



Tom Pernal Electrical Seminars, LLC

May 8, 2024

IPCs (Insulation Piercing Connectors) Suitable for Supply-Side of Service

Crackerbarrel Presentation
2024 Building Safety Conference of New Jersey
Hard Rock Hotel and Casino
Atlantic City, New Jersey

Presenter: Tom Pernal

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May 6, 2024

**Spring 2024 Construction Code Communicator Article
Listing of Insulation Piercing Connectors**

The Code Assistance Unit has received many calls regarding application and acceptance of insulation piercing connectors (IPCs) and their listing for use on the line side of service equipment, commonly used in PV installations.

Some code officials are under the assumption that there are no listed products for this purpose. However, this assumption is false. When this information is disseminated, installers get misconceptions, and frankly, the rest of the code enforcement community gets confused as well. Underwriters Laboratory (UL) utilizes a category-based system of listing products for certification, and it has been erroneously stated that IPCs are under category ZMWW. This category is inaccurate; products complying with Section 230.46, Spliced and Tapped Conductors, of the electrical subcode, the 2020 National Electric Code (NEC), must be listed under ZMVV. Engineering at UL has confirmed support of this determination. Furthermore, UL lists on their website all products and the product number by their manufacturer that comply with this category.

When specifically asked as to what category IPCs must be listed, this is the response from UL engineering:

The short answer is that ZMVV (Wire Connectors and Soldering Lugs) is the correct category for certifications intended to satisfy the requirements of the NEC, including those at Section 230.46. Regarding Section 230.46, the following information is on the ZMVV guide card under Product Markings and Ratings:

Suitable for Use on the Line Side of Service Equipment - Wire connectors evaluated for use on service conductors may be marked on the connector, the smallest unit container, or on an information sheet placed in the smallest unit container, with the following or equivalent: "SR", or "Suitable for Use on the Line Side of Service Equipment".

The reason ZMWW gets mentioned, is because the source of requirements for that utility-based category is the ANSI/NEMA C119 Series of Standards, which happens to be the same set of requirements identified in the UL standards cited in ZMVV (UL 486A-486B and UL 486C). So, a connector with the above marking is evaluated to the NEC-based requirements of UL 486 Series of standards, **in addition** to the utility-based requirements of C119; however, a connector solely evaluated to C119 would not be subject to the requirements specific to the NEC. It is common practice for a connector certified to ZMWW to show a certification mark for ZMVV, as those connectors meet UL 486 and C119 requirements. For the purposes of complying with Section 230.46, a connector certified to ZMVV, with the marking noted above, should be used.

Provided an installer can supply you with the appropriate documentation that is confirmed to match the installed product, it should be accepted as complying with the applicable code.

Source: Scott Borsos - Code Assistance Unit - (609) 984-7609

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Some Suggestions for Code Enforcement Personnel:

230.46 Spliced and Tapped Conductors.

Service-entrance conductors shall be permitted to be spliced or tapped in accordance with 110.14, 300.5(E), 300.13, and 300.15. Power distribution blocks, pressure connectors, and devices for splices and taps shall be listed. Power distribution blocks installed on service conductors shall be marked "suitable for use on the line side of the service equipment" or equivalent.

Effective January 1, 2023, pressure connectors and devices for splices and taps installed on service conductors shall be marked "suitable for use on the line side of the service equipment" or equivalent.

- 1) Prior to issuing a permit, request a cut sheet of the IPC or other tap(s) to be used for the installation. If the cut-sheet shows a Code-Compliant, and/or suitable device, then issue the permit and upon inspection, verify that the tap specified prior to issuance of the permit was in-fact used for the installation. This will decrease the failure rate of tap installations.
- 2) It seems that the biggest issue some AHJs are having is the lack of the marking that went into effect January 1, 2023. While this is a valid argument, the AHJ can review the suitability of these connectors for these installations, and approve them if he or she wishes based on NEC Section 90.4. *(By special permission, the authority having jurisdiction may waive specific requirements in this Code or permit alternative methods where it is assured that equivalent objectives can be achieved by establishing and maintaining effective safety. This Code may require new products, constructions, or materials that may not yet be available at the time the Code is adopted. In such event, the authority having jurisdiction may permit the use of the products, constructions, or materials that comply with the most recent previous edition of this Code adopted by the jurisdiction).*
- 3) If these products are suitable for the purpose, but not yet labeled as per 230.46, the required effective safety is assured by the listing/suitability, and should pose no safety concerns to the AHJ. Of course proper documentation is required.
- 4) Finally, consider the millions of units already in supply houses and distributors nationwide manufactured prior to the requirement put in place on January 1, 2023. Are these to be recalled only to be marked by the manufacturer, when these products are already suitable for the purpose. The identified products are identical to those already at market. They just lack the currently required marking.
- 5) Another simple yet safer way to subvert this entire issue is to install a back-fed circuit breaker with a retention clip.

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Northeast Region
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The IPC connectors that are listed to UL 486 and are suitable for line side connectors are marked as suitable with a SR marking. Other connectors are listed to UL 486 but have been evaluated for line side by a different standard, ANSI C119.5. This Standard has been used by Utilities to evaluate connectors on the supply side of service for some time now.

It will be up to the AHJ to "approve" the suitability for the connectors based on the knowledge they have with these two Standards. The language doesn't require the listing for the line-side, only the suitability. Keep in mind most if not all are listed under UL 486 as connectors.

The NEC uses the term "suitable for use" for these connections and through that definition an AHJ can decide based on an evaluation of the product.

The UL standard does include an evaluation of a connector in the UL 486 standard for line side and the stated SR marking is an additional testing of any additional connector in the standard. The UL standard is not the only standard that evaluates connectors that are also listed as a UL 486 connector. The ANSI C119.5 specifically evaluate the IPC connectors for line side connectors as they have used this standard at the Utility applications for a long time.

The question is "is the IPC suitable if they have a "SR " marking" yes, but if the marking on the package, allowed under the C119 standard says that connector has been evaluated," is it good enough" I say yes!

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May 6, 2024

UL Certification Requirement Decision

Product Category (CCN): ZMVV Standard Number:

UL 486A-4868

Standard Title: Standard for Wire Connectors

Subject: Requirements for Rating Wire Connectors as "Suitable for Use on the Line Side of the Service Equipment."

Markings

Connectors complying with Annex F shall be permitted to be marked on the connector, the smallest unit container, or on an information sheet placed in the smallest unit container. with the following -- "SR", "Suitable for use on the line side of the service equipment" or equivalent.

RATIONALE FOR DECISION:

This Certification Requirement Decision (CRD) addresses the revised NEC® requirements (refer to Section 230.46), which will become effective on January 1st, 2023.

The NEMA/ANSI C119 family of standards were identified as being the industry accepted standards for connectors used in electric utility applications. In the NEC, the "Service" is the conductors and equipment connecting the serving utility to the wiring system of the premises served (reference NEC Article 100). Connectors used in electric utility applications will always be on the "line side of the service". *For that reason, it was concluded that subjecting connectors, intended to be used in accordance with NEC Section 230.46, to additional requirements in the NEMA/ANSI C119 family of standards is appropriate when identifying a connector as being "suitable for use on the line side of the service equipment."*

This CRD adds a new Annex to UL 486A-486B to include Normative requirements which would apply when rating connectors for use on the "Lineside of Service." This new Annex refers to NEMA/ANSI C119.4 (Electric Connectors - Connectors for Use between Aluminum-to-Aluminum and Aluminum-to-Copper Conductors Designed for Normal Operation.

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4701 Creek Road, Suite 110
Cincinnati, Ohio 45242

nVent.com/ILSCO

nVent ILSCO Insulation Piercing Connector: First in the Industry to Meet New NEC Requirement for Service Entrance Connections

nVent is excited to announce that nVent ILSCO Insulation Piercing Copper Connector, IPC-250-4/0 is now UL Listed as suitable for use on the line side of service equipment. It meets the 2020 NEC 230.46 requirement that went into effect on January 1, 2023, requiring pressure connectors installed on service entrance splices and taps be listed and marked "suitable for use on the line side of service equipment." nVent ILSCO connectors were tested to UL 486A-486B Annex H which is the test standard required to meet 2020 NEC 230.46.

nVent ILSCO is the first manufacturer to meet the NEC 230.46 requirement. This is the second announcement by nVent ILSCO regarding its product performance and ability to meet this important standard. nVent ILSCO now offers its customers 293 SKUs of pressure connectors, parallel tap connectors and insulation piercing connector for the 2020 NEC 230.46 requirement:

Please contact nVent ILSCO for your next power connections project's need. To learn more, visit www.nVent.com/ILSCO.

INSULATION PIERCING	IPC-250-4/0
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April 26, 2024

The **IPC-250-4/0 KUP-L-Tap Insulation Piercing Copper Connector** from IIsco is a versatile connector designed for both splicing and tapping applications. Here are some key features and specifications:

- **Dual Rated:** This connector is dual rated, suitable for use with both aluminum (AL) and copper (CU) conductors.
- **Main Conductor Range:** It accommodates main conductors ranging from 250 kcmil to 1 AWG.
- **Tap Range:** The tap range covers 4/0 AWG to 6 AWG.
- **Tin Plated:** The connector is tin plated for corrosion resistance.
- **Insulation Piercing:** No need to strip the conductor, which saves installation time.
- **Breakout Feature:** It can be easily broken out by hand.
- **Prevents Oxidation and Moisture:** The design prevents oxidation and moisture from entering the contact area.
- **Can Be Installed "Hot":** It can be installed on energized conductors as long as the tap conductor is not under load.
- **UL and CSA Listed:** The connector meets UL 486A/B and CSA C22.2 No. 65-03 standards.
- **Temperature Rating:** Suitable for use in environments with a temperature rating of 90°C.
- **Voltage Rating:** It has a voltage rating of 600V.
- **Amperage Ratings:** For aluminum conductors, it's rated at 205 Amps (derated where applicable), and for copper conductors, it's rated at 260 Amps (derated where applicable).
- **Dimensions:** The connector's dimensions include a height of 3.332 inches, a length of 1.87 inches, and a width of 2.345 inches.
- **Torque Specifications:** The wire binding torque is 360 inch-pounds.

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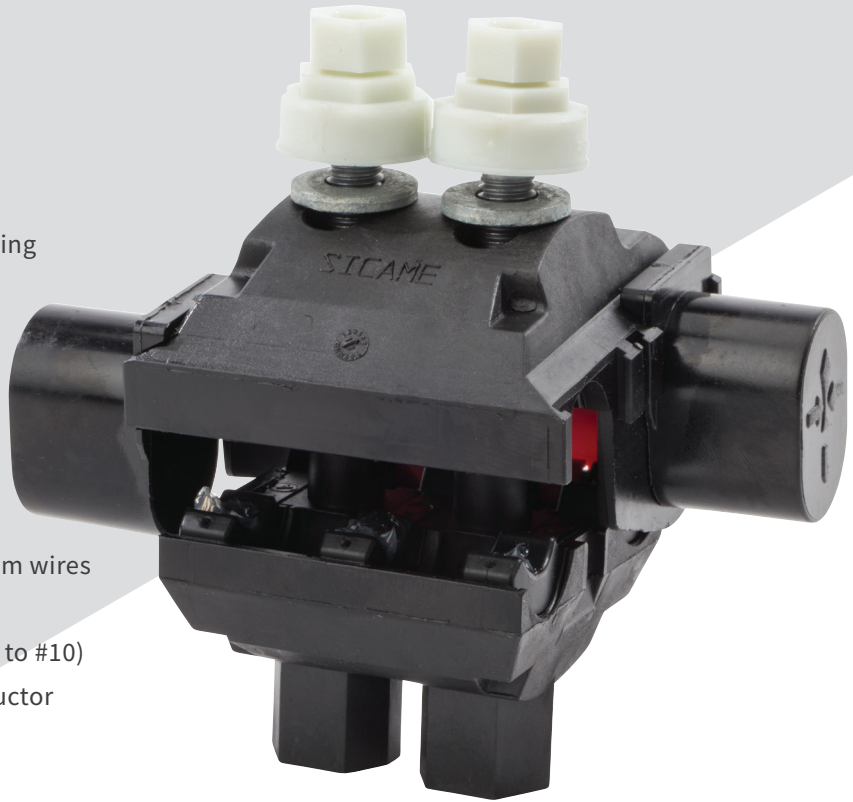
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EASY-TAP™

INSULATION PIERCING CONNECTORS

IPCS SERIES

- No need to strip wire
- No tape or cover needed
- Can be installed on energized connectors
- No spacer required between connections
- “Turbo spacer” keeps tabs open during tightening
- Watertight and corrosion-free
- Connectors handle a large wire range (#14 AWG-750 MCM)
- Double shear-head bolts ensure a perfect connection every time
- Use as a splice or tap
- No special tools required
- For any combination of copper and/or aluminum wires
- Suitable for solid and/or stranded wires
- Four sizes approved for use with bare wire (4/0 to #10)
- Blue insert re-creates insulation to avoid conductor
- UL486B Listed
- Meets ANSI C119.4 requirements
- 600 V, 90° C Rated



CATALOG NUMBER	UPC CODE	CONDUCTOR RANGE		CURRENT RATING		DIMENSIONS (IN)			NO. OF BOLTS	CARTON QTY.	SHIPPING WT. LB/100
		MAIN AWG	TAP AWG	CU AMP	AL AMP	HEIGHT	WIDTH	LENGTH			
IPCS2001*	08260	2/0-4	10-14	55	40	3	1.8	2.2	1	6	.23
IPCS7501	08261	750-3/0	10-14	55	40	3.7	2.4	2.6	1	6	.35
IPCS1002	08262	1/0-8	2-10	190	150	3.1	1.8	2.2	1	6	.30
IPCS1010	08263	1/0-8	1/0-8	190	150	3.1	1.8	2.2	1	6	.30
IPCS4002*	08264	4/0-3	2-10	190	150	3.1	1.8	2.2	1	6	.26
IPCS4020	08265	4/0-2	2/0-6	300	235	3.3	2.2	2.6	1	4	.41
IPCS4040	08266	4/0-2	4/0-4	405	315	3.3	2.4	3.5	1	4	.43
IPCS2540**	08272	250-1	4/0-4	405	315	3.5	2.2	2.6	1	4	.56
IPCS3535**	08267	350-1/0	350-1/0	570	445	4.5	3	3.9	2	2	1.11
IPCS5040**	08268	500-2/0	4/0-4	405	315	4.5	3	3.9	2	2	1.16
IPCS5035**	08269	500-4/0	350-1/0	570	445	4.5	3	3.9	2	2	1.11
IPCS7550**	08270	750-250	500-250	700	545	4.7	3.3	4.3	2	2	1.66

*Cannot be used with bare wire or as a splice

**Cannot be used with bare wire

All sizes can be installed on an energized main conductor when the tap is not under load

Not recommended for use with extra-flexible cables

Not approved for submersible applications





IDEAL INDUSTRIES, INC.

1375 Park Avenue • Sycamore, Illinois 60178 • 815.895.5181 • www.idealind.com

ALL IDEAL Customers

4/21/23

Subject: The Buchanan B-TAP® splice/tap connectors meet the 2020 NEC article 230.46 requirement for “line side applications”

This letter is being issued as a follow up to the announcement letter dated 2/9/23 related to the Buchanan B-TAP® splice/tap connectors installed on service conductors from service equipment to the service point (excluding the service point) being marked or identified “suitable for use on the line side of the service equipment”. We would like to make it clear to our customers that utilizing the Buchanan B-TAP® Insulation Piercing Connectors meet the “SR” rating requirements based on the ANSI C119.5 product testing conducted in an ISO 17025 accredited laboratory.

As part of the ANSI C119.5 evaluation, the Buchanan B-TAP® Insulation Piercing Connectors underwent NEMA/ANSI C119.5 tests required in the “UL LLC CERTIFICATION REQUIREMENT DECISION” for product category ZMVV Class A and Class 3 Connectors. A report of these connectors’ compliance with ANSI C119.5 Standard is available upon request.

However, we want to clarify that we have not yet performed the pertinent tests in the UL-accredited laboratory in order to obtain the same “SR” rating as part of IDEAL’s UL Certification. Therefore, our compliance should be considered a self-declaration to this added Certification Requirements Decision of the UL 486B standard.

Sushil Keswani

A handwritten signature in black ink, appearing to read "Sushil Keswani", written in a cursive style.

Director of Engineering
IDEAL Industries, Inc.



Regarding: Connectors rated for use on the Lineside of the Service.;

To: [Whom it may concern](#)

Polaris insulated products are UL listed (UL 486A/B) and CSA certified (CSA22.2-65) These connectors are dual rated for use with copper and or aluminum. We recently completed testing and qualification (2-9-2023) to the 2023 NEC article 230.46 requiring connectors to be listed for use on the line side of the service equipment.

Our connectors (PL, IPL, IPLM, IPLMD, IPLD, IT, ISR, PLH, IPLH, IPLDH, IPLMDH, ISRH and ITH) for the 350 – 750 kcmil sizes connectors are now rated for use on the “line side of the service equipment.”

We will begin marking our products with “Suitable for use on the line side of the service equipment” as per the NEC requirement. Our connector design was not changed to achieve this new qualification, so our inventory is qualified for this new rating as well, but will possible need this document to share with the AHJ

Thanks for using our connectors,

Sincerely,

Robert

Robert Westbrook
Polaris Connectors
Application Support / Lab Administrator
Robert.Westbrook@PolarisConnectors.com
Office 727-372-1703 X 242



New!

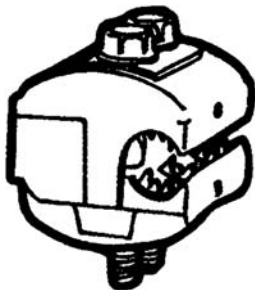
INSULATION PIERCING CONNECTORS - IPC

Galvan IPC Series connectors are an easy fit in copper-to-copper, copper-to-aluminum and aluminum-to-aluminum applications. Designed for splice or tap use, these units are not recommended for use with extra-flexible cables. The connectors are fully insulated and safe to install without special tools. IPC connectors eliminate time spent on wire stripping, taping and covers.

Insulation piercing connectors

- Wire range: #14 AWG to 750 MCM
- Versatile and reliable
- Use only with insulated conductors
- Installs without tape, stripping or cover
- Easy one-person installation
- UL 486B listed
- Rated: 600 volts, 90° C

Catalog Number	Conductor Range		No. of Bolts	Pieces Per Carton	Weight Per Carton
	Main AWG	Tap AWG			
IPC-1/0-2	1/0-8	2-10	1	6	30
IPC-1/0-1/0	1/0-8	1/-8	1	6	30
IPC-2/0-10	2/0-4	10-14	1	6	23
IPC-4/0-2	4/0-3	2-10	1	6	26
IPC-4/0-20	4/0-2	2/ 0-6	1	4	41
IPC-4/0-4/0	4/0-2	4/0-4	1	4	43
IPC-350-350	350-1/0	350-1/0	2	2	111
IPC-500-4/0	500-2/0	4/0-4	2	2	116
IPC-500-350	500-4/0	350-1/0	2	2	111
IPC-750-10	750-3/0	10-14	1	6	35
IPC-750-500	750-250	500-250	2	2	166



INSULATION – PIERCING CONNECTORS • TYPE IPC

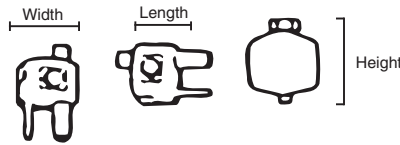
For all combinations of copper and aluminum



UL 486 B
 LISTED
 AL 9CU



- Dual rated for insulated copper and aluminum wire
- For outdoor or indoor installation on energized conductor (not under load)
- Molded of glass-filled nylon for long life
- Extra hard copper teeth for proper penetration
- Use as tap, splice, or dead end
- No need to strip insulation



Catalog Number	Volts	Cond. Range		Current Rating		Dimensions (in)			Recomm. Torque ft. lbs.	Bolt Hd. Size	No. of Bolts
		Run	Tap	CU	AL	Width	Height	Length			
IPC-1/0-2 †	300	1/0-8	2-8	130	100	1.47	2.31	1.22	16	1/2	1
IPC-4/0-6	600	4/0-4	6-14	75	60	1.00	1.87	1.42	13	1/2	1
IPC-4/0-2/0	600	4/0-2	2/0-6*	195	150	1.88	2.88	1.66	25	1/2	1
IPC-250-4/0	600	250-1	4/0-6	260	205	2.34	3.34	1.88	30	5/8	1
IPC-350-4/0 †	300	350-4/0	4/0-10	260	205	2.44	3.13	1.67	25	5/8	1
IPC-350-350 †	300	350-4/0	350-4/0	350	280	2.72	3.25	2.67	25	5/8	2
										Bolt Nut	
IPC-500-250 Δ	600	500-350	250-4	260	205	2.90	3.75	2.42	60	5/8-11/16	1
IPC-500-500 Δ	600	500-300	500-250	430	350	3.63	5.00	3.19	75	7/8-7/8	1
IPC-750-500 Δ	600	750-500	500-350	430	350	3.63	5.00	3.19	75	7/8-7/8	1

† 480 Volts Grounded Y Systems

Δ Uses Bolt & Nut Clamping

*Maximum diameter of tap wire when measured over the insulation may not be larger than .528 in.

Cross Reference				
PUC	ILSCO	Kupler	Blackburn	Buchanan
IPC-1/0-2	IPC-1/0-2	130001	IPC-1102	BTC 3/0-12
IPC-4/0-6	IPC-4/0-6	130021	-	-
-	-	130003	IPC-4111	-
IPC-4/0-2/0	IPC-4/0-2/0	-	-	BTC 4/0-6
-	-	130004	IPC-4141	-
IPC-250-4/0	IPC-250-4/0	130024	-	-
IPC-350-4/0	IPC-350-4/0	130013	IPC-3541	BTC 350-10
IPC-350-350	IPC-350-350	130012	IPC-3535	BTC 350-2/0
IPC-500-250	IPC-500-250	130005	IPC-5041	BTC 500-4
IPC-500-500	IPC-500-500	130006	-	-
IPC-750-500	IPC-750-500	130007	-	-