provides an exact 90° cut in relation to the conduit



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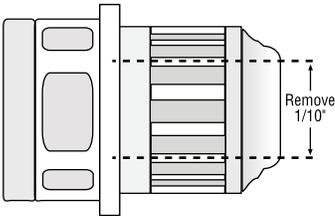
Manual and power threading

Threading

PVC-coated conduit has a larger OD (Outside Diameter) than uncoated conduit. Standard die heads will not clear the additional thickness. Never strip the PVC coating to use a standard die head. Doing so will result in exposed steel, which will compromise the protection of the conduit system. Both hand-held and power threading devices require special die heads suitable for PVC-coated conduit. These die heads are available from ABB as well as the equipment manufacturer.

If special die heads are not available, standard die heads can be modified for use on PVC-coated conduit:

- 1 Remove the cover plate and the four die teeth.
- 2 Have a machinist remove 100 thousandths of an inch (1/10") from the throat and collar diameter of the die head.
- 3 Reinstall the dies and cover.



NOTE: The die teeth are cutting tapered threads and will become clogged with PVC and metal shavings, which can damage the threads. To avoid this, score the PVC coating before threading. Use a conduit thread cap to determine the length to score from the conduit end. Then, use a knife to score the conduit lengthwise from the point where the threads will end to where they begin. This will allow the PVC and metal shavings to fall into the throat of the die head.

Manual and power threading

- 01 Ratchet threader
- 02 Hand-held powered threader
- 03 Reamer
- 04 Ocal urethane compound (Ocal-Blue patch)
- 05 Kopr-Shield® compound

Hand-held ratchet threading

The hand-held ratchet threader is typically used to thread smaller size conduit. The ratchet knob indicates forward and reverse. Die heads snap in from both sides and lock in place.



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Hand-held powered threading

Hand-held power threaders are typically used to thread conduits up to 2" in diameter.

Once threading is complete, ream the conduit with approved reamers. Spiral and straight-style reamers are both acceptable.

The threads must be dressed per NEC (article 300.6 [a]): "Where unusually corrosive elements require additional protection, it is recommended that threads be zinc coated with a hot dipped process or equivalent."

Clean the threads with a quality degreaser, and coat them with either Ocal urethane (Ocal-Blue® patch) or Kopr-Shield® compound.



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Manual and power threading

- 01 Geared threader
- 02 Stationary power threader

Geared threading

Geared threaders will thread 2½" through 6" PVC-coated conduit; however, they are primarily used for 5" and 6" conduit. Since the geared threaders use an open-style die head design, scoring is not required to prepare the conduit for threading.

The geared threader requires a clamp screw to secure the conduit. The clamp screw will penetrate the PVC coating. Make sure the clamp screw is tight to prevent it from slipping around the conduit, which could tear the PVC coating. After threading, be sure to touch up the penetrated area with Ocal exterior patching compound. Ream the conduit and dress the threads as previously described.



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Stationary power threading

Make sure the machine is set up for NPT threading. All machines can cut straight threads; however, not all machines can cut tapered threads. Always make sure the thread cutting oil is clean and that you are using the type or grade recommended by the manufacturer. The preferred machines feature a hand wheel to tighten three jaws to the conduit.

Some stationary power threading machines have the capacity to only thread rigid conduit from 1/2" to 2".

The standard jaw inserts for these units are intended to secure uncoated rigid conduit and may damage the coating of PVC-coated conduit. To prevent this, shells or special jaw inserts for coated conduit may be used.

- Shells — Range: ½" to 1½"
 - To properly clamp the conduit, the shells described previously can be used with conduit sizes from ½" to 1½". However, for 2" conduit, the chuck lacks sufficient space to accommodate both the conduit and shells.
- Special Jaw inserts for coated conduit — Range: ½" to 2". Special Jaw inserts for coated conduit have teeth that penetrate the PVC coating and bite into the conduit itself. They leave slits in the PVC coating that require touch-up with Ocal exterior patching compound after threading.

Most stationary threading machines use a roller-style cutter and will remove ¼" of the PVC coating, eliminating the need to pencil cut before threading. In addition, these machines use open-style die heads, making it unnecessary to score the PVC coating. The PVC cuttings and steel shavings will freely fall out of the die head.

Manual and power threading

Stationary power threading (continued)

Larger stationary power threading machines have the capacity to thread rigid conduit from ½" to 4".

The standard jaw inserts for these machines are intended to secure uncoated rigid conduit and may damage the coating of PVC-coated conduit. To prevent this, shells or special jaw inserts for coated conduit may be used.

- Shells – Range: ½" to 3½"
To properly clamp the conduit, the shells described previously can be used on conduit sizes from ½" to 3½". However, for 4" conduit, the chuck lacks sufficient space to accommodate both the conduit and shells.
- Special jaw inserts for coated conduit – Range: ½" to 4"
Jaw inserts for coated conduit have a wider surface area to effectively grip the PVC coating.

These machines use a roller cutter and will remove ¼" of the PVC coating, eliminating the need for pencil cutting or scoring of the PVC before threading. The cuttings will fall onto the screen on the lower portion of the machine.

Special jaw insert for PVC-coated conduit — used with threaders that only thread up to 2"



Special jaw insert for PVC-coated conduit — used with larger stationary power threaders



In hot weather, use scored shells to prevent slipping



Manual and powered bending

- 01 Manual bender
- 02 Electric bender

Hand bending

A standard hand bender can be used for saddles, offsets and conventional bending. PVC-coated conduit fits perfectly inside a hand bending shoe. No upsizing or machining of a standard hand bender is required for Ocal PVC-coated conduit.



Note: Never use any type of lubricant on conduit bending shoes. Use rubbing alcohol to clean the shoe prior to bending.

Power bending

Most electric benders will bend ½" to 2" conduit. Some manufacturers offer shoes and roller assemblies ready for use with PVC-coated conduit.



Alternatively, conventional shoes and rollers, may be used, but they must be machined to remove 60 thousandths of an inch (6/100"). Some manufacturers use slide bars instead of a roller assembly and these must also be machined 60 thousandths of an inch. You will need to compensate for "spring back" since PVC coating often requires the setting to be adjusted as much as 5°.



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Manual and powered bending

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01 Hydraulic
bending tool

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02 Shoe for hydraulic
bending tool

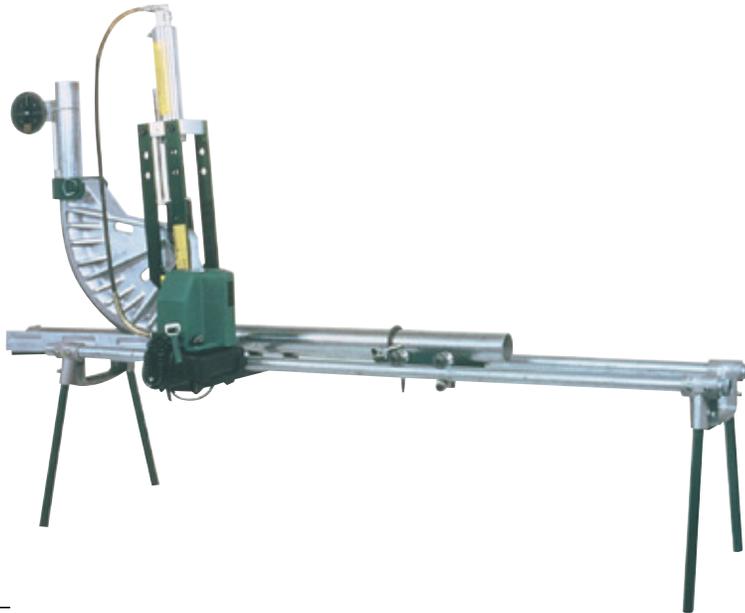
Hydraulic bending

Hydraulic is the preferred style of bending for larger sizes of conduit, 2½" and above. The shoe assembly should be of the design for PVC-coated conduit. The roller wheel and/or slide bar do not need to be machined to accommodate PVC-coated conduit.

Some hydraulic benders have trouble with larger sizes of PVC-coated conduit slipping vertically out of the shoe during the bending process, which can cause kinking.

Note:

- Sequential bends can be manufactured by ABB upon request.
- 5" and 6" conduit must be bent at the factory.



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Repairing

Ocal® PVC-coated conduit should always be damage-free. Any compromise to the PVC coating can lead to corrosion, which places personnel and the electrical system at risk. ABB offers two Ocal PVC patching compounds to repair minor damage of PVC coating. To repair areas larger than 1 inch in width, use a quality vinyl or PVC tape.

Air-cure patching

To prepare for patching, use a wire brush to remove any rough or loose edges surrounding the damaged area.

Next, using the integrated cap brush, apply a generous amount of Ocal liquid air-cure patching compound to the area. The compound should overlap the surrounding PVC since the compound only adheres to PVC.

Make sure that the patched area is level with the original factory coating, which is a nominal 0.04". This may require two or more applications. Allow each coat of the compound to cure up to 24 hours.

Heat-cure patching

Ocal heat-cure patch compound offers a thicker consistency at higher ambient temperatures than standard air-cure compounds, helping provide better coverage and a more effective patch in warm weather applications.

Using a standard chip brush, apply heat-cure patching compound in the same manner as air-cure patching compound.

The compound should overlap the surrounding PVC since the compound only adheres to PVC.

To dry, use a common heat-shrink gun. The compound should cure in approximately 2 minutes, resulting in a dull finish. As mentioned previously, be sure to build the patched area to the level of original factory coating with as many coated layers as necessary, allowing each coat to dry thoroughly.



Repairing

PVC tape

If patching is not an option, you can repair a large area of exposed metal greater than 1" wide by using vinyl or PVC tape. This type of repair should be used as a temporary solution until the compromised section can be replaced.

- 1 First, remove any loose PVC material and smooth rough PVC edges surrounding the damaged area.
- 2 Wrap the conduit with the tape to at least 0.04" thickness, overlapping one-half the width of the tape as well as the surrounding PVC coating.
- 3 Completely cover the taped area with Ocal PVC spray to assist with sealing the taped area as well as aesthetically color matching the factory PVC coating.



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Installation and special care

- 01 T&B hub
- 02 ST 1/2
- 03 Reducing coupling
- 04 Stainless steel Superstrut® channel

As previously mentioned, “no exposed metal shall be allowed” in PVC-coated conduit systems. When a PVC-coated conduit terminates into an enclosure, a PVC-coated hub is required for exit out of the enclosure with the PVC sleeve covering all exposed threads.



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Conventional flexible conduits and fittings may not be used in PVC-coated conduit system. The flex as well as the fittings must be PVC-coated.



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When changing from one size PVC-coated conduit to another, an REC-style reducing coupling is preferred over a standard RE reducing bushing.



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Stainless steel strut is recommended over PVC-coated strut.



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Installation and special care

When working with PVC-coated conduit, special wrenches must be used to protect the PVC coating. Pipe wrenches with extra-fine teeth, strap-type wrenches and slip-joint pliers with special jaws should be used to help avoid damage.



Special care — sleeves

Sleeves are provided on PVC-coated conduit couplings and fittings to help ensure a continuous coating. Sleeves shall not be cut off or split. The required lengths for sleeves is set forth in NEMA RN-1 Section 3.5.

In cases where two sleeves meet, each sleeve is permitted to be trimmed equally to allow the two sleeves to fit flush.

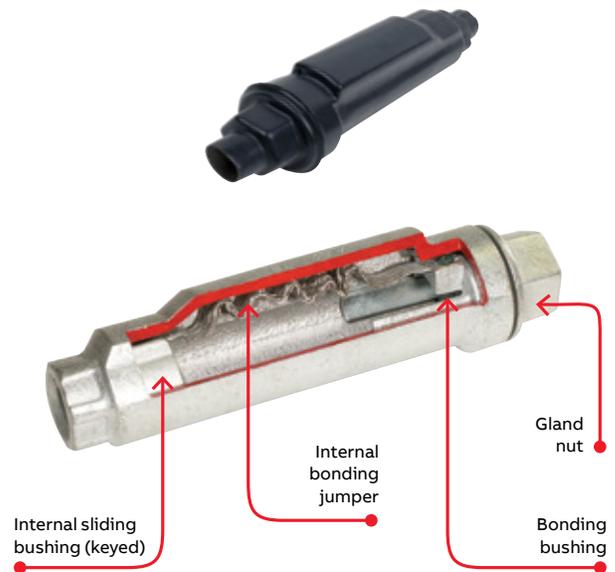
To make installation easier, silicon sprays may be used on the inside diameter of the sleeves.



Special care — grounding and bonding

When expansion joints are used in PVC-coated conduit systems, use of one with an internal bonding jumper is recommended.

The use of an expansion joint without an internal bonding jumper requires removing portions of the PVC coating where the external jumper attaches, followed by repair patching of the exposed metal.



Ocal liquid-tight connectors with UL listed grounding ring meet the requirement of UL 467 for grounding and bonding. These grounding rings are made from naval brass for superior corrosion resistance.



Special care — assembly

Threadless fittings shall NOT be used with PVC-coated conduit.

Since the threads are not visible during installation, take extra care to ensure that threads are fully engaged and wrench tight.

Recommended hand tools

- 01 J460
- 02 J42
- 03 J60
- 04 J460
- 05 J442

Strap wrench

A strap wrench can also be used to tighten PVC-coated conduit.

Be sure to use a strap wrench with a non-absorbent strap, designated by its yellow color.

Avoid using a conventional strap wrench with a white strap, which will absorb oil over time and begin to slip when used with PVC-coated conduit.



Cat. no.	Handle length in. mm	Strap length in. mm	Strap width in. mm	Pipe capacity in. mm	Pipe capacity (O.D.)	Weight lbs. kg
					in. mm	
31355	11.75	17.00	1.75	2.00	3.50	1.75
	298.45	431.80	44.45	50.80	88.90	.79
31370	18.00	29.25	1.75	5.00	5.50	2.75
	457.20	742.95	44.45	127.00	139.70	1.25

J-wrench

Conventional slip-joint pliers will cause severe damage to PVC coating.

ABB offers J-wrenches that are of a slip-joint design with extra wide jaws to protect the Ocal PVC coating while gripping.



Ocal J-wrench

Removable aluminum jaws for PVC-coated conduit.

Use with our pliers, or purchase the jaws only and adapt to your pliers.



- 01
- 02
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Cat. no.	Description	Pipe capacity
J442	12" J-wrench with jaws	½" to 1¼"
J460	16" J-wrench with jaws	1½" to 2½"
J42	12" jaw set only	½" to 1¼"
J60	16" jaw set only	1½" to 2½"

KOPR-SHIELD® joint compound

Protects, lubricates and enhances the conductivity of all electrical connections



Product features

- Meets NEC requirements for protection against corrosion: “Where corrosion protection is necessary and the conduit is threaded in the field, all threads shall be coated with an approved electrically conductive, corrosion-resistant compound.”
- Extremely adhesive compound flows smoothly into uneven contours and voids, ensuring easy application and complete, positive protection and lubrication
- Won’t settle out, thin, thicken, harden or dry out under the most severe environmental conditions
- Excellent temperature characteristics — can be brushed on at -50 ° F to 250 ° F (-45 ° C to 121 ° C) and remains intact for short periods even at 1,800 ° F (982 ° C)
- Helps ensure low resistance and seals out air and moisture
- Unique, homogenized blend of pure, polished colloidal copper, rust and corrosion inhibitors

KOPR-SHIELD® joint compound



Product code	Container	Size
201-31879	Brush cap can	1½ oz. (.04 liter)
201-31879-1	Brush cap can	4 oz. (.12 liter)
CP8-TB	Brush cap can	8 oz. (.24 liter)
CP16	Brush cap can	1 pint (.47 liter)
CP128	Can	1 gallon (3.79 liter)

Note: Not recommended for food and beverage processing applications.

Ocal® touch-up compounds

Fast-drying, air-cure patch for Ocal® PVC-coated conduit and fittings



Ocal touch-up compounds

Product code	Container	Size	Color
Exterior PVC patch			
SPRAY-G	Spray can	12½ oz. (.37 liter)	Dark gray
SPRAY-W	Spray can	12½ oz. (.37 liter)	White
SPRAY-B	Spray can	12½ oz. (.37 liter)	Light blue
PATCHP-G	Brush cap can	1 pint (.47 liter)	Dark gray
PATCHP-W	Brush cap can	1 pint (.47 liter)	White
PATCHP-B	Brush cap can	1 pint (.47 liter)	Light blue
PATCHG-G	Bottle	1 gallon (3.79 liter)	Dark gray
PATCHG-W	Bottle	1 gallon (3.79 liter)	White
PATCHG-B	Bottle	1 gallon (3.79 liter)	Light blue
Interior urethane patch			
URETHANEPATCH	Brush cap can	1 pint (.47 liter)	Blue

Ocal® heat-cure patch

A better patching solution for hot weather applications



Even in the best of installations, the PVC jacket on PVC-coated conduit or fittings can be cut, nicked or abraded. To maintain corrosion protection, ABB has added a new, thicker PVC patch to its offering of Ocal touch-up compounds.

Ideal for use in hot weather, Ocal heat-cure patch offers a thicker consistency at high ambient temperatures than standard air-cure patches, helping to ensure better coverage and a more effective patch.

Ocal heat-cure patch makes patching fast and easy.

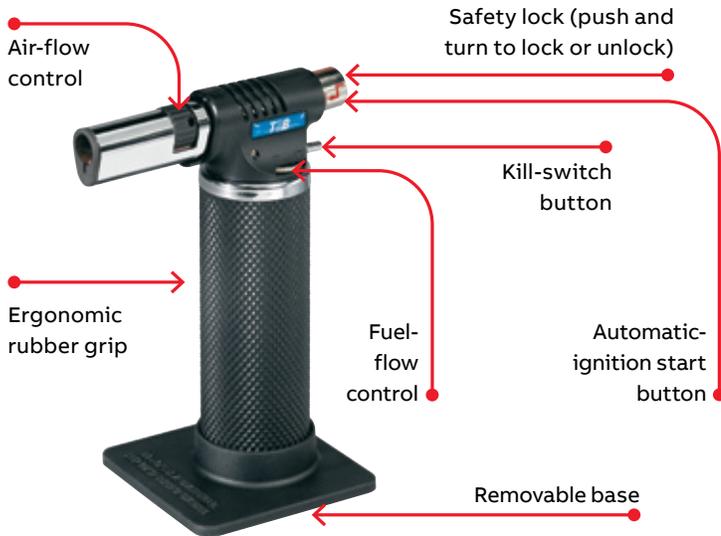
1. Make sure the area to be patched is clean and dry.
2. Squeeze the amount of patch material needed onto the area to be repaired.
3. If necessary, spread and level the patch material with a putty knife.
4. Apply heat with a heat gun or torch, such as the ABB portable heat-shrink torch.
5. Being careful not to overheat (500° F/260°C max.), apply heat for two minutes total, or at least one minute after surface of patch has turned glossy. (The patch material is a glossy liquid that turns flat with initial heat application and then turns glossy again as heating continues.)
6. Allow the patched area to air cool, or use a water quench.

Ocal heat-cure patch

Product code	Color	Size
PATCHT-G	Dark gray	6 oz. (.18 liter)
PATCHT-W	White	6 oz. (.18 liter)
PATCHT-B	Light blue	6 oz. (.18 liter)

Portable heat-shrink torch

Separate controls enable precise adjustment of flame and temperature



Product features

- 2,500 ° F (1,371 ° C) output capacity satisfies virtually any heating, brazing or soldering need
- Dual fuel- and air-flow controls enable separate adjustment of temperature and flame precision
- Brass and steel construction provides durability
- Operates on standard butane lighter fluid (not included)
- Operating time (per full fuel tank): Up to 220 minutes
- Fuel tank capacity: 2.03 fl. oz. / 60.03 ml

Portable heat-shrink torch

Product code	Description	Dimensions (without base)						Weight (when filled)	
		Length		Width		Height		(oz)	(g)
		(in.)	(mm)	(in.)	(mm)	(in.)	(mm)		
WT-PTORCH	Portable heat-shrink torch	3.90	99.06	1.40	35.56	5.40	137.16	9.88	280.09

Electric heat gun



Product features

- UL listed
- 600 ° F to 950 ° F heat range
- Brass and steel construction provides durability
- 120 V AC 60 Hz

Electric heat gun



Product code	Description	Pkg qty
WT1400	Dual-temp. heat gun 600 ° F/950 ° F, 1300 W, 120 V AC, 60 Hz	1

Order multiple is std. pkg.



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