

Hypertherm®

Powermax45 XP® Plasma Arc Cutting System



Service Manual

809230 | Revision 2 | English

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Powermax45 XP

Service Manual

809230
Revision 2

English
Original instructions

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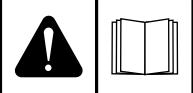
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For training and education resources, go to the Hypertherm Cutting Institute (HCI) online at www.hypertherm.com/hci.



ENGLISH

WARNING! Before operating any Hypertherm equipment, read the safety instructions in your product's manual and in the *Safety and Compliance Manual* (80669C). Failure to follow safety instructions can result in personal injury or in damage to equipment.

Copies of the manuals may accompany the product in electronic and printed formats. You can also obtain copies of the manuals, in all languages available for each manual, from the "Documents library" at www.hypertherm.com.

DEUTSCH / GERMAN

WARNUNG! Bevor Sie ein Hypertherm-Gerät in Betrieb nehmen, lesen Sie bitte die Sicherheitsanweisungen in Ihrer Bedienungsanleitung sowie im *Handbuch für Sicherheit und Übereinstimmung* (80669C). Das Nichtbefolgen der Sicherheitsanweisungen kann zu Verletzungen von Personen oder Schäden am Gerät führen.

Bedienungsanleitungen und Handbücher können dem Gerät in elektronischer Form oder als Druckversion beiliegen. Alle Handbücher und Anleitungen können in den jeweils verfügbaren Sprachen auch in der „Dokumente-Bibliothek“ unter www.hypertherm.com heruntergeladen werden.

FRANÇAIS / FRENCH

AVERTISSEMENT! Avant d'utiliser tout équipement Hypertherm, lire les consignes de sécurité importantes dans le manuel de votre produit et dans le *Manuel de sécurité et de conformité* (80669C). Le non-respect des consignes de sécurité peut engendrer des blessures physiques ou des dommages à l'équipement.

Des copies de ces manuels peuvent accompagner le produit en format électronique et papier. Vous pouvez également obtenir des copies de chaque manuel dans toutes les langues disponibles à partir de la « Bibliothèque de documents » sur www.hypertherm.com.

ESPAÑOL / SPANISH

ADVERTENCIA! Antes de operar cualquier equipo Hypertherm, leer las instrucciones de seguridad del manual de su producto y del *Manual de Seguridad y Cumplimiento* (80669C). No cumplir las instrucciones de seguridad podría dar lugar a lesiones personales o daño a los equipos.

Pueden venir copias de los manuales en formato electrónico e impreso junto con el producto. También se pueden obtener copias de los manuales, en todos los idiomas disponibles para cada manual, de la “Biblioteca de documentos” en www.hypertherm.com.

ITALIANO / ITALIAN

AVVERTENZA! Prima di usare un'attrezzatura Hypertherm, leggere le istruzioni sulla sicurezza nel manuale del prodotto e nel *Manuale sulla sicurezza e la conformità* (80669C). Il mancato rispetto delle istruzioni sulla sicurezza può causare lesioni personali o danni all'attrezzatura.

Il prodotto può essere accompagnato da copie elettroniche e cartacee del manuale. È anche possibile ottenere copie del manuale, in tutte le lingue disponibili per ogni manuale, dall’“Archivio documenti” all’indirizzo www.hypertherm.com.

NEDERLANDS / DUTCH

WAARSCHUWING! Lees voordat u Hypertherm-apparatuur gebruikt de veiligheidsinstructies in de producthandleiding en in de *Veiligheids- en nalevingshandleiding* (80669C). Het niet volgen van de veiligheidsinstructies kan resulteren in persoonlijk letsel of schade aan apparatuur.

De handleidingen kunnen in elektronische en gedrukte vorm met het product worden meegeleverd. De handleidingen, elke handleiding beschikbaar in alle talen, zijn ook verkrijgbaar via de “Documentenbibliotheek” op www.hypertherm.com.

DANSK / DANISH

ADVARSEL! Inden Hypertherm udstyr tages i brug skal sikkerhedsinstruktionerne i produktets manual og i *Manual om sikkerhed og overholdelse af krav* (80669C), gennemlæses. Følges sikkerhedsvejledningen ikke kan det resultere i personskade eller beskadigelse af udstyret.

Kopier af manualerne kan ledsage produktet i elektroniske og trykte formater. Du kan også få kopier af manualer, på alle sprog der er til rådighed for hver manuel, fra “Dokumentbiblioteket” på www.hypertherm.com.

PORTUGUÊS / PORTUGUESE

ADVERTÊNCIA! Antes de operar qualquer equipamento Hypertherm, leia as instruções de segurança no manual do seu produto e no *Manual de Segurança e de Conformidade* (80669C). Não seguir as instruções de segurança pode resultar em lesões corporais ou danos ao equipamento.

Cópias dos manuais podem acompanhar os produtos nos formatos eletrônico e impresso. Também é possível obter cópias dos manuais em todos os idiomas disponíveis para cada manual na “Biblioteca de documentos” em www.hypertherm.com.

日本語 / JAPANESE

警告！ Hypertherm 機器を操作する前に、安全に関する重要な情報について、この製品説明書にある安全情報、および製品に同梱されている別冊の「安全とコンプライアンスマニュアル」(80669C)をお読みください。安全情報に従わないと怪我や装置の損傷を招くことがあります。

説明書のコピーは、電子フォーマット、または印刷物として製品に同梱されています。各説明書は、www.hypertherm.com の「ドキュメントライブラリ」から各言語で入手できます。

简体中文 / CHINESE (SIMPLIFIED)

警告！ 在操作任何海宝设备之前，请阅读产品手册和《安全和法规遵守手册》(80669C)中的安全操作说明。若未能遵循安全操作说明，可能会造成人员受伤或设备损坏。

随产品提供的手册可能提供电子版和印刷版两种格式。您也可从“Documents library”（文档资料库）中获取每本手册所有可用语言的副本，网址为 www.hypertherm.com。

NORSK / NORWEGIAN

ADVARSEL! Før du bruker noe Hypertherm-utstyr, må du lese sikkerhetsinstruksjonene i produktets håndbok og i *Håndboken om sikkerhet og samsvar* (80669C). Unnlatelse av å følge sikkerhetsinstruksjoner kan føre til personskade eller skade på utstyr.

Eksemplarer av håndbøkene kan medfølge produktet i elektroniske og trykte utgaver. Du kan også få eksemplarer av håndbøkene i alle tilgjengelige språk for hver håndbok fra dokumentbiblioteket på www.hypertherm.com.

SVENSKA / SWEDISH

VARNING! Läs häftet säkerhetsinformationen i din produkts säkerhets- och efterlevnadsmanual (80669C) föriktig säkerhetsinformation innan du använder eller underhåller Hypertherm-utrustning. Underlätenhet att följa dessa säkerhetsinstruktioner kan resultera i personskador eller skador på utrustningen.

Kopior av manualen kan medfölja produkten i elektronisk och tryckform. Du hittar även kopior av manualerna i alla tillgängliga språk i dokumentbiblioteket (Documents library) på www.hypertherm.com.

한국어 / KOREAN

경고! Hypertherm 장비를 사용하기 전에 제품 설명서와 안전 및 규정 준수 설명서 (80669C)에 나와 있는 안전 지침을 읽으십시오. 안전 지침을 준수하지 않으면 신체 부상이나 장비 손상을 초래할 수 있습니다.

전자 형식과 인쇄된 형식으로 설명서 사본이 제품과 함께 제공될 수 있습니다. www.hypertherm.com 의 ‘Documents library (문서 라이브러리)’에서도 모든 언어로 이용할 수 있는 설명서 사본을 얻을 수 있습니다.

ČESKY / CZECH

VAROVÁNÍ! Před uvedením jakéhokoliv zařízení Hypertherm do provozu si přečtěte bezpečnostní pokyny v příručce k produktu a v *Manuálu pro bezpečnost a dodržování předpisů* (80669C). Nedodržování bezpečnostních pokynů může mít za následek zranění osob nebo poškození majetku.

Kopie příruček a manuálů mohou být součástí dodávky produktu, a to v elektronické i tištěné formě. Kopie příruček a manuálů ve všech jazykových verzích, v nichž byly dané příručky a manuály vytvořeny, naleznete v „Knihovně dokumentů“ na webových stránkách www.hypertherm.com.

POLSKI / POLISH

OSTRZEŻENIE! Przed rozpoczęciem obsługi jakiegokolwiek systemu firmy Hypertherm należy się zapoznać z instrukcjami bezpieczeństwa zamieszczonymi w podręczniku produktu oraz w *Podręczniku bezpieczeństwa i zgodności* (80669C). Nieprzestrzeganie instrukcji bezpieczeństwa może skutkować obrażeniami ciała i uszkodzeniem sprzętu.

Do produktu mogą być dołączone kopie podręczników w formacie elektronicznym i drukowanym. Kopie podręczników, w każdym udostępnionym języku, można również znaleźć w „Bibliotece dokumentów“ pod adresem www.hypertherm.com.

РУССКИЙ / RUSSIAN

БЕРЕГИСЬ! Перед работой с любым оборудованием Hypertherm ознакомьтесь с инструкциями по безопасности, представленными в руководстве, которое поставляется вместе с продуктом, а также в *Руководстве по безопасности и соответствуанию* (80669J). Невыполнение инструкций по безопасности может привести к телесным повреждениям или повреждению оборудования.

Копии руководств, которые поставляются вместе с продуктом, могут быть представлены в электронном и бумажном виде. Копии руководств на всех языках, на которые переведено то или иное руководство, можно также загрузить в разделе «Библиотека документов» на веб-сайте www.hypertherm.com.

SUOMI / FINNISH

VAROITUS! Ennen minkään Hypertherm-laitteen käyttöä lue tuotteen käyttöoppaassa olevat turvalisusohjeet ja *turvallisuus- ja vaatimustenmukaisuusohje* (80669C). Turvalisusohjeiden laiminlyönti voi aiheuttaa henkilökohtaisen loukkaantumisen tai laitevahingon.

Käyttöoppaiden kopiot voivat olla tuotteen mukana elektronisessa ja tulostetussa muodossa. Voit saada käyttöoppaiden kopiot kaikilla kielillä "latauskirjastosta", joka on osoitteessa www.hypertherm.com.

БЪЛГАРСКИ / BULGARIAN

ПРЕДУПРЕЖДЕНИЕ! Преди да работите с което и да е оборудване Hypertherm, прочетете инструкциите за безопасност в ръководството на вашия продукт и „Инструкция за безопасност и съответствие“ (80669C). Неспазването на инструкциите за безопасност би могло да доведе до телесно нараняване или до повреда на оборудването.

Копия на ръководствата може да придръжават продукта в електронен и в печатен формат. Можете да получите копия на ръководствата, предлагани на всички езици, от „Documents library“ (Библиотека за документи) на адрес www.hypertherm.com.

ROMÂNĂ / ROMANIAN

AVERTIZARE! Înainte de utilizarea oricărui echipament Hypertherm, citiți instrucțiunile de siguranță din cadrul manualului produsului și din cadrul *Manualului de siguranță și conformitate* (80669C). Nerespectarea instrucțiunilor de siguranță pot rezulta în vătămare personală sau în avarierea echipamentului.

Produsul poate fi însoțit de copii ale manualului în format tipărit și electronic. De asemenea, dumneavoastră puteți obține copii ale manualelor, în toate limbile disponibile pentru fiecare manual, din cadrul secțiunii „Biblioteca documente“ aflată pe site-ul www.hypertherm.com.

TÜRKÇE / TURKISH

UYARI! Bir Hypertherm ekipmanını çalıştırmadan önce, ürün kullanım kılavuzunda ve *Güvenlik ve Uyumluluk Kılavuzu*'nda (80669C) yer alan güvenlik talimatlarını okuyun. Güvenlik talimatlarına uyulmaması durumunda kişisel yaralanmalar veya ekipman hasarı meydana gelebilir.

Kılavuzların kopyaları, elektronik ve basılı formatta ürünle birlikte verilebilir. Her biri tüm dillerde yayınlanan kılavuzların kopyalarını www.hypertherm.com adresindeki "Documents library" (Dosyalar kitaplığı) başlığından da elde edebilirsiniz.

MAGYAR / HUNGARIAN

VIGYÁZAT! Mielőtt bármilyen Hypertherm berendezést üzemeltetné, olvassa el a biztonsági információkat a termék kézikönyvében és a *Biztonsági és szabálykövetési kézikönyvben* (80669C). A biztonsági utasítások betartásának elmulasztása személyi sérüléshez vagy a berendezés károsodásához vezethet.

A termékhez a kézikönyv példányai elektronikus és nyomtatott formában is mellékelve lehetnek. A kézikönyvek példányai (minden nyelven) a www.hypertherm.com weboldalon a „Documents library“ (Dokumentum könyvtár) részben is beszerezhetők.

ΕΛΛΗΝΙΚΑ / GREEK

ΠΡΟΕΙΔΟΠΟΙΗΣΗ! Πριν θέσετε σε λειτουργία οποιονδήποτε εξοπλισμό της Hypertherm, διαβάστε τις οδηγίες ασφαλείας στο εγχειρίδιο του προϊόντος και στο *Εγχειρίδιο ασφάλειας και συμμόρφωσης* (80669C). Η μη τήρηση των οδηγών ασφαλείας μπορεί να επιφέρει σωματική βλάβη ή ζημιά στον εξοπλισμό.

Αντίγραφα των εγχειριδίων μπορεί να συνοδεύουν το προϊόν σε ηλεκτρονική και έντυπη μορφή. Μπορείτε, επίσης, να λάβετε αντίγραφα των εγχειριδίων σε όλες τις γλώσσες που διατίθενται για κάθε εγχειρίδιο από την φημιακή βιβλιοθήκη εγγράφων (Documents library) στη διαδικτυακή τοποθεσία www.hypertherm.com.

繁體中文 / CHINESE (TRADITIONAL)

警告！ 在操作任何 Hypertherm 設備前，請閱讀您產品手冊和《安全和法務遵從手冊》(80669C) 內的安全指示。不遵守安全指示可能會導致人身傷害或設備損壞。

手冊複本可能以電子和印刷格式隨附產品提供。您也可以在 www.hypertherm.com 的「文檔資料庫」內獲取所有手冊的多語種複本。

SLOVENŠČINA / SLOVENIAN

OPOZORILO! Pred uporabo katerekoli Hyperthermove opreme preberite varnostna navodila v priročniku vašega izdelka ter v *Priročniku za varnost in skladnost* (80669C). Neupoštevanje navodil za uporabo lahko povzroči telesne poškodbe ali materialno škodo.

Izdelku so lahko priloženi izvodi priročnikov v elektronski ali tiskani obliki. Izvode priročnikov v vseh razpoložljivih jezikih si lahko prenesete tudi iz knjižnice dokumentov "Documents library" na naslovu www.hypertherm.com.

SRPSKI / SERBIAN

UPOZORENJE! Pre rukovanja bilo kojom Hyperthermovom opremom pročitajte uputstva o bezbednosti u svom priručniku za proizvod i u *Priručniku o bezbednosti i usaglašenosti* (80669C). Oglušavanje o praćenje uputstava o bezbednosti može da ima za posledicu ličnu povredu ili oštećenje opreme.

Može se dogoditi da kopije priručnika prate proizvod u elektronskom i stampanom formatu. Takođe možete da pronađete kopije priručnika, na svim jezicima koji su dostupni za svaki od priručnika, u "Biblioteci dokumenata" ("Documents library") na www.hypertherm.com.

SLOVENČINA / SLOVAK

VÝSTRAHA! Pred použitím akéhokoľvek zariadenia od spoločnosti Hypertherm si prečítajte bezpečnostné pokyny v návode na obsluhu vášho zariadenia a v *Manuáli o bezpečnosti a súlade s normami* (80669C). V prípade nedodržania bezpečnostných pokynov môže dôjsť k ujme na zdraví alebo poškodeniu zariadenia.

Kópia návodu, ktorá je dodávaná s produkтом, môže mať elektronickú alebo tlačenú podobu. Kópie návodov, vo všetkých dostupných jazykoch, sú k dispozícii aj v sekcií z „knížnice Dokumenty“ na www.hypertherm.com.

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Introduction

Hypertherm's CE-marked equipment is built in compliance with standard EN60974-10. The equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

The limits required by EN60974-10 may not be adequate to completely eliminate interference when the affected equipment is in close proximity or has a high degree of sensitivity. In such cases it may be necessary to use other measures to further reduce interference.

This cutting equipment is designed for use only in an industrial environment.

Installation and use

The user is responsible for installing and using the plasma equipment according to the manufacturer's instructions.

If electromagnetic disturbances are detected then it shall be the responsibility of the user to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing the cutting circuit, see *Earthing of the workpiece*. In other cases, it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases, electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Assessment of area

Before installing the equipment, the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

- a. Other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the cutting equipment.
- b. Radio and television transmitters and receivers.
- c. Computer and other control equipment.
- d. Safety critical equipment, for example guarding of industrial equipment.
- e. Health of the people around, for example the use of pacemakers and hearing aids.
- f. Equipment used for calibration or measurement.
- g. Immunity of other equipment in the environment. User shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures.
- h. Time of day that cutting or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

Methods of reducing emissions

Mains supply

Cutting equipment must be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply.

Consideration should be given to shielding the supply cable of permanently installed cutting equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the cutting mains supply so that good electrical contact is maintained between the conduit and the cutting power source enclosure.

Maintenance of cutting equipment

The cutting equipment must be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the cutting equipment is in operation. The cutting equipment should not be modified in any way, except as set forth in and in accordance with the manufacturer's written instructions. For example, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Cutting cables

The cutting cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

Equipotential bonding

Bonding of all metallic components in the cutting installation and adjacent to it should be considered.

However, metallic components bonded to the workpiece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode (nozzle for laser heads) at the same time.

The operator should be insulated from all such bonded metallic components.

Electromagnetic Compatibility (EMC)

Earthing of the workpiece

Where the workpiece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, for example, ship's hull or building steel work, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitances selected according to national regulations.

Note: The cutting circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, for example, by allowing parallel cutting current return paths which may damage the earth circuits of other equipment. Further guidance is provided in IEC 60974-9, Arc Welding Equipment, Part 9: Installation and Use.

Screening and shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire plasma cutting installation may be considered for special applications.

Attention

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage or injury caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty, and will constitute misuse of the Hypertherm Product.

You are solely responsible for the safe use of the Product. Hypertherm does not and cannot make any guarantee or warranty regarding the safe use of the product in your environment.

General

Hypertherm Inc. warrants that its Products shall be free from defects in materials and workmanship for the specific periods of time set forth herein and as follows: if Hypertherm is notified of a defect (i) with respect to the plasma power supply within a period of two (2) years from the date of its delivery to you, with the exception of Powermax brand power supplies, which shall be within a period of three (3) years from the date of delivery to you, and (ii) with respect to the torch and leads within a period of one (1) year from its date of delivery to you, with the exception of the HPRXD short torch with integrated lead, which shall be within a period of six (6) months from the date of delivery to you, and with respect to torch lifter assemblies within a period of one (1) year from its date of delivery to you, and with respect to Automation products one (1) year from its date of delivery to you, with the exception of the EDGE Connect CNC, EDGE Connect T CNC, EDGE Connect TC CNC, EDGE Pro CNC, EDGE Pro Ti CNC, MicroEDGE Pro CNC, and ArcGlide THC, which shall be within a period of two (2) years from the date of delivery to you, and (iii) with respect to HyIntensity fiber laser components within a period of two (2) years from the date of its delivery to you, with the exception of laser heads and beam delivery cables, which shall be within a period of one (1) year from its date of delivery to you.

This warranty shall not apply to any Powermax brand power supplies that have been used with phase converters. In addition, Hypertherm does not warranty systems that have been damaged as a result of poor power quality, whether from phase converters or incoming line power. This warranty shall not apply to any product which has been incorrectly installed, modified, or otherwise damaged.

Hypertherm provides repair, replacement or adjustment of the Product as the sole and exclusive remedy, if and only if the warranty set forth herein properly is invoked and applies. Hypertherm, at its sole option, shall repair, replace, or adjust, free of charge, any defective Products covered by this warranty which shall be returned with Hypertherm's prior authorization (which shall not be unreasonably withheld), properly packed, to Hypertherm's place of business in Hanover, New Hampshire, or to an authorized Hypertherm repair facility, all costs, insurance and freight pre paid by the customer. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph and with Hypertherm's prior written consent.

The warranty set forth above is exclusive and is in lieu of all other warranties, express, implied, statutory, or otherwise with respect to the Products or as to the results which may be obtained therefrom, and all implied warranties or conditions of quality or of merchantability or fitness for a particular purpose or against infringement. The foregoing shall constitute the sole and exclusive remedy for any breach by Hypertherm of its warranty.

Distributors/OEMs may offer different or additional warranties, but Distributors/OEMs are not authorized to give any additional warranty protection to you or make any representation to you purporting to be binding upon Hypertherm.

Patent indemnity

Except only in cases of products not manufactured by Hypertherm or manufactured by a person other than Hypertherm not in strict conformity with Hypertherm's specifications and in cases of designs, processes, formulae, or combinations not developed or purported to be developed by Hypertherm, Hypertherm will have the right to defend or settle, at its own expense, any suit or proceeding brought against you alleging that the use of the Hypertherm product, alone and not in combination with any other product not supplied by Hypertherm, infringes any patent of any third party. You shall notify Hypertherm promptly upon learning of any action or threatened action in connection with any such alleged infringement (and in any event no longer than fourteen (14) days after learning of any action or threat of action), and Hypertherm's obligation to defend shall be conditioned upon Hypertherm's sole control of, and the indemnified party's cooperation and assistance in, the defense of the claim.

Limitation of liability

In no event shall Hypertherm be liable to any person or entity for any incidental, consequential direct, indirect, punitive or exemplary damages (including but not limited to lost profits) regardless of whether such liability is based on breach of contract, tort, strict liability, breach of warranty, failure of essential purpose, or otherwise, and even if advised of the possibility of such damages. Hypertherm shall not be liable for any losses to Distributor based on down time, lost production or lost profits. It is the intention of the Distributor and Hypertherm that this provision be construed by a court as being the broadest limitation of liability consistent with applicable law.

National and local codes

National and local codes governing plumbing and electrical installation shall take precedence over any instructions contained in this manual. In no event shall Hypertherm be liable for injury to persons or property damage by reason of any code violation or poor work practices.

Warranty

Liability cap

In no event shall Hypertherm's liability, if any, whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise, for any claim, action, suit or proceeding (whether in court, arbitration, regulatory proceeding or otherwise) arising out of or relating to the use of the Products exceed in the aggregate the amount paid for the Products that gave rise to such claim.

Insurance

At all times you will have and maintain insurance in such quantities and types, and with coverage sufficient and appropriate to defend and to hold Hypertherm harmless in the event of any cause of action arising from the use of the products.

Transfer of rights

You may transfer any remaining rights you may have hereunder only in connection with the sale of all or substantially all of your assets or capital stock to a successor in interest who agrees to be bound by all of the terms and conditions of this Warranty. Within thirty (30) days before any such transfer occurs, you agree to notify in writing Hypertherm, which reserves the right of approval. Should you fail timely to notify Hypertherm and seek its approval as set forth herein, the Warranty set forth herein shall be null and void and you will have no further recourse against Hypertherm under the Warranty or otherwise.

Waterjet product warranty coverage

Product	Parts coverage
HyPrecision pumps	27 months from the ship date, or 24 months from the date of proven installation, or 4,000 hours, whichever occurs first
PowerDredge abrasive removal system	15 months from the ship date or 12 months from the date of proven installation, whichever occurs first
EcoSift abrasive recycling system	15 months from the ship date or 12 months from the date of proven installation, whichever occurs first
Abrasive metering devices	15 months from the ship date or 12 months from the date of proven installation, whichever occurs first
On/off valve air actuators	15 months from the ship date or 12 months from the date of proven installation, whichever occurs first
Diamond orifices	600 hours of use with the use of a thimble filter and compliance with Hypertherm's water quality requirements

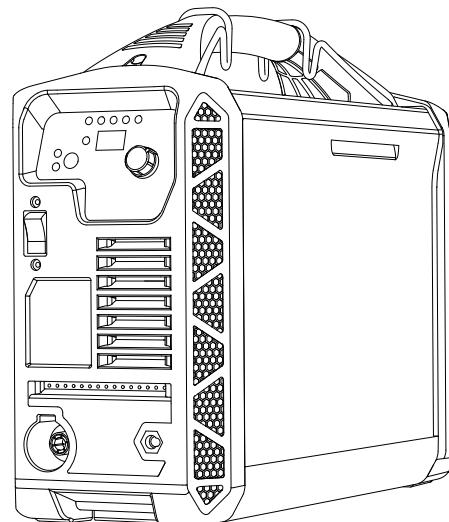
Consumable parts are not covered by this warranty. Consumable parts include, but are not limited to, high-pressure water seals, check valves, cylinders, bleed-down valves, low-pressure seals, high-pressure tubing, low- and high-pressure water filters and abrasive collection bags. All third-party pumps, pump accessories, hoppers, hopper accessories, dryer boxes, dryer box accessories and plumbing accessories are covered by the respective manufacturers' warranties and not covered by this warranty.

Installation and Setup

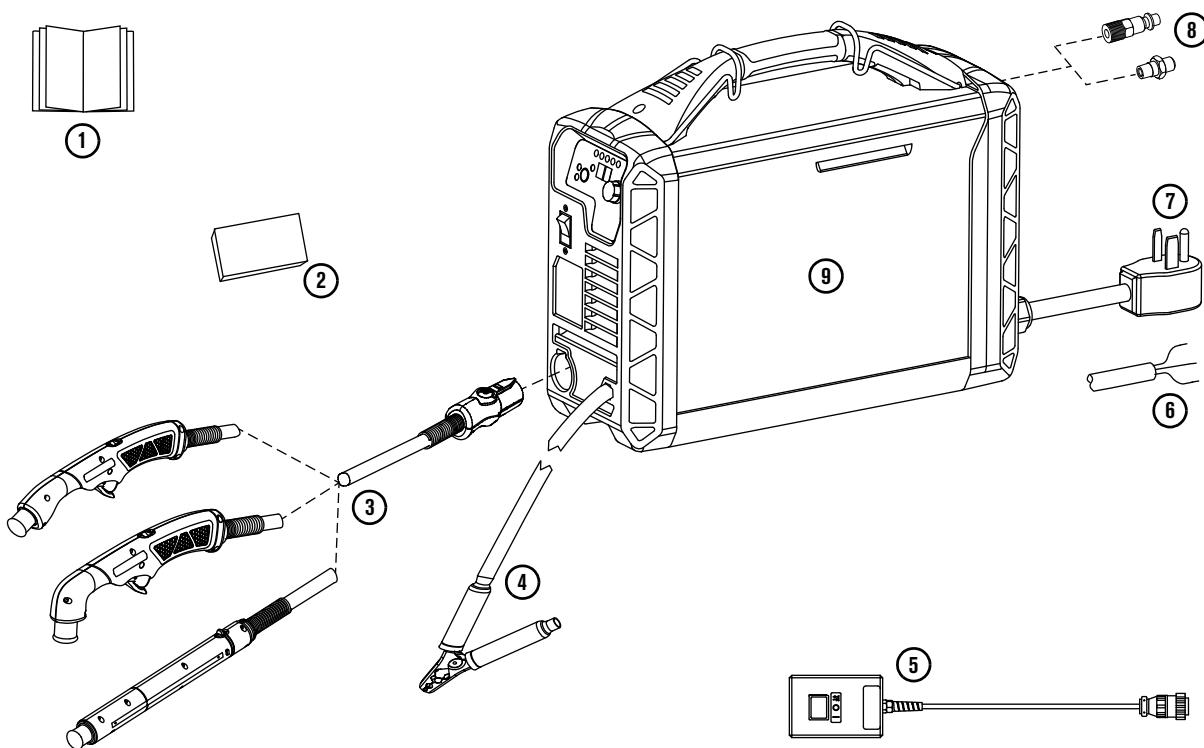
The Powermax45 XP is a portable 45 A plasma cutting system that you can use for many handheld and mechanized cutting and gouging applications. The system's automatic gas and automatic voltage features make it easy to set up and use even if you have limited plasma cutting experience.

With the Powermax45 XP you can:

- Use air or nitrogen to cut electrically conductive metals such as mild steel, stainless steel, and aluminum
- Cut thicknesses up to 16 mm (5/8 inch)
- Pierce thicknesses up to 12 mm (1/2 inch)
- Sever thicknesses up to 29 mm (1-1/8 inch)
- Use 2 different gouging processes for a wide range of gouging applications: Maximum Control gouging (26 A – 45 A) and Precision gouging (10 A – 25 A)
- Mark metal surfaces using air or argon
- Use F5 to cut stainless steel
- Disable the Duramax Lock hand and machine torches without turning OFF the power supply using the torch-disable switch
- Quickly switch between torches using the FastConnect™ system (quick-disconnect)



System contents



- 1** Documentation:
 - Operator Manual
 - Quick Setup Card
 - Registration card
 - Safety and Compliance Manual
- 2** Starter consumable kit
- 3** 15° or 75° hand torch with lead or machine torch with lead
- 4** Work clamp with work lead
- 5** Remote-start pendant (optional – mechanized configurations only)
- 6** CE/CCC and 480 V CSA models: power cord with no power plug (some models ship without a power cord)
- 7** CSA 200 V – 240 V models: power cord with 50 A, 250 V plug (NEMA 6-50P)
- 8** Region-specific gas inlet fitting (may not be preinstalled)
- 9** Plasma power supply



You can order additional consumables and accessories from any Hypertherm distributor. See *Replacement Parts and Accessories* on page 317.

What to do if components are missing or damaged

- **Claims for damage during shipment**
 - File a claim with the carrier if your system was damaged during shipment.
 - Obtain the system's model number and serial number, located on the bottom of the plasma power supply.
 - Obtain a copy of the bill of lading from Hypertherm.
- **Claims for missing or damaged merchandise**
 - Contact your Hypertherm distributor if any component is missing or damaged.

If you need additional assistance, call the nearest Hypertherm office listed in the front of this manual.

Hypertherm plasma power supply ratings

Rated open-circuit voltage (U_0)	200 – 240 V, CSA/CE/CCC 400 V, CE/CCC 480 V, CSA	275 VDC 265 VDC 275 VDC		
Output characteristic*	Drooping			
Rated output current (I_2)	10 A – 45 A			
Rated output voltage (U_2)	145 VDC			
Duty cycle at 40°C (104°F)†	50% at 45 A (I_2) / 145 VDC (U_2) 60% at 41 A (I_2) / 145 VDC (U_2) 100% at 32 A (I_2) / 145 VDC (U_2)			
Operating temperature	-10°C – 40°C (14°F – 104°F)			
Storage temperature	-25°C – 55° C (-13°F – 131°F)			
Power factor	200 – 240 V, 1-phase, CSA/CE/CCC 400 V, 3-phase, CE/CCC 480 V, 3-phase, CSA	0.99 0.94 0.93		
R_{sce} – Short Circuit Ratio (CE systems only)	U_1 – Volts AC rms, 3-phase 400 V CE	R_{sce} 250		
EMC emissions classification CISPR 11 (CE models only)‡	Class A			
Input voltage (U_1) / Input current (I_1) at rated output ($U_2 \text{ MAX } I_2 \text{ MAX }$) (See <i>Voltage configurations</i> on page 30.)	200 – 240 V CSA 230 V CE/CCC**, †† 400 V CE/CCC**, ‡‡ 480 V CSA	200 – 240 V, 1-phase, 50/60 Hz, 39 – 32 A 230 V, 1-phase, 50/60 Hz, 33 A 400 V, 3-phase, 50/60 Hz, 11 A 480 V, 3-phase, 50/60 Hz, 9.4 A		
Gas type	Air	Nitrogen (N_2)	F5***	Argon†††

Gas quality	Clean, dry, oil-free per ISO 8573-1 Class 1.2.2	99.95% pure Clean, dry, oil-free	99.98% pure (F5 = 95% nitrogen [N ₂], 5% hydrogen [H])	99.99% pure Clean, dry, oil-free
Recommended gas inlet flow rate/pressure	Cutting	188.8 L/min at 5.9 bar (400 scfh at 85 psi)		
	Maximum control gouging	165.2 L/min at 4.1 bar (350 scfh at 60 psi)		
	Precision gouging, marking	165.2 L/min at 3.8 bar (350 scfh at 55 psi)		

- * Defined as a plot of output voltage versus output current.
- † See the data plate on the bottom of the power supply for more information on duty cycle and for IEC ratings.
- ‡ WARNING: This Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low voltage supply system. There may be potential difficulties in delivering electromagnetic compatibility in those locations, due to conducted as well as radiated disturbances.
- ** This product meets the technical requirements of IEC 61000-3-3 and is not subject to conditional connection.
- †† Equipment complies with IEC 61000-3-12.
- # Equipment complies with IEC 61000-3-12 provided that the short-circuit power S_{sc} is greater than or equal to 1911 KVA at the interface point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a short-circuit power S_{sc} greater than or equal to 1911 KVA.
- *** F5 recommended only for cutting stainless steel. See page 119.
- ††† Argon recommended only for marking applications at 10 – 25 A. See page 121.

Cutting specifications

Recommended cut capacity – handheld

Cut speed	Material thickness
500 mm/min (20 inches per minute [in/min])*	16 mm (5/8 inch)
250 mm/min (10 in/min)*	22 mm (7/8 inch)
125 mm/min (5 in/min)* – severance capacity	29 mm (1-1/8 inch)

* Cut capacity speeds are not necessarily maximum speeds. They are the speeds that must be achieved to be rated at that thickness.

Pierce capacity

Torch type	Material thickness
Handheld	12 mm (1/2 inch)
Mechanized with a programmable torch height control	12 mm (1/2 inch)

Maximum cut speeds (mild steel)

Maximum cut speeds are the results of Hypertherm's laboratory testing. Actual cutting speeds may vary based on different cutting applications.

Material thickness	Cut speed
6 mm (1/4 inch)	2286 mm/min (90 in/min)
9 mm (3/8 inch)	1219 mm/min (48 in/min)
12 mm (1/2 inch)	762 mm/min (30 in/min)
16 mm (5/8 inch)	508 mm/min (20 in/min)
19 mm (3/4 inch)	330 mm/min (13 in/min)
25 mm (1 inch)	178 mm/min (7 in/min)

Gouge capacity

Process	Metal type	Output current	Metal removal rate
Maximum Control gouging (26 – 45 A)	Mild steel	45 A	3.4 kg/hour (7.5 pounds/hour)
Precision gouging (10 – 25 A)	Mild steel	10 A	0.2 kg/hour (0.5 pounds/hour)

Noise levels

This plasma system may exceed acceptable noise levels as defined by national and local codes. Always wear proper ear protection when cutting or gouging. Any noise measurements taken depend on the specific environment in which the system is used. Refer to *Noise can damage hearing* in the *Safety and Compliance Manual* (80669C) included with your system.

In addition, you can find an Acoustical Noise Data Sheet for your system at www.hypertherm.com:

1. Click “Documents library” near the bottom of the page.
2. Select a product from the “Product type” menu in the “Search” section of the page.
3. Select “Regulatory” from the “All Categories” menu.
4. Select “Acoustical Noise Data Sheets” from the “All subcategories” menu.

Position the plasma power supply

! WARNING



CHANCE OF ELECTRIC SHOCK

Never cut under water or submerge the torch in water. Electric shock can cause serious injury.

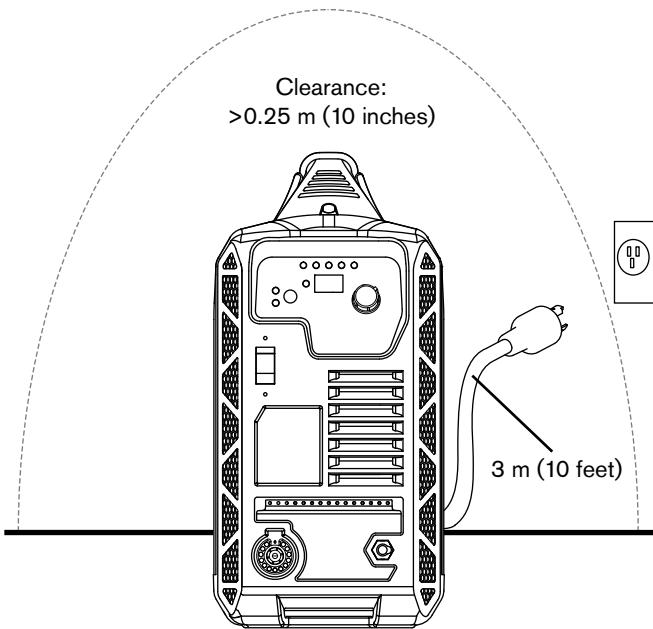
! WARNING



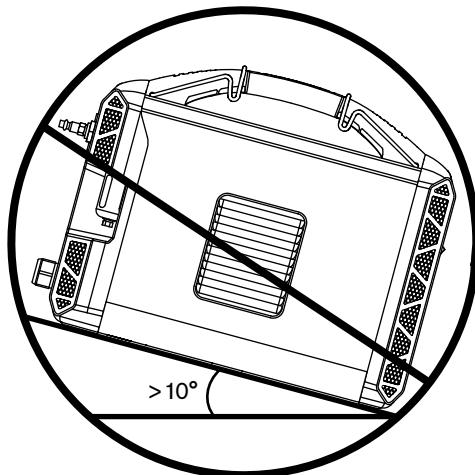
TOXIC FUMES CAN CAUSE INJURY OR DEATH

Some metals, including stainless steel, may release toxic fumes when cut. Make sure your work site has adequate ventilation to ensure that the air quality level meets all local and national standards and regulations. Refer to the *Safety and Compliance Manual (80669C)* for more information.

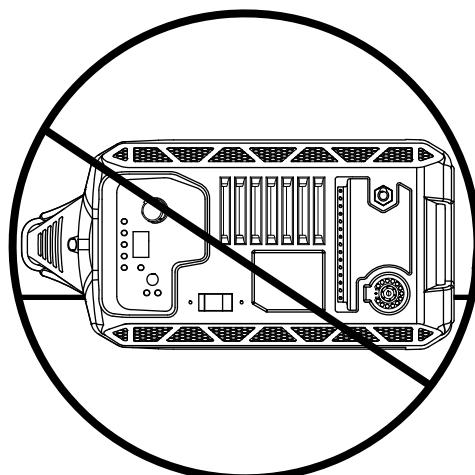
- Do not use the system in rain or snow.
- Position the plasma power supply near an appropriate power receptacle. Its power cord is approximately 3.0 m (10 feet).
- Allow at least 0.25 m (10 inches) of space around the power supply for proper ventilation.



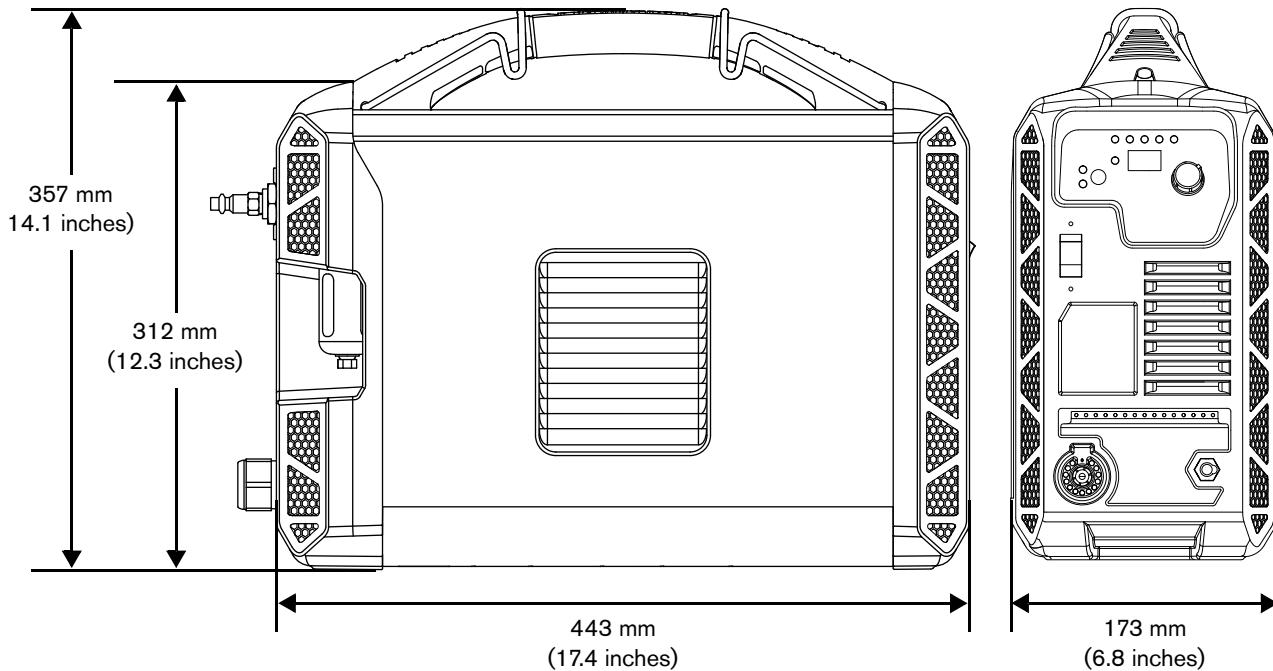
- Place the power supply on a stable, level surface before using. It can tip over if set at an angle greater than 10°.



- Do not place the power supply on its side. Doing so can block the louvers on the side of the cover and prevent proper air circulation needed to cool internal components.



Power supply dimensions and weight



	Power supply with power cord	Power supply (and power cord) with 6.1 m (20 foot) hand torch and 7.6 m (25 foot) work lead
200 – 240 V CSA	12 kg (26 pounds)	15 kg (33 pounds)
230 V CE/CCC	12 kg (27 pounds)	15 kg (33 pounds)
400 V CE/CCC	11 kg (25 pounds)	14 kg (31 pounds)
480 V CSA	11 kg (25 pounds)	14 kg (31 pounds)

Work lead weights

Work lead	Weight
Work clamp with 7.6 m (25 foot) work lead	1.2 kg (2.6 pounds)
Work clamp with 15 m (50 foot) work lead	2.1 kg (4.7 pounds)



For hand torch weights, see page 63. For machine torch weights, see page 95.

Connect to electrical power

Use the Hypertherm input current ratings to determine conductor sizes for power connection and installation instructions. The Hypertherm ratings are designated *HYP* on the data plate on the bottom of the power supply. Use the higher *HYP* input current value for installation purposes. See page 339 for a sample data plate.

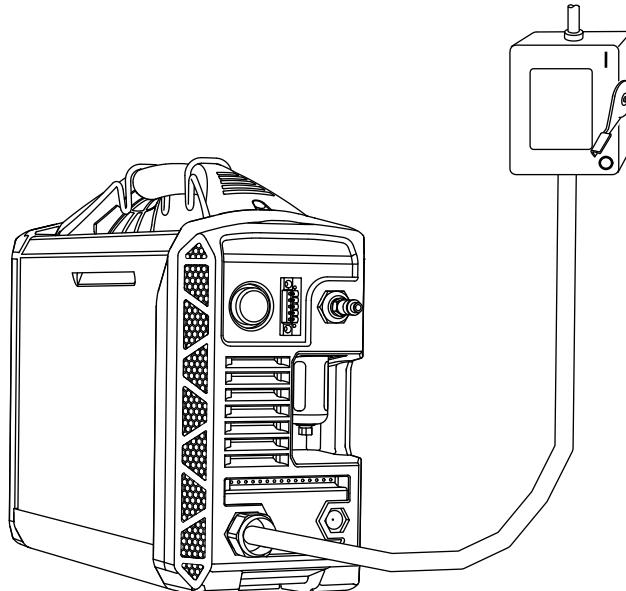
NOTICE

Protect the circuit with appropriately sized time-delay fuses and a line-disconnect switch.

The maximum output voltage varies based on input voltage and the circuit's amperage. Because the current draw varies during startup, time-delay fuses are recommended. See *Voltage configurations* on page 30. Time-delay fuses can withstand currents up to 10 times the rated value for short periods of time.

Install a line-disconnect switch

- Use a line-disconnect switch for each plasma power supply to allow the operator to turn off the incoming power quickly in an emergency.
- Place the switch so that it is easily accessible to the operator. Installation must be performed by a licensed electrician according to national and local codes.
- The interrupt level of the switch must equal or exceed the continuous rating of the fuses/breakers.
- The switch should also:
 - Isolate the electrical equipment and disconnect all live conductors from the incoming supply voltage when in the OFF position.
 - Have one OFF and one ON position that are clearly marked with **O** (OFF) and **I** (ON).
 - Have an external operating handle that can be locked in the OFF position.
 - Contain a power-operated mechanism that serves as an emergency stop.
 - Have appropriate slow-blow fuses installed. See *Voltage configurations* on page 30 for recommended fuse/breaker sizes.



Requirements for grounding

To aid personal safety, proper operation, and to reduce electromagnetic interference (EMI), the power supply must be properly grounded.



- The power supply must be grounded through the power cord according to national and local electrical codes.
- Three-phase service must be of the 4-wire type with a green or green/yellow wire for protective earth ground and must comply with national and local requirements.
- Refer to the *Safety and Compliance Manual* (80669C) included with your system for more information on grounding.

The system's rated output (cutting power)

A plasma system's cutting power is determined more by its wattage output than by its amperage output. The rated output for this system is:

- 10 A – 45 A maximum output current
- 145 VDC maximum rated output voltage
- 6.5 kW cutting power

To determine the cutting power in watts (W), multiply the maximum output amperage (A) by the maximum rated output voltage (VDC):

$$45 \text{ A} \times 145 \text{ VDC} = 6,525 \text{ W (6.5 kW)}$$

Voltage configurations

The system automatically adjusts for proper operation at the current input voltage without requiring any switching or rewiring. However, you must:

- Install a set of consumables in the torch. See *Step 1 – Install consumables and activate torch* on page 48.
- Set the output current using the adjustment knob on the front panel. See *Step 6 – Set mode and adjust output current (amperage)* on page 53.

To operate the power supply at full output and 50% duty cycle as rated, you must size your electrical service accordingly. The following tables show the maximum rated output for typical input voltages. The output setting to use depends on the thickness of the metal and is limited by the input power to the system.



The recommended fuse/breaker sizes account for spikes in input current that occur when you stretch the plasma arc. Stretching the plasma arc is common in some applications, such as gouging.

CSA/CE/CCC 200 V – 240 V (1-phase)

Input voltage	200 V – 240 V
Input current at rated output ($45 \text{ A} \times 145 \text{ V} = 6.5 \text{ kW}$)	39 A – 32 A
Input current at arc stretch	44 A – 36 A
Recommended fuse/breaker size	50 A
Voltage tolerance	20% / -15%

CSA 208 V (1-phase)

Input voltage	208 V
Input current at rated output ($45 \text{ A} \times 145 \text{ V} = 6.5 \text{ kW}$)	37 A
Input current at arc stretch	43 A
Recommended fuse/breaker size	50 A
Voltage tolerance	20% / -15%

CCC 220 V (1-phase)

Input voltage	220 V
Input current at rated output ($45 \text{ A} \times 145 \text{ V} = 6.5 \text{ kW}$)	33 A
Input current at arc stretch	39 A
Recommended fuse/breaker size	50 A
Voltage tolerance	20% / -15%

CE 230 V (1-phase)

Input voltage	230 V
Input current at rated output ($45 \text{ A} \times 145 \text{ V} = 6.5 \text{ kW}$)	33 A
Input current at arc stretch	37 A
Recommended fuse/breaker size	48 A
Voltage tolerance	20% / -15%

CCC 380 V (3-phase)

Input voltage	380 V
Input current at rated output ($45 \text{ A} \times 145 \text{ V} = 6.5 \text{ kW}$)	12 A
Input current at arc stretch	20 – 15 A
Recommended fuse/breaker size	20 A
Voltage tolerance	+20% / -10%

CE 400 V (3-phase)

Input voltage	400 V
Input current at rated output ($45 \text{ A} \times 145 \text{ V} = 6.5 \text{ kW}$)	11 A
Input current at arc stretch	20 – 15 A
Recommended fuse/breaker size	20 A
Voltage tolerance	+20% / -15%

CSA 480 V (3-phase)

Input voltage	480 V
Input current at rated output ($45 \text{ A} \times 145 \text{ V} = 6.5 \text{ kW}$)	9.4 A
Input current at arc stretch	17 – 12 A
Recommended fuse/breaker size	20 A
Voltage tolerance	+20% / -10%

Decrease output current and arc stretch for lower rated electrical service

If you operate the power supply on an electrical service rated lower than what is recommended in *Voltage configurations* on page 30, you may need to:

- Turn down the cutting current (amperage setting). See *Step 6 – Set mode and adjust output current (amperage)* on page 53.
- Avoid stretching the plasma arc for prolonged periods. The more you stretch the plasma arc, the more current the system draws and the more likely you are to overheat the system or trip the circuit breaker.

NOTICE

Do not operate this system on a 15 A or 16 A circuit breaker.

Example: 230 V input on 20 A electrical service

If you use a 1-phase system with an input voltage of 230 V on a 20 A breaker, the recommended output current is 19 A.

Input voltage	230 V
Input current at rated output ($19 \text{ A} \times 145 \text{ V} = 2.8 \text{ kW}$)	18 A
Input current at arc stretch	19 A
Voltage tolerance	20% / -15%

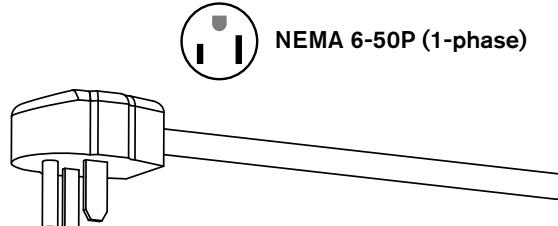
Prepare the power cord

CSA systems

1-phase (200 V - 240 V)

- 10 AWG 3-wire power cord
- 50 A, 250 V power plug (NEMA 6-50P) included

 To connect to a generator that requires a 4-wire connection, refer to *Adapter for 4-wire 1-phase connections (CSA 1-phase models only)* on page 36.



NEMA 6-50P (1-phase)

3-phase (480 V)

- 14 AWG 4-wire power cord (some models ship without a power cord)
- Power plug not included*

* An appropriate plug must be installed on the power cord by a licensed electrician according to national and local codes.

CE/CCC systems

1-phase (200 V - 240 V)

- 6 mm² 3-wire H07RN-F power cord
- Power plug not included*

3-phase (380 V / 400 V)

- 2.5 mm² 4-wire H07RN-F power cord
- Power plug not included*

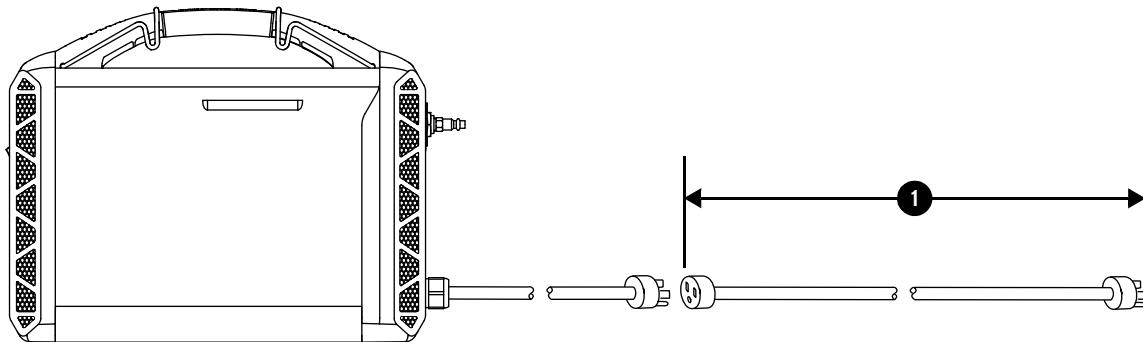
* An appropriate plug must be installed on the power cord by a licensed electrician according to national and local codes.

Extension cord recommendations

Use an extension cord that:

- Is an appropriate wire gauge for the cord length and system voltage
- Meets national and local codes

 Extension cords can cause the machine to receive less input voltage than the output of the circuit. This can limit the operation of your system.



Input voltage	Phase	1	
		Cord Length	Cord Gauge
200 – 240 VAC	1	up to 15 m (50 feet)	10 mm ² (8 AWG)
		15 – 30 m (50 – 100 feet)	16 mm ² (6 AWG)
		30 – 45 m (100 – 150 feet)	25 mm ² (4 AWG)
380 – 480 VAC	3	up to 15 m (50 feet)	4 mm ² (12 AWG)
		15 – 45 m (50 – 150 feet)	6 mm ² (10 AWG)

Generator recommendations

Generators used with this system must meet the voltage requirements in the following table and in *Hypertherm plasma power supply ratings* on page 23.

Engine drive rating	Plasma system output current	Performance (arc stretch)
10 kW	45 A	Full
8 kW	45 A	Limited
6 kW	30 A	Full

- Adjust the cutting current (amperage) as needed based on the rating, age, and condition of the generator.

- A 10 kW generator is recommended for cutting applications that require full arc stretch, such as many gouging applications. It allows for the spikes in input current that occur when you stretch the plasma arc.
- If a fault occurs while using a generator, turn OFF (O) the system. Wait approximately 1 minute before you turn the system back ON (I).

Adapter for 4-wire 1-phase connections (CSA 1-phase models only)

Some generators require a 4-wire single phase connection (for example, NEMA 14-50R). In this case, use an adapter to connect the power supply's 3-wire power cord plug (NEMA 6-50P) to the 4-wire connector on the generator.

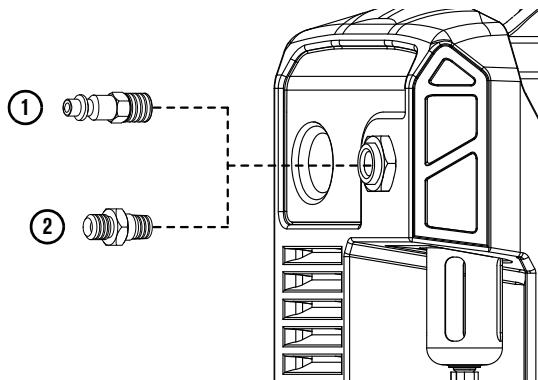
Connect the gas supply

WARNING

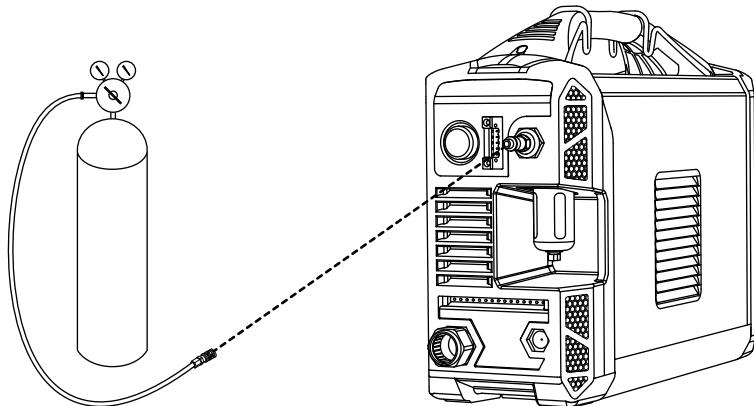


The filter bowl in the power supply may explode if the gas pressure exceeds 9.3 bar (135 psi).

- **All models:** Use an inert gas hose with internal diameter of 9.5 mm (3/8 inch) or greater. **Do not use hoses with an internal diameter less than 9.5 mm (3/8 inch).** Hoses that are too small can cause issues with cut quality and cut performance.
- **CSA models:** An industrial interchange quick-disconnect nipple with 1/4 NPT threads ① comes with the system.
- **CE/CCC models:** A British Pipe Thread adapter G-1/4 BSPP with 1/4 NPT threads ② comes with the system.
- The gas inlet fitting that comes with the system may or may not be preinstalled. To install the fitting, screw it into place on the back of the power supply.
 - **CSA models:** Tighten the 1/4 NPT fitting to 115 kg·cm (100 inch·pounds). The fitting comes with thread sealant preapplied.
 - **CE/CCC models:** Tighten the G-1/4 BSPP adapter to 104 kg·cm (90 inch·pounds).



Gas supply source



Recommended gas supply pressure: 5.5 – 6.9 bar (80 – 100 psi)

Maximum gas supply pressure: 9.3 bar (135 psi)

Recommended flow rate and pressure: 189 slpm at 5.9 bar (400 scfh at 85 psi)

Minimum flow rate: 165.2 slpm (350 scfh)

Maximum particle size: 0.1 micron at maximum concentration of 0.1 mg/m³*

Maximum water vapor dewpoint: -40°C (-40°F)

Maximum oil concentration: 0.1 mg/m³ (for aerosol, liquid, and vapor)

* Per ISO8573-1:2010, Class 1.2.2. That is, it should have a maximum number of solid particulate per meter cubed of 20,000 for particle sizes in the range of 0.1 – 0.5 microns, a maximum of 400 for particle sizes in the range of 0.5 – 1 microns, and a maximum of 10 for particle sizes in the range of 1 – 5 microns.

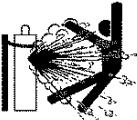
NOTICE

Synthetic lubricants containing esters that are used in some air compressors will damage polycarbonates used in the air filter bowl.

- Use shop-compressed gas or cylinder-compressed gas.
 - Use a high-pressure regulator on either type of gas supply. The regulator must be capable of delivering gas to the air inlet on the power supply at the flow rate and pressure specified above.
- **Use only clean, moisture-free gas.**
 - Oil, water, vapor, and other contaminants in the gas supply can damage internal components over time.
 - Poor gas supply quality results in:
 - Reduced cut quality and cut speeds
 - Reduced cut thickness capability
 - Reduced consumable life

High-pressure gas cylinders

WARNING



GAS CYLINDERS CAN EXPLODE IF DAMAGED

Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.

For high pressure regulators, adhere to the manufacturer's guidelines for safe installation, operation, and maintenance.

Before plasma cutting with compressed gas, read the safety instructions in the *Safety and Compliance Manual* (80669C). Failure to follow safety instructions can result in personal injury or in damage to equipment.

WARNING



EXPLOSION HAZARD – CUTTING WITH FUEL GASES

Do not use combustible fuel gases or oxidizing gases with Powermax systems. These gases can result in explosive conditions during plasma cutting operations.

You can use the following gases to cut with this system. See *Hypertherm plasma power supply ratings* on page 23 for requirements on gas quality.

- Air
- Nitrogen
- F5 (stainless steel only – see page 119)
- Argon (recommended for marking applications only – see page 122)

If you use high-pressure gas cylinders as the gas supply:

- Refer to the manufacturer's specifications for installation and maintenance procedures of high-pressure regulators.
- Make sure the cylinder valves are clean and free of oil, grease, and other contaminants. Open each cylinder valve just long enough to blow out any dust that may be present.
- Make sure the cylinder is equipped with an adjustable high-pressure regulator that is capable of:
 - Gas outlet pressures up to 6.9 bar (100 psi). **Never exceed the maximum gas pressure of 9.3 bar (135 psi).**
 - Gas flow rates of 235.9 L/min (500 scfh).
- Connect the supply hose securely to the cylinder.

Gas flow rates

Refer to the cut charts starting on page 131 for flow rates specific to each cutting process specified (based on the type of metal, the type of gas, and the output current).

Process	Gas flow rate
Cutting	188.8 slpm (400 scfh) at a minimum 5.9 bar (85 psi)
Maximum control gouging (26 – 45 A)	165.2 slpm (350 scfh) at a minimum 4.1 bar (60 psi)
Precision gouging / marking (10 – 25 A)	165.2 slpm (350 scfh) at a minimum 3.8 bar (55 psi)

Minimum inlet pressure (while gas is flowing)

WARNING



The filter bowl in the power supply may explode if the gas pressure exceeds 9.3 bar (135 psi).

The following pressure specifications apply for air, nitrogen, F5, and argon. Never exceed an inlet gas supply pressure of 9.3 bar (135 psi).

You may need to adjust these pressures based on the equipment and conditions specific to your environment. For example, additional gas filtration installed between the gas supply and the plasma power supply may increase the required minimum inlet pressure. Consult the filter manufacturer.

Cutting

Torch lead length – hand torches	Minimum inlet pressure
6.1 m (20 feet)	5.5 bar (80 psi)
15 m (50 feet)	5.9 bar (80 psi)

Torch lead length – machine torches	Minimum inlet pressure
7.6 m (25 feet)	5.5 bar (80 psi)
11 m (35 feet)	5.5 bar (80 psi)
15 m (50 feet)	5.9 bar (85 psi)

Maximum control gouging (26 – 45 A)

Torch lead length – hand torches	Minimum inlet pressure
6.1 m (20 feet)	3.8 bar (55 psi)
15 m (50 feet)	4.1 bar (60 psi)

Torch lead length – machine torches	Minimum inlet pressure
7.6 m (25 feet)	3.8 bar (55 psi)
11 m (35 feet)	3.8 bar (55 psi)
15 m (50 feet)	4.1 bar (60 psi)

Precision gouging / Marking (10 – 25 A)

Torch lead length – hand torches	Minimum inlet pressure
6.1 m (20 feet)	3.5 bar (50 psi)
15 m (50 feet)	3.8 bar (55 psi)

Torch lead length – machine torches	Minimum inlet pressure
7.6 m (25 feet)	3.5 bar (50 psi)
11 m (35 feet)	3.5 bar (50 psi)
15 m (50 feet)	3.8 bar (55 psi)

Additional gas filtration

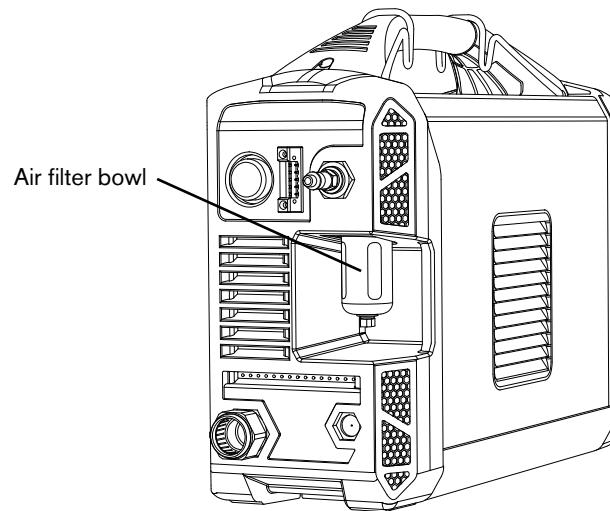
It is extremely important to maintain a clean, dry gas line in order to:

- Prevent oil, water, dirt, and other contaminants from damaging internal components.
- Achieve optimal cut quality and consumable life.

Dirty, oily air is the root cause of many common problems that occur in Powermax systems, and in some instances it can void the warranty on the power supply and on the torch. See the gas quality recommendations in the ratings table on page 23.

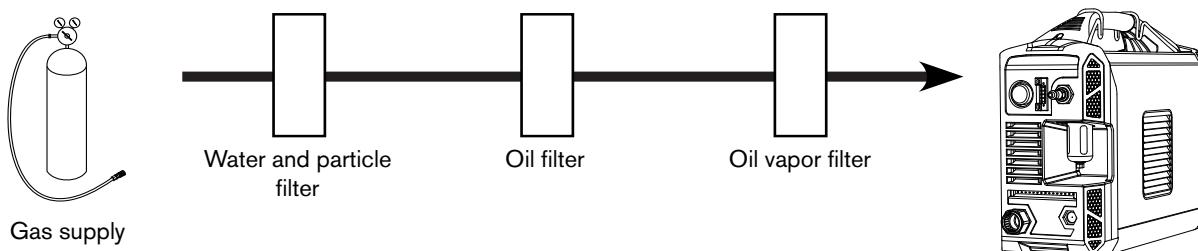
The power supply contains a built-in air filter. Regularly check the filter element inside the air filter bowl and replace as needed. See *Replace the air filter bowl and filter element* on page 212.

The built-in air filter should not take the place of adequate external filtration. If you work in an environment that is extremely warm and humid, or if work site conditions introduce oil, vapors, or other contaminants into the gas line, install an external filtration system that cleans the gas supply before it enters the plasma power supply.



A 3-stage coalescing filtration system is recommended. A 3-stage filtering system works as follows to clean contaminants from the gas supply.

Install the filtering system between the gas supply and the power supply. Additional gas filtration may require higher pressure from the source.

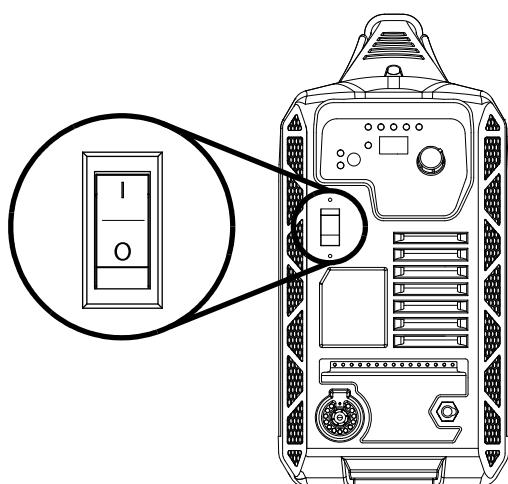


Operation

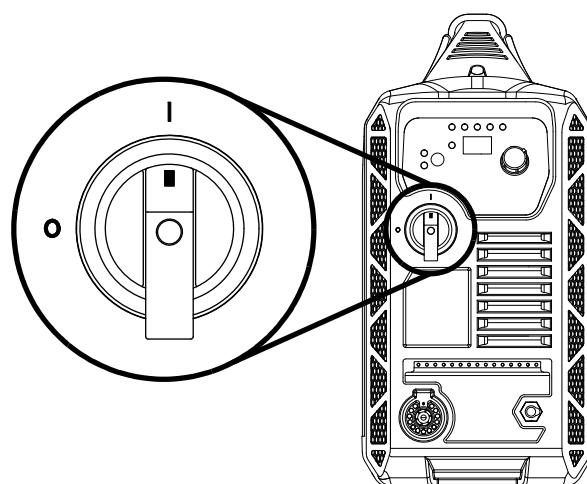
Controls and indicators

ON (I) / OFF (O) power switch

The power switch is located on the front panel.

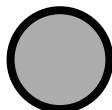
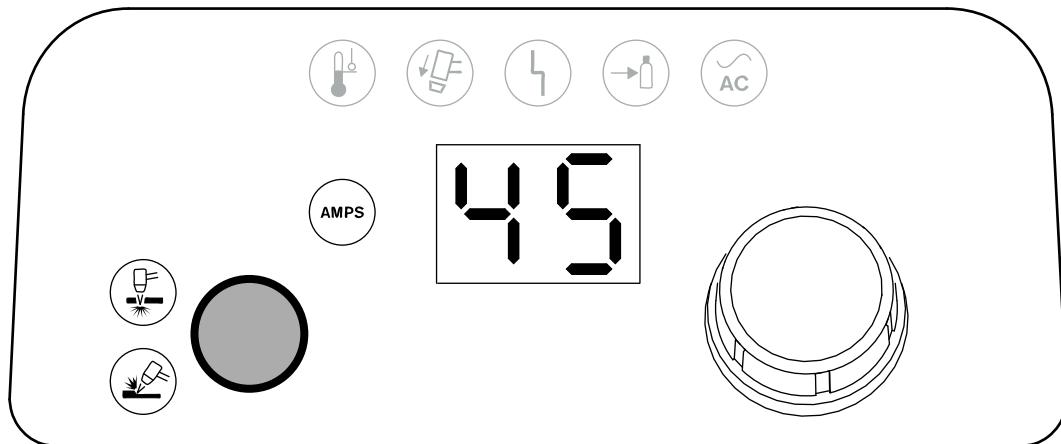


200 – 240 V



400 V, 480 V

Cutting controls



Mode button – Press this button to toggle between cut mode and gouge/mark mode. The system automatically adjusts the gas pressure based on:

- ❑ The mode selected
- ❑ The torch connected to the power supply
- ❑ The length of the torch lead



Cut Mode LED (green) – When illuminated, this LED indicates that the system is ready to perform plasma cutting operations.



Gouge/Marking Mode LED (green) – When illuminated, this LED indicates that the system is ready to perform plasma gouging or marking operations.



2-digit display – This display shows the output current (10 – 45 A) by default.

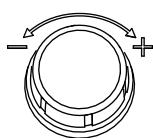
When certain system faults occur, this display shows a fault code. See *Fault LEDs and fault codes* on page 163.

If you manually adjust the gas pressure, this display shows the gas pressure. See *Adjust the gas pressure manually* on page 56.



AMPS LED (green) – When illuminated, this LED indicates that the 2-digit display shows the cutting current (amperage).

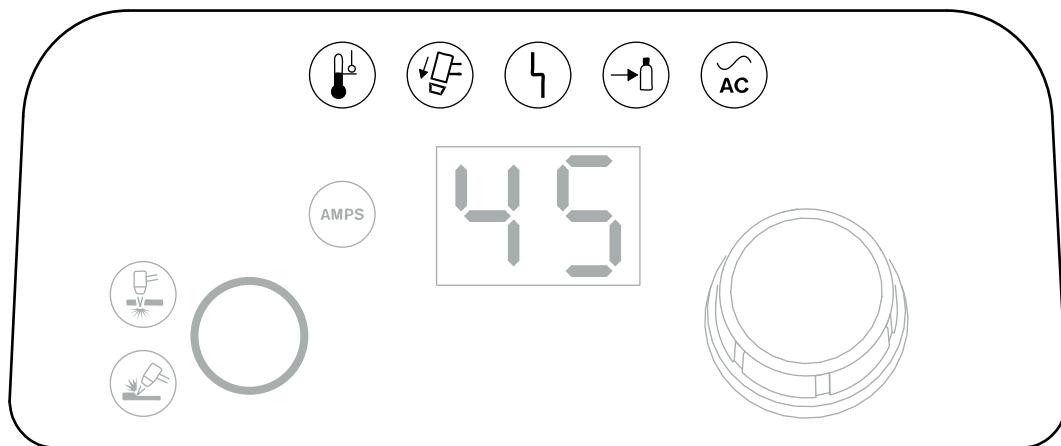
When the 2-digit display shows other values, such as gas pressure or a fault code, the AMPS LED is not illuminated.



Adjustment knob – Use this knob to set the cutting current between 10 A and 45 A in 1-unit increments.

You can also use this knob to increase or decrease the gas pressure. See *Adjust the gas pressure manually* on page 56.

Indicator LEDs



Power ON LED (green) – When illuminated, this LED indicates that the power switch is set to ON (I) and the system is ready to cut.



Gas Pressure LED (yellow) – When illuminated, this fault LED indicates that the inlet gas pressure is too low or that there is no inlet gas connection.



System Fault LED (yellow) – When illuminated, this fault LED indicates that there is a fault with the power supply. In many instances, when this LED illuminates, a fault code also flashes on the 2-digit display. See *Fault LEDs and fault codes* on page 163.



Torch Cap LED (yellow) – When illuminated, this fault LED indicates that the consumables are loose, improperly installed, or missing.



Temperature LED (yellow) – When illuminated, this fault LED indicates that the system's temperature is outside the acceptable operating range.



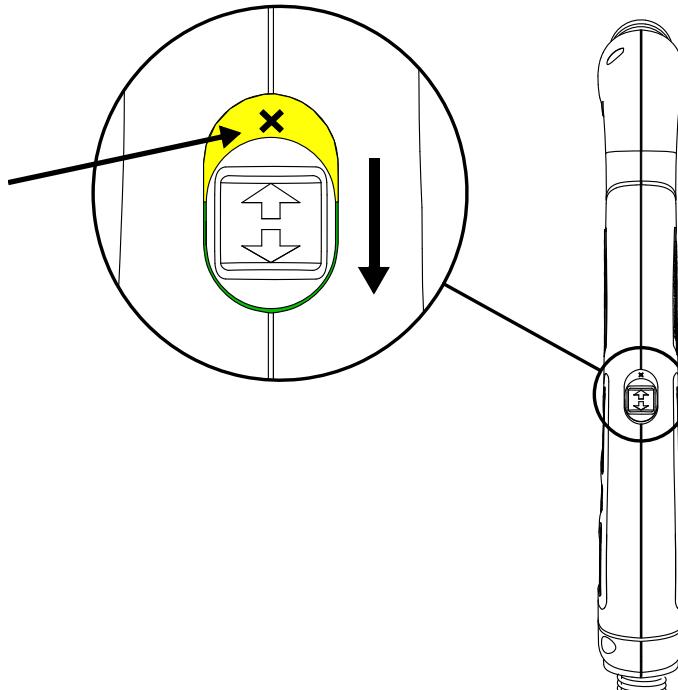
Some fault conditions cause multiple LEDs to illuminate or blink at the same time. For information on what these fault conditions are and how to clear them, see *Fault LEDs and fault codes* on page 163.

Disable the torch

The Duramax Lock torches include a switch that enables you to lock the torch. This torch-disable switch prevents the torch from firing accidentally even when the power supply is ON. Use this switch to lock the torch when it is not in use, when you need to change the consumables, or when you need to move the power supply or torch while the system is powered ON.

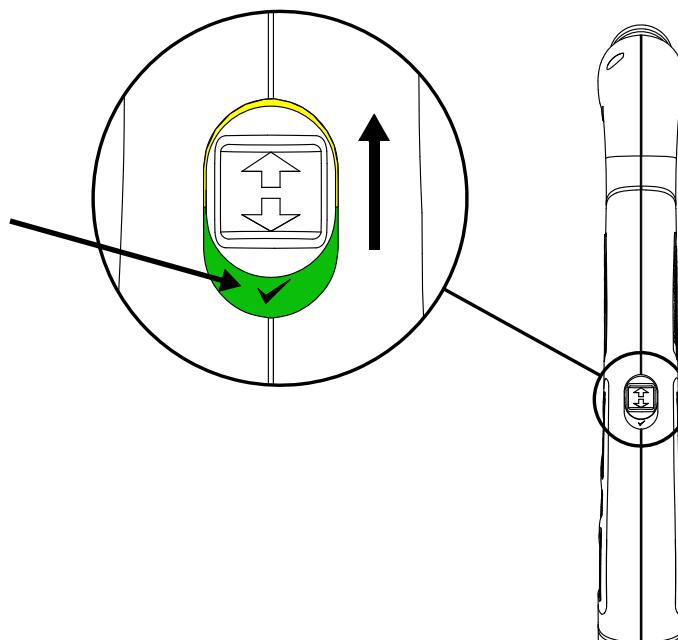
Torch **LOCK** position:

- The torch-disable switch is in the backward position, closer to the torch lead.
- The **yellow** label with the “**X**” indicates the torch is not ready to fire.
- Point the torch away from yourself and others, and pull the trigger to make sure it does not fire.
- Change the consumables (if needed).



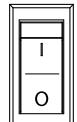
Torch “ready to fire” position:

- The torch-disable switch is in the forward position, closer to the torch head.
- The **green** label with the “**✓**” indicates the torch is ready to fire.
- Do NOT change the consumables.
 - To change the consumables without danger of the torch firing accidentally, lock the torch or turn OFF the power supply.



The first time you pull the torch trigger after you set the torch to the “ready to fire” position, the torch emits multiple puffs of air in quick succession. This warns you that the torch is active and will fire an arc the next time the trigger is pulled.
See page 47.

! WARNING



INSTANT-ON TORCHES – PLASMA ARC CAN CAUSE INJURY, BURNS

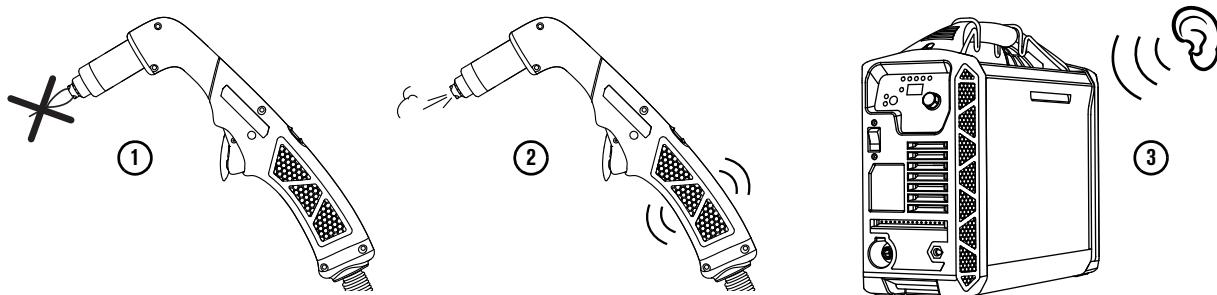
The plasma arc ignites immediately when you pull the torch trigger. Before changing consumables, one of the following actions must be taken. Whenever possible, complete the first action.

- Turn OFF (O) the plasma power supply.
- OR
- Move the torch-disable switch to the yellow lock (X) position (closest to the torch lead). Pull the trigger to make sure the torch does not fire a plasma arc.

Warning puffs of air

The first time you try to fire the torch after moving the torch-disable switch to the yellow lock (X) position and then back to the green “ready to fire” (✓) position:

- The plasma arc does not fire. ①
- The torch emits multiple puffs of air in quick succession. The torch vibrates slightly with each puff of air. ②
- The power supply makes an audible pressure-release sound with each puff of air. ③



This feedback serves as a warning. It does not indicate a fault condition. It alerts you that the torch is activated and will produce a plasma arc the next time the torch is fired.



The Torch Cap LED on the front panel illuminates when you remove the consumables or set the torch-disable switch to the yellow lock (X) position while the plasma power supply is still ON. The LED extinguishes after you install the consumables and set the torch-disable switch to the green “ready to fire” (✓) position.



For hand torches

After moving the torch-disable switch to the green “ready to fire” (✓) position:

- Pull the torch trigger 1 time to get the warning puffs of air.
- Pull the torch trigger again to fire a plasma arc.

For machine torches

After moving the torch-disable switch to the green “ready to fire” (✓) position:

- Run a START/STOP command from the CNC to get the warning puffs of air.



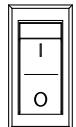
If this feature is integrated into your CNC, there may be other steps to follow that are specific to the CNC.

- Start the torch again to fire a plasma arc.

Operate the plasma system

Step 1 – Install consumables and activate torch

WARNING



INSTANT-ON TORCHES – PLASMA ARC CAN CAUSE INJURY, BURNS

The plasma arc ignites immediately when you pull the torch trigger. Before changing consumables, one of the following actions must be taken. Whenever possible, complete the first action.

- Turn OFF (O) the plasma power supply.
OR
- Move the torch-disable switch to the yellow lock (X) position (closest to the torch lead). Pull the trigger to make sure the torch does not fire a plasma arc.

WARNING



RISK OF BURNS AND ELECTRIC SHOCK – WEAR INSULATED GLOVES

Always wear insulated gloves when changing the consumables. The consumables get very hot during cutting and can cause severe burns.

Touching the consumables can also result in electric shock if the power supply is ON and the torch-disable switch is not in the yellow lock (X) position.

1. Turn OFF (O) the power switch on the power supply, or move the torch-disable switch on the torch to the yellow lock (X) position.
2. Point the torch away from yourself and others, and pull the trigger to make sure it does not fire.
3. Choose the correct consumables for your cutting, gouging, or marking application.

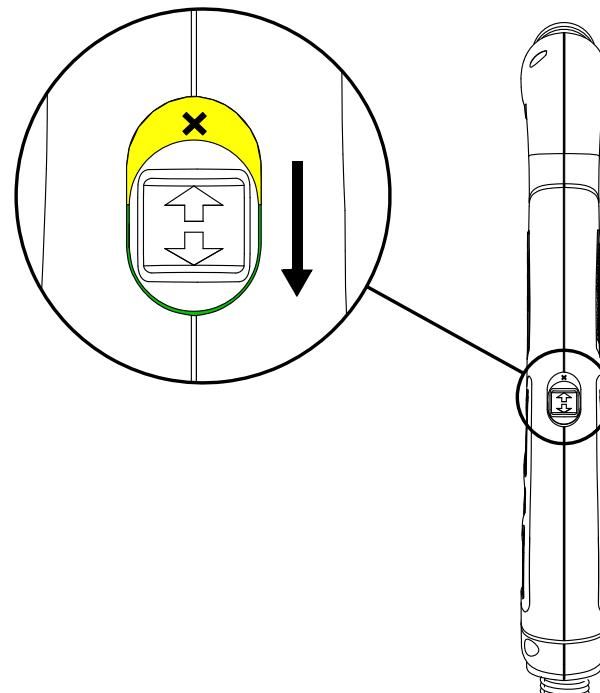
Cutting and piercing with a hand torch:

See *Choose the consumables* on page 64.

Cutting and piercing with a machine torch: See *Choose the consumables* on page 113.

Gouging: See *Gouging processes* on page 77.

Marking: See *Marking consumables (10 – 25 A)* on page 121.

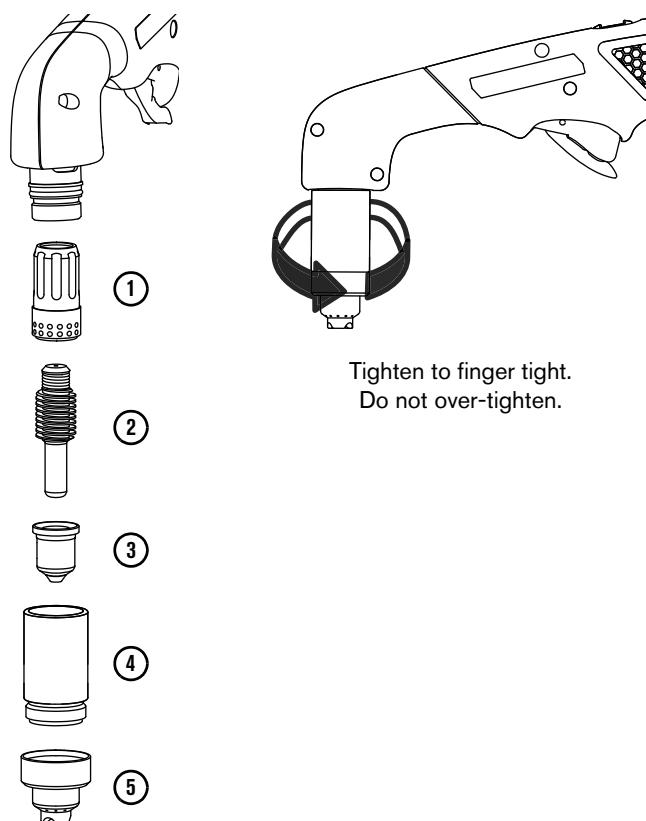


4. Install a complete set of consumables in the hand torch or machine torch as shown:

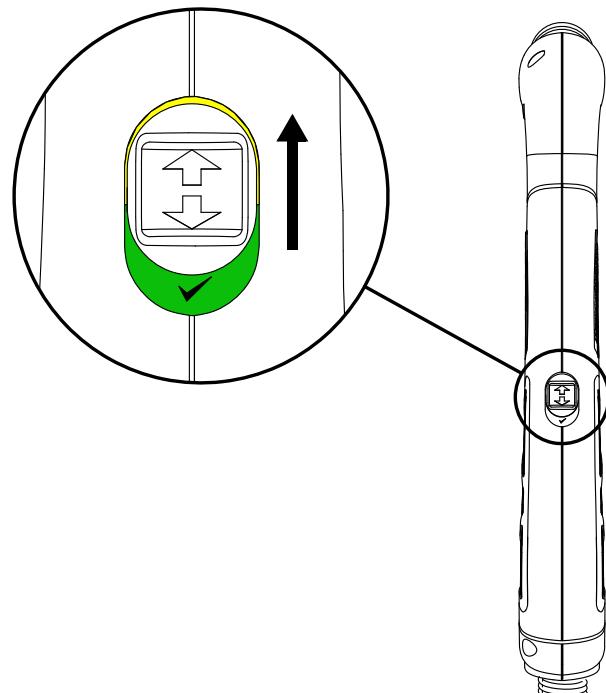
- ① Swirl ring
- ② Electrode
- ③ Nozzle
- ④ Retaining cap
- ⑤ Shield (or deflector)



Consumables are not preinstalled on new torches. Remove the vinyl cap from the torch before installing the consumables.

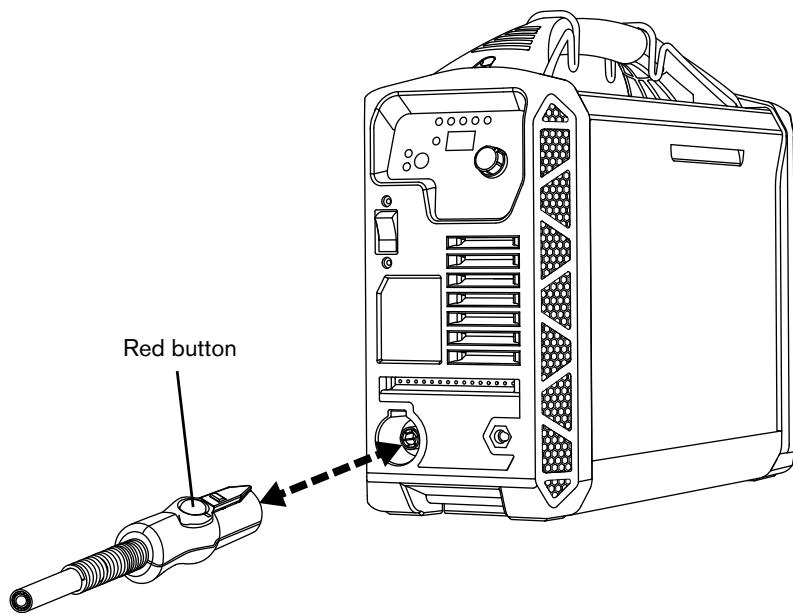


5. Move the torch-disable switch on the torch to the green “ready to fire” (✓) position.



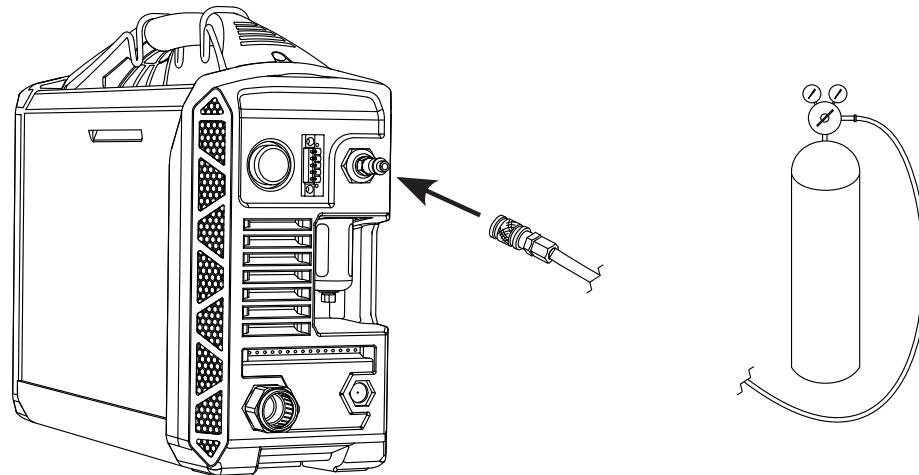
Step 2 – Connect torch lead

- Turn OFF (O) the power supply before you connect or disconnect a torch.
- To connect a hand torch or machine torch, push the connector into the receptacle on the front of the power supply.
- To disconnect the torch, press the red button on the connector and pull the connector out of the receptacle.



Step 3 – Connect gas supply

- If needed, install the gas inlet fitting that came with the system onto the back of the power supply. See page 36.
- Connect the gas supply line to the fitting on the back of the power supply.
- For gas supply requirements, see *Gas supply source* on page 37.



Step 4 – Connect work lead and work clamp

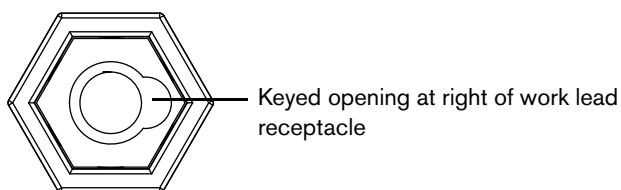
NOTICE

Make sure you use a work lead that is appropriate for your power supply. Use a 45 A work lead with the Powermax45 XP. The amperage is marked near the rubber boot of the work lead connector.

To prevent overheating, check the work lead often to make sure it is fully seated in the receptacle.

Work lead

1. Insert the work lead connector into the receptacle on the front of the power supply. Align the key on the connector with the opening on the right of the receptacle.
2. Push the work lead connector all the way into the receptacle. Turn the connector clockwise a 1/4 turn until the connector is fully seated against the stop.

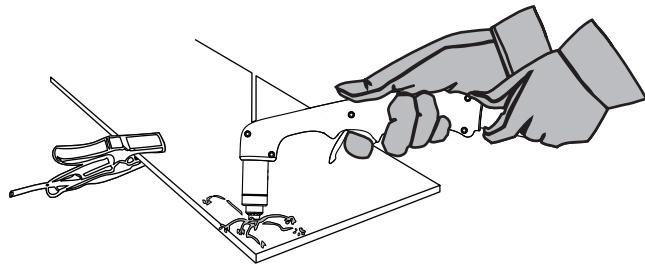


Work clamp

NOTICE

Do not attach the work clamp under water. If the power supply is below the work clamp, water can enter the power supply via the work lead and cause severe damage.

- **Hand cutting:** The work clamp must be connected to the workpiece you are cutting.
- **Mechanized cutting:** If you are using this system with a cutting table, you can connect the work clamp directly to the table or to the workpiece you are cutting. See your table manufacturer's instructions.
- Make sure the work clamp makes good metal-to-metal contact with the workpiece or cutting table.
- Remove rust, dirt, paint, coatings, and other debris so the work clamp makes proper contact with the workpiece or cutting table.
- To achieve the best cut quality, attach the work clamp as close as possible to the area being cut.



NOTICE

Do not attach the work clamp to the portion of the workpiece to be cut away.

Step 5 – Connect electric power and turn ON the system

1. Plug in the power cord.
 - When you first receive your system, the power cord may not have a power plug installed. For information on connecting the proper plug to the power cord, see *Prepare the power cord* on page 34.
 - For more information on the system's electrical requirements, see *Connect to electrical power* on page 29.

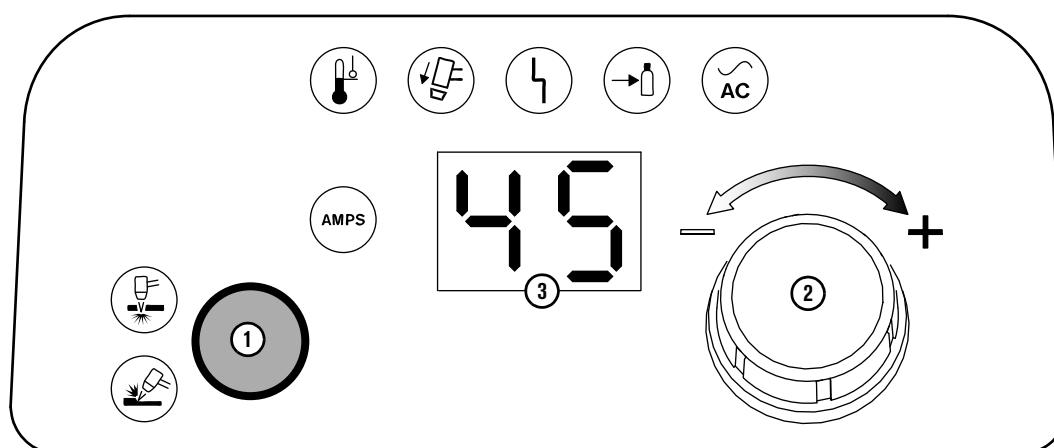
2. Set the power switch to the ON (I) position.



Step 6 – Set mode and adjust output current (amperage)

1. Press the **Mode** button ① to toggle between Cut mode and Gouge/Marking mode.

 The system's Smart Sense™ technology automatically regulates the gas pressure for optimum cutting according to the selected mode, the torch type, and the length of the torch lead.
2. Turn the adjustment knob ② to set the output current to a maximum of 45 A. The 2-digit display ③ shows the output current in amperage.



Cutting expanded metal

To cut expanded metal, use the consumables for shielded cutting that come with the system. The system does not require a dedicated mode for cutting expanded metal.



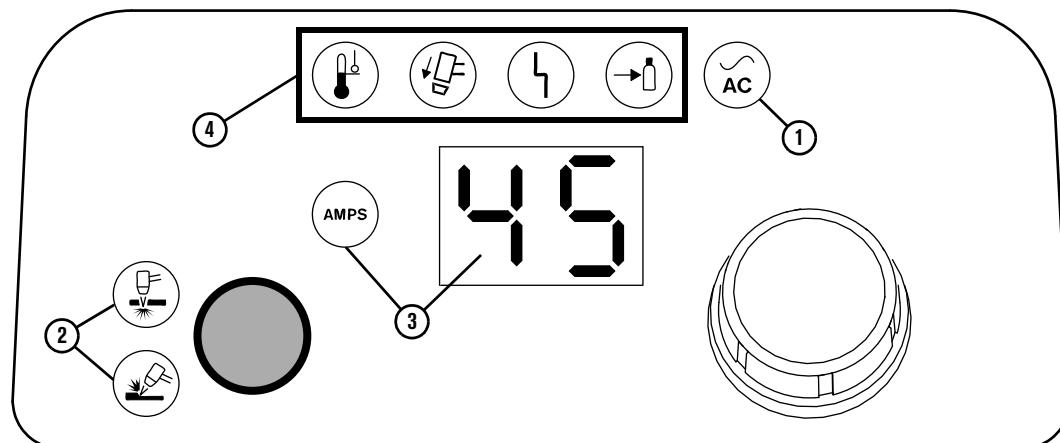
Expanded metal has a slotted or mesh pattern. Cutting expanded metal wears out consumables more quickly because it requires a continuous pilot arc. A pilot arc occurs when the torch is fired but the plasma arc is not in contact with the workpiece.

Step 7 – Check cut settings and indicator LEDs

Before you start to cut, make sure:

- ① The green power ON LED on the front of the power supply is illuminated.
- ② The correct mode LED is illuminated (cut or gouge/mark). Also make sure the consumables installed on the torch match the selected mode.
- ③ The output current (amperage) displayed on the front panel is correct, and the AMPS LED is illuminated.
- ④ None of the 4 fault LEDs are illuminated or blinking.

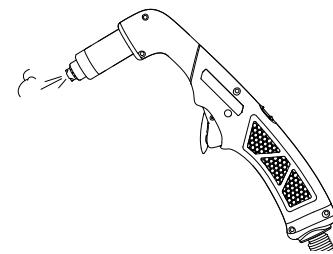
If any of the fault LEDs illuminate or blink, or if the power ON LED blinks, this indicates a fault. Correct the fault condition before continuing. See *Fault LEDs and fault codes* on page 163.



What to expect during and after cutting

Postflow – After you complete a cut and release the torch trigger, air continues to flow from the torch in order to cool the consumables. This is referred to as *postflow*.

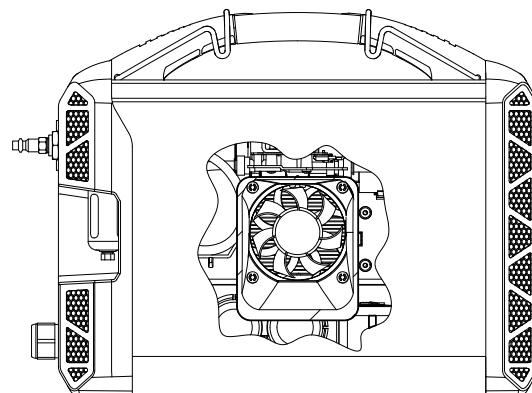
The length of postflow depends on the mode and the output current. Under certain conditions, it also depends on the gas supply.



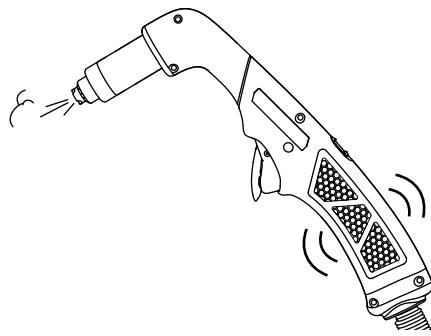
Mode	Output current	Length of postflow
Cut	10 – 45 A	20 seconds
Gouge/marking	26 – 45 A	20 seconds
Gouge/marking	10 – 25 A	10 seconds for air (or nitrogen) 3 seconds for argon

Exception for argon: The system recognizes when argon is being used and reduces postflow from 10 seconds to 3 seconds in order to minimize gas usage. To achieve 3-second postflow, the system must be set to Gouge/Marking mode with the output current set between 10 – 25 A. When the torch fires without transferring the pilot arc to the workpiece, postflow is 10 seconds even when the supply gas is argon.

Fan activity – The cooling fan inside the plasma power supply runs intermittently during and after cutting in order to cool internal components.



Warning puffs of air – When you set the torch-disable switch to the “ready to fire” (✓) position after the torch has been locked, the torch does not fire the first time you pull the trigger. Instead, the torch emits multiple puffs of air in quick succession. With each puff of air, the torch vibrates slightly, and the power supply emits an audible pressure-release sound. This serves as a warning to alert you that the torch is active and will fire an arc the next time you pull the trigger. See page 47.



- █ For the machine torch, run a START/STOP command from the CNC to cause the torch to emit the puffs of air. On the next start signal, the torch will fire an arc.

- █ The Torch Cap LED on the front panel illuminates when you remove the consumables or set the torch-disable switch to the yellow lock (X) position while the plasma power supply is still ON. The LED extinguishes after you install the consumables and set the torch-disable switch to the green “ready to fire” (✓) position.



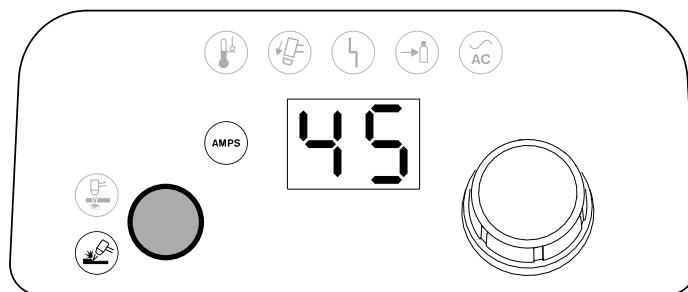
Adjust the gas pressure manually

The power supply automatically regulates the gas pressure for you. However, you can adjust the gas pressure manually if you need to for a specific application.

- █ Overriding the system's gas pressure setting should be done only by experienced users who need to optimize the gas setting for a specific cutting application.

1. Select the mode, and set the output current. In this example, we selected gouge/marking mode and set the output current to 45 A.

- Set the mode and output current first because doing so can reset the gas pressure. See page 58.



- 2.** Press-and-hold the **Mode** button with one hand. Turn the adjustment knob to the desired gas pressure with the other hand. In this example, we turned down the gas pressure to 35 psi.

- ❑ As you manually adjust the gas pressure, the AMPS LED turns off, and the 2-digit display changes from amperage to gas pressure, as follows:

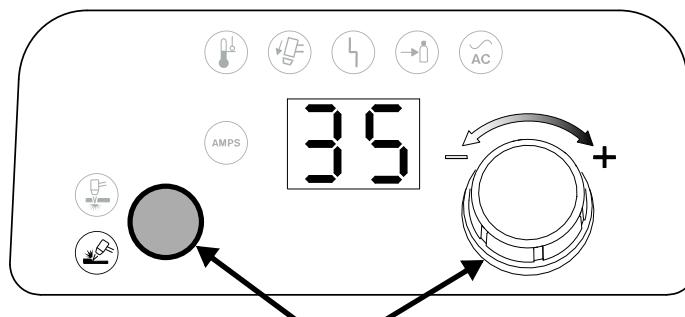
- **CSA models:** The gas pressure displays in **psi** by default.
- **CE/CCC models:** The gas pressure displays in **bar** by default.



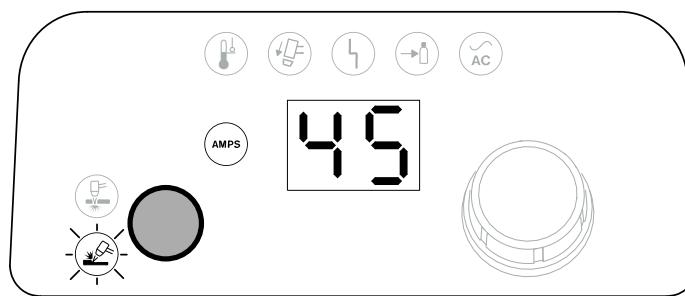
You can change the display values for gas pressure. See page 59.

- 3.** Release the **Mode** button.

- ❑ After you release the **Mode** button, the AMPS LED illuminates again, and the 2-digit display changes from gas pressure back to amperage.
- ❑ The selected mode LED blinks to let you know that the gas pressure has been manually adjusted. It continues to blink until you reset the pressure.
- ❑ To view the gas pressure setting again, repeat step 2 above, or enter gas test mode. See *Run a gas test* on page 158.



Press-and-hold the button while turning the knob.



Reset the gas pressure

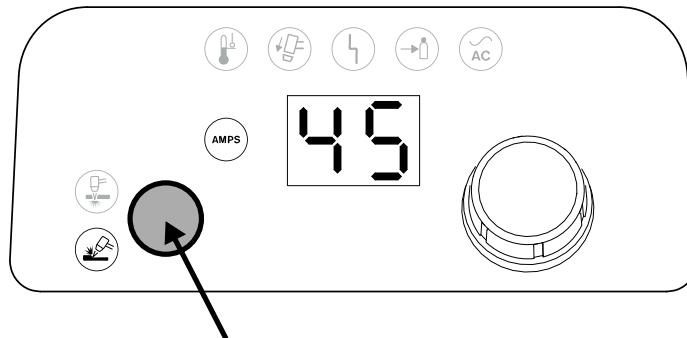
When you manually adjust the gas pressure, the pressure you set remains in place until you reset it. You can reset the gas pressure by pressing the **Mode** button.

 When you reset the gas pressure, the selected mode LED stops blinking.

The gas pressure also resets to the default setting when:

- You are in gouge/marking mode and you change the output current from:
 - The Maximum Control gouging process (26 – 45 A) to the Precision gouging process (10 – 25 A)
 - The Precision gouging process (10 – 25 A) to the Maximum Control gouging process (26 – 45 A)
- You connect a different torch to the power supply.

 Turning the power supply OFF and ON does not reset the gas pressure.



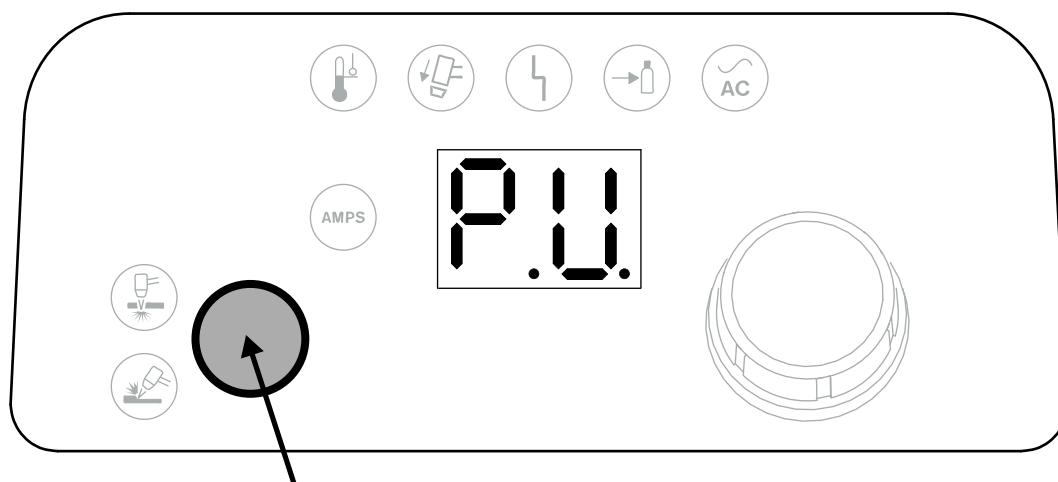
Press the button to reset the gas pressure.

Change the gas pressure values between *psi* and *bar*

- **CSA models:** The gas pressure displays in **psi** by default.
- **CE/CCC models:** The gas pressure displays in **bar** by default.

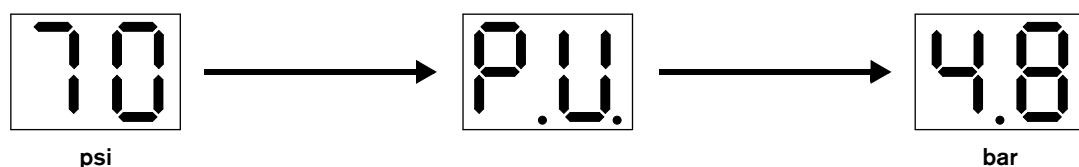
To change the gas pressure display values from *psi* to *bar* or from *bar* to *psi*:

1. Press-and-hold the **Mode** button for approximately 15 seconds until the 2-digit display shows **P.U.**



Press-and-hold for 15 seconds to toggle between **psi** and **bar**.

2. Release the **Mode** button. The system will now display gas pressure values in **bar** instead of **psi** or in **psi** instead of **bar**.



Understand duty cycle to prevent overheating

Duty cycle – Percentage of time during a 10-minute interval that a plasma arc can remain on without causing the system to overheat.

Output current	Duty cycle*
45 A	50%
41 A	60%
32 A	100%

* Assumes ambient operating temperature of 40°C (104°F).

When you exceed the duty cycle and the system overheats:

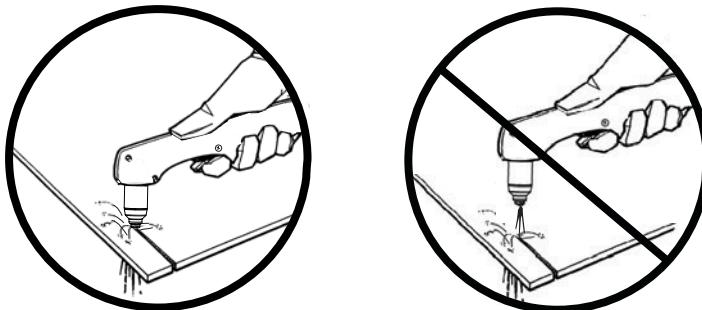
- The plasma arc shuts off.
- The Temperature LED illuminates. 
- The cooling fan inside the power supply runs.

When the system overheats:

- a. Leave the system on to allow the fan to cool the power supply.
- b. Wait for the Temperature LED to turn off before you start to cut again.

Stretching the plasma arc for prolonged periods negatively impacts duty cycle. Whenever possible, drag the torch on the workpiece. See *Start a cut from the edge of the workpiece* on page 73.

If you operate the system on a lower rated electrical service, stretching the plasma arc for prolonged periods can cause the system to overheat more quickly and can cause the circuit breaker to trip. See *Decrease output current and arc stretch for lower rated electrical service* on page 33.



3

Cut with the Hand Torch

Duramax Lock hand torches come in 15° and 75° models.

- The 75° hand torch is a general purpose torch designed for the widest range of applications.
- The 15° hand torch is designed to direct heat away from the operator during heavy gouging. It also facilitates cutting overhead or in hard to reach areas.

Duramax Lock torch features include:

- A torch-disable switch that prevents the torch from firing accidentally even when the power supply is ON. See *Disable the torch* on page 46.
- The FastConnect™ quick-disconnect system to easily remove the torch for transport or to switch from one torch to another.
- Automatic cooling with ambient air. Special cooling procedures are not needed.

This section provides an overview of hand torch parts, dimensions, consumables, cutting guidelines, and basic cutting methods. For gouging information, see *Gouge with the Hand Torch and Machine Torch* on page 77.

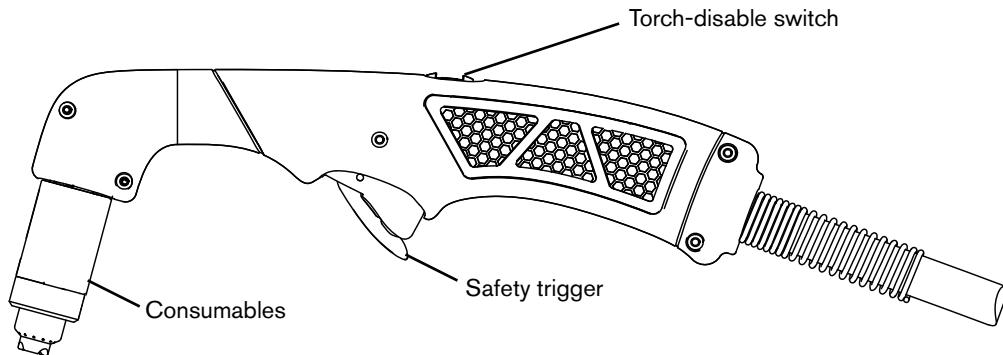


To resolve issues with cut quality, refer to *Troubleshooting guide* on page 172.

The Duramax Lock hand torches ship without consumables installed. To install the consumables, see page 48.

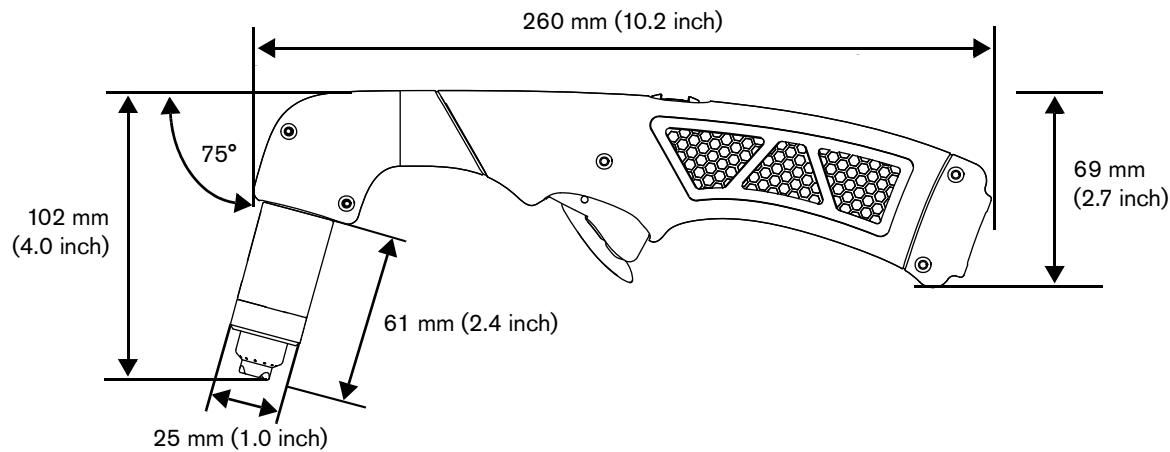
Hand torch components, dimensions, weights

Components

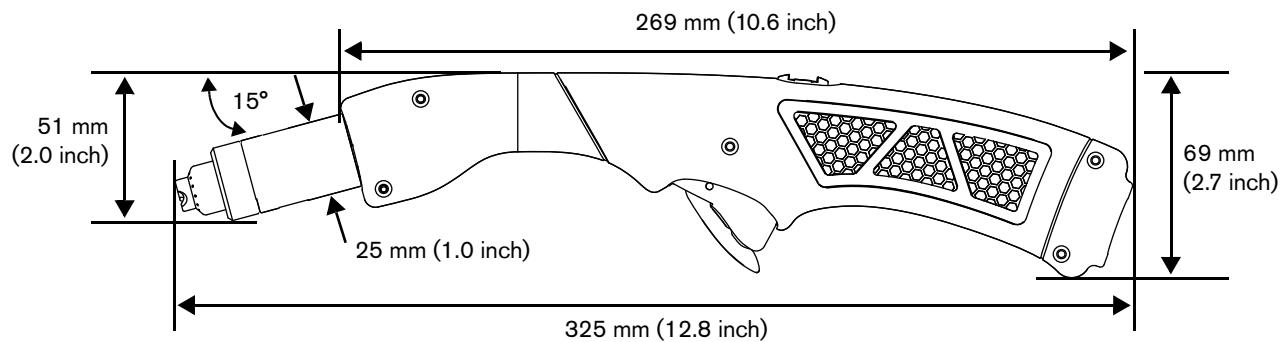


Dimensions

75° hand torch



15° hand torch

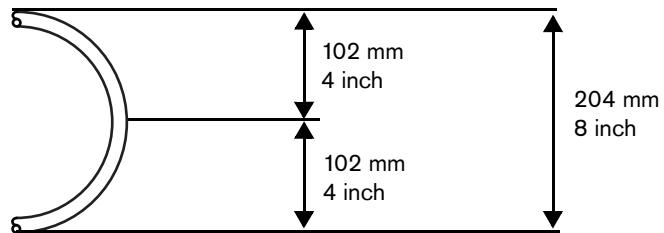


Weights

Torch	Weight
Hand torch with 6.1 m (20 foot) lead	1.8 kg (3.9 pounds)
Hand torch with 15 m (50 foot) lead	3.7 kg (8.1 pounds)

Minimum bend radius for torch leads

The recommended minimum bend radius for torch leads is 102 mm (4 inches).



$$\text{Diameter} = 2 \times \text{Radius} = 204 \text{ mm (8 inches)}$$

Choose the consumables

The 15° and 75° Duramax Lock hand torches use the same consumables.

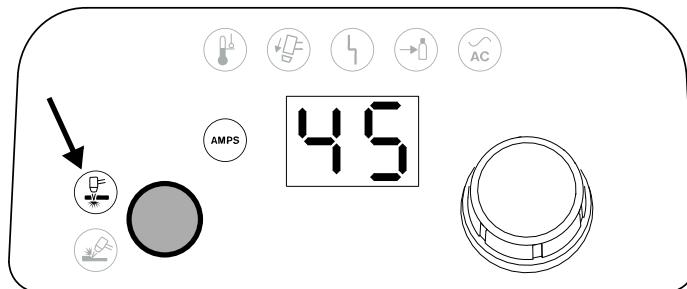
Your system ships with a starter consumable kit that includes the shielded consumables on page 65 plus 1 extra electrode and 1 extra nozzle.

Consumable Type	Purpose
Shielded drag-cutting	Drag cut for the widest range of cutting applications.
FineCut®	Achieve narrower kerf on thin mild steel and stainless steel up to 3 mm (10 gauge).
HyAccess™	Cut or gouge in hard to reach areas or confined spaces.
FlushCut™	Cut as close to the base as possible without piercing or damaging the workpiece.
Maximum Control gouging (26 – 45 A)*	Remove metal and achieve a controlled gouge profile.
Precision gouging (10 – 25 A)*	Achieve very shallow gouge and lower metal removal rate than with Maximum Control gouging, such as for spot weld removal.
Marking (10 – 25 A)†	Mark metal surfaces using air or argon.

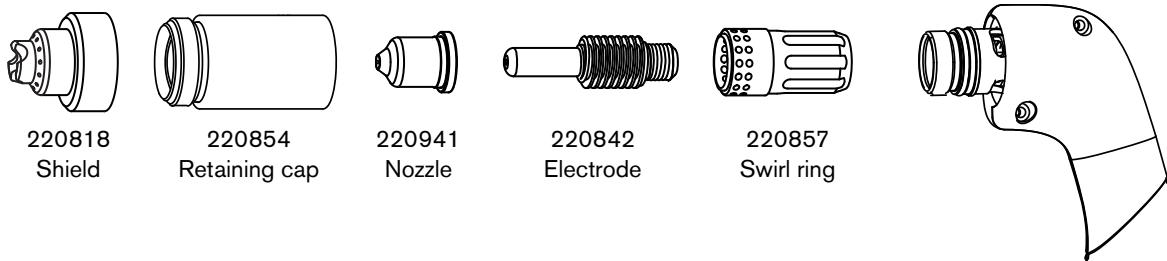
* For details on gouging processes and consumables, see *Gouging processes* on page 77.

† For details on marking consumables, see *Marking consumables (10 – 25 A)* on page 121.

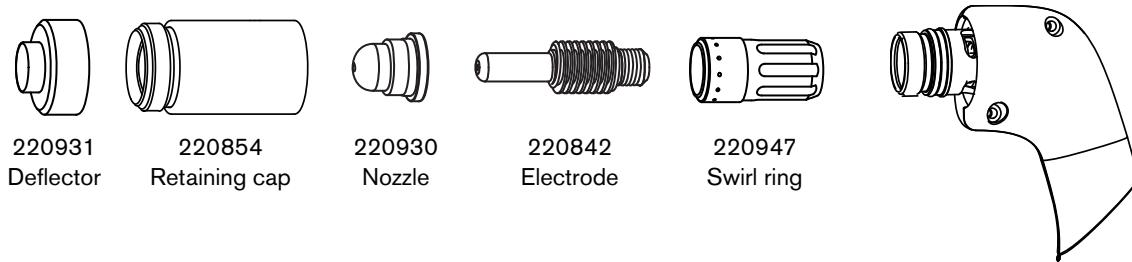
When you use the following shielded and FineCut consumables, select Cut mode on the front panel. See page 53.



Shielded drag-cutting consumables

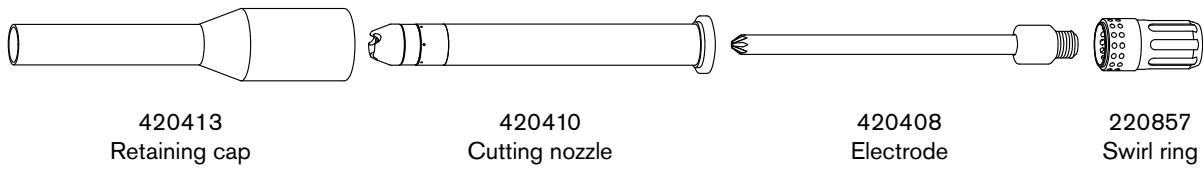


FineCut consumables



Specialty consumables

HyAccess cutting consumables



HyAccess consumables extend the reach of the regular shielded consumables by approximately 7.5 cm (3 inches). Use them with your hand torch to achieve greater reach and visibility.



HyAccess gouging consumables are also available. See page 79.

You can expect to cut approximately the same thicknesses as with the regular shielded consumables. You may need to reduce your cut speed slightly to achieve the same cut quality. Typically, you can expect HyAccess consumables to last approximately half as long as the regular shielded consumables.

3 Cut with the Hand Torch

You can order each HyAccess consumable separately or in starter kits. When the tip of the nozzle wears out, replace the entire nozzle.

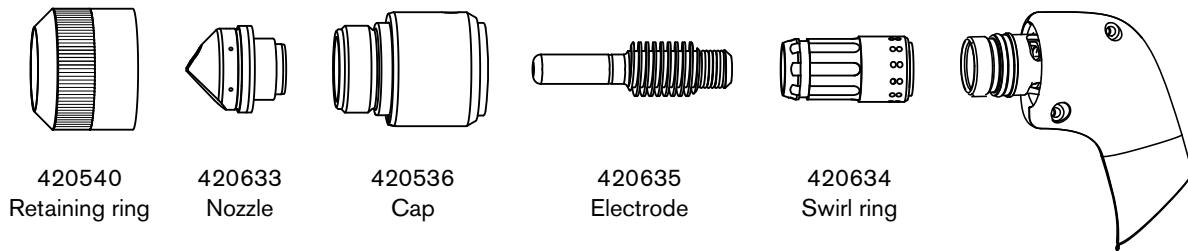
The 428445 cutting starter kit contains:

- 1 HyAccess electrode
- 1 HyAccess cutting nozzle
- 1 HyAccess retaining cap

The 428414 cutting/gouging starter kit contains:

- 2 HyAccess electrodes
- 1 HyAccess cutting nozzle
- 1 HyAccess gouging nozzle
- 1 HyAccess retaining cap
- 1 swirl ring (standard Powermax45 XP swirl ring)

FlushCut™ consumables



FlushCut consumables are designed to remove lugs, pad eyes, and other attachments without piercing or damaging the workpiece underneath. FlushCut consumables produce an angled plasma arc that enables you to cut very close to the base material without leaving a large amount of residual material to grind off.

You can expect to cut approximately the same thicknesses as with the regular shielded consumables. However, make sure to account for any added thickness that may be present from weld beads. Consumable life will vary, but typically you can expect FlushCut consumables to last approximately 3/4 as long as the regular shielded consumables.

You can order FlushCut consumables individually or in a starter kit (428746) that contains 1 of each consumable shown above. If you order FlushCut consumables individually:

- The minimum order quantity for the electrode is 5.
- All other FlushCut consumables can be ordered in single quantities.

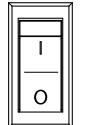
⚠ WARNING


ARC RAYS CAN BURN EYES AND SKIN

When you use FlushCut consumables, wear a face shield that covers your entire face. Use a shield with a shade 10 lens.

Plasma arc rays produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.

⚠ WARNING

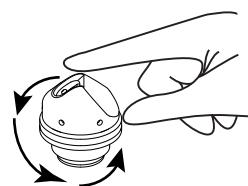

INSTANT-ON TORCHES – PLASMA ARC CAN CAUSE INJURY, BURNS

Before rotating the FlushCut nozzle, one of the following actions must be taken. Whenever possible, complete the first action.

- Turn OFF (O) the plasma power supply.
OR
- Move the torch-disable switch to the yellow lock (X) position (closest to the torch lead). Pull the trigger to make sure the torch does not fire a plasma arc.

To install:

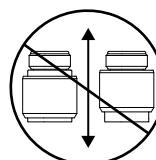
1. Turn OFF (O) the power supply, or set the torch-disable switch to the yellow lock (X) position.
2. Put the swirl ring, electrode, cap, and nozzle on the torch. Rotate the nozzle based on the direction you plan to cut. Make sure the flat side of the nozzle is on the bottom so you can drag it along the workpiece.
3. Fully tighten the retaining ring onto the cap.



Repeat these steps while cutting if you need to change the orientation of the nozzle in order to complete the cut.

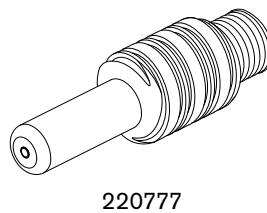
Tips:

- Drag the flat side of the nozzle along the base, but maintain a standoff of approximately 3 mm – 6 mm (1/8 inch to 1/4 inch) from the vertical workpiece you are cutting.
- You can use the FlushCut consumables in Gouge/Marking mode to remove residual material from the base workpiece. Turn down the amperage as needed.
- Replace the cap when the outer sleeve no longer slides freely up and down.



CopperPlus™ electrode

The CopperPlus electrode (220777) delivers at least 2 times longer consumable life over standard consumables (Hypertherm consumables designed for the system). This electrode is designed exclusively for use with Duramax and Duramax Lock torches when cutting metal up to 12 mm (1/2 inch).



220777

Consumable life

Many factors influence how often you need to change the consumables on your hand torch:

- **Poor gas supply quality**
 - It is extremely important to maintain a clean, dry gas line. The presence of oil, water, vapor, and other contaminants in the gas supply can degrade cut quality and consumable life. See page 37 and page 41.
- **Cutting technique**
 - Whenever possible, start cuts from the edge of the workpiece. This helps to extend the life of the shield and the nozzle. See page 73.
 - Use the proper piercing technique for the thickness of metal you are cutting. In many instances, a rolling pierce technique is an efficient way to pierce the metal while minimizing the consumable wear that naturally occurs during piercing. See page 74 for an explanation of the straight pierce and rolling pierce techniques and when each is appropriate.
- **Shielded versus non-shielded consumables**
 - Non-shielded consumables use a deflector instead of a shield. They can provide better visibility and accessibility for some cutting applications. The trade-off is that non-shielded consumables generally have a shorter life than shielded consumables.
- **Thickness of metal being cut**
 - In general, the thicker the metal being cut, the more quickly the consumables become worn. For best results, do not exceed the thickness specifications for this system. See page 24.
- **Expanded metal cutting**
 - Expanded metal has a slotted or mesh pattern. Cutting expanded metal wears out consumables more quickly because it requires a continuous pilot arc. A pilot arc occurs when the torch is fired but the plasma arc is not in contact with the workpiece.

■ Incorrect consumables for output current and mode

- To optimize consumable life, make sure the consumables installed on the torch match the selected mode and output current. For example:
 - Do not use gouging consumables when the system is set to Cut mode. See page 53.
 - Do not set the output current between 26 A and 45 A with the Precision gouging consumables installed.

■ Unnecessary arc stretch when cutting

- To maximize consumable life, avoid stretching the arc when it is not necessary. Drag the torch on the workpiece whenever possible. See page 72.

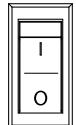
■ Insufficient arc stretch when gouging

- A proper arc stretch while gouging maintains distance between the torch tip and the molten metal that builds up during the gouge. See page 81.
 - An arc stretch of 19 – 25 mm (3/4 – 1 inch) is recommended for gouging with the Maximum Control gouging consumables at 26 – 45 A.
 - An arc stretch of 10 – 11 mm (3/8 – 1/2 inch) is recommended for gouging with the Precision gouging consumables at 10 A– 25 A.

As a general rule, the consumables last approximately 1 to 2 hours of actual “arc on” time for hand cutting. However, consumable life can vary a lot based on the factors listed above.

Prepare to fire the torch

! WARNING



INSTANT-ON TORCHES – PLASMA ARC CAN CAUSE INJURY, BURNS

The plasma arc ignites immediately when you pull the torch trigger. Before changing consumables, one of the following actions must be taken. Whenever possible, complete the first action.

- Turn OFF (O) the plasma power supply.
OR
- Move the torch-disable switch to the yellow lock (X) position (closest to the torch lead). Pull the trigger to make sure the torch does not fire a plasma arc.

The plasma arc will cut quickly through gloves and skin.

- Wear correct and appropriate protective equipment.
- Keep hands, clothing, and objects away from the torch tip.
- Do not hold the workpiece. Keep your hands clear of the cutting path.
- Never point the torch toward yourself or others.

! WARNING



RISK OF BURNS AND ELECTRIC SHOCK – WEAR INSULATED GLOVES

Always wear insulated gloves when changing the consumables. The consumables get very hot during cutting and can cause severe burns.

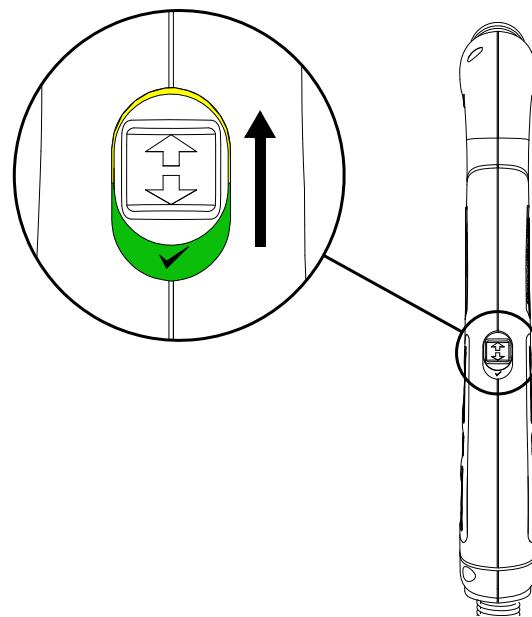
Touching the consumables can also result in electric shock if the power supply is ON and the torch-disable switch is not in the yellow lock (X) position.

To prevent accidental firing, the hand torch is equipped with a torch-disable switch and a safety trigger. To fire the torch:

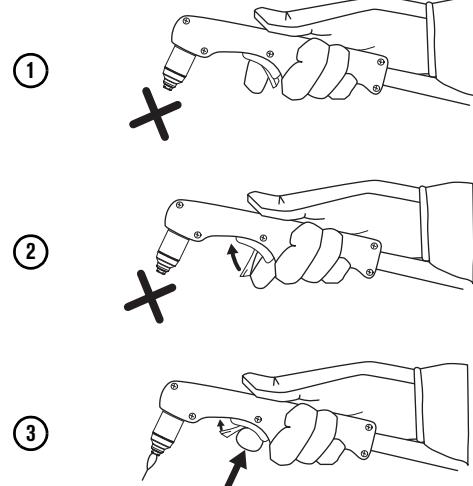
1. Install the correct consumables. See page 48.

- 2.** Make sure the torch-disable switch is in the green “ready to fire” (✓) position.

 The first time you pull the torch trigger after you set the torch to the “ready to fire” position, the torch may emit multiple puffs of air in quick succession. This warns you that the torch is active and will fire an arc the next time the trigger is pulled.
See page 47.



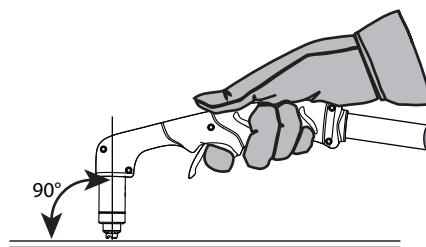
- 3.** Flip the trigger's safety cover forward (toward the torch head) and press the red torch trigger.



Hand torch cutting guidelines

- Drag the torch tip lightly along the workpiece to maintain a steady cut.
-  Sometimes the torch sticks slightly to the workpiece when you cut with FineCut consumables.
- Pulling, or dragging, the torch along the cut is easier than pushing it.
 - If sparks spray up from the workpiece, move the torch more slowly, or set the output current higher.
 - While cutting, make sure that sparks exit from the bottom of the workpiece. The sparks should lag slightly behind the torch as you cut ($15^\circ - 30^\circ$ angle from vertical).

- Hold the torch tip perpendicular to the workpiece so that the head of the torch is at a 90° angle to the cutting surface. Observe the cutting arc as the torch cuts.



- If you fire the torch unnecessarily, you will shorten the life of the nozzle and electrode.
- For straight-line cuts, use a straight edge as a guide. To cut circles, use a template or a radius cutter attachment (a circle cutting guide). For beveled cuts, use a bevel cutting guide. See *Accessory parts* on page 332.



To troubleshoot issues with cut quality, see *Troubleshooting guide* on page 172.

Start a cut from the edge of the workpiece

Edge starting, when possible, is a good way to reduce damage to the shield and nozzle that can be caused by the slag produced during piercing. This helps to optimize consumable life.

1. With the work clamp attached to the workpiece, hold the torch tip perpendicular (90°) to the edge of the workpiece.



2. Press the torch's trigger to start the arc. Pause at the edge until the arc has cut completely through the workpiece.

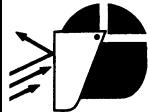


3. Drag the torch lightly across the workpiece to proceed with the cut. Maintain a steady, even pace.



Pierce a workpiece

WARNING



SPARKS AND HOT METAL CAN INJURE EYES AND BURN SKIN

When firing the torch at an angle, sparks and hot metal will spray out from the nozzle. Point the torch away from yourself and others. Always wear proper protective equipment including gloves and eye protection.

The hand torch can pierce interior features on metal with a thickness of up to 12 mm (1/2 inch).

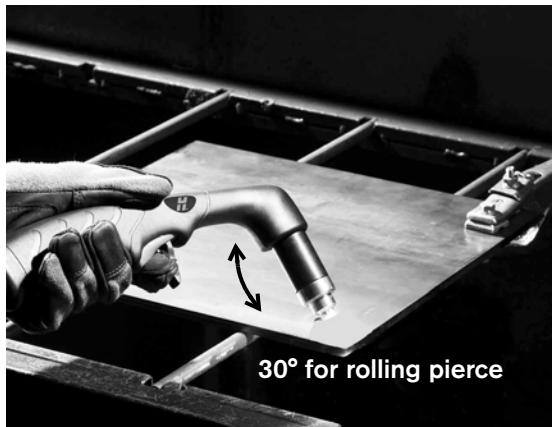
The type of pierce to perform depends on the thickness of the metal.

- **Straight pierce** – To cut metal that is thinner than 8 mm (5/16 inch).
- **Rolling pierce** – To cut metal that is 8 mm (5/16 inch) or thicker.

1. Attach the work clamp to the workpiece.

2. Straight pierce: Hold the torch perpendicular (90°) to the workpiece.

Rolling pierce: Hold the torch at an approximate 30° angle to the workpiece with the torch tip within 1.5 mm (1/16 inch) of the workpiece before firing the torch.



3. Straight pierce: Press the torch trigger to start the arc.

Rolling pierce: Press the torch trigger to start the arc while still at an angle to the workpiece, then rotate the torch to the perpendicular (90°) position.



4. Hold the torch in place while continuing to press the trigger. When sparks exit below the workpiece, the arc has pierced the material.



5. When the pierce is complete, drag the torch tip lightly along the workpiece to proceed with the cut.

3 *Cut with the Hand Torch*

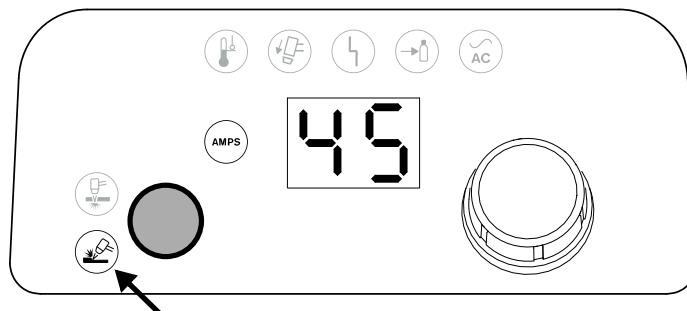
Gouge with the Hand Torch and Machine Torch

Gouging processes

This system offers 2 gouging processes. Each process uses its own set of consumables:

- **Maximum Control gouging**
 - Use this process to remove metal and to achieve a controlled gouge profile.
- **Precision gouging**
 - Use this process to achieve a very shallow gouge and a lower metal removal rate than with Maximum Control gouging. For example, this process is useful for removing spot welds and for washing material at very low depths.

Before you use either process, press the **Mode** button on the front panel to set the plasma power supply to Gouge/Marking mode. See page 53.



Make sure the Gouge/Marking Mode LED is illuminated.

Maximum Control gouging

- Use the Maximum Control gouging consumables.

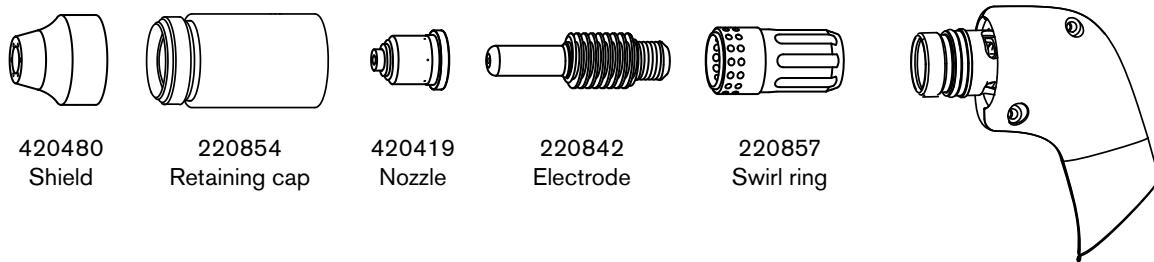


Hypertherm also offers *Maximum Removal* gouging consumables. At higher amperages on other Powermax systems, you can use the Maximum Removal consumables for greater metal removal rate and deeper gouge profiles. However, at 45 A with this system and torch, the Maximum Removal consumables do not offer an advantage over the Maximum Control consumables in terms of metal removal rate. You can expect each set of consumables to produce similar results on this system.

- Set the output current between 26 A and 45 A.

- Gouging at lower amperages (10 – 25 A) can limit the torch's arc stretch capability. In some instances it may also cause the arc to extinguish or trigger a "torch stuck open" (TSO) fault. See page 171.

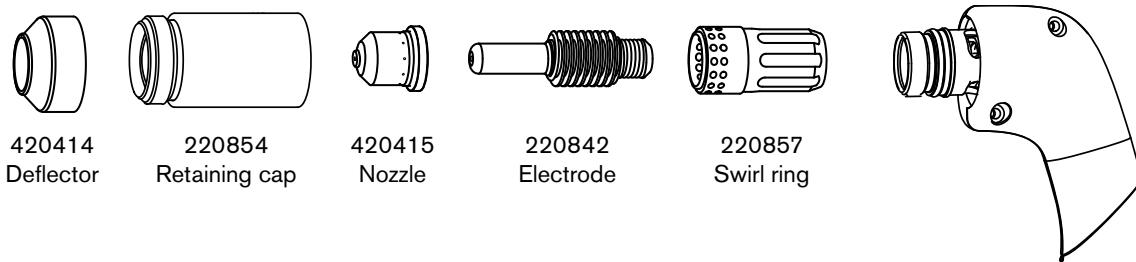
Maximum Control gouging consumables (26 – 45 A)



Precision gouging

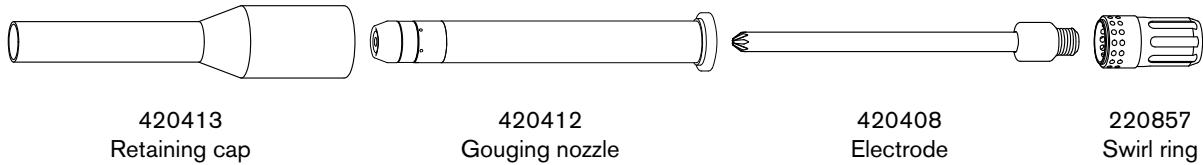
- Use the Precision gouging consumables.
- Set the output current between 10 A and 25 A.
- Gouging at higher amperages (26 – 45 A) can shorten the life of the nozzle.

Precision gouging consumables (10 – 25 A)



Specialty consumables

HyAccess gouging consumables



HyAccess consumables extend the reach of the regular shielded consumables by approximately 7.5 cm (3 inches). Use them with your hand torch to achieve greater reach and visibility.



HyAccess cutting consumables are also available. For more information on HyAccess consumables, see page 65.

You can order each HyAccess consumable separately or in starter kits. When the tip of the nozzle wears out, replace the entire nozzle.

The 428446 gouging starter kit contains:

- 1 HyAccess electrode
- 1 HyAccess gouging nozzle
- 1 HyAccess retaining cap

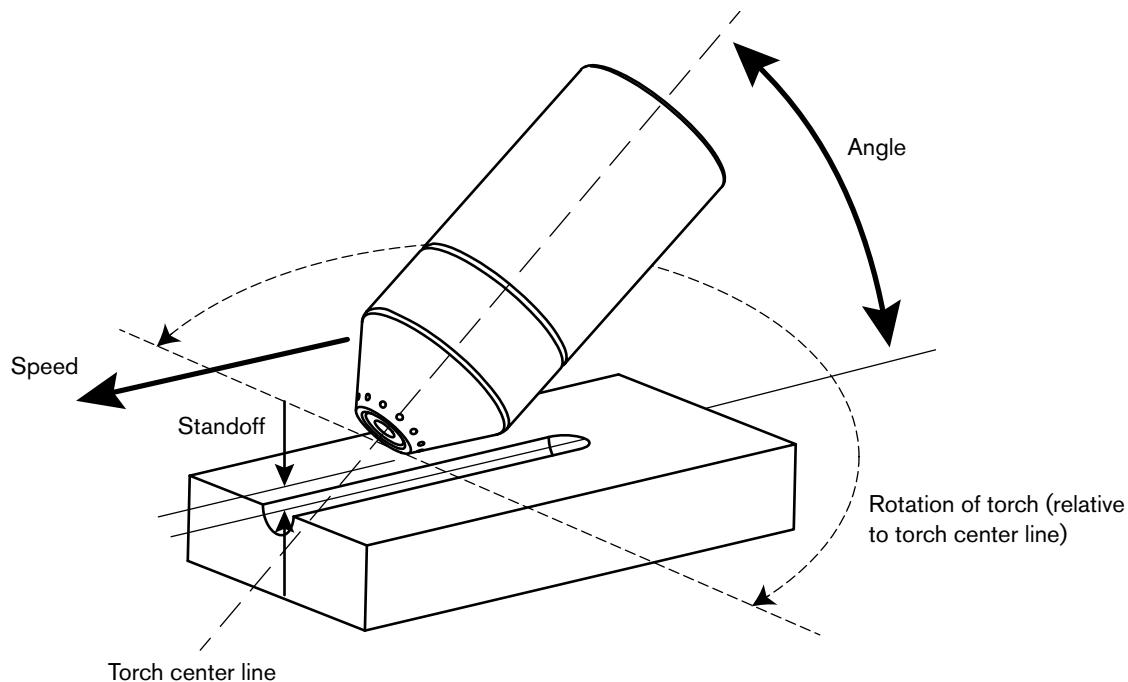
The 428414 cutting/gouging starter kit contains:

- 2 HyAccess electrodes
- 1 HyAccess cutting nozzle
- 1 HyAccess gouging nozzle
- 1 HyAccess retaining cap
- 1 swirl ring (standard Powermax45 XP swirl ring)

How to control the gouge profile

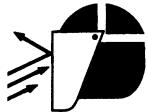
The following factors affect the width and the depth of the gouge profile. Adjust these elements to achieve the gouge you need.

- **Output current of the plasma power supply** – Turn down the amperage on the front panel to make the gouge narrower and more shallow.
 - If you are using the Maximum Control gouging consumables, keep the amperage between 26 – 45 A.
 - If you are using the Precision gouging consumables, keep the amperage between 10 – 25 A.
- **Angle of the torch to the workpiece** – Position the torch in a more upright position to make the gouge narrower and deeper. Tilt down the torch so that it is closer to the workpiece to make the gouge wider and more shallow.
- **Rotation of the torch** – Rotate the torch relative to the torch center line to make the gouge flatter and steeper on one side.
- **Torch-to-work standoff** – Move the torch further away from the workpiece to make the gouge wider and more shallow. Move the torch closer to the workpiece to make the gouge narrower and deeper.
- **Speed of the torch over the workpiece** – Slow down to make the gouge wider and deeper. Speed up to make the gouge narrower and more shallow.



Gouge with the hand torch

WARNING



SPARKS AND HOT METAL CAN INJURE EYES AND BURN SKIN

When firing the torch at an angle, sparks and hot metal will spray out from the nozzle. Point the torch away from yourself and others. Always wear proper protective equipment including gloves and eye protection.

1. Install the Maximum Control gouging consumables or the Precision gouging consumables.
2. Set the system to Gouge/Marking mode. See page 53.
3. Set the output current to match the consumables installed:
 - Maximum Control gouging consumables: 26 – 45 A
 - Precision gouging consumables: 10 – 25 A
4. Hold the torch at approximately a 40° angle to the workpiece before firing the torch.
 - Maximum Control gouging consumables: Hold the torch approximately 6 mm (1/4 inch) above the workpiece.
 - Precision gouging consumables: Hold the torch approximately 2 – 3 mm above the workpiece.

Press the trigger to obtain a pilot arc. Transfer the arc to the workpiece.



5. Stretch the arc as follows:
 - Maximum Control gouging consumables: 19 – 25 mm (3/4 – 1 inch)
 - Precision gouging consumables: 10 – 11 mm (3/8 – 1/2 inch)

- 6.** Change the torch's angle as needed to achieve the desired dimensions for the gouge. Maintain the same angle to the workpiece as you feed into the gouge. Push the plasma arc in the direction of the gouge you want to create.



Keep at least a small distance between the torch tip and the molten metal to avoid reducing consumable life or damaging the torch.

Remove spot welds

To remove a spot weld, gouge around the weld in order to cut completely through the top layer of metal without damaging the layer underneath.

The Precision gouging consumables were designed specifically for applications like removing spot welds. When used at a lower amperage, these consumables provide:

- Very good visibility due to a plasma arc that is less bright and that allows you to see the metal being gouged more clearly
- A very high width-to-depth ratio, which provides much better control of the metal removal rate

Tips

Many different techniques can be used to remove spot welds. The method described in the following procedure is recommended as a good starting point. It is intended to minimize possible damage to the underneath layer.

Regardless of technique, these tips can help you to successfully remove spot welds:

- **Keep the torch pointed in the same direction all the way around the spot weld.**
 - By keeping the torch pointed in the same direction, you avoid blowing slag over areas you already gouged. This reduces the clean-up needed on the underneath layer. It also makes the process more ergonomic and efficient, since you do not need to rotate the torch or the workpiece while gouging.
- **Maintain a proper arc stretch.**
 - Maintain an arc stretch of approximately 10 – 11 mm (3/8 – 1/2 inch) as you gouge around the weld. This provides good visibility and prevents the torch tip from hitting slag, which can shorten consumable life and interrupt the gouge.

- Start at a lower output current, and gradually increase it.
 - Start with the current set to 10 A if you have never removed a spot weld before. Once you develop a technique you are comfortable with, try gradually increasing the output current. This enables you to gouge with better speed and efficiency.

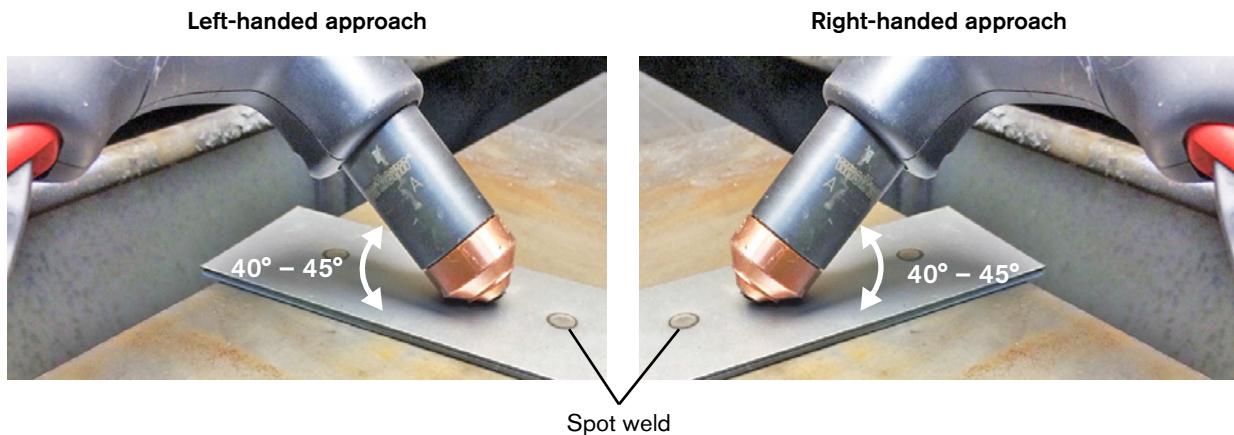
Procedure

This procedure describes how to separate 2 metal layers and then remove the spot weld from the underneath layer.



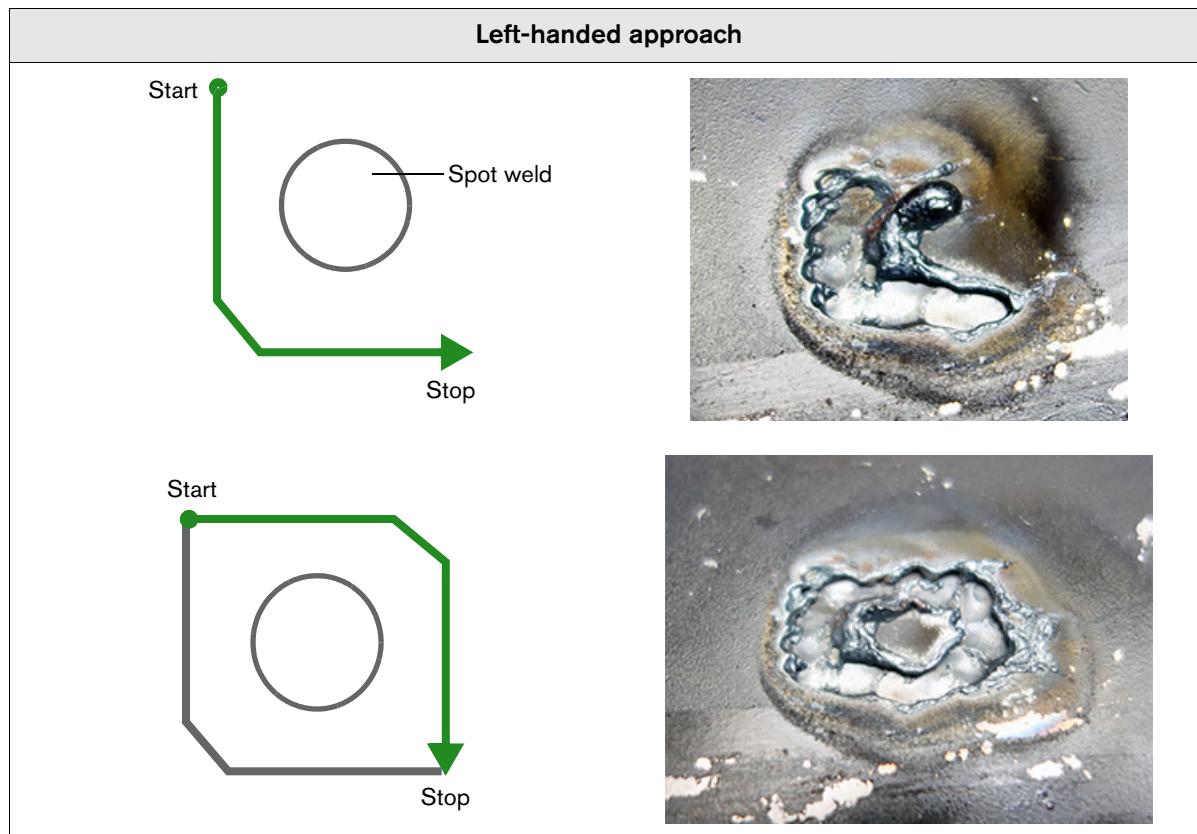
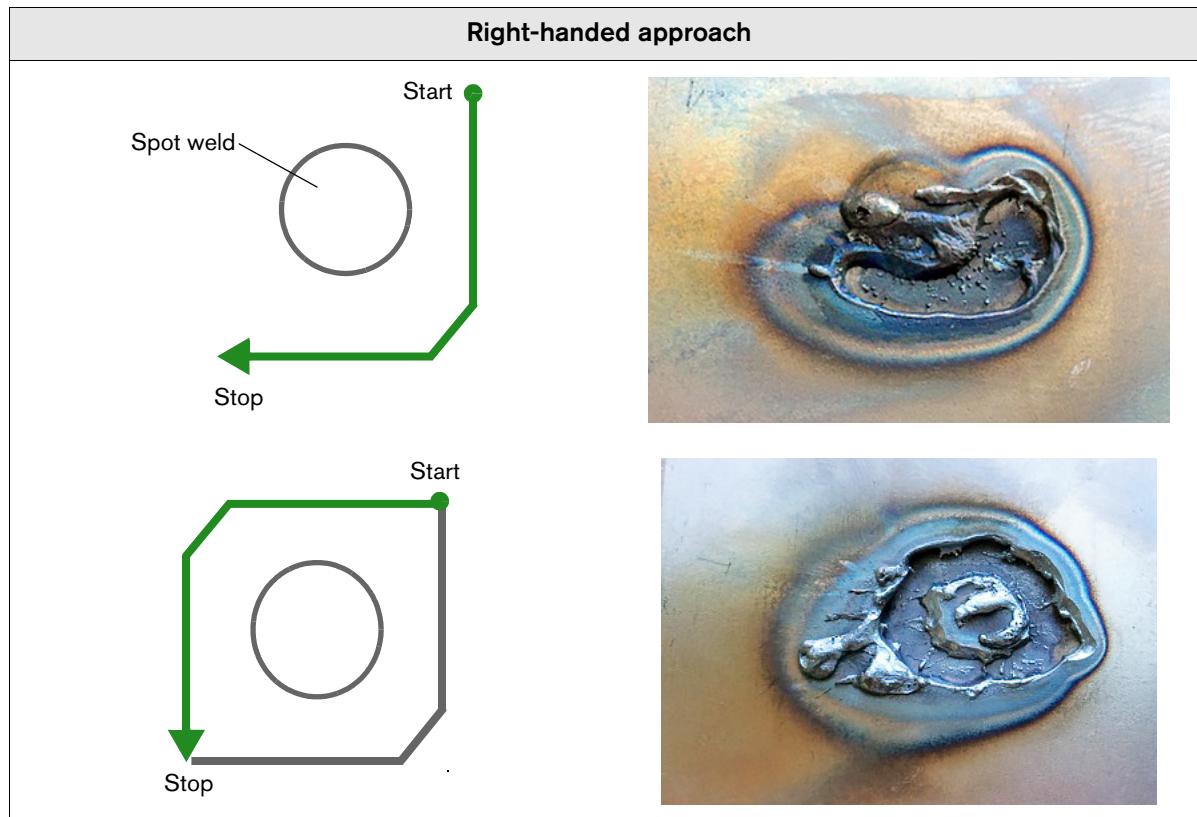
The pictures in this procedure show mild steel plates. The slag on stainless steel is darker, more jagged, and harder to remove.

1. Install the Precision gouging consumables.
2. On the front panel, select Gouge/Marking mode. Set the output current to 10 – 25 A.
3. Position the torch on one side of the spot weld. Hold the torch at approximately a 40° – 45° angle to the workpiece.



4. Press the trigger to obtain a pilot arc. Transfer the arc to the workpiece, then stretch the arc to approximately 10 – 11 mm (3/8 – 1/2 inch). Maintain this arc as you gouge.
5. Make 2 separate gouges in an "L"-shaped motion to gouge all the way around the spot weld. See *Table 1* on page 84.
 - *Table 1* shows one example of this technique (for both right-handed and left-handed gouging). You can start at different points around the spot weld. The important thing is to keep the torch pointed in the same direction all the way around the weld.
 - As you gouge, use very short strokes in a back-and-forth weaving motion until you have cut through the top layer.
 - You may need to adjust the angle of the torch slightly, depending on the thickness of the metal.

Table 1 – Gouging around the spot weld



6. Make sure you have gouged completely through the top layer. Pull the metal plates apart.
7. Use the same gouging process to remove the spot weld that remains on the bottom plate.
 - To avoid damaging the bottom plate, you may want to turn down the output current to 10 A. Increase the current if needed based on the thickness of the metal.
 - Hold the torch at a 40° – 45° angle. Slightly adjust the angle of the torch as needed based on the thickness of the metal.
 - Stretch the arc to approximately 10 – 11 mm (3/8 – 1/2 inch) as you gouge.
 - Use very short strokes in a back-and-forth weaving motion until you have removed the spot weld.



Some scraping or grinding may be required to completely remove all remnants of the spot weld from the bottom plate.



Spot weld on bottom plate



Spot weld removed

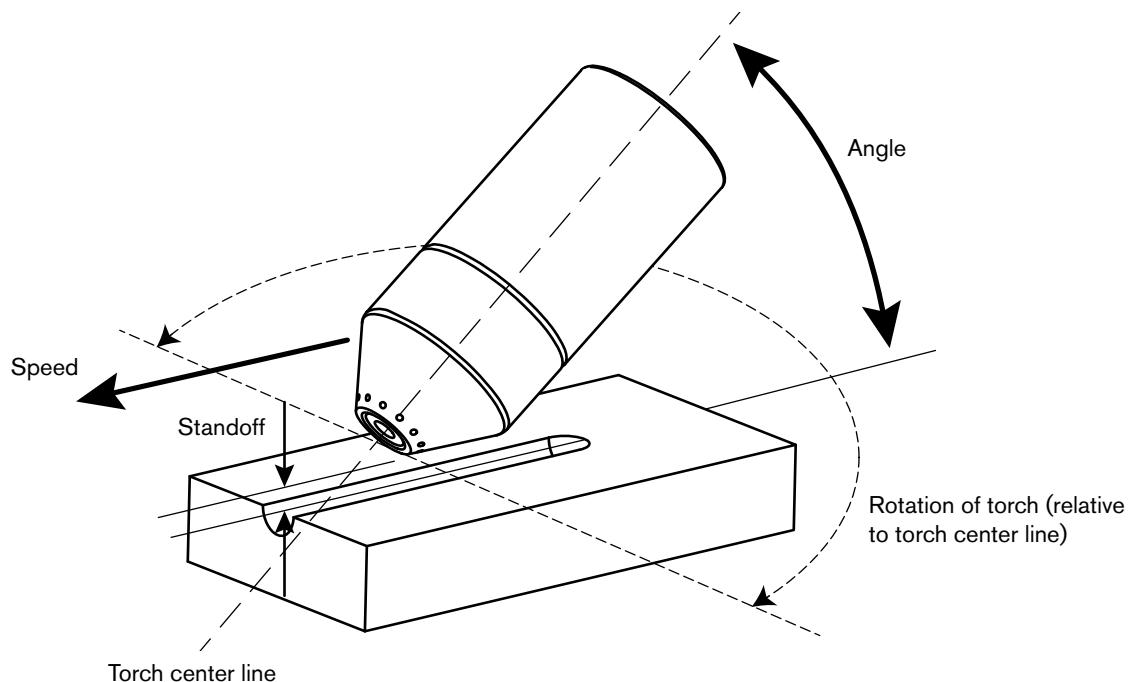


Gouge with the machine torch

You can vary the gouge profile by adjusting the:

- Output current (amperage) of the power supply
- Angle of the torch to the workpiece
- Rotation of the torch relative to the torch center line
- Torch-to-work standoff
- Speed of the torch over the workpiece

See page 80 for more details.



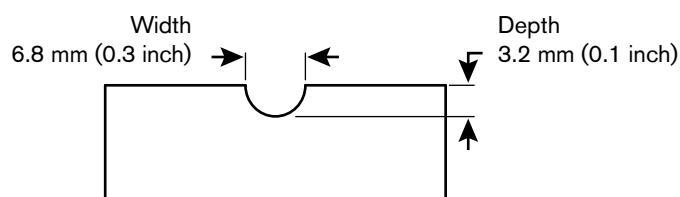
Typical gouge profiles

Maximum Control gouging consumables (45 A)

Operating parameters	
Speed	254 – 1016 mm/min (10 – 40 in/min)
Standoff	6 mm (1/4 inch)
Angle	40° – 50°
Output current	26 – 45 A
Consumables	Maximum Control gouging consumables
Gas	Air

45 A

Metal removal rate on mild steel:
3.4 kg/hour (7.5 pounds/hour)



The following tables show the 45 A gouging profile at 40° and 50° on mild steel and stainless steel. These settings are intended to serve as a starting point to help you determine the best gouging profile for a given cutting job. Adjust these settings as needed for your application and table to obtain the desired result.

Table 2 – Mild steel (Metric)

Torch angle	Speed (mm/min)	Depth (mm)	Width (mm)	Width/depth ratio
40°	254	4.6	8.4	1.83
	508	3.2	6.8	2.13
	762	1.9	5.9	3.11
	1016	1.4	5.2	3.71
50°	254	5.0	6.7	1.34
	508	3.4	5.2	1.53
	762	2.7	4.9	1.81
	1016	2.2	4.6	2.09

Table 3 – Mild steel (English)

Torch angle	Speed (in/min)	Depth (inches)	Width (inches)	Width/depth ratio
40°	10	0.183	0.331	1.81
	20	0.126	0.268	2.13
	30	0.074	0.231	3.12
	40	0.055	0.206	3.74
50°	10	0.195	0.263	1.35
	20	0.132	0.205	1.55
	30	0.107	0.192	1.79
	40	0.088	0.181	2.06

Table 4 – Stainless steel (Metric)

Torch angle	Speed (mm/min)	Depth (mm)	Width (mm)	Width/depth ratio
40°	254	2.9	6.2	2.14
	508	2.0	5.7	2.85
	1016	1	4.8	4.8
50°	254	5.3	5.7	1.08
	508	3.5	5.0	1.43
	1016	2.0	3.8	1.90

Table 5 – Stainless steel (English)

Torch angle	Speed (in/min)	Depth (inches)	Width (inches)	Width/depth ratio
40°	10	0.114	0.245	2.15
	20	0.080	0.222	2.76
	40	0.048	0.190	3.96
50°	10	0.210	0.224	1.07
	20	0.139	0.199	1.43
	40	0.080	0.150	1.88

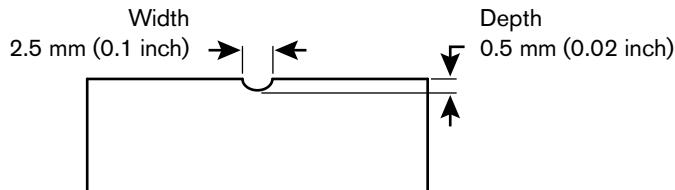
Precision gouging consumables (10 A)

Operating parameters	
Speed	254 – 762 mm/min (10 – 30 in/min)
Standoff	0.3 – 1.3 mm (0.01 – 0.05 inch)*
Angle	40° – 50°
Output current	10 – 25 A
Consumables	Precision gouging consumables
Gas	Air

* Increase the standoff to a maximum of 3 – 4 mm (0.12 – 0.16 inch) for a very light gouge.

10 A

Metal removal rate on mild steel:
0.2 kg/hour (0.5 pounds/hour)



The following tables show the 10 A gouging profile at 40° and 50° on mild steel. These settings are intended to serve as a starting point to help you determine the best gouging profile for a given cutting job. Adjust these settings as needed for your application and table to obtain the desired result.

Table 6 – Mild steel (Metric)

Torch angle	Standoff (mm)	Speed (mm/min)	Depth (mm)	Width (mm)	Width/depth ratio
40°	0.3	254	0.5	3.3	6.6
	0.3	508	0.3	2.4	8
	0.3	762	0.1	2.2	22
	1.3	254	0.3	3	10
	1.3	508	0.1	2.2	22
	1.3	762	0.05	1.9	38

4 Gouge with the Hand Torch and Machine Torch

Torch angle	Standoff (mm)	Speed (mm/min)	Depth (mm)	Width (mm)	Width/depth ratio
50°	0.3	254	1.1	2.6	2.36
	0.3	508	0.6	2.3	3.83
	0.3	762	0.4	2.0	5
	1.3	254	1.1	2.8	2.55
	1.3	508	0.5	2.4	4.8
	1.3	762	0.25	2.1	8.4

Table 7 – Mild steel (English)

Torch angle	Standoff (inches)	Speed (in/min)	Depth (inches)	Width (inches)	Width/depth ratio
40°	0.01	10	0.0207	0.129	6.23
	0.01	20	0.0113	0.095	8.41
	0.01	30	0.0044	0.088	20
	0.05	10	0.0122	0.12	9.84
	0.05	20	0.004	0.088	22
	0.05	30	0.002	0.074	37
50°	0.01	10	0.0427	0.103	2.41
	0.01	20	0.0222	0.09	4.05
	0.01	30	0.0147	0.08	5.44
	0.05	10	0.043	0.11	2.56
	0.05	20	0.0208	0.095	4.57
	0.05	30	0.01	0.084	8.4

Troubleshooting tips for gouging

When gouging, always make sure:

- Gouging consumables are installed, and the output current matches those consumables.
- The power supply is set to Gouge/Marking mode.

Many common metal removal issues can be resolved by installing new consumables in the torch. Do not use worn or damaged consumables.

Problem	Solution
The arc goes out during gouging.	<ul style="list-style-type: none"> ▪ Decrease the arc stretch (standoff). ▪ Increase the angle of the torch to the workpiece.
The torch tip bumps into slag.	<ul style="list-style-type: none"> ▪ Increase the arc stretch (standoff). ▪ Keep the torch tip pointed in the direction of the gouge you want to create.
The gouge is too deep.	<ul style="list-style-type: none"> ▪ Decrease the angle of the torch to the workpiece. ▪ Increase the arc stretch (standoff). ▪ Increase the gouging speed. ▪ Decrease the output current. Do not set the output current below 26 A if you are using the Maximum Control gouging consumables.
The gouge is too shallow.	<ul style="list-style-type: none"> ▪ Increase the angle of the torch to the workpiece. ▪ Decrease the arc stretch (standoff). ▪ Decrease the gouging speed. ▪ Increase the output current. Do not set the output current above 25 A if you are using the Precision gouging consumables.
The gouge is too wide.	<ul style="list-style-type: none"> ▪ Increase the angle of the torch to the workpiece. ▪ Decrease the arc stretch (standoff). ▪ Increase the gouging speed. ▪ Decrease the output current. Do not set the output current below 26 A if you are using the Maximum Control gouging consumables.
The gouge is too narrow.	<ul style="list-style-type: none"> ▪ Decrease the angle of the torch to the workpiece. ▪ Increase the arc stretch (standoff). ▪ Decrease the gouging speed. ▪ Increase output current. Do not set the output current above 25 A if you are using the Precision gouging consumables.

Problem	Solution
When removing a spot weld, the arc pierces the bottom metal plate.	<ul style="list-style-type: none">▪ Decrease the output current (amperage).▪ Make sure the Precision gouging consumables are installed.▪ Maintain a steady gouging speed and gouge only until the bottom metal plate is visible.▪ Increase the arc stretch to approximately 10 – 11 mm (3/8 – 1/2 inch).
The spot weld is not visible while gouging.	<ul style="list-style-type: none">▪ Stretch the arc to approximately 10 – 11 mm (3/8 – 1/2 inch) for better visibility of the spot weld.▪ Make sure the Precision gouging consumables are installed.▪ Make sure the output current is not set above 25 A.

5

Set Up the Machine Torch

Duramax Lock machine torch features include:

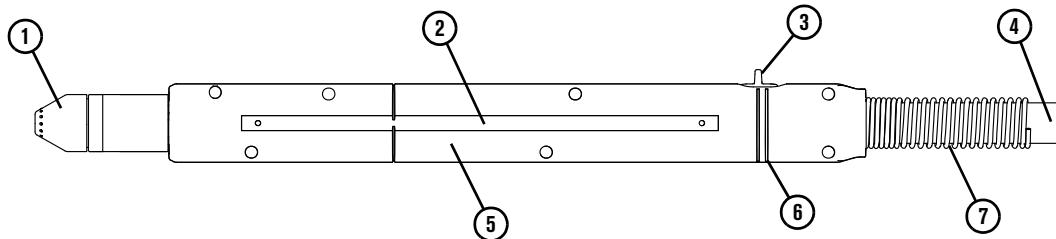
- A torch-disable switch that prevents the torch from firing accidentally even when the power supply is ON. See *Disable the torch* on page 46.
- The FastConnect™ quick-disconnect system to easily remove the torch for transport or to switch from one torch to another.
- Automatic cooling with ambient air. Special cooling procedures are not needed.

This section provides information on:

- Machine torch components and dimensions
- Setup details for installing the torch on X-Y tables, track burners, pipe bevelers, or other mechanized equipment

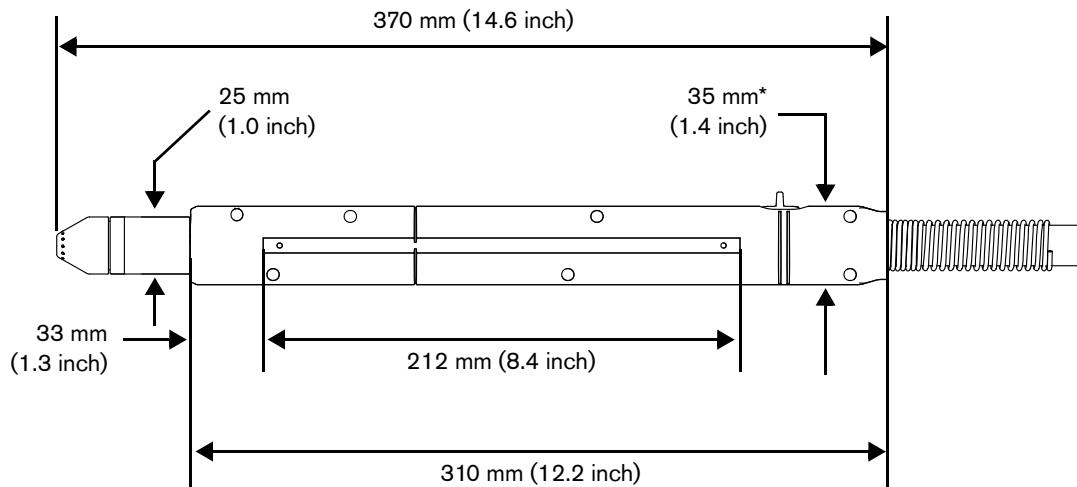
Machine torch components, dimensions, weights

Components



- | | |
|--------------------------------|--------------------------------|
| 1 Consumables | 5 Shell |
| 2 32-pitch removable gear rack | 6 Switch position lines |
| 3 Torch-disable switch | 7 Strain relief for torch lead |
| 4 Torch lead | |

Dimensions



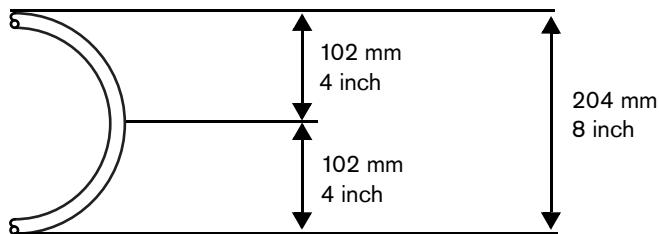
* This measurement is for the outer dimension of the torch. The height of the outer torch shell is 41 mm (1.6 inch) when the torch-disable switch is included.

Weights

Torch	Weight
Machine torch with 7.6 m (25 foot) lead	3.2 kg (7.1 pounds)
Machine torch with 10.7 m (35 foot) lead	4.2 kg (9.3 pounds)
Machine torch with 15 m (50 foot) lead	5.8 kg (12.7 pounds)

Minimum bend radius for torch leads

The recommended minimum bend radius for torch leads is 102 mm (4 inches).



Diameter = 2 x Radius = 204 mm (8 inches)

Mount the torch

The machine torch can be mounted on a wide variety of X-Y tables, track burners, pipe bevelers, and other equipment. Install the torch per the table or equipment manufacturer's instructions.

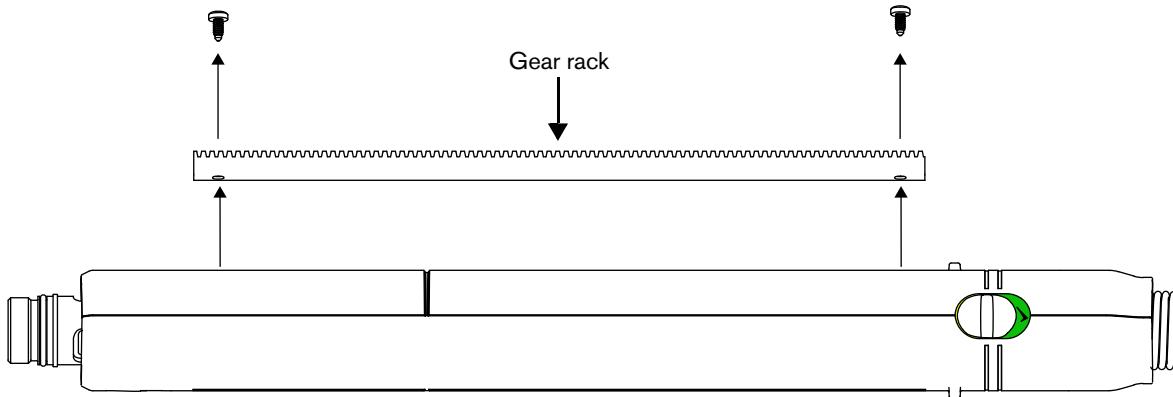
If your cutting table's track is large enough for you to route the torch through it without removing the torch shell, do so and then attach the torch to the lifter per the manufacturer's instructions.

Remove the gear rack

The gear rack can be mounted on either side of the torch. If you need to remove the gear rack, remove the 2 screws that secure the rack to the torch shell.



When you install the gear rack, tighten the screws by hand. To avoid stripping the screws, do not overtighten.



Disassemble the machine torch

Use the following procedure if you need to disassemble the torch to route the torch through the cutting table's track or other mounting system.

NOTICE

While disconnecting and reconnecting the torch parts, do not twist the torch or the lead. Maintain the same orientation between the torch head and torch lead. Twisting the torch head in relation to the torch lead can damage the torch wires.

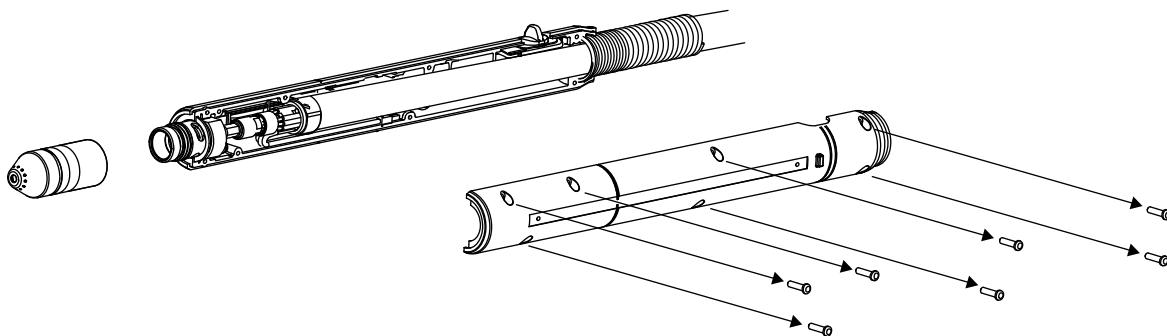
1. Disconnect the torch from the plasma power supply.
2. Remove the consumables from the torch.
3. Place the torch on a flat surface with the left side of the shell facing up.



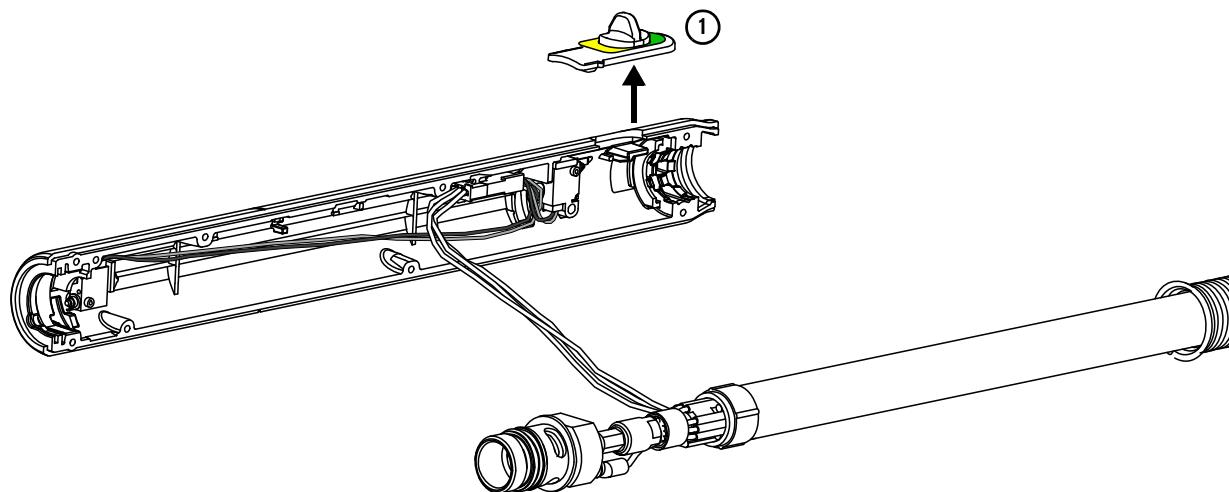
The left side of the shell is the side with the screws.

4. Remove the 7 screws from the torch shell. Set the screws aside.

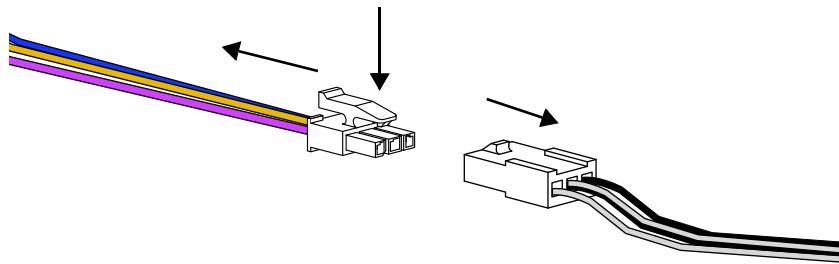
- Carefully pry the left side of the shell away from the torch.



- Remove the plastic slider ① for the torch-disable switch and set it aside.
- The torch body fits snugly into the right side of the shell. Gently pry the head of the torch body out and away from the right side of the shell to remove it.



- Disconnect the wires that sit in the right shell. Press down the tab on the wire connector to pull the 2 sides apart.



- You can now route the torch body and the torch lead through the mounting system for the cutting table.



Slide the strain relief along the torch lead as needed to move it out of the way as you route the torch lead through the track.

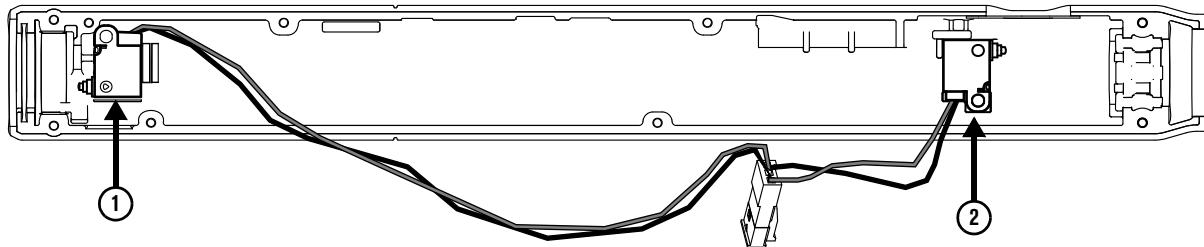
Assemble the machine torch

If you disassembled the torch to route it through the cutting table's track or other mounting system, use the following procedure to reassemble the torch.

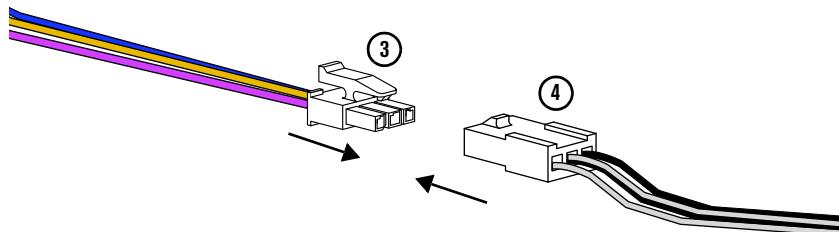


While disconnecting and reconnecting the torch parts, do not twist the torch or the lead. Maintain the same orientation between the torch head and torch lead. Twisting the torch head in relation to the torch lead can cause damage to the torch wires.

1. Place the right torch shell on a flat surface.
2. Make sure the cap-sensor switch ① and the torch-disable switch ② sit in the right torch shell as shown. Mounting posts in the torch shell hold each switch in place.

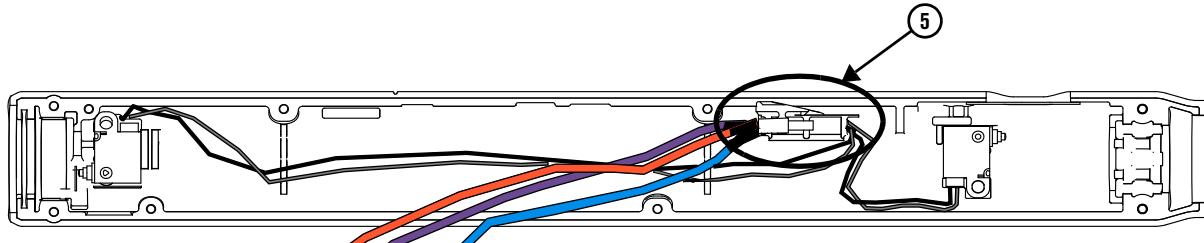


3. Connect the wires from the torch body ③ to the wires from the cap-sensor switch/torch-disable switch assembly ④.



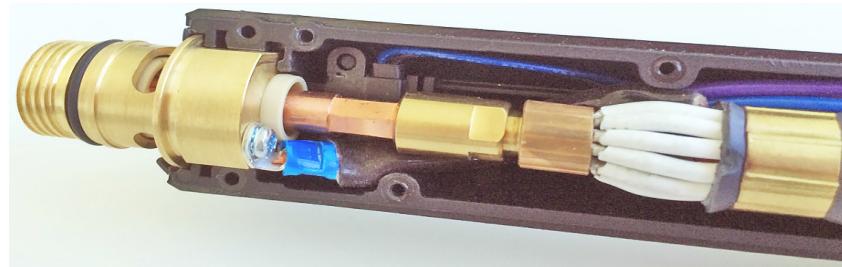
4. Place the wire connector ⑤ on the mounting shelf in the right torch shell as shown.

Route the blue and black wires from the cap-sensor switch and the torch-disable switch outside of and below the mounting shelf. This helps to prevent the wires from getting pinched and damaged when the torch is fully assembled.



5. Push the head of the torch body into the right torch shell as shown. Make sure:

- ❑ The torch shell fits over the flat edges of the torch head. The rounded edge of the torch head should be facing up.
- ❑ The wire connector from the previous step remains in place on the mounting shelf. Hold the wire connector in place as you fit the torch body into the torch shell.



6. Fit the rest of the torch body into the right torch shell as shown. As you do, tuck all of the wires under the torch body. Do not pinch or crimp the wires. Make sure none of the wires are covering the screw holes in the torch shell.

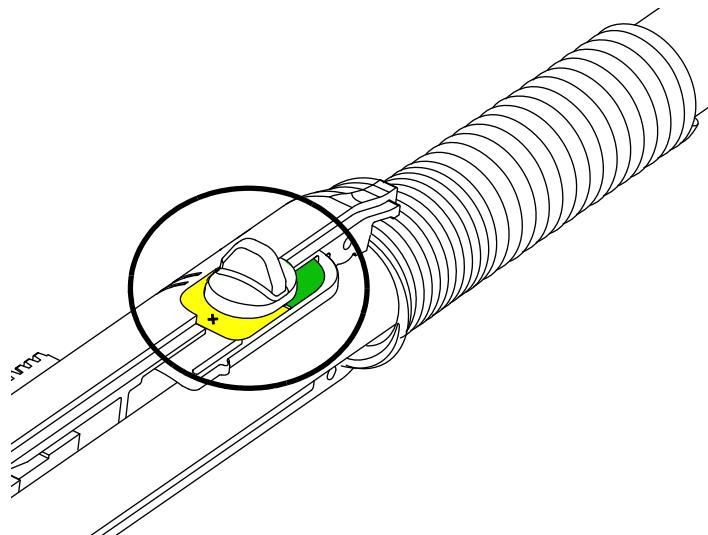
7. Fit the strain relief ⑥ into the base of the right torch shell.



8. Put the plastic slider for the torch-disable switch into place in the yellow lock (X) position.



If you try to put the torch back together with the slider in the green "ready to fire" (✓) position, you can damage the torch-disable switch that is inside the shell behind the torch body.



- 9.** Attach the left torch shell to the right torch shell using the 7 screws. Firmly grasp the torch shells at the base near the strain relief and hold them together as you install the screws.

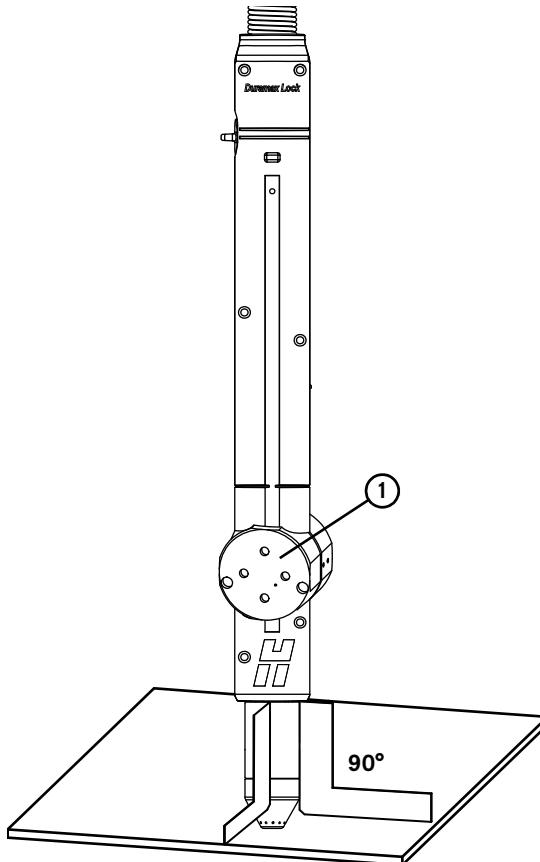
NOTICE

Be careful to avoid pinching the wires between the torch shells. This can damage the wires and prevent the torch from operating properly.

- 10.** Examine the torch to make sure no wires are pinched where the torch shells meet.
- 11.** Install the gear rack on the torch shell.
- 12.** Attach the torch to the lifter per the manufacturer's instructions.
- 13.** Reinstall the consumables on the torch. See page 48.

Align the torch

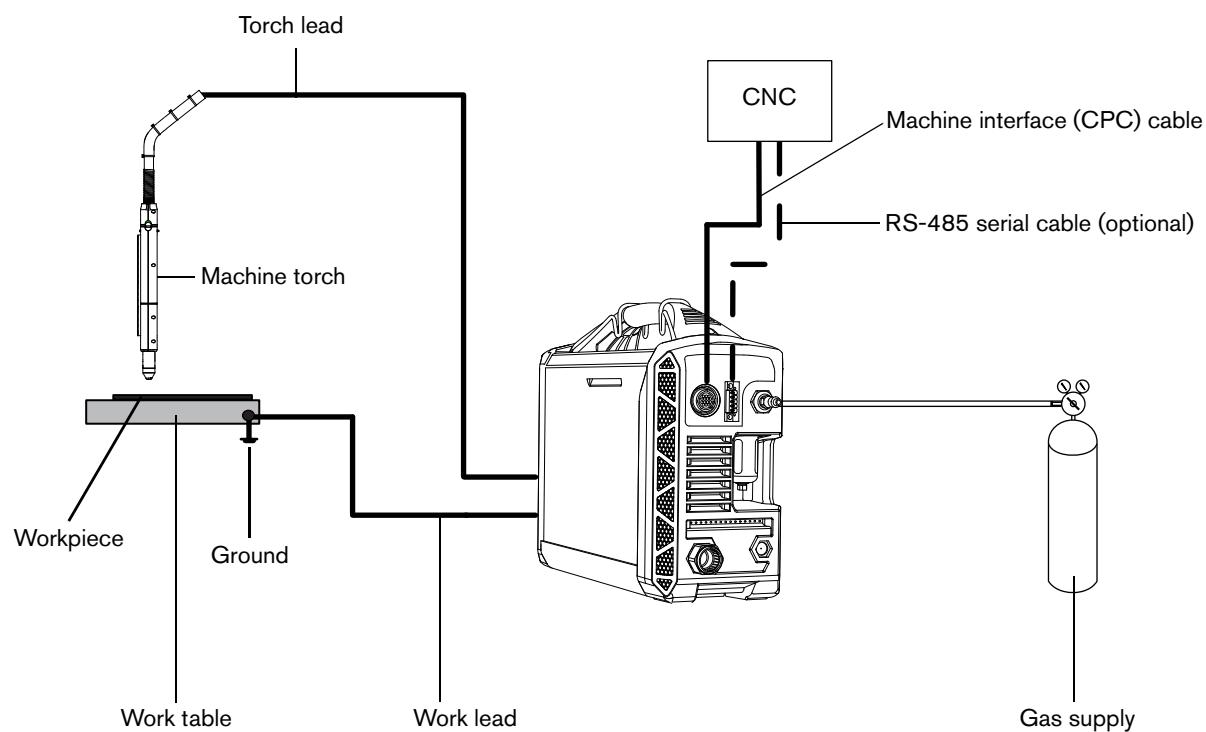
- Mount the machine torch perpendicular to the workpiece to get a vertical cut. Use a square to align the torch at a 90° angle to the workpiece.
- Position the mounting bracket ① lower on the torch to minimize vibration at the tip of the torch.
- **Do not overtighten the mounting bracket.** Excessive pressure from the clamp can warp or damage the torch shell over time.



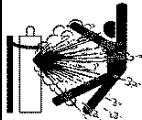
6

Configure Controls for Mechanized Cutting

Machine torch setup overview



! WARNING



GAS CYLINDERS CAN EXPLODE IF DAMAGED

Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.

For high pressure regulators, adhere to the manufacturer's guidelines for safe installation, operation, and maintenance.

Before plasma cutting with compressed gas, read the safety instructions in the ***Safety and Compliance Manual (80669C)***. Failure to follow safety instructions can result in personal injury or in damage to equipment.

! WARNING



EXPLOSION HAZARD – CUTTING WITH ALUMINUM NEAR WATER

Do not cut aluminum alloys underwater or on a water table unless you can prevent the accumulation of hydrogen gas. Never cut aluminum-lithium alloys in the presence of water.

Aluminum can react with water to produce hydrogen, resulting in a potentially explosive condition that can detonate during plasma cutting operations. Refer to the ***Safety and Compliance Manual (80669C)*** for more information.

Set up the plasma system and machine torch for mechanized cutting

1. Attach the work lead from the plasma power supply to the work table.
2. Connect the gas supply to the plasma power supply. See page 36.
 - ❑ Use compressed air to cut mild steel, stainless steel, aluminum, and other conductive metals.
 - ❑ Use F5 to cut stainless steel. See page 119.
 - ❑ Use argon for marking applications. See page 122.
3. Connect the plasma power supply to your CNC (or other controller) using the machine interface (CPC) connection.
 - ❑ Your plasma system must be equipped with a factory-installed (or user-installed) CPC port with internal voltage divider board. See page 104.
 - ❑ A CPC connection is required to fire the torch and to control the signals for arc transfer and arc voltage.

4. Optional: Connect the plasma power supply to your CNC using the RS-485 serial interface connection.
 - ❑ To use the optional RS-485 serial interface, make sure your plasma system is equipped with a factory-installed (or user-installed) RS-485 serial interface port. See page 111.
 - ❑ The RS-485 serial interface provides added capabilities for controlling the plasma system from the CNC, but it cannot be used to fire the torch.
5. Attach the torch to the table or other cutting equipment per the manufacturer's instructions. See page 95 for additional information.
6. Install the correct cutting, gouging, or marking consumables for your application:
 - ❑ **Cutting and piercing with a machine torch:** See *Choose the consumables* on page 113.
 - ❑ **Gouging:** See *Gouging processes* on page 77.
 - ❑ **Marking:** See *Marking consumables (10 – 25 A)* on page 121.
7. Select Cut mode or Gouge/Marking mode on the front panel of the plasma power supply to match the consumables you installed. See *Cutting controls* on page 44.
8. Adjust the torch speed and output current (amperage) as needed. See the cut charts starting on page 131.

Connect the remote-start pendant

Powermax45 XP configurations with a Duramax Lock machine torch can include an optional remote-start pendant.

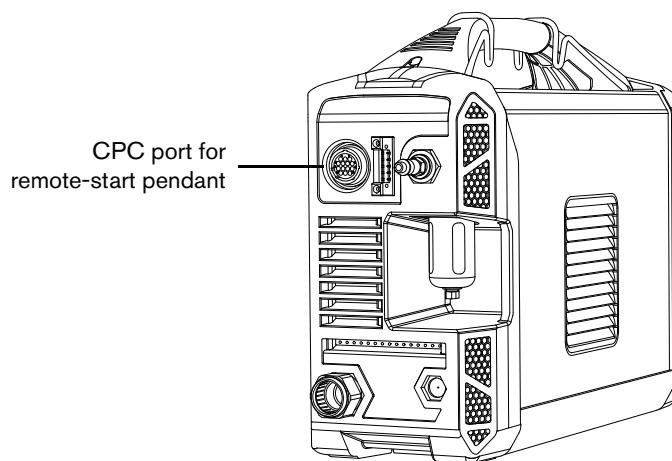


The remote-start pendant enables you to remotely start and stop the machine torch. For example, use it when you mount the torch on a simple track burner or cutting guide that does not have its own CNC or other controller.

To use the Hypertherm remote-start pendant, plug it into the CPC port on the rear of the power supply.



The remote-start pendant is for use only with a machine torch. It will not operate if a hand torch is installed.



Connect the machine interface cable

To connect a machine interface cable to this system, a factory-installed (or user-installed) CPC port with 5-position voltage divider must be installed. The voltage divider provides a scaled down arc voltage of 20:1, 21.1:1, 30:1, 40:1, or 50:1 (maximum output of 16 V). The CPC port on the rear of the power supply provides access to the scaled down arc voltage and signals for arc transfer and plasma start.



The factory presets the voltage divider to 50:1. To change the voltage divider to a different setting, see page 110.

! CAUTION

The internal voltage divider provides a maximum of 16 V under open circuit conditions. This is an impedance-protected functional extra low voltage (ELV) output to prevent shock, energy, and fire under normal conditions at the machine interface receptacle and under single fault conditions with the machine interface wiring. The voltage divider is not fault tolerant, and ELV outputs do not comply with safety extra low voltage (SELV) requirements for direct connection to computer products.

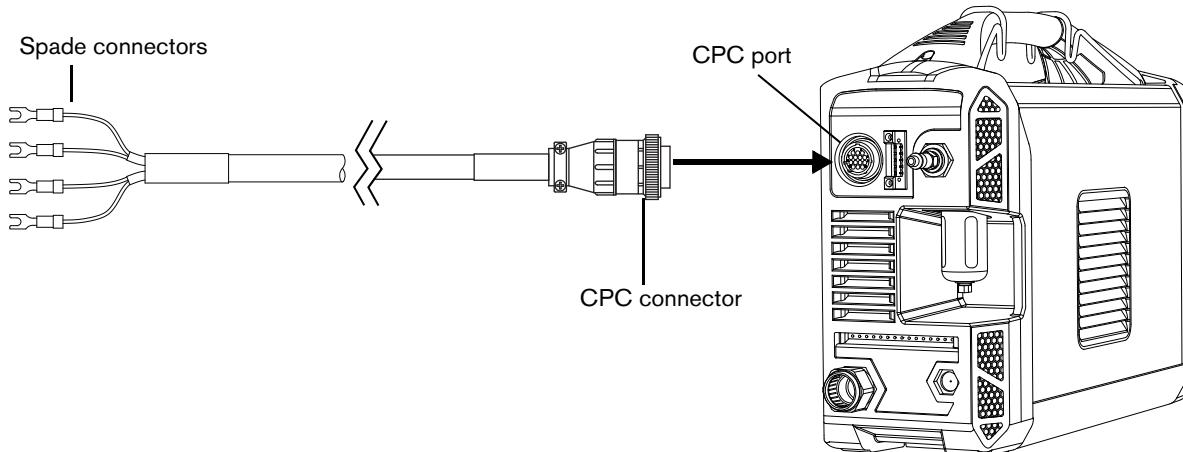
Hypertherm offers several choices of external machine interface cables. To install the CPC port and voltage divider board in the power supply, see page 227.

External cables that do not use voltage divider board

To use signals for arc transfer and plasma start only, use one of the following cables:

- 023206 (7.5 m, 25 feet)
- 023279 (15 m, 50 feet)

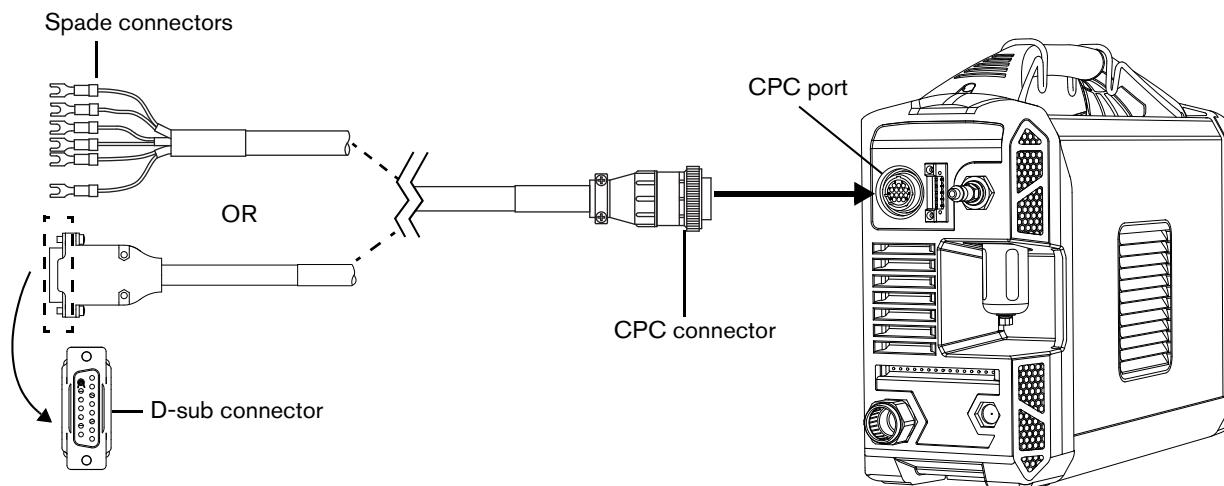
These cables end in wires that are terminated with spade connectors.



External cables that use voltage divider board

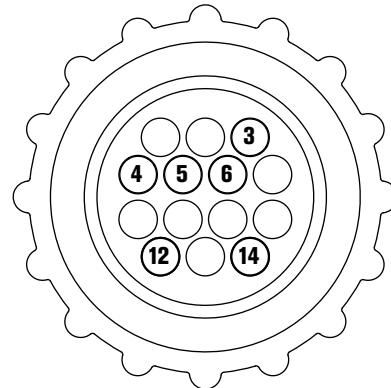
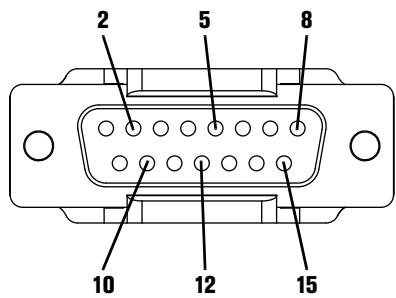
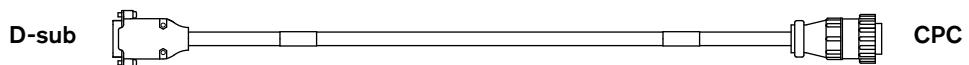
To use the built-in voltage divider that provides a scaled down arc voltage in addition to signals for arc transfer and plasma start:

- For wires terminated with spade connectors, use one of the following cables:
 - 228350 (7.6 m, 25 feet)
 - 228351 (15 m, 50 feet)
- For a cable with a D-sub connector, use one of the following cables:
 - 223354 (3.0 m, 10 feet)
 - 223355 (6.1 m, 20 feet)
 - 223048 (7.6 m, 25 feet)
 - 223356 (10.7 m, 35 feet)
 - 123896 (15 m, 50 feet)



Cable signals (for troubleshooting)

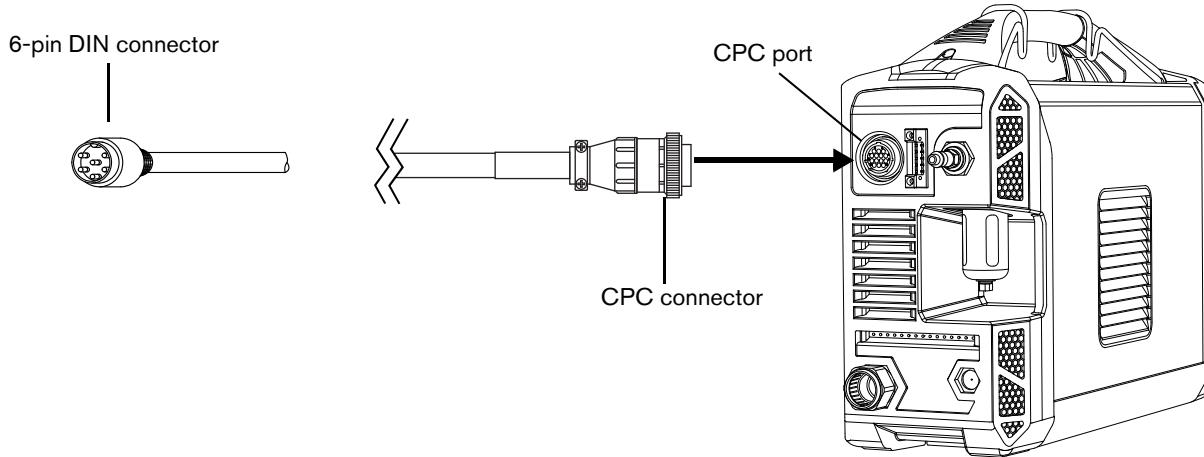
Signal	D-sub pin number	CPC pin number
Plasma start	2	4
	10	3
Arc transfer	5	14
	12	12
Voltage divider	8 (+)	6 (+)
	15 (-)	5 (-)



External cables for PlasmaCAM® tables

Hypertherm provides machine interface cables designed specifically for use with PlasmaCAM tables. These cables require the voltage divider board to be set to 21.1:1. See page 110.

- 223733 (4.6 m, 15 feet)
- 223734 (6.1 m, 20 feet)



Cable signals (for troubleshooting)

Signal	DIN pins*	CPC pin number
Plasma start	5	3
	4	4
Voltage divider (21.1:1)	2 (+)	6 (+)
	1 (-)	5 (-)

* The pins on the DIN connector are not numbered. The DIN pin numbers in this diagram are labels provided for reference.



Installation of the machine interface cable

Installation of the machine interface cable must be performed by a qualified service technician. To install a machine interface cable:

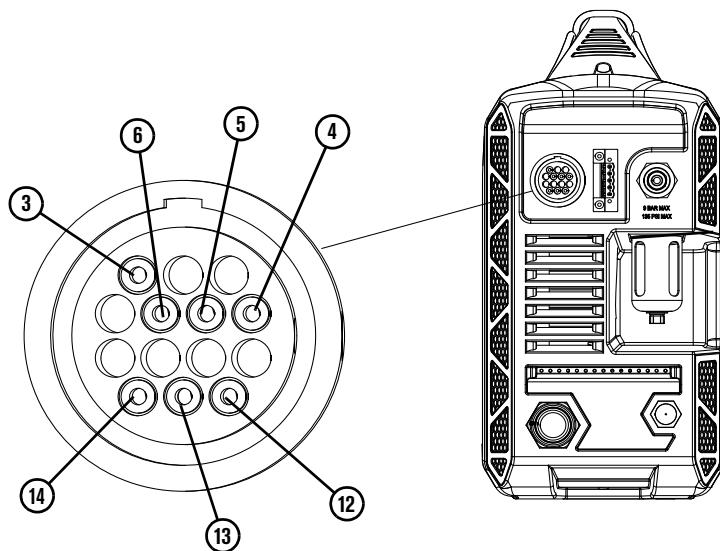
1. Turn OFF (O) the power and disconnect the power cord.
 2. Remove the machine interface receptacle's cover from the rear of the power supply.
 3. Connect the Hypertherm machine interface cable to the power supply.
 4. If you are using a cable with a D-sub connector on the other end:
 - a. Plug it into the appropriate pin connector on the torch height controller or CNC.
 - b. Secure it with the screws on the D-sub connector.
- If you are using a cable with wires and spade connectors on the other end:
- a. Terminate the machine interface cable inside the electrical enclosure of the torch height controller or CNC controller. This prevents unauthorized access to the connections after installation.
 - b. Verify that the connections are correct and that all live parts are enclosed and protected before operating the equipment.



The integration of Hypertherm equipment and customer-supplied equipment including interconnecting cords and cables, if not listed and certified as a system, is subject to inspection by local authorities at the final installation site.

Machine interface pinout

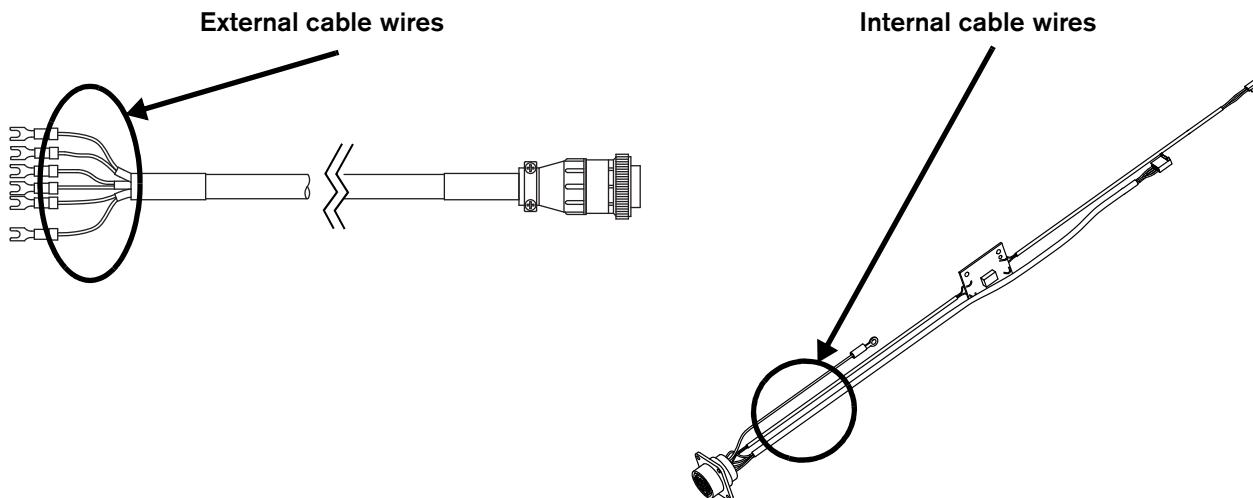
The following figure shows the connector sockets for each type of signal available through the machine interface cable.



Machine interface cable signals

Refer to the following table for the cable signal details when connecting the power supply to a torch height controller or CNC controller with a machine interface cable.

Signal	Type	Notes	Connector sockets	External cable wires	Internal cable wires
Start (start plasma)	Input	Normally open. 15 VDC open circuit voltage at START terminals. Requires dry contact closure to activate.	3	Green	Black
			4	Black	Red
Transfer (start machine motion)	Output	Normally open. Dry contact closure when the arc transfers. 120 VAC / 1 A maximum at the machine interface relay.	12	Red	White
			14	Black	Green
Voltage divider	Output	Divided arc signal of 20:1, 21.1:1, 30:1, 40:1, 50:1 (provides a maximum of 16 V).	5 (-)	Black (-)	Black (-)
			6 (+)	White (+)	Red (+)
Ground	Ground		13		Green/yellow

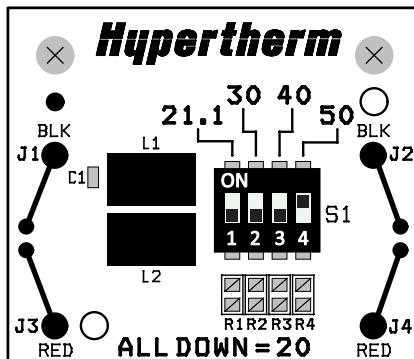


Set the 5-position voltage divider

To change the factory preset voltage divider from 50:1 to a different setting:

1. Turn OFF (O) the power supply and disconnect the power cord.
2. Remove the power supply cover.
3. Locate the voltage divider DIP switches on the fan side of the power supply.

This figure shows the voltage divider at the default setting (50:1) with the number 4 switch up.

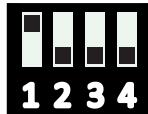


4. Set the DIP switches to one of the following settings and replace the power supply cover.

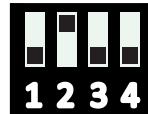
20:1



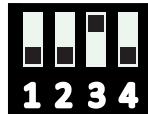
21.1:1



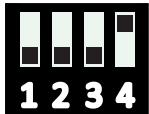
30:1



40:1



50:1



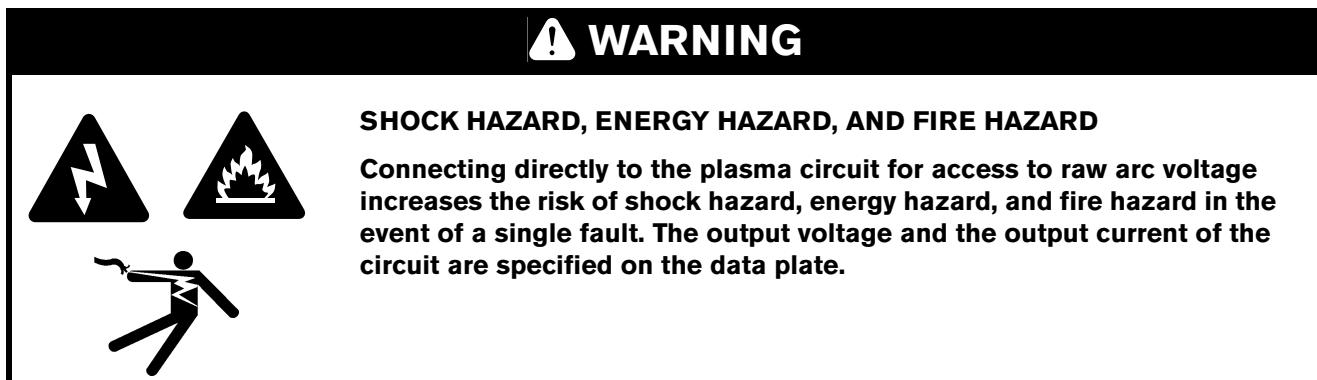
If the Hypertherm 5-position voltage divider does not supply the required voltage for your application, contact your system integrator for assistance.



The 21.1:1 setting is specifically designed for PlasmaCAM cutting systems.

Access raw arc voltage

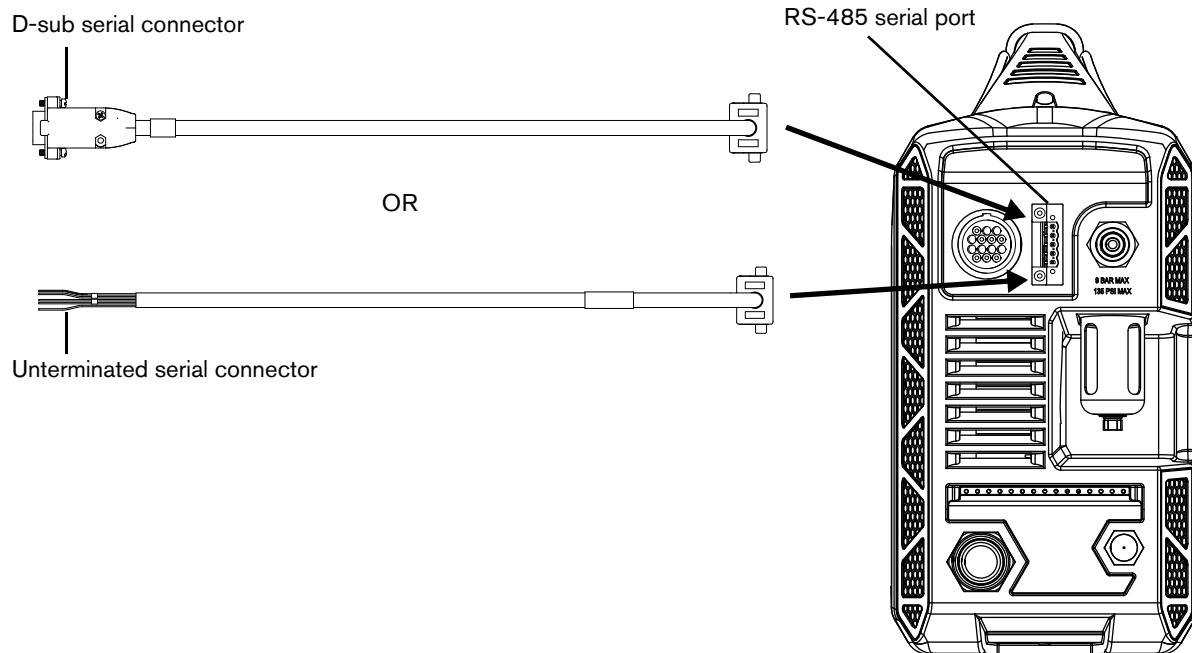
To access divided raw arc voltage, refer to Field Service Bulletin 809520.



Connect an optional RS-485 serial interface cable

The RS-485 serial interface port on the back of the power supply allows you to connect an external device to your Powermax. For example, you can remotely operate the Powermax with a CNC controller.

- The Powermax power supply must be equipped with a factory-installed (or user-installed) RS-485 serial interface port on the rear panel.



If your power supply is not equipped with the RS-485 port, order kit 428654. Follow the installation instructions on page 231.

With the RS-485 port installed:

1. Turn OFF (O) the power supply.
2. Connect the RS-485 cable from your external device to the serial port on the back of the plasma power supply.

External serial port cables

The following external serial cables are available with the specified lengths and connectors:

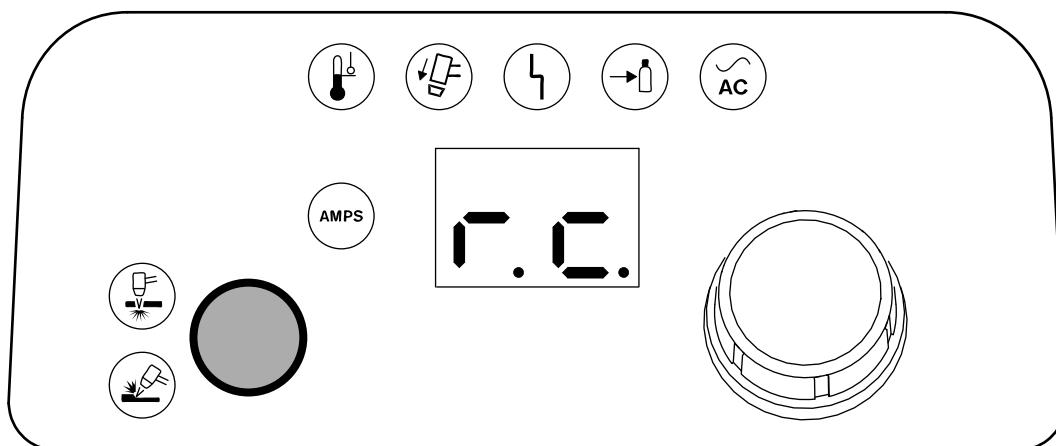
- 223236 – RS-485 cable, unterminated, 7.6 m (25 feet)
- 223237 – RS-485 cable, unterminated, 15 m (50 feet)
- 223239 – RS-485 cable, 9-pin D-sub connector for Hypertherm controls, 7.6 m (25 feet)
- 223240 – RS-485 cable, 9-pin D-sub connector for Hypertherm controls, 15 m (50 feet)

Remote mode

When you operate the plasma system remotely using a CNC controller, the 2-digit display on the front panel shows “r.c.” This indicates that the power supply is being controlled remotely via serial communications and that all front panel controls are disabled until you exit remote mode.



When the power supply is being remotely controlled, fault LEDs and fault codes still display as they would otherwise. See page 163.



Cut with the Machine Torch

This section provides information to help you:

- Choose the correct consumables
- Optimize cut quality
- Pierce metal
- Cut stainless steel with F5 gas

Choose the consumables

Your Duramax Lock machine torch ships with a starter consumable kit that contains a complete set of shielded consumables plus 1 extra electrode and 1 extra nozzle. Consumables for gouging and marking are available to order separately.

- For details on **gouging** processes and consumables, see *Gouge with the Hand Torch and Machine Torch* on page 77.
- For details on the system's **marking** capabilities and consumables, see *Guidelines for Marking* on page 121.



FlushCut consumables can also be used with the Duramax Lock machine torch. See *FlushCut™ consumables* on page 66.

Consumables are shielded or unshielded.

- **Shielded** consumables provide greater protection for the nozzle to minimize damage caused from slag during piercing. Hypertherm recommends the use of shielded consumables whenever possible.

- If you are using **unshielded** consumables (for example, a deflector instead of a shield), be careful to maintain the correct torch height in order to avoid damaging the nozzle from slag or from accidental contact with the workpiece.

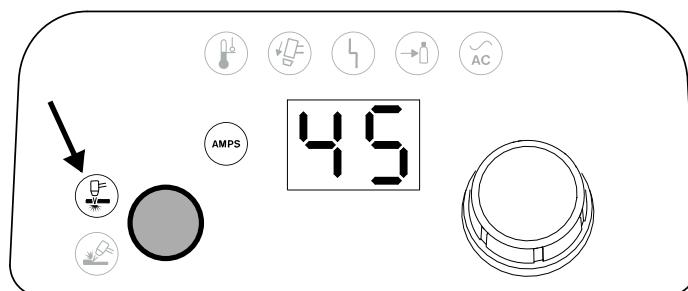


Hypertherm does not recommend the use of any other consumables in the Duramax Lock machine torch except for those listed in this manual. The use of any other consumables could adversely affect system performance.



For help installing the consumables onto the torch, see page 48. Do not use worn or damaged consumables.

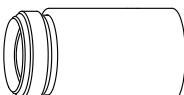
When you use the following shielded and FineCut consumables, select Cut mode on the front panel. See page 53.



Mechanized shielded consumables



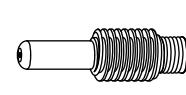
220817
Shield



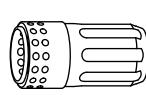
220854
Retaining cap



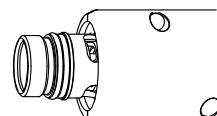
220941
Nozzle



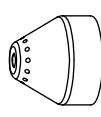
220842
Electrode



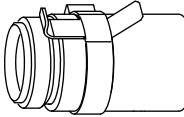
220857
Swirl ring



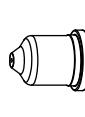
Mechanized shielded consumables with ohmic retaining cap



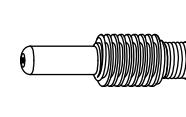
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Shield



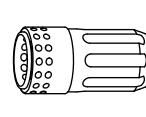
220953
Ohmic retaining
cap



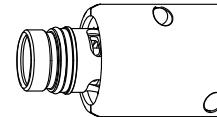
220941
Nozzle



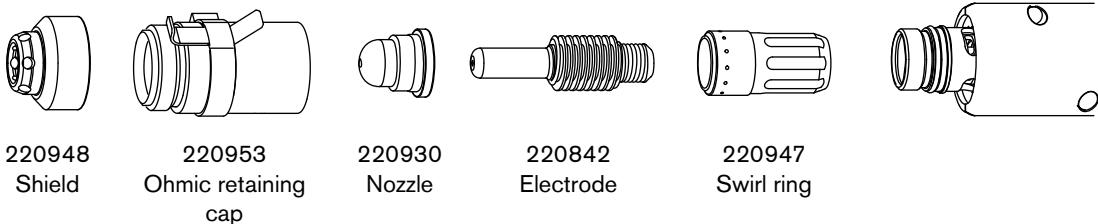
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Electrode



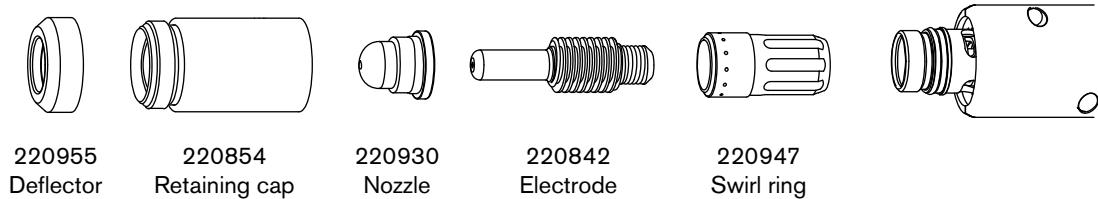
220857
Swirl ring



FineCut shielded consumables with ohmic retaining cap



FineCut unshielded consumables



Consumable life

Many factors influence how often you need to change the consumables on your machine torch:

- **Poor gas supply quality**
 - It is extremely important to maintain a clean, dry gas line. The presence of oil, water, vapors, and other contaminants in the gas supply can degrade cut quality and consumable life. See page 37 and page 41.
- **Cutting and gouging technique**
 - Whenever possible, start cuts from the edge of the workpiece. This helps to extend the life of the shield and the nozzle.
 - Maintain a proper pierce height. Refer to the cut charts starting on page 131.
 - Maintain a proper torch-to-work distance (standoff) when gouging. See page 86.
- **Shielded versus non-shielded consumables**
 - Non-shielded consumables use a deflector instead of a shield. Non-shielded consumables generally have a shorter life than shielded consumables.
- **Thickness of metal being cut**
 - In general, the thicker the metal being cut, the more quickly the consumables become worn. For best results, do not exceed the thickness specifications for this system. See page 24.

- **Expanded metal cutting**
 - Expanded metal has a slotted or mesh pattern. Cutting expanded metal wears out consumables more quickly because it requires a continuous pilot arc. A pilot arc occurs when the torch is fired but the plasma arc is not in contact with the workpiece.
- **Incorrect consumables for output current and mode**
 - To optimize consumable life, make sure the consumables installed on the torch match the selected mode and output current. For example:
 - Do not use gouging consumables when the system is set to Cut mode. See page 53.
 - Do not set the output current between 26 A and 45 A with the Marking consumables or the Precision gouging consumables installed.

As a general rule, the consumables last approximately 3 to 5 hours of actual “arc on” time for mechanized cutting. However, consumable life can vary a lot based on the factors listed above.

Understand and optimize cut quality

Several factors affect cut quality:

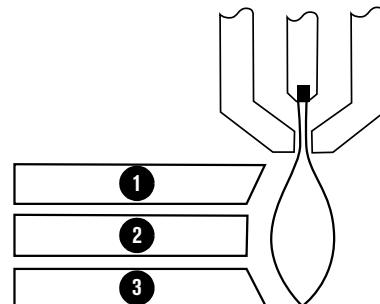
- **Cut angle** – The degree of angularity of the cut edge.
- **Dross** – The molten material that solidifies on the top or bottom of the workpiece.
- **Straightness of the cut surface** – The cut surface can be concave or convex.

Cut or bevel angle

- A positive cut angle results when more material is removed from the top of the cut than from the bottom.
- A negative cut angle results when more material is removed from the bottom of the cut.



The squarest cut angle is on the right side with respect to the forward motion of the torch. The left side always has some degree of cut angle.



	Problem	Cause	Solution
①	Negative cut angle	The torch is too low.	Raise the torch; or if you are using a torch height control, increase the arc voltage.
②	Square cut		
③	Positive cut angle	The torch is too high.	Lower the torch; or if you are using a torch height control, decrease the arc voltage.

To determine whether a cut-angle problem is being caused by the plasma system or the drive system:

- 1.** Make a test cut.



A square often works well for test cuts. It makes it easier to determine which side is affected by the cut-angle problem and if that side moved with the rotation of the torch.

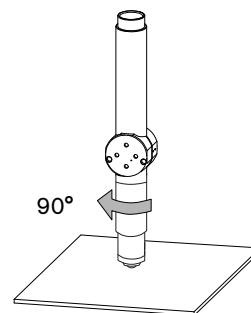
- 2.** Measure the angle of each side of the test cut.

- 3.** Turn the torch 90° in its holder.

- 4.** Repeat steps 1 – 3.

If the angles are the same in both tests:

- Verify that mechanical causes have been eliminated. See *Machine torch setup overview* on page 101.
- Check the torch-to-work distance (especially if the cut angles are all positive or all negative).
- Consider the material being cut. If the metal is magnetized or hardened, you are more likely to experience cut angle problems.



If the cut angle problem persists, consult with your cutting table manufacturer to verify that your automatic height control or torch height control is working properly.

Dross

Dross is molten metal created during the cut process that hardens on the bottom of the part. Some amount of dross will always result when cutting with air plasma. To minimize the amount and type of dross, adjust your system correctly for your application.

Problem	Cause	Solution
Excess dross on the top edge of both pieces of the plate.	<ul style="list-style-type: none"> ▪ The torch is too low. ▪ Voltage is too low when using a torch height control. 	<ul style="list-style-type: none"> ▪ Adjust the torch or adjust the voltage in small increments (5 volts or less) until the dross is reduced.
Low-speed dross on the bottom of the cut forming a heavy, bubbly deposit.	<ul style="list-style-type: none"> ▪ The torch's cutting speed is too slow. ▪ The arc angles ahead. 	<ul style="list-style-type: none"> ▪ Increase the cutting speed.
High-speed dross forms close to the cut as a thin, linear bead of solid metal. It is welded to the bottom of the cut and is difficult to remove.	<ul style="list-style-type: none"> ▪ The cutting speed is too fast. ▪ The arc angles behind. 	<ul style="list-style-type: none"> ▪ Decrease the cutting speed. ▪ Decrease the torch-to-work distance.

Pierce a workpiece using the machine torch

You can start a cut with the machine torch at the edge of the workpiece or by piercing the workpiece. Refer to the cut charts on page 131 and the piercing guidelines below.



Piercing may result in shorter consumable life than with edge starts.

Pierce delay

The pierce delay is the length of time the triggered torch remains stationary at the pierce height before the torch starts the cutting motion. The pierce delay must be long enough that the arc can pierce the material before the torch moves, but not so long that the pierce hole enlarges and causes the arc to “wander” or extinguish before the torch starts to move. As consumables wear, this delay time may need to be increased.

Pierce delay times given in the cut charts are based on average delay times throughout the life of the consumables.

Pierce height

For this system, the pierce height is generally between 1.5 and 4 times the cut height. Refer to the cut charts starting on page 131 for specific values.

Pierce maximum thickness

When piercing materials close to the maximum thickness for a specific process, consider the following important factors:

- Allow a lead-in distance approximately equal to the thickness of the material being pierced. For example, 12 mm (1/2 inch) material requires a 12 mm lead-in.
- To avoid damage to the shield from the buildup of molten material created by the pierce, do not allow the torch to descend to cut height until it has cleared the puddle of molten material.
- Different material chemistries can have an adverse effect on the pierce capability of the system. In particular, high-strength steel with a high manganese or silicon content can reduce the maximum pierce capability. Hypertherm derives mild steel parameters on thicknesses of 12 mm (1/2 inch) or less using certified A572 Grade 50 plate.

Cut stainless steel with F5

WARNING



TOXIC FUMES CAN CAUSE INJURY OR DEATH

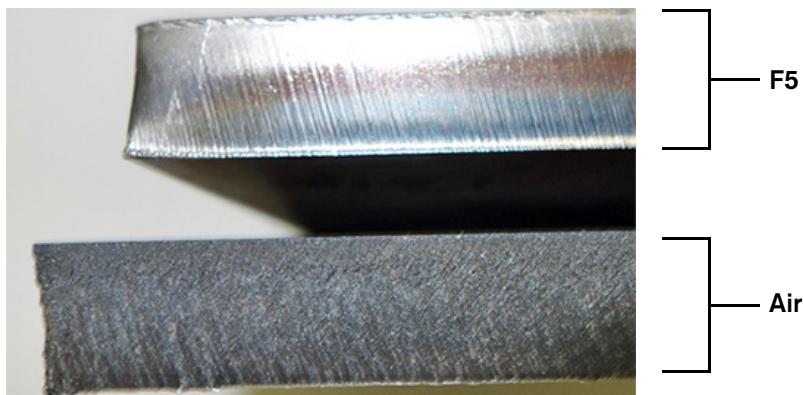
Some metals, including stainless steel, may release toxic fumes when cut. Make sure your work site has adequate ventilation to ensure that the air quality level meets all local and national standards and regulations. Refer to the *Safety and Compliance Manual (80669C)* for more information.

You can use F5 gas to cut stainless steel with Duramax Lock torches on the Powermax45 XP. When used with a Powermax system, F5 is recommended only for cutting stainless steel to achieve the advantages in cut quality listed below.



See page 141 for a cut chart on cutting stainless steel with F5.

Plasma cutting with F5 produces smooth, shiny cuts with silver edges that are close to the base color of the metal. F5 avoids the rough, dark finish that typically results with air plasma cutting.



F5: Advantages	F5: Disadvantages	F5: Similarities to air
<ul style="list-style-type: none"> Smooth, shiny cut edge Silver cut edge, similar to the base color of the metal – does not leave the rough, dark surface that air produces No oxidation of the cut surface – the cut steel maintains its corrosion resistance Ability to use the same Duramax Lock consumables as for standard cutting and gouging with air (includes CopperPlus™ electrodes) 	<ul style="list-style-type: none"> Advantages limited to stainless steel Slower cut speeds F5 gas is more expensive than compressed air Not recommended for thicknesses less than 7 mm or 1/4 inch or for use with FineCut® consumables Slightly degraded cut quality on bevel cuts 	<ul style="list-style-type: none"> Approximately the same amount of dross. With F5 and with air, stainless steel dross is dark in color and can be challenging to remove. Approximately the same gas pressure requirements

Guidelines for Marking

You can use the Marking consumables on the Duramax Lock machine torch to perform marking, scoring, and dimpling applications on mild steel, stainless steel, and aluminum using air or argon.



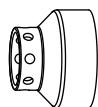
For marking cut charts, refer to page 142 and page 143.



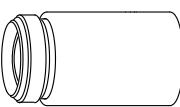
The Marking consumables can also be used on the Duramax Lock hand torches for hand marking applications.

Marking consumables (10 – 25 A)

A maximum output current of 25 A is recommended for marking applications. Using the Marking consumables at higher amperages can shorten the life of the nozzle. It may also result in deeper marks than desired and poorer results overall.



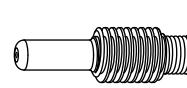
420542
Shield



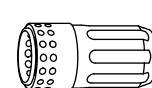
220854
Retaining cap



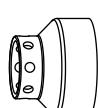
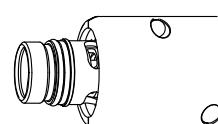
420415
Nozzle



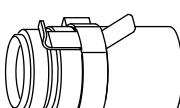
220842
Electrode



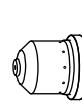
220857
Swirl ring



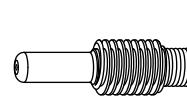
420542
Shield



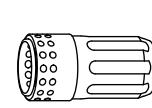
220953
Ohmic retaining
cap



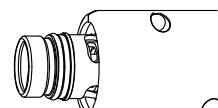
420415
Nozzle



220842
Electrode

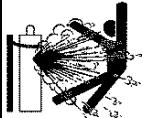


220857
Swirl ring



Process gas: air versus argon

WARNING



GAS CYLINDERS CAN EXPLODE IF DAMAGED

Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.

For high pressure regulators, adhere to the manufacturer's guidelines for safe installation, operation, and maintenance.

Before plasma cutting with compressed gas, read the safety instructions in the **Safety and Compliance Manual (80669C)**. Failure to follow safety instructions can result in personal injury or in damage to equipment.

With this system and torch, you can use air or argon for marking applications.

	Air	Argon
Advantages	<ul style="list-style-type: none"> ▪ Low cost ▪ Excellent all around process ▪ Little or no top-side slag on mild steel 	<ul style="list-style-type: none"> ▪ Low heat input lessens chance of material deformation ▪ Excellent high contrast for light scoring
Disadvantages	<ul style="list-style-type: none"> ▪ High heat input, especially on thin metal; may cause material deformation ▪ Mark edges may appear jagged on aluminum ▪ More dross and wider marks than with argon ▪ Minimum recommended character height of 8 mm for marks such as letters and numbers to be legible 	<ul style="list-style-type: none"> ▪ More expensive than air (see <i>How the system handles postflow for marking</i> below) ▪ Heavy scoring leaves top-side slag on steel ▪ Minimum recommended character height of 4 mm for marks such as letters and numbers to be legible

How the system handles postflow for marking

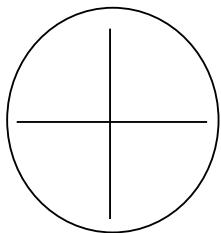
Postflow is gas that flows from the torch in order to cool the consumables after the plasma arc extinguishes. When you use air (or nitrogen) for marking applications, the duration of postflow is 10 seconds. The system recognizes when argon is being used and decreases postflow from 10 seconds to 3 seconds in order to minimize gas usage. To achieve 3-second postflow:

- The system must be set to Gouge/Marking mode.
- The output current must be set to 10 – 25 A.
- The plasma arc must be sustained for a minimum of 0.5 seconds because the system monitors arc voltage to determine if argon is being used.

There are 2 scenarios in which postflow is 10 seconds even when argon is used because the plasma arc is not sustained long enough to produce 3-second postflow:

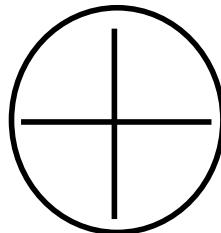
- When the torch fires without transferring the pilot arc to the workpiece
- In some dimpling applications where the plasma arc is sustained for less than 0.5 seconds

Types of marking



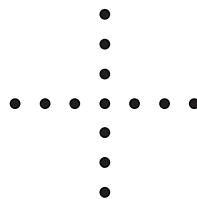
Light marking

- Thin, clean, slag-free lines with little depth
- Marks can be removed or covered by secondary operations as desired



Heavy marking / scoring

- Heavier, deeper lines
- Very little slag beside the intended mark



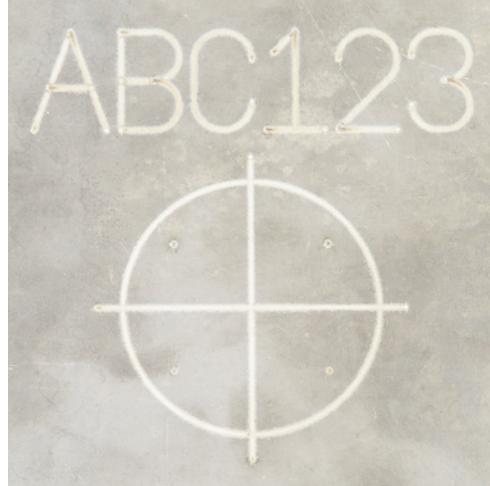
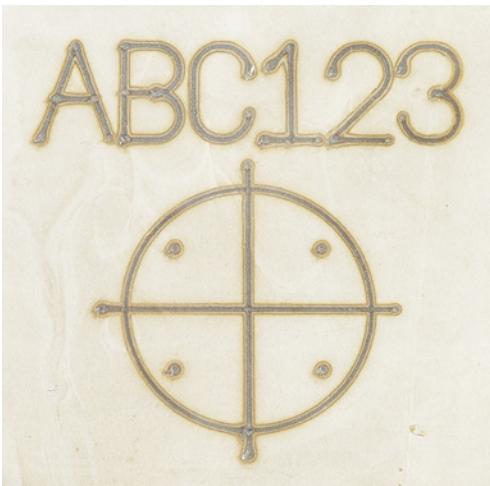
Dimpling

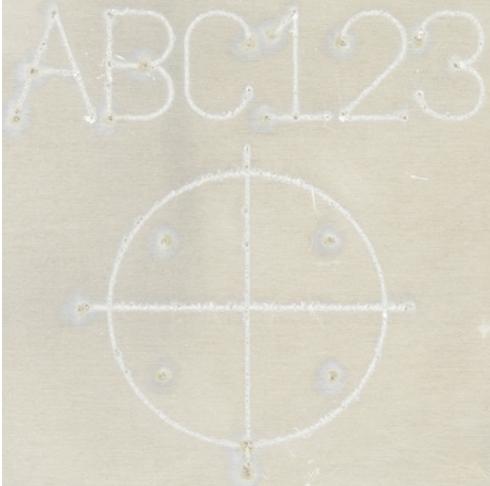
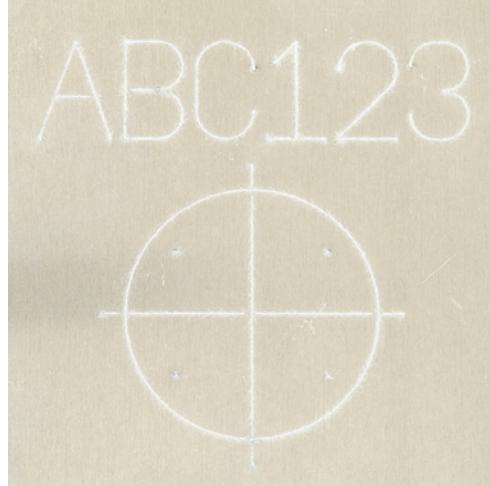
- Series of round marks
- Dimensions and spacing controlled by adjusting output current, gas type, torch height, and dwell time

Marking samples

The following pictures are intended to provide only a rough approximation of the differences between marking with air versus marking with argon with this system.

	Air	Argon
Light marking on mild steel		

	Air	Argon
Heavy marking on mild steel	 A photograph showing heavy, dark, jagged markings on a light-colored metal surface. The text "ABC123" and a crosshair pattern are visible but heavily obscured by dark, irregular marks.	 A photograph showing lighter, more controlled markings than the air example. The text "ABC123" and the crosshair pattern are partially visible through the lighter, textured marks.
Light marking on stainless steel	 A photograph showing very faint, thin markings on a light-colored metal surface. The text "ABC123" and the crosshair pattern are barely visible as thin, light-colored lines.	 A photograph showing very faint, thin markings on a light-colored metal surface. The text "ABC123" and the crosshair pattern are barely visible as thin, light-colored lines.
Heavy marking on stainless steel	 A photograph showing heavy, dark, jagged markings on a light-colored metal surface. The text "ABC123" and a crosshair pattern are visible but heavily obscured by dark, irregular marks.	 A photograph showing lighter, more controlled markings than the air example. The text "ABC123" and the crosshair pattern are partially visible through the lighter, textured marks.

	Air	Argon
Light marking on aluminum	 A photograph showing light markings on a piece of aluminum. The markings consist of faint, illegible letters 'ABC123' and a large circle with a crosshair inside, all in a light grey color.	 A photograph showing light markings on a piece of aluminum using Argon gas. The markings are very faint and blurry, appearing as light grey shapes of 'ABC123' and a circle with a crosshair.

Marking, scoring, and dimpling profiles

The following tables show typical width and depth profiles for light marking, heavy marking and scoring, and dimpling on mild steel.



The width and depth of the marks change as you adjust the output current, gas type, torch standoff, and marking speed (or dwell time for dimpling).

Light marking		
	Air	Argon
Width	2.79 mm (0.11 inch)	1.22 mm (0.048 inch)
Depth	Less than 0.02 mm (0.001 inch)	Less than 0.02 mm (0.001 inch)
Travel speed	2.5 m/min (100 in/min)	3.2 m/min (125 in/min)

Heavy marking / Scoring		
	Air	Argon
Width	2.79 mm (0.11 inch)	1.22 mm (0.048 inch)
Depth	0.09 mm (0.0035 inch)	Less than 0.02 mm (0.001 inch)
Travel speed	2.5 m/min (100 in/min)	3.2 m/min (125 in/min)

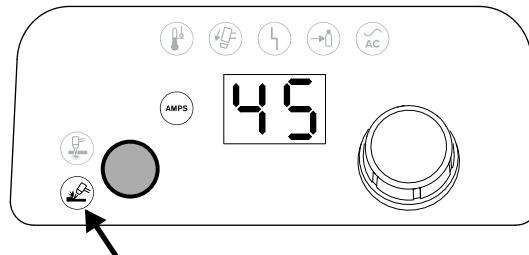
Dimpling		
	Air	Argon
Width	1.98 mm (0.078 inch)	0.99 mm (0.039 inch)
Depth	0.25 mm (0.01 inch)	Less than 0.02 mm (0.001 inch)
Dwell time*	50 milliseconds	200 milliseconds

* The **dwell time** is the period of time that the torch fires at one spot on the workpiece to form a dimple. The longer the dwell time, the deeper the dimple that will form. Dwell times vary between CNC and table configurations. You may need to adjust your CNC/table setup accordingly.

Marking process guidelines

Before you begin marking, scoring, or dimpling:

- Choose a process gas: air or argon.
- Set up your machine torch and table. See *Machine torch setup overview* on page 101.
- Install the Marking consumables.
- Set the plasma power supply to Gouge/Marking mode. See page 53.
- Adjust the torch speed and power supply output current (amperage) for your marking or dimpling job. See the cut charts starting on page 142.
- Set the output current between 10 A and 25 A. **Do not exceed 25 A for marking applications.**



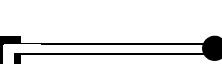
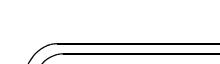
Make sure the Gouge/Marking Mode LED is illuminated.

Additional considerations:

- The power supply adjusts gas pressure for you automatically. Hypertherm recommends using these auto-gas settings for marking.
- Hypertherm strongly recommends that you use the Marking consumables with the power supply set to Gouge/Marking mode and the output current set to 10 – 25 A. These settings and consumables were designed specifically for marking applications.
- This system requires different consumables for marking and for regular cutting. Make sure you have the correct consumables installed if you switch between marking and cutting jobs. See page 113 for cutting consumable part numbers.
- You can vary the depth and width of marks by varying torch speed, output current, and torch height.
- You may need to try different cornering methods to optimize 90° corners for your CNC and table. See *Cornering guidelines* below.

Cornering guidelines

- Reduce both output current and marking speed for the entire marking operation.
 - Depending on the capabilities of your cutting table and CNC, you may need to try different cornering methods to achieve the best possible results on 90° corners.
 - On many tables, it can be difficult to achieve a clean 90° corner. It requires the torch to come to a complete stop for some length of time, which can result in a corner that is wider and deeper than desired.
 - The rounded corner method shown below is recommended for most table/CNC configurations. This method does not require the torch to come to a complete stop in the corner.
 - If a sharper 90° corner is necessary, you can try the 2-step operation shown below. However, this method does leave dimples at the “start” and “stop” points.

90° corner – difficult to achieve on many tables	Recommended method for most tables/CNCs	Alternate 2-step operation
		

Marking troubleshooting tips

Factors that affect marking width, depth, and quality include:

- Process gas – see the comparison of argon to air on page 122
 - Material type (mild steel, stainless steel, or aluminum)
 - Material thickness and surface finish
 - Plasma power supply output current (amperage)
 - Torch marking/dimpling speed
 - Torch standoff
 - Characteristics of the cutting table and CNC, such as how they handle delays, accelerations, and decelerations
 - Gas pressure, if you manually adjusted the pressure to be outside the recommended range automatically set by the system – see page 56

To optimize your marking or dimpling process and results, use the troubleshooting tips on page 128 and the cut charts starting on page 142.

Common marking problems and solutions

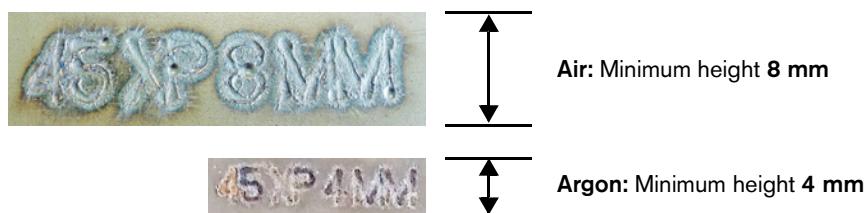
For marking applications, always make sure:

- The Marking consumables are installed.
- The power supply is set to Gouge/Marking mode, and the output current is set between 10 – 25 A.

Many common marking issues can be resolved by installing new consumables in the torch. Do not use worn or damaged consumables.

Problem	Solution
The arc goes out during marking.	<ul style="list-style-type: none"> ▪ Make sure that the torch-to-work distance (standoff) is not too high. ▪ Change worn or damaged consumables.
The dimple diameter is wrong.	<ul style="list-style-type: none"> ▪ For a larger diameter dimple, increase the output current. ▪ For a smaller diameter dimple, decrease the output current. ▪ Adjust the torch-to-work distance (standoff). ▪ Change worn or damaged consumables.
The dimple depth is wrong.	<ul style="list-style-type: none"> ▪ For a deeper dimple, increase the dwell time. ▪ For a shallower dimple, decrease the dwell time (if possible). ▪ Adjust the torch-to-work distance (standoff).
The mark is too wide or too deep.	<ul style="list-style-type: none"> ▪ Decrease the output current. ▪ Increase the marking speed. ▪ Inspect the consumables, especially the center hole of the nozzle. Change worn or damaged consumables.
The mark is too narrow or too shallow.	<ul style="list-style-type: none"> ▪ Change worn or damaged consumables. ▪ Increase the output current. ▪ Decrease the marking speed. ▪ Decrease the torch height.
The beginning of the mark is too large.	<ul style="list-style-type: none"> ▪ If the delay time between when the CNC receives the machine motion signal and when the machine motion actually occurs is significant, piercing may occur. If possible, decrease the delay time to 0 (zero). ▪ Check the table parameters, especially the acceleration parameter. It may need to be increased. ▪ Decrease the output current to reduce the size of the dimple at the beginning of the mark. The marking speed may also need to be adjusted for the lower output current. ▪ Check the torch-to-work distance (standoff) to make sure there is a good, fast transfer of the plasma arc to the workpiece.
The end of the mark is too large.	<ul style="list-style-type: none"> ▪ Check the cutting table parameters. If possible, increase the deceleration parameter.

Problem	Solution
The mark becomes too deep and too wide during cornering.	<ul style="list-style-type: none"> You may need to try a different method for cornering. See page 127.
Marks such as letters, numbers, and other symbols are not legible.	<ul style="list-style-type: none"> Make the marks larger. If you use air, the minimum recommended height is 8 mm for marks such as letters and numbers. If you use argon, the minimum recommended height is 4 mm for marks such as letters and numbers. See <i>Figure 1</i>.

Figure 1 – Recommended minimum mark heights

9

Cut Charts and Marking Charts

⚠ WARNING



EXPLOSION HAZARD – CUTTING WITH ALUMINUM NEAR WATER

Do not cut aluminum alloys underwater or on a water table unless you can prevent the accumulation of hydrogen gas. Never cut aluminum-lithium alloys in the presence of water.

Aluminum can react with water to produce hydrogen, resulting in a potentially explosive condition that can detonate during plasma cutting operations. Refer to the *Safety and Compliance Manual* (80669C) for more information.

⚠ WARNING



EXPLOSION HAZARD – CUTTING WITH FUEL GASES

Do not use combustible fuel gases or oxidizing gases with Powermax systems. These gases can result in explosive conditions during plasma cutting operations.

⚠ WARNING



TOXIC FUMES CAN CAUSE INJURY OR DEATH

Some metals, including stainless steel, may release toxic fumes when cut. Make sure your work site has adequate ventilation to ensure that the air quality level meets all local and national standards and regulations. Refer to the *Safety and Compliance Manual* (80669C) for more information.

Using the cut charts

The cut charts in this section are intended to provide a good starting point. Adjust the variables in the cut charts as needed to achieve optimal results for your cutting equipment and environment.

Cut charts are provided for each set of mechanized cutting and marking consumables. A consumable diagram with part numbers precedes each cut chart.

Cut charts are included for:

- Cutting mild steel, stainless steel, and aluminum at 45 A with air using shielded consumables
- Cutting mild steel and stainless steel with air using FineCut consumables
- Cutting stainless steel at 45 A with F5 using shielded consumables
- Marking and dimpling at 10 – 25 A with air and argon using Marking consumables

Each cut chart may contain the following information:

- **Amperage setting** – The amperage setting at the top of the page applies to all the settings given on that page. In FineCut charts, the amperage setting for each thickness is included in the cut chart.
- **Material Thickness** – Thickness of the workpiece (metal plate being cut).
- **Torch-to-Work Distance** – For shielded consumables, the distance between the shield and the workpiece during cutting. For unshielded consumables, the distance between the nozzle and the workpiece during cutting. This is also known as cut height.
- **Initial Pierce Height** – Distance between the shield (shielded) or the nozzle (unshielded) and the workpiece when the torch is fired, prior to descending to the cut height. In marking charts, this is referred to as *Initial Marking Height*.
- **Pierce Delay Time** – Length of time the triggered torch remains stationary at the pierce height before the torch starts the cutting motion. In marking charts, this is referred to as *Delay Time*.
- **Best Quality Settings** (cut speed and voltage) – Settings that provide the starting point for finding the best cut quality (best angle, least dross, best cut-surface finish). Adjust the speed for your application and table to obtain the desired result.
- **Production Settings** (cut speed and voltage) – 70% to 80% of the maximum speed ratings. These speeds result in the greatest number of cut parts, but not necessarily the best possible cut quality.



The arc voltage increases as the consumables wear, so the voltage setting may need to be increased to maintain the correct torch-to-work distance. Some CNCs monitor the arc voltage and adjust the torch lifter automatically.

- **Kerf Width** – Width of material removed by the cutting process. The kerf widths were obtained with the “Best Quality” settings and are for reference only. Differences between installations and material composition may cause actual results to vary from those shown in the tables.
- **Width and Depth** – The marking and dimpling cut charts list the profile dimensions of the mark or dimple.

Each cut chart lists hot and cold gas flow rates.

- **Hot flow rate** – Plasma is on, the system is operating at running current, and the system is in a steady state at the default system pressure (cutflow, or automatic mode).
- **Cold flow rate** – Plasma is off and the system is in a steady state with gas flowing through the torch at the default system pressure (postflow).

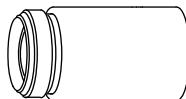


Hypertherm collected the cut chart data under laboratory test conditions using new consumables.

Mild Steel - 45 A - Air - Shielded



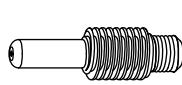
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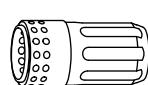
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(220953 for
ohmic sensing)



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Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		Kerf Width		
					Cut Speed	Voltage	Cut Speed	Voltage			
mm	mm	mm	%	seconds	mm/min	volts	mm/min	volts	mm		
2	1.5	3.8	250	0.2	5560	128	7910	125	1.4		
3					3960	128	5590	128			
4				0.4	2800	128	3960	128	1.5		
6					1430	130	2110	127			
8				0.6	1020	133	1385	130	1.7		
10					780	136	920	134	1.8		
12				1	540	140	690	138	1.9		
16	Edge Start				310	146	400	141	2.1		
20					170	152	240	147	2.3		
25					110	157	145	154	3		

English

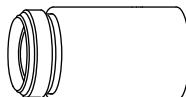
Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		Kerf Width		
					Cut Speed	Voltage	Cut Speed	Voltage			
inches	inches	inches	%	seconds	in/min	volts	in/min	volts	inches		
16 GA	0.06	0.15	250	0.1	249	128	320	125	0.053		
14 GA					225	128	320	125	0.054		
10 GA				0.4	129	128	181	128	0.057		
3/16					85	129	122	127	0.059		
1/4				0.6	48	130	72	127	0.061		
3/8					33	136	38	133	0.069		
1/2				1	18	141	24	139	0.077		
5/8	Edge Start				13	146	16	141	0.082		
3/4					7	151	10	145	0.086		
7/8					6	154	7	151	0.103		
1					4	157	6	154	0.119		

Gas flow rate - slpm / scfh

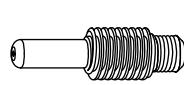
151 / 320	Hot (cutflow)
184 / 390	Cold (postflow)

Stainless Steel - 45 A - Air - Shielded

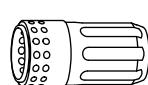
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ohmic sensing)

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Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		Kerf Width
		mm	%		seconds	mm/min	volts	mm/min	
2	1.5	3.8	250	0.1	5620	126	7830	129	0.6
3				0.2	3285	129	4725	128	0.9
4				0.4	1995	130	2960	129	1.1
6				0.6	1145	131	1695	131	1.2
8					830	134	1100	134	1.4
10				0.8	605	137	870	137	1.6
12		4.6	300	1.2	380	141	540	139	1.8
16			Edge Start		240	145	320	142	2.4
20					160	149	205	146	3.1

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		Kerf Width
		inches	%		seconds	in/min	volts	in/min	
16 GA	0.06	0.15	250	0.1	237	125	320	128	0.017
14 GA				0.2	230	126	320	129	0.022
10 GA				0.4	90	130	134	128	0.041
3/16				0.5	63	131	93	130	0.044
1/4				0.6	40	131	59	131	0.047
3/8				0.8	26	137	29	136	0.061
1/2		0.18	300	1.2	12	142	19	140	0.075
5/8			Edge Start		10	145	13	142	0.096
3/4					7	148	9	145	0.116
7/8					5	151	6	149	0.137

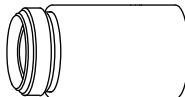
Gas flow rate - slpm / scfh

151 / 320	Hot (cutflow)
184 / 390	Cold (postflow)

Aluminum - 45 A - Air - Shielded



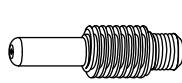
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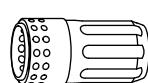
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ohmic sensing)



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Metric

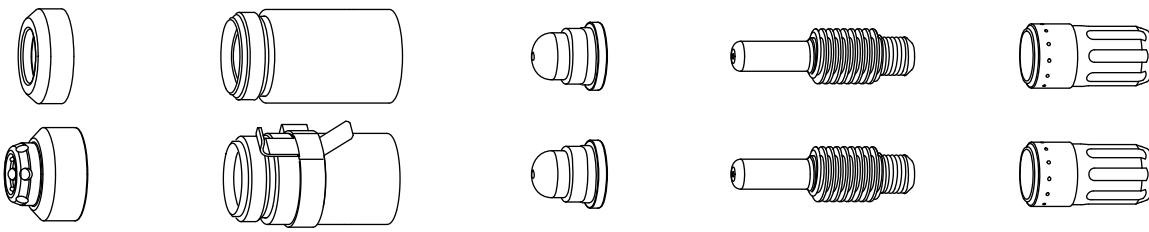
Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		Kerf Width
					Cut Speed	Voltage	Cut Speed	Voltage	
mm	mm	mm	%	seconds	mm/min	volts	mm/min	volts	mm
2	1.5	3.8	250	0.1	7890	121	9585	134	1.3
3				0.2	4850	130	7120	129	1.5
4				0.4	3670	133	5650	129	
6				0.5	2060	139	3095	132	1.6
8				0.6	1330	139	1830	136	1.7
10				0.7	860	142	1015	140	1.9
12					620	144	745	142	2
16					360	152	340	148	2.5
Edge Start									

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		Kerf Width
					Cut Speed	Voltage	Cut Speed	Voltage	
inches	inches	inches	%	seconds	in/min	volts	in/min	volts	inches
1/10	0.06	0.15	250	0.2	240	126	320	131	0.056
1/8				0.4	170	131	263	128	0.060
3/16					120	134	184	130	0.061
1/4				0.5	70	137	104	132	0.063
3/8				0.7	36	141	42	139	0.073
1/2					21	145	26	143	0.082
5/8					15	152	14	148	0.100
3/4					8	158	9	153	0.117
Edge Start									

Gas flow rate - slpm / scfh

151 / 320	Hot (cutflow)
184 / 390	Cold (postflow)

Mild Steel - FineCut - Air - Shielded and Unshielded220955 (deflector)
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220953 (ohmic)

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Metric

Material Thickness mm	Current A	Torch-to-Work Distance mm	Initial Pierce Height		Pierce Delay Time seconds	Recommended		Kerf Width mm
			mm	%		Cut Speed mm/min	Voltage volts	
0.5	40	1.5	3.8	250	0.0	8250	78	0.7
0.6					0.0	8250	78	
0.8					0.1	8250	78	0.6
1					0.2	8250	78	0.7
1.5					0.4	6400	78	1.2
2						4800	78	1.3
3						0.5	2500	
4						0.6	1900	

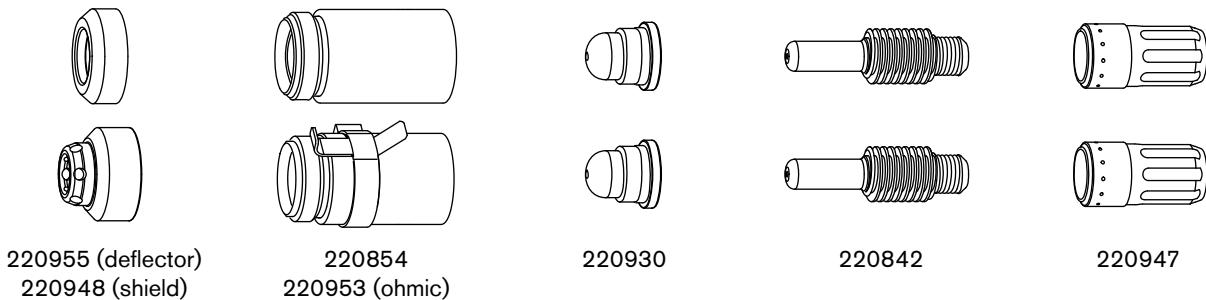
English

Material Thickness inches	Current A	Torch-to-Work Distance inches	Initial Pierce Height		Pierce Delay Time seconds	Best Quality Settings		Kerf Width inches
			inches	%		Cut Speed in/min	Voltage volts	
26 GA	40	0.06	0.15	250	0.0	325	78	0.025
24 GA					0.0	325	78	0.029
22 GA					0.1	325	78	0.024
20 GA					0.1	325	78	0.020
18 GA					0.2	325	78	0.043
16 GA					0.4	250	78	0.046
14 GA						200	78	0.049
12 GA					0.5	120	78	0.052
10 GA						95	78	0.051

Gas flow rate - slpm / scfh

155 / 330	Hot (cutflow)
215 / 460	Cold (postflow)

Stainless Steel - FineCut - Air - Shielded and Unshielded



Metric

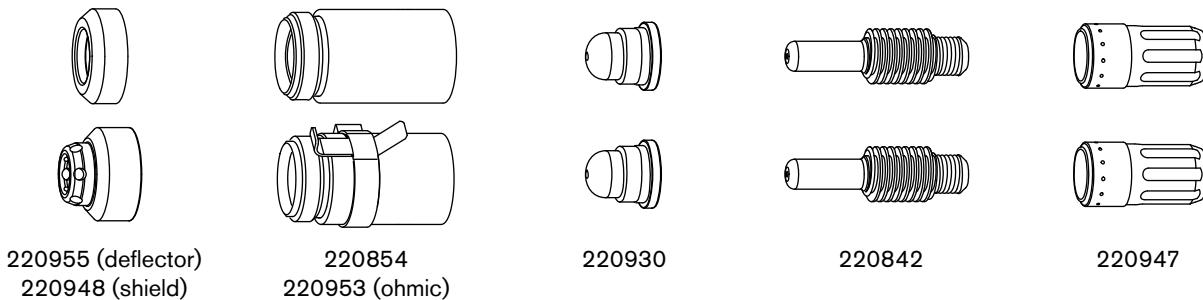
Material Thickness mm	Current A	Torch-to-Work Distance mm	Initial Pierce Height		Pierce Delay Time seconds	Recommended		Kerf Width mm
			mm	%		Cut Speed mm/min	Voltage volts	
0.5	40	0.5	2.0	400	0.0	8250	68	0.6
0.6						8250	68	0.5
0.8					0.1	8250	68	
1					0.2	8250	68	0.6
1.5					0.4	6150	70	1.0
2						4800	71	
3					0.5	2550	80	1.4
4					0.6	1050	84	1.5

English

Material Thickness inches	Current A	Torch-to-Work Distance inches	Initial Pierce Height		Pierce Delay Time seconds	Best Quality Settings		Kerf Width inches
			inches	%		Cut Speed in/min	Voltage volts	
26 GA	40	0.02	0.08	400	0.0	325	68	0.024
24 GA						325	68	0.021
22 GA					0.1	325	68	0.018
20 GA						325	68	0.017
18 GA					0.2	325	68	0.036
16 GA					0.4	240	70	0.039
14 GA						200	70	0.040
12 GA					0.5	120	80	0.049
10 GA					0.6	75	80	0.055

Gas flow rate - slpm / scfh

155 / 330	Hot (cutflow)
215 / 460	Cold (postflow)

Mild Steel - FineCut Low Speed - Air - Shielded and Unshielded**Metric**

Material Thickness mm	Current A	Torch-to-Work Distance mm	Initial Pierce Height		Pierce Delay Time seconds	Recommended		Kerf Width mm			
			mm	%		Cut Speed mm/min	Voltage volts				
0.5	30	1.5	3.8	250	0.0	3800	69	0.6			
0.6						3800	68				
0.8					0.1	3800	70	0.8			
1*					0.2	3800	72				
1.5*					0.4	3800	75	0.8			
2						3700	76				
3	45				0.5	2750	78	1.3			
4					0.6	1900	78	1.5			

English

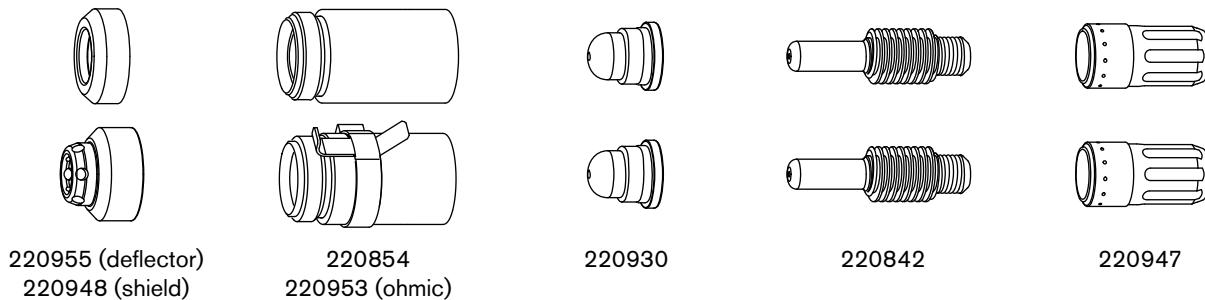
Material Thickness inches	Current A	Torch-to-Work Distance inches	Initial Pierce Height		Pierce Delay Time seconds	Best Quality Settings		Kerf Width inches			
			inches	%		Cut Speed in/min	Voltage volts				
26 GA	30	0.06	0.15	250	0.0	150	70	0.026			
24 GA						150	68	0.024			
22 GA					0.1	150	70	0.025			
20 GA						150	71				
18 GA	40				0.2	150	73	0.031			
16 GA*					0.4	150	75	0.029			
14 GA*	45					150	76	0.027			
12 GA	0.5				120	78	0.052				
10 GA					95	78	0.051				

Gas flow rate - slpm / scfh

155 / 330	Hot (cutflow)
215 / 460	Cold (postflow)

* Not a dross-free cut.

Stainless Steel – FineCut Low Speed – Air – Shielded and Unshielded



Metric

Material Thickness mm	Current A	Torch-to-Work Distance mm	Initial Pierce Height		Pierce Delay Time seconds	Recommended		Kerf Width mm
			mm	%		Cut Speed mm/min	Voltage volts	
0.5	30	0.5	2.0	400	0.0	3800	69	0.7
0.6						3800	69	
0.8					0.1	3800	69	
1					0.2	3800	69	0.6
1.5					0.4	2900	69	0.5
2						2750	69	1.3
3					0.5	2550	80	1.4
4					0.6	1050	80	1.5

English

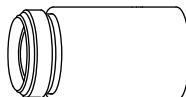
Material Thickness inches	Current A	Torch-to-Work Distance inches	Initial Pierce Height		Pierce Delay Time seconds	Best Quality Settings		Kerf Width inches
			inches	%		Cut Speed in/min	Voltage volts	
26 GA	30	0.02	0.08	400	0.0	150	69	0.028
24 GA						150	69	
22 GA					0.1	150	69	0.025
20 GA						150	69	0.023
18 GA					0.2	145	69	
16 GA					0.4	115	69	0.022
14 GA						110	69	0.021
12 GA					0.5	120	80	0.049
10 GA					0.6	75	80	0.055

Gas flow rate - slpm / scfh

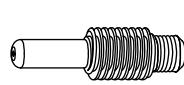
155 / 330	Hot (cutflow)
215 / 460	Cold (postflow)

Stainless Steel - 45 A - F5 - Shielded

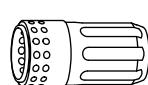
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(220953 for
ohmic sensing)

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Metric

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		Kerf Width
		mm	%		mm/min	volts	mm/min	volts	
mm	mm	mm	%	seconds	mm/min	volts	mm/min	mm	mm
8	1.5	3.8	250	0.8	630	150	860	144	2.1
10					435	153	525	147	2.3
12		Edge Start			340	156	440	150	2.5

English

Material Thickness	Torch-to-Work Distance	Initial Pierce Height		Pierce Delay Time	Best Quality Settings		Production Settings		Kerf Width
		inches	%		in/min	volts	in/min	volts	
inches	inches	inches	%	seconds	in/min	volts	in/min	inches	inches
1/4	0.06	0.15	250	0.6	32	147	47	141	0.075
3/8				0.8	18	152	22	146	0.088
1/2		Edge Start			12	157	16	151	0.101

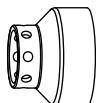
Gas flow rate - slpm / scfh

149 / 315	Hot (cutflow)
184 / 390	Cold (postflow)

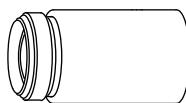


F5 is not recommended for thicknesses less than 7 mm or 1/4 inch or for use with FineCut consumables.

Marking and Dimpling – Air – Shielded



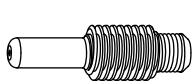
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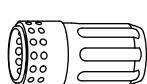
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(220953 for
ohmic sensing)



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Mild steel

Current	Torch-to-Work Distance		Initial Marking Height		Delay Time	Marking Speed		Arc Voltage	Width		Depth	
	A	mm	in	mm	in	seconds	mm/min	in/min	mm	in	mm	in
Light marking												
10	6.4	0.25	6.4	0.25	0	2540	100	134	2.79	0.11	<0.02	<0.001
Heavy marking												
10	4.6	0.18	4.6	0.18	0	2540	100	111	2.79	0.11	0.09	0.0035
Dimpling												
10	6.4	0.25	—	—	0.05	—	—	—	1.98	0.078	0.25	0.01

Stainless steel

Current	Torch-to-Work Distance		Initial Marking Height		Delay Time	Marking Speed		Arc Voltage	Width		Depth	
	A	mm	in	mm	in	seconds	mm/min	in/min	mm	in	mm	in
Light marking												
10	5.1	0.2	5.1	0.2	0	5080	200	123	2.03	0.08	<0.02	<0.001
Heavy marking												
10	6.4	0.25	6.4	0.25	0	3175	125	133	2.54	0.1	0.08	0.003
Dimpling												
10	6.4	0.25	—	—	0.05	—	—	—	2.03	0.08	0.23	0.009

Aluminum

Current	Torch-to-Work Distance		Initial Marking Height		Delay Time	Marking Speed		Arc Voltage	Width		Depth	
	A	mm	in	mm	in	seconds	mm/min	in/min	mm	in	mm	in
Marking												
11	2.5	0.1	5.1	0.2	0	5080	200	98	0.89	0.035	<0.02	<0.001
Dimpling												
10	3.2	0.125	—	—	0.15	—	—	—	0.89	0.035	0.09	0.0035

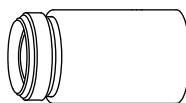
Gas flow rate - slpm / scfh

136 / 290	Hot (cutflow)
141 / 300	Cold (postflow)

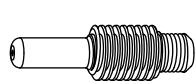
Marking and Dimpling – Argon – Shielded



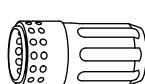
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(220953 for
ohmic sensing)

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220857

Mild steel

Current	Torch-to-Work Distance		Initial Marking Height		Delay Time	Marking Speed		Arc Voltage	Width		Depth	
	A	mm	in	mm	in	seconds	mm/min	in/min	mm	in	mm	in
Light marking												
10	2.0	0.08	2.0	0.08	0	3175	125	44	1.22	0.048	<0.02	<0.001
Heavy marking												
15	1.5	0.06	1.5	0.06	0	3175	125	42	1.22	0.048	<0.02	<0.001
Dimpling												
20	3.2	0.125	—	—	0.25	—	—	—	0.99	0.039	<0.02	<0.001

Stainless steel

Current	Torch-to-Work Distance		Initial Marking Height		Delay Time	Marking Speed		Arc Voltage	Width		Depth	
	A	mm	in	mm	in	seconds	mm/min	in/min	mm	in	mm	in
Light marking												
12	2.5	0.1	2.5	0.1	0	3175	125	46	1.40	0.055	<0.02	<0.001
Heavy marking												
15	2.5	0.1	2.5	0.1	0	2540	100	46	2.16	0.085	0.02	0.001
Dimpling												
10	3.2	0.125	—	—	0.25	—	—	—	0.94	0.037	0.18	0.007

Aluminum

Current	Torch-to-Work Distance		Initial Marking Height		Delay Time	Marking Speed		Arc Voltage	Width		Depth	
	A	mm	in	mm	in	seconds	mm/min	in/min	mm	in	mm	in
Marking												
16	0.5	0.02	0.5	0.02	0	4445	175	42	0.63	0.025	<0.02	<0.001
Dimpling												
20	0.5	0.02	—	—	0.4	—	—	—	0.66	0.026	0.04	0.0015

Gas flow rate - slpm / scfh

120 / 255	Hot (cutflow)
122 / 260	Cold (postflow)

Troubleshooting and System Tests

Theory of operation

Overview

In addition to the functional descriptions below, refer to:

- *Sequence of operation* on page 148
- *System Diagrams* on page 343

200 – 240 V 1-phase power supply functional description

For CSA models, AC power enters the system through the power switch (S1). For CE/CCC models, AC power is routed through the EMI board (PCB2) before it reaches the power switch. AC power goes from the power switch to the input diode bridge (D6). The voltage from the diode bridge supplies the power factor correction (PFC) boost converter, which provides a nominal 400 VDC bus voltage. The bus wires then supply voltage and current to the inverter and the flyback circuit power supply (DC to DC converter) on the power board (PCB3). The power board provides noise suppression and spike protection. A “soft start” is implemented via the power board resistor and relays.

The PFC boost converter consists of an insulated gate bipolar transistor (IGBT Q2), PFC choke, and control circuit. It provides a 400 VDC bus voltage when the input AC voltage is between 200 – 240 VAC.

The inverter consists of a dual IGBT package (Q1), the power transformer, an output current sensor, and the control circuit. The inverter operates as a pulse-width modulated half-bridge circuit driving an isolation transformer. The output of the isolation transformer is rectified by the output bridge (Q10).

The output circuitry consists of 2 current sensors located on the power board, the pilot arc IGBT (inside the Q10 module), and the output choke.

The digital signal processor (DSP) on the power board monitors and regulates the system operation and safety circuits. The adjustment knob on the display board (PCB1) is used to set the output current to the desired value between 10 – 45 amperes (A). The system compares the set-point to the output current by monitoring the current sensors and adjusting the pulse-width output of the inverter IGBTs (Q1). A trip coil on the power switch provides over-voltage protection.

400 V CE/CCC 3-phase power supply functional description

AC power enters the system through the power switch (S1) to the input diode bridge (D48). The voltage from the diode bridge supplies the power factor correction (PFC) choke, which provides a nominal 560 VDC bus voltage. The bus wires then supply voltage and current to the inverter and the flyback circuit power supply (DC to DC converter) on the power board (PCB3). The power board provides noise suppression and spike protection. A “soft start” is implemented via the power board resistor and relays.

The inverter consists of a dual IGBT package (Q1), the power transformer, an output current sensor, and the control circuit. The inverter operates as a pulse-width modulated half-bridge circuit driving an isolation transformer. The output of the isolation transformer is rectified by the output bridge (Q10).

The output circuitry consists of 2 current sensors located on the power board, the pilot arc IGBT (inside the Q10 module), and the output choke.

The digital signal processor (DSP) on the power board monitors and regulates the system operation and safety circuits. The adjustment knob on the display board (PCB1) is used to set the output current to the desired value between 10 – 45 amperes (A). The system compares the set-point to the output current by monitoring the current sensors and adjusting the pulse-width output of the inverter IGBT (Q1).

480 V CSA 3-phase power supply functional description

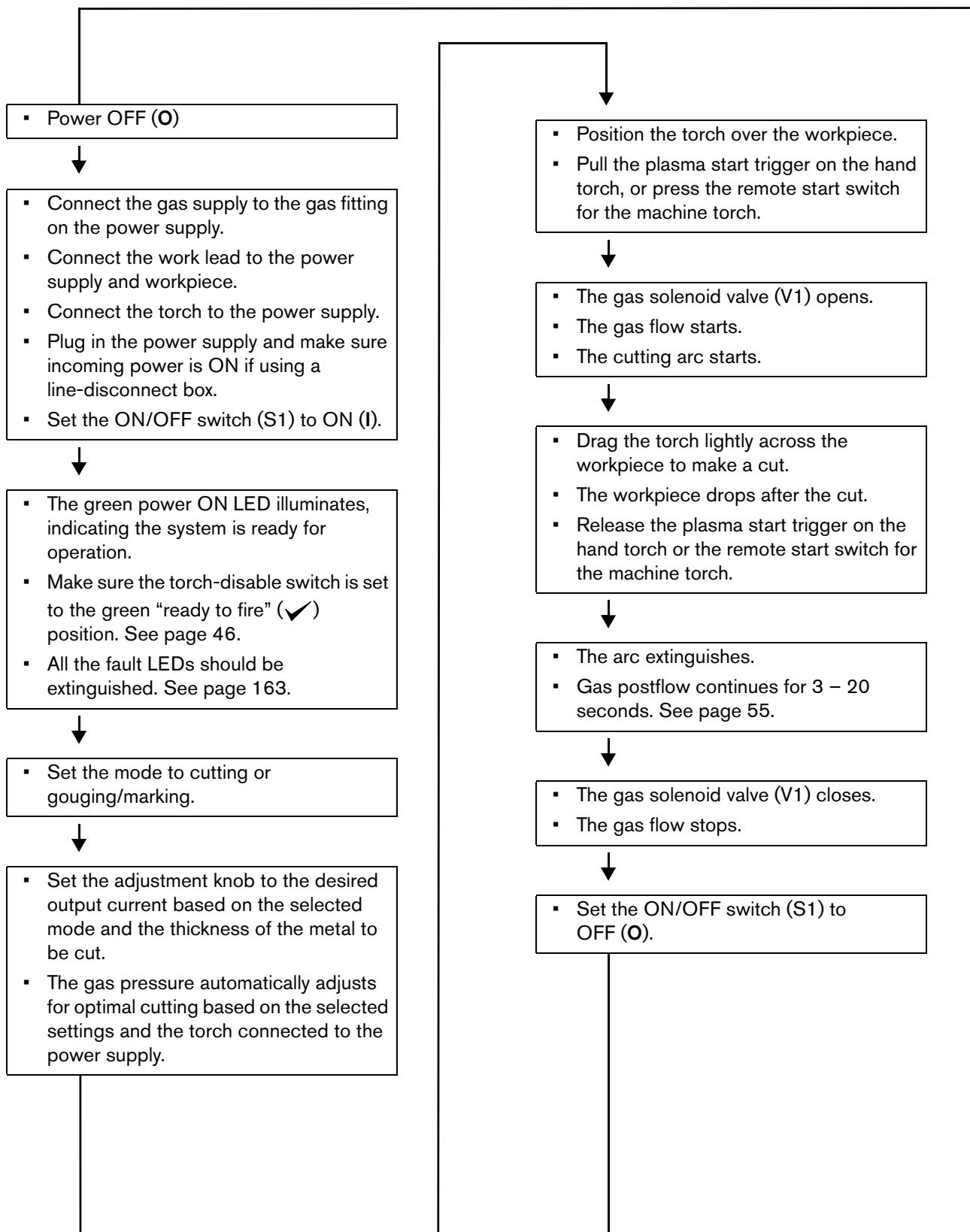
AC power enters the system through the power switch (S1) to the input diode bridge (D48). The voltage from the diode bridge supplies the power factor correction (PFC) choke, which provides a nominal 670 VDC bus voltage. The bus wires then supply voltage and current to the inverter and the flyback circuit power supply (DC to DC converter) on the power board (PCB3). The power board provides noise suppression and spike protection. A “soft start” is implemented via the power board resistor and relays.

The inverter consists of a dual IGBT package (Q1), the power transformer, an output current sensor, and the control circuit. The inverter operates as a pulse-width modulated half-bridge circuit driving an isolation transformer. The output of the isolation transformer is rectified by the output bridge (Q10).

The output circuitry consists of 2 current sensors located on the power board, the pilot arc IGBT (inside the Q10 module), and the output choke.

The digital signal processor (DSP) on the power board monitors and regulates the system operation and safety circuits. The adjustment knob on the display board (PCB1) is used to set the output current to the desired value between 10 – 45 amperes (A). The system compares the set-point to the output current by monitoring the current sensors and adjusting the pulse-width output of the inverter IGBT (Q1).

Sequence of operation



Troubleshooting preparation

The complexity of the circuits requires that service technicians have a working knowledge of inverter power supply theory. In addition to being technically qualified, technicians must perform all testing with safety in mind. If questions or problems arise during servicing, call the Hypertherm Technical Services team listed in the front of this manual.

! WARNING



ELECTRIC SHOCK CAN KILL

Turn OFF (O) the power and disconnect the electrical power before removing the cover from the power supply. If the power supply is connected directly to a line disconnect box, switch the line disconnect to OFF (O). In the U.S., use a “lock-out / tag-out” procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.

Do not touch live electrical parts! Do not touch the tip of the nozzle when the system is powered ON (!)! If power is required for servicing, use extreme caution when working near live electrical circuits. Dangerous voltages exist inside the power supply that can cause serious injury or death.

Do not attempt to repair the power board, control board, EMI board, or solenoid valve board. Do not cut away or remove any protective conformal coating from these boards. To do so risks a short circuit between the AC input circuit and the output circuit and may result in serious injury or death.

! CAUTION



HOT PARTS CAN CAUSE SEVERE BURNS

Allow the power supply to cool before servicing.



MOVING BLADES CAN CAUSE INJURY

Keep hands away from moving parts.

NOTICE



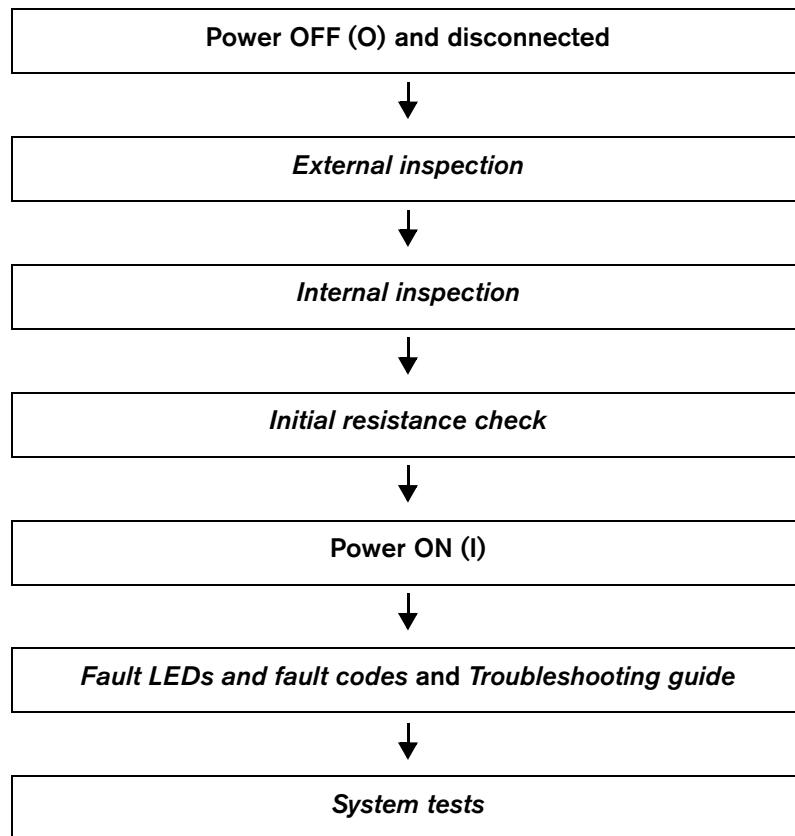
STATIC ELECTRICITY CAN DAMAGE CIRCUIT BOARDS

Put on a grounded wrist strap before handling printed circuit boards.

Troubleshooting procedures and sequence

When performing the troubleshooting procedures, refer to:

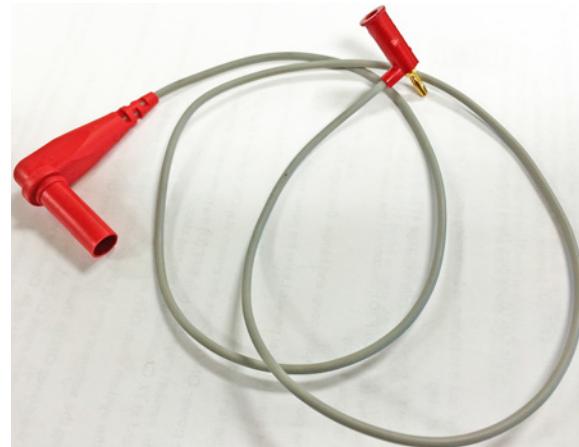
- *Safety and Compliance Manual (80669C)* for detailed safety information
- *System Diagrams* on page 343 for electrical schematics
- *Replacement Parts and Accessories* on page 317 for power supply components and torch components
- Replacement procedures:
 - *Power Supply Component Replacement* on page 211
 - *Hand Torch Component Replacement* on page 285
 - *Machine Torch Component Replacement* on page 303



After the problem has been located and repaired, refer to *Sequence of operation* on page 148 to test the power supply for proper operation.

Test equipment

- Multimeter with a variety of test leads. The power board contains test points with a diameter of 2.25 mm (0.09 inches) that accept miniature banana plugs (for example, Pamona® 2945 plugs).



External inspection

1. Inspect the exterior of the power supply for damage to the cover and external components, such as the power cord and plug.
2. Inspect the torch and the torch lead for damage.
3. Inspect the consumables for damage or wear.
4. Repair or replace components as necessary.

Internal inspection

1. Set the power switch to OFF (**O**), and disconnect the power cord from the power source.
2. Remove the power supply handle and cover. See page 215.
3. Remove the component barrier. See page 218.
4. Inspect the inside of the power supply:
 - **Power board side:** Look for broken or loose wiring connections, burn and char marks, damaged components, and so on.
 - **Fan side:** Check for gas leaks and loose connections at each pneumatic (gas) connection point on the air filter and solenoid valve.
5. Repair or replace components as necessary.

Initial resistance check

All resistance values must be taken with the power cord disconnected and all internal power supply wires attached. Perform the steps in *Internal inspection* (above) before continuing in this section.

- The type of multimeter you use significantly affects the results of the tests in this section. The resistance values in this manual are intended as a general reference point.
- If resistance values indicate a problem based on the range of values provided in this section, isolate the problem by removing wires attached to the resistance check points or component until the problem is found.
- After the problem is located and repaired, see *Sequence of operation* on page 148 to test the power supply for proper operation.

! WARNING



ELECTRIC SHOCK CAN KILL

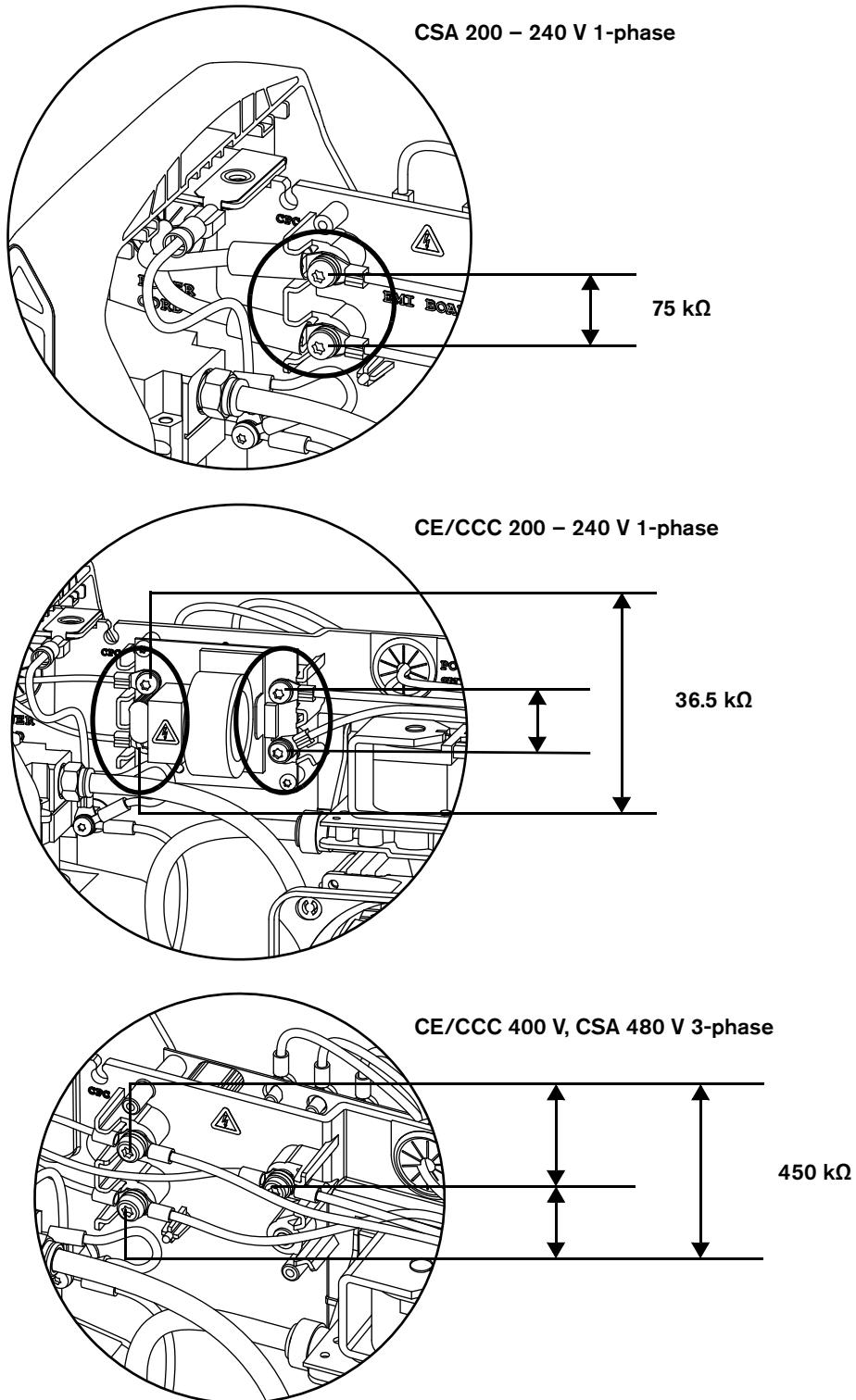
Allow internal voltages to discharge before touching any components on the EMI board (CE/CCC 1-phase models only). Live voltages can be present on the EMI board for several minutes after the system is turned OFF.

Check the power switch and snubber resistors

1. Set the power switch to OFF (O), and disconnect the power cord from the power source.
2. Disconnect the torch from the power supply.
3. Set the power switch (S1) to ON (I).
4. Check the resistance across the input leads. Pull back the red insulating covers, and measure the resistance where the wires connect to the center panel (or to the EMI board, for CE/CCC 1-phase models). See *Figure 2* on page 153.

Power supply model	Resistance across input leads
CSA 200 – 240 V 1-phase	75 kΩ
CE/CCC 200 – 240 V 1-phase	36.5 kΩ*
400 V, 480 V 3-phase (all models)	450 kΩ

* The resistance should be consistent when measured on both sides of the EMI board.

Figure 2 – Power switch resistance

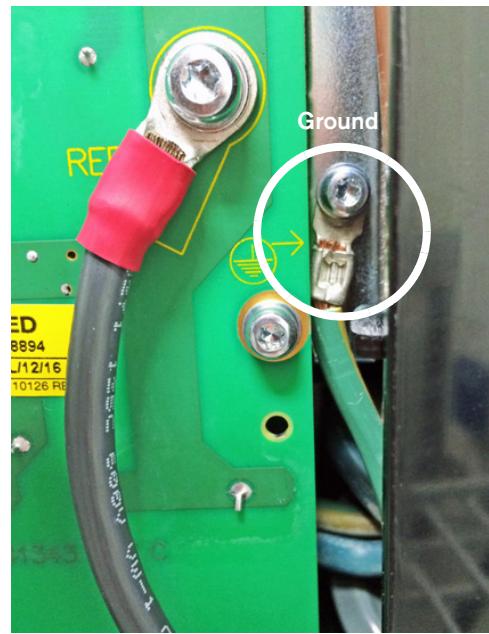
- 5.** Check the resistance from the input leads to ground to verify that it reads as open. For all power supplies, the resistance from input to ground should read as $>20\text{ M}\Omega$.



With the electrical power disconnected and the power switch set to OFF (O), all circuits should read as open.



The electrical values shown are $\pm 25\%$. However, this range is intended only for reference. Resistance values can vary widely depending on the type of multimeter and the polarity used to measure the readings.

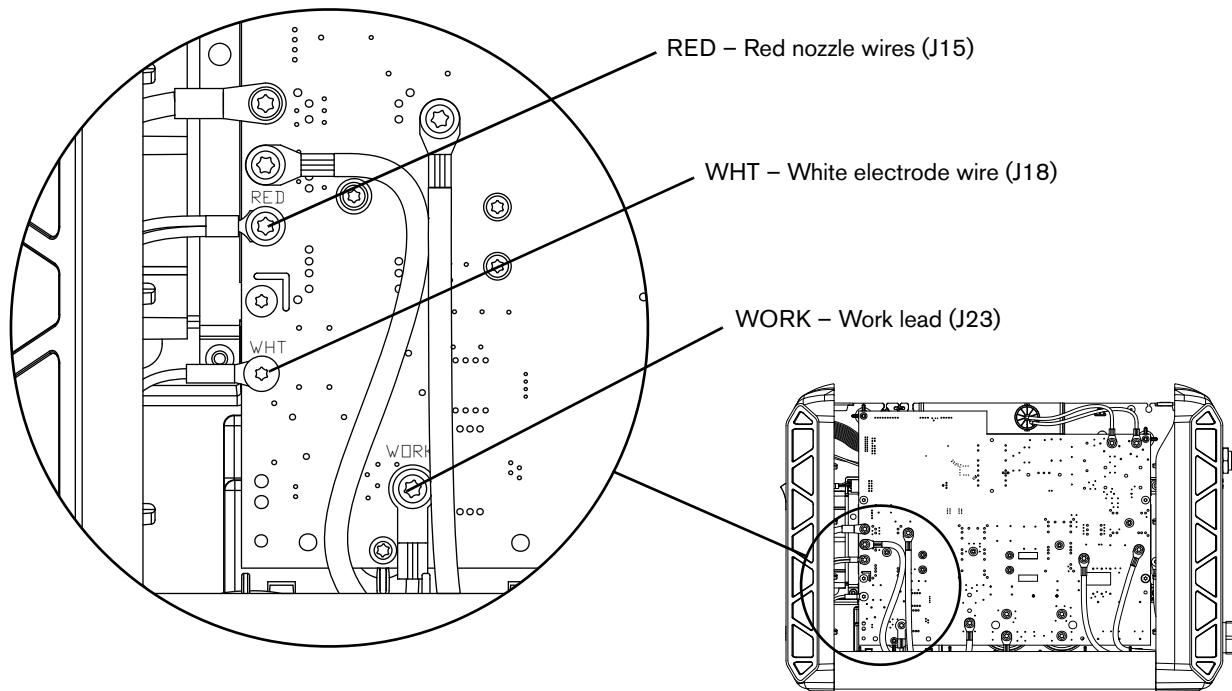


- 6.** Disconnect the torch from the power supply. Check the output resistance for the values shown in the following table. See *Figure 3* on page 155.

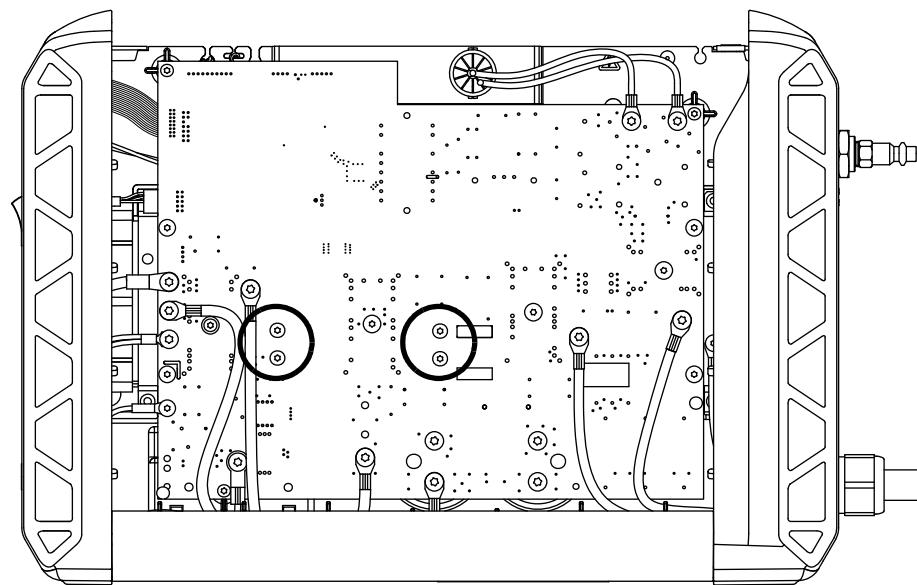
Measure resistance from	All models with torch disconnected
Work lead (J23) to nozzle (red wires – RED)	200 k Ω
Work lead (J23) to electrode (white wire – WHT)	16 k Ω
Electrode (white wire – WHT) to nozzle (red wires – RED)	200 k Ω
Work lead (J23), nozzle (red wires – RED), and electrode (white wire – WHT) to ground	$>20\text{ M}\Omega$



The red nozzle wires connect to J15 (RED) on the power board. The white electrode wire connects to J18 (WHT).

Figure 3 – Output resistance for torch and work lead

7. Measure the resistance on each snubber resistor. The resistance should be approximately $10\ \Omega$.

Figure 4 – Snubber resistor connections on power board

8. If you do not find any problems during the visual inspection or the initial resistance check, and the power supply is still not operating correctly, see *Troubleshooting guide* on page 172.



The *Troubleshooting guide* on page 172 provides most probable causes and solutions. Study the *System Diagrams* on page 343 and understand the *Theory of operation* on page 145 before troubleshooting. Before purchasing any major replacement component, verify the problem with Hypertherm Technical Service or the nearest Hypertherm repair facility.

Check the gas pressure

- **Gas supply:** Incorrect gas pressure can result in issues with cut quality and cut performance. Refer to *Gas supply source* on page 37 for details on the inlet gas supply requirements for this system. **Never exceed the maximum gas pressure of 9.3 bar (135 psi).**
- **Gas hose:** An incoming gas supply hose with too small a diameter can result in issues with cut quality and cut performance. Only use gas hoses with an internal diameter of 9.5 mm (3/8 inch) or greater.
- **Pressure setting:** The system regulates gas pressure automatically, but you can adjust the gas pressure manually if needed. See page 56.
- **Gas test:** You can run a gas test to see if adequate pressure is exiting the torch. The gas test lets you see the actual gas pressure of the plasma system so that you can compare it to the inlet set pressure. See page 158.



If you manually adjusted the gas pressure and then started to notice issues with cut quality or cut performance, reset the gas pressure to the default setting. See page 58.

Check the gas quality

It is extremely important to maintain a clean, dry gas line in order to:

- Prevent oil, water, dirt, and other contaminants from damaging internal components.
- Achieve optimal cut quality and consumable life.

Dirty, oily air is the root cause of many common problems that occur in Powermax systems, and in some instances it can void the warranty on the power supply and on the torch. See the gas quality recommendations in the ratings table on page 23.

The built-in air filter in the system is designed to filter out particulates as small as 5 microns. It can remove some moisture from the gas supply. However, if you work in an environment that is extremely warm and humid, or if work site conditions introduce oil, vapor, or other contaminants into the gas line, install an external filtration system that cleans the gas supply before it enters the plasma power supply. See page 41.

NOTICE

Synthetic lubricants containing esters that are used in some air compressors will damage polycarbonates used in the air filter bowl.

To maintain a clean gas line:

1. Examine the air filter element in the system's built-in air filter. Replace it if it is contaminated. See page 212.
2. Clean the air filter bowl that houses the air filter element. Make sure it is free from oil, dirt, and other contaminants.

 A yellow residue on the filter bowl often indicates that oil is getting into the gas supply line.
3. Examine the O-ring at the top of the air filter bowl. Replace it if it is cracked or damaged.
4. If you are using an external air filtration system, clean or replace any parts in it that may be contaminated.

Run a gas test

! CAUTION

Point the torch away from you before performing a gas test. Always keep hands, clothes, and objects clear of the torch tip. Never point the torch toward yourself or others.

Use a gas test to determine if adequate gas pressure is exiting the torch. The gas test lets you see the plasma system's actual gas pressure so that you can compare it to the inlet set pressure.

Enter gas test mode

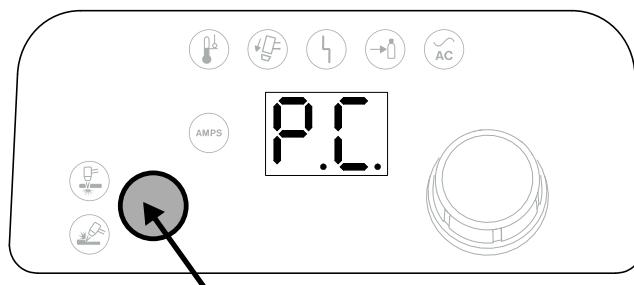
1. Make sure the correct mode is selected for the process you want to validate (Cut or Gouge/Marking).

2. Press-and-hold the **Mode** button for approximately 5 seconds.

3. Release the **Mode** button when the 2-digit display shows **P.C.**

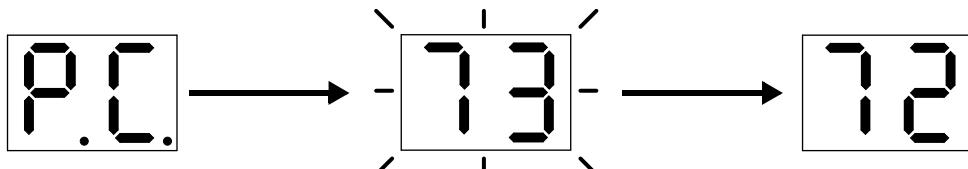


P.C. indicates pressure check.



Press-and-hold for 5 seconds.

4. The set pressure blinks on the 2-digit display before the actual output gas pressure displays. Make note of the set pressure so that you can compare it to the actual pressure.



"P.C." displays when you enter gas test mode.

The set pressure blinks briefly.

The actual pressure displays.

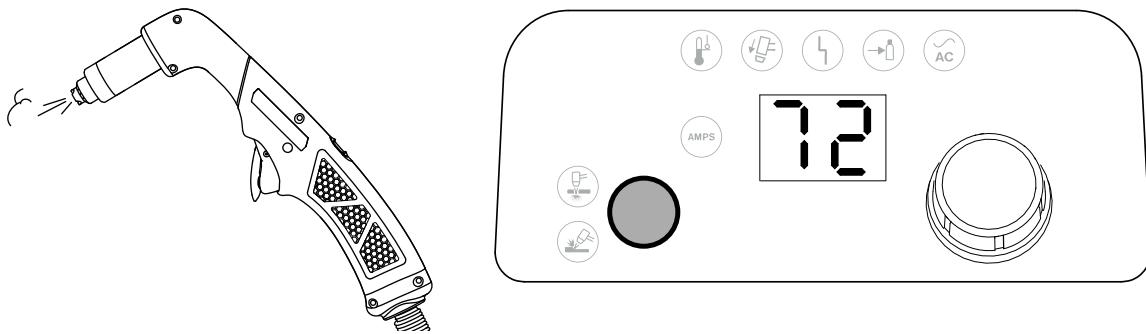
If the 2-digit display shows "0.0" (bar) or "00" (psi) when you enter gas test mode, the torch is not in a "ready to fire" state. In this case, pull the trigger (hand torches) or initiate a start signal (machine torches). This releases the system from a cap-sense condition. After the system is released, it emits the warning puffs of air and displays the actual pressure.



A cap-sense condition occurs when you use the torch-disable switch to lock and then unlock the torch without turning OFF the plasma power supply. In this condition, the Torch Cap LED illuminates until you install the consumables and set the torch-disable switch to the green "ready to fire" (✓) position. See page 47.

While gas test mode is active

- Air flows continuously from the torch tip.
- The 2-digit display shows the output gas pressure (in psi or bar – see page 59).
- The AMPS LED remains off.



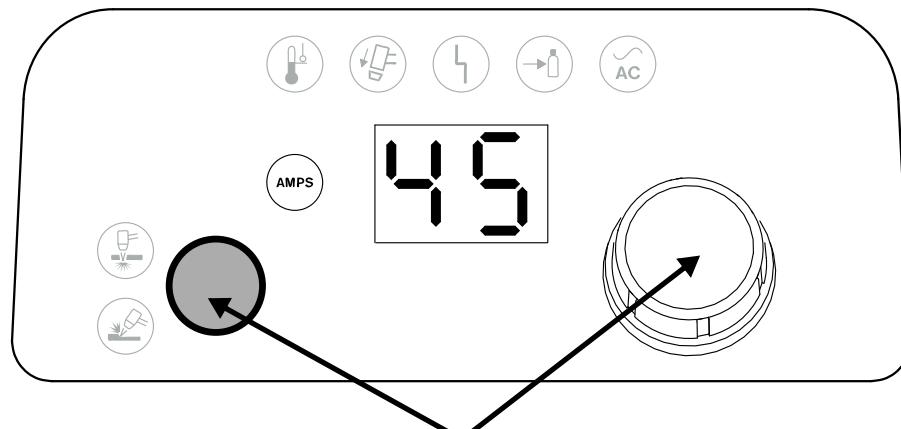
Exit gas test mode

You can do either of the following actions to exit gas test mode:

- Press the **Mode** button.
- Turn the adjustment knob.

After the system exits gas test mode:

- The 2-digit display shows the cutting current (amperage).
- The AMPS LED illuminates.

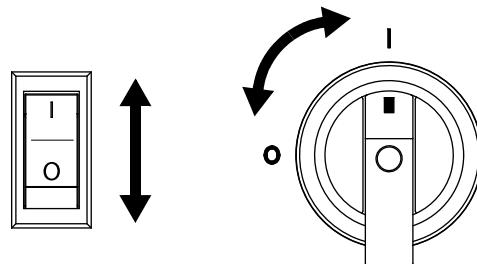


Press button or turn knob to exit gas test mode.

Cold restarts and quick restarts

To restart the system, turn OFF (**O**) the power switch on the plasma power supply and then turn ON (**I**) the power switch again.

In some instances, you may be asked specifically to perform a “cold restart” or a “quick restart.”



Perform a cold restart

1. Set the power switch on the plasma power supply to the OFF (**O**) position.
2. Wait a minimum of 30 seconds.
3. Set the power switch on the plasma power supply to the ON (**I**) position.

Perform a quick restart

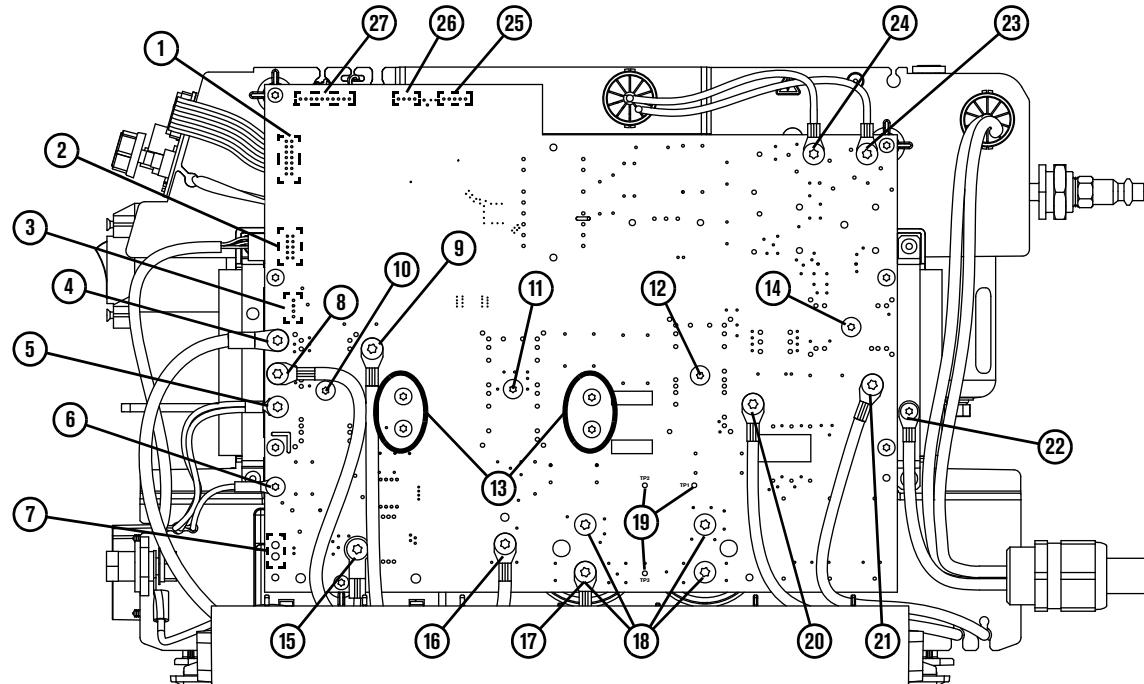
1. Set the power switch on the plasma power supply to the OFF (**O**) position.
2. Immediately set the power switch on the plasma power supply back to the ON (**I**) position.



If a fault occurs while using a generator, a quick restart may not clear the fault. Instead, turn OFF (**O**) the plasma power supply and wait 60 – 70 seconds before turning it ON (**I**) again.

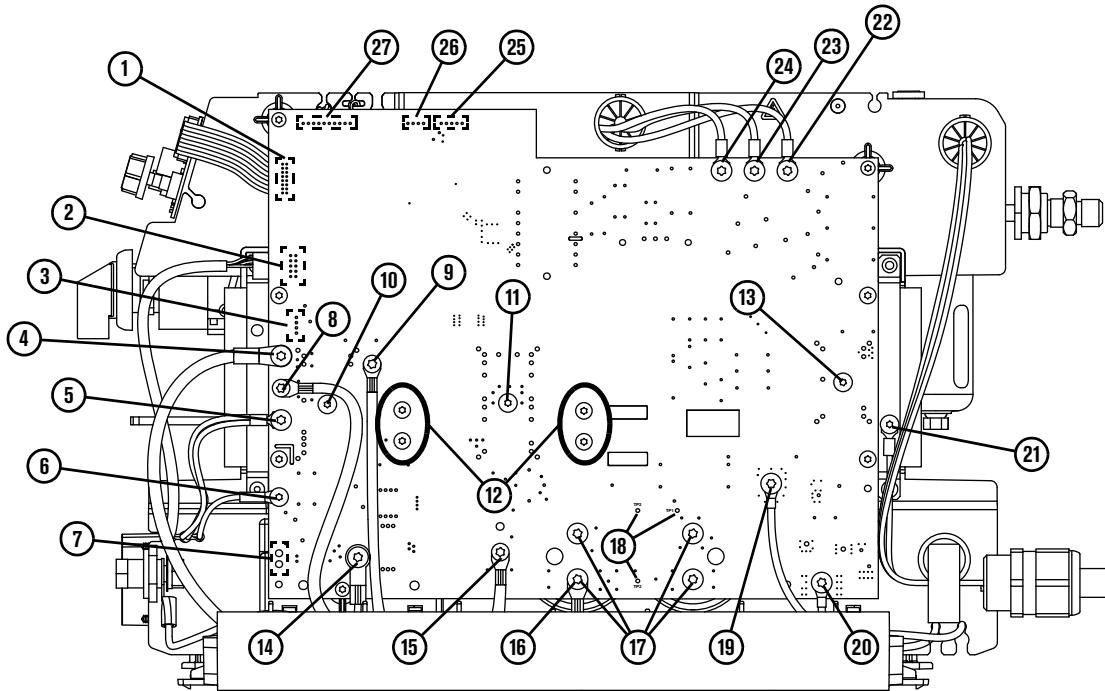
Power supply overview

200 – 240 V 1-phase power supply



- 1 Display board interface (J3)
- 2 Torch interface (J19)
- 3 Machine interface (CPC) (J21)
- 4 Output inductor – yellow (J13)
- 5 Red nozzle wires (J15)
- 6 White electrode wire (J18)
- 7 Voltage divider board interface (J17)
- 8 Power transformer secondary – black (J14)
- 9 Power transformer secondary – red (J12)
- 10 Output diode and pilot arc IGBT (Q10)
- 11 Inverter IGBT (Q1)
- 12 PFC IGBT (Q2)
- 13 Snubber resistors (2)
- 14 Input diode bridge (D6)
- 15 Work lead wire (J23)
- 16 Power transformer primary – black (J6)
- 17 Power transformer primary – red
- 18 Capacitor screws (4)
- 19 Test points (TP1, TP2, TP3)
- 20 PFC inductor – black (J4)
- 21 PFC inductor – red (J5)
- 22 Ground
- 23 AC input wire – white (J1)
- 24 AC input wire – black (J2)
- 25 Serial communication (RS-485) interface (J11)
- 26 Fan interface (J7)
- 27 Solenoid valve interface (J8)

400 V CE/CCC and 480 V CSA 3-phase power supply



- | | |
|---|--|
| 1 Display board interface (J3) | 15 Power transformer primary – black (J6) |
| 2 Torch interface (J19) | 16 Power transformer primary – red |
| 3 Machine interface (CPC) (J21) | 17 Capacitor screws (4) |
| 4 Output inductor – yellow (J13) | 18 Test points (TP1, TP2, TP3) |
| 5 Red nozzle wires (J15) | 19 PFC inductor – black (J26) |
| 6 White electrode wire (J18) | 20 PFC inductor – red (J5) |
| 7 Voltage divider board interface (J17) | 21 Ground |
| 8 Power transformer secondary – black (J14) | 22 AC input wire – brown with white stripe (J4) |
| 9 Power transformer secondary – red (J12) | 23 AC input wire – black with white stripe (J2) |
| 10 Output diode and pilot arc IGBT (Q10) | 24 AC input wire – white with black stripe (J1) |
| 11 Inverter IGBT (Q1) | 25 Serial communication (RS-485) interface (J11) |
| 12 Snubber resistors (2) | 26 Fan interface (J7) |
| 13 Input diode bridge (D48) | 27 Solenoid valve interface (J8) |
| 14 Work lead wire (J23) | |

Fault LEDs and fault codes

- Some fault conditions cause one or more fault LEDs to illuminate or blink.



Temperature fault LED (yellow)



Torch Cap fault LED (yellow)



System Fault LED (yellow)



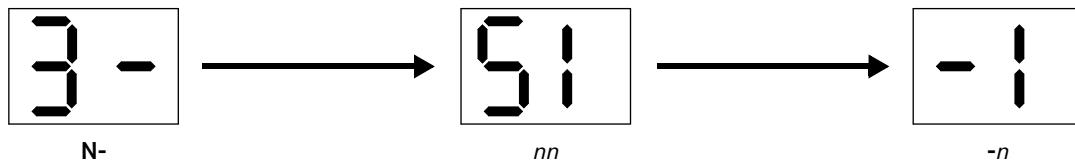
Gas Pressure fault LED (yellow)



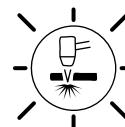
Power ON LED (green)

- Other fault conditions display a fault code in addition to the fault LEDs. The fault code provides additional information when needed to make the source of the problem easier to identify.

Fault codes follow the format **N-nn-n**. They blink on the 2-digit display in increments:

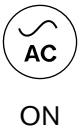
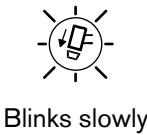
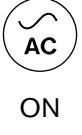


- If the Cut Mode LED or the Gouge/Marking Mode LED blinks, this indicates that the gas pressure has been manually adjusted. See page 56. It does not indicate a fault condition. When you reset the gas pressure to its default setting, the LED stops blinking. See page 58.

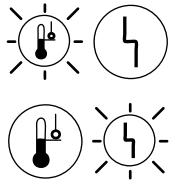


Refer to the following table to identify and troubleshoot each fault condition. A label with descriptions for several common fault codes can be found inside the front cover of the *Operator Manual*. Peel off the label and place it on the power supply or near your work area for reference.

Fault code	Description	LED behavior	Solutions
None	The ON/OFF power switch is set to ON (I), but the Power ON LED does not illuminate.		<ul style="list-style-type: none"> Make sure that the power cord is plugged into the receptacle. Make sure that the power is on at the main power panel or at the disconnect-power switch box. Make sure the system is plugged into an appropriately-sized circuit and that the circuit breaker has not been tripped. Make sure that the line voltage is not too low (more than 10% below the rated voltage for 1-phase models or 15% below the rated voltage for 3-phase models). See page 23 and page 30. Perform <i>Test 1 – voltage input</i> on page 183 to check the incoming voltage and the power switch.
None	Output gas pressure low, high, or unstable		<p>These output gas pressure faults do not stop the system from operating, and they do not appear on the 2-digit display.</p> <p>They display only on a CNC via an RS-485 serial interface, as follows:</p> <ul style="list-style-type: none"> 0-12-1 = Low output gas pressure 0-12-2 = High output gas pressure 0-12-3 = Unstable output gas pressure <p>To troubleshoot these faults:</p> <ul style="list-style-type: none"> Adjust the gas inlet pressure as needed. Make sure none of the gas lines are kinked or blocked. Run a gas test to see if the actual pressure is lower or higher than the set pressure. See <i>Run a gas test</i> on page 158. Perform <i>Test 5 – solenoid valve – low gas pressure</i> on page 195.
None	Low gas pressure	  	<ul style="list-style-type: none"> The gas pressure is below the minimum pressure for that process, mode, torch, and lead length. Check the input gas supply. See <i>Gas Pressure fault LED</i> on page 170 and <i>Test 5 – solenoid valve – low gas pressure</i> on page 195.

Fault code	Description	LED behavior		Solutions	
None	No gas input			<ul style="list-style-type: none"> Connect the input gas supply to the plasma power supply. Turn OFF (O) then turn ON (I) the power supply. See <i>Gas Pressure fault LED</i> on page 170 and <i>Test 4 – solenoid valve – no gas input</i> on page 192. 	
None	Torch stuck open (TSO) The nozzle and electrode are not touching after a start signal is received.			<ul style="list-style-type: none"> Turn OFF (O) the power supply. Make sure that the consumables are installed correctly and that they are in good condition. See <i>Torch Cap fault LED</i> on page 171 and <i>Test 7 – torch stuck open (TSO) or torch stuck closed (TSC)</i> on page 201. If you are using FlushCut consumables, make sure the retaining ring is fully tightened onto the cap. 	
None	Torch stuck closed (TSC) The nozzle and electrode will not separate after a start signal is received.			<ul style="list-style-type: none"> Turn OFF (O) the power supply. Make sure that the consumables are installed correctly and that they are in good condition. See <i>Torch Cap fault LED</i> on page 171 and <i>Test 7 – torch stuck open (TSO) or torch stuck closed (TSC)</i> on page 201. 	
None	Power supply is over temperature or under temperature				<ul style="list-style-type: none"> The system may have overheated. Leave the plasma power supply ON to allow the fan to cool the internal components. See <i>Understand duty cycle to prevent overheating</i> on page 60. Make sure the fan is operating properly. Perform <i>Test 10 – fan</i> on page 209. Make sure the power supply cover is installed with the louvers in front of the fan. Make sure there is adequate air flow around the power supply. Make sure the component barrier is in place on the power board side of the power supply. The system may be too cold to operate. If the internal temperature of the plasma power supply approaches -30°C (-22°F), move the system to a warmer location.

Fault code	Description	LED behavior		Solutions
None	Retaining cap off	 ON	 ON	<ul style="list-style-type: none"> Turn OFF (O) the power supply. Make sure that the torch is connected to the power supply and the consumables are installed correctly. Make sure the torch-disable switch is set to the green "ready to fire" (✓) position. See <i>Torch Cap fault LED</i> on page 171 and <i>Test 9 – torch cap sensor</i> on page 206.
0-11-0	Remote controller mode invalid. Valid remote modes for this system: <ul style="list-style-type: none"> 1, 2 – Continuous pilot arc 3 – Gouge 	 ON		<p>There is a problem with the remote controller or the software interface to the system. The system cannot interpret the mode, output current, or gas pressure information coming from the controller.</p> <ul style="list-style-type: none"> Fix the controller. Check the RS-485 interface cable. Examine the programming code for incorrect process variables.
0-11-1	Remote controller current invalid. Valid remote current settings for this system: 10 – 45 A.	 ON		
0-11-2	Remote controller pressure invalid. Valid remote pressure settings for this system depend on the process, mode, torch, and torch lead.	 ON		
0-13-0	Alternating current (AC) input power unstable (system continues to operate)	 Blanks		<ul style="list-style-type: none"> Perform a cold restart. If applicable, disconnect the system from generator power. See <i>Generator considerations</i> on page 172. If the fault does not clear, have an electrical technician correct the power source. See page 29. Change the character, generally the impedance, of the line.

Fault code	Description	LED behavior	Solutions	
0-51-0	Start/trigger signal on at power up This condition indicates that the power supply is receiving a start signal. It is sometimes referred to as a “stuck start.”	 Blinks alternately	 ON	<ul style="list-style-type: none"> Hand torch: The torch trigger was being held in the “fire” position while the plasma power supply was being powered ON (I). Release the trigger and restart the power supply. Machine torch: The plasma power supply was receiving a start signal when it was powered ON (I). Turn off the start signal and restart the power supply. Check for continuity between pin 6 and pin 7 of the torch connector. There should be very low resistance when the torch trigger is pulled. See page 178. If possible, test with a known working torch.
0-60-0	Alternating current (AC) input voltage phase loss		 Blinks	<ul style="list-style-type: none"> Have an electrical technician check all input phases and fuses/breakers for proper voltage (phase to phase and phase to ground) at the power source and at the plasma system. Perform <i>Test 1 – voltage input</i> on page 183. If applicable, disconnect the system from generator power. See <i>Generator considerations</i> on page 172.
0-60-1	Alternating current (AC) input voltage too low		 Blinks	<ul style="list-style-type: none"> The input line voltage is too low (more than 10% below the rated voltage for 1-phase models or 15% below the rated voltage for 3-phase models). Have an electrical technician check the line and increase the voltage. See page 23 and page 30. Perform <i>Test 1 – voltage input</i> on page 183. If applicable, disconnect the system from generator power. See <i>Generator considerations</i> on page 172.

Fault code	Description	LED behavior	Solutions
0-60-2	Alternating current (AC) input voltage too high	 Blinks	<ul style="list-style-type: none"> The input line voltage is too high (more than 10% above the rated voltage for 1-phase models or 20% above the rated voltage for 3-phase models). Have an electrical technician check the line and decrease the voltage. See page 23 and page 30. Perform <i>Test 1 – voltage input</i> on page 183. If applicable, disconnect the system from generator power. See <i>Generator considerations</i> on page 172.
0-61-0	Alternating current (AC) input unstable – system shutdown	 Blinks	<ul style="list-style-type: none"> The current from the incoming power line is unstable. Power down and correct the line resonance problem before continuing. Make sure the plasma system is not being used on a phase converter. Test the machine from another AC power source. If applicable, disconnect the system from generator power. See <i>Generator considerations</i> on page 172.

Internal component faults (fault code formats 1-nn-n, 2-nn-n, 3-nn-n)

Fault code	Description	LED behavior	Solutions
1-00-0	Digital signal processor (DSP) fault	 ON	<ul style="list-style-type: none"> These are internal processor checks and might not be caused by a hardware failure. First perform a cold restart. If that does not fix the problem, it is possible that the power board failed.
1-10-0	Analog-to-digital converter (ADC) fault		
1-20-0	Input/output (I/O) fault		
2-00-0	Analog-to-digital converter (ADC) value out of range	 ON	<ul style="list-style-type: none"> Perform a cold restart. If that does not fix the problem, it is possible that the power board failed.
2-10-0	Inverter module temperature sensor open	 ON	<ul style="list-style-type: none"> Perform a cold restart. If that does not fix the problem, it is possible that the power board failed.
2-10-1	Inverter module temperature sensor shorted		

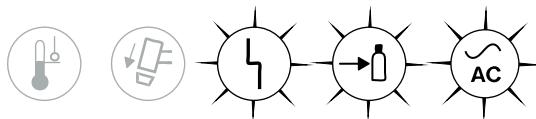
Fault code	Description	LED behavior		Solutions
2-11-0	Pressure sensor is open	 ON	 ON	▪ Perform <i>Test 6 – solenoid valve pressure sensor</i> on page 197.
2-11-1	Pressure sensor is shorted			
3-00-0	VBUS fault	 ON	 ON	▪ Perform <i>Test 3 – VBUS and voltage balance on power board</i> on page 189.
3-10-0	Fan speed fault The fan speed is below the minimum speed.	 ON	 ON	▪ Clean the fan assembly. ▪ Perform <i>Test 10 – fan</i> on page 209.
3-10-1	Fan fault			
3-11-0	PFC module temperature sensor open	 ON	 ON	▪ Perform a cold restart. ▪ If that does not fix the problem, it is possible that the power board failed.
3-11-1	PFC module temperature sensor shorted			
3-11-2	PFC module temperature sensor circuit fault			
3-51-1	Inverter saturation fault (the inverter is over current)	 ON	 ON	▪ The inverter IGBT is being activated in phase rather than 180° out of phase. ▪ If necessary, replace the power board.
3-52-0	Inverter shoot-through fault			
3-60-0	Power board fault	 ON	 ON	▪ Make sure the correct power board is installed for the power supply. See page 323 for part numbers.

Gas Pressure fault LED

The minimum gas pressure required varies based on:

- Selected mode (cut or gouge)
- Type of torch
- Length of torch lead

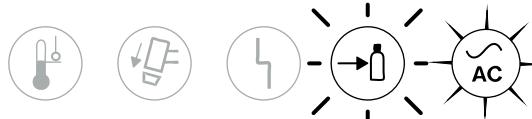
For example, if you select cut mode and are using a hand torch with a 6 m (20 foot) lead, the Gas Pressure LED and System Fault LED illuminate if the inlet gas pressure is less than 3.8 bar (55 psi).



The Gas Pressure LED and System Fault LED illuminate while the system is powered ON.

The input gas pressure is too low.

- Check all the connections for the input gas supply. Make sure there are no leaks or loose connections.
- Make sure the incoming gas supply hose has an internal diameter of 9.5 mm (3/8 inch) or greater.
- Check the inlet gas pressure. Adjust as needed. See page 36.
- Manually adjust the gas pressure on the plasma system. See page 56. Perform a quick restart.
- Run a gas test. See page 158. Compare the inlet set pressure against the actual output gas pressure. If there is no apparent issue with the inlet gas supply, check the air filter bowl and air filter element in the plasma power supply. Clean or replace as needed. See page 212.
- Perform *Test 5 – solenoid valve – low gas pressure* on page 195.



The Gas Pressure LED blinks while the system is powered ON.

The input gas supply is not connected to the plasma power supply.

- Make sure the input gas supply is properly connected to the plasma system.
- Check all the connections for the input gas supply. Make sure there are no leaks or loose connections.
- Restart the plasma power supply.
- Perform *Test 4 – solenoid valve – no gas input* on page 192.

Torch Cap fault LED



The Torch Cap LED illuminates while the system is powered ON.

- Make sure the torch lead is securely plugged into the plasma power supply. See page 50.
- Make sure the torch-disable switch on the torch is set to the green "ready to fire" (✓) position.
- Turn OFF (O) the power supply. Make sure that the consumables are installed correctly. See page 48. Turn ON (I) the power supply.



If the consumables are not installed, or if they are not installed correctly, the Torch Cap LED illuminates even if the torch-disable switch is set to the green "ready to fire" (✓) position.

- Make sure the consumables are not too loose or too tight. Never tighten the consumables more than finger-tight. It is normal for some gas to escape between the torch shell and the retaining cap during use. This is part of the torch design.
- When you use the torch-disable switch to lock and then unlock the torch without turning OFF the plasma power supply, the Torch Cap LED illuminates until you set the torch-disable switch to the green "ready to fire" (✓) position. See page 47.
- If the torch will not fire an arc, test the torch-disable switch to see if it is working properly. Replace the switch if it is broken.
- If the consumables are in good condition and appear to be installed correctly, the torch may be damaged. If possible, test with a known working torch.
- Perform *Test 9 – torch cap sensor* on page 206.



The Torch Cap LED blinks slowly (TSO) or rapidly (TSC) while the system is powered ON.

- If the consumables became loose or were removed while the plasma power supply was ON and the torch-disable switch remained ON, turn OFF (O) the power supply, correct the problem, and then turn ON (I) the power supply to clear the fault.
- **A slow blink rate (less than 1 blink per second) indicates a “torch stuck open” (TSO) condition.** Check the consumables, including the swirl ring. Make sure they are not worn or damaged. If you are in gouge/mark mode, make sure you are not using the Maximum Control gouging consumables with the output current set below 26 A. Either increase the output current above 25 A or install the Precision gouging consumables. See *Gouging processes* on page 77. Next, check the gas line. See *Check the gas pressure* on page 156 and *Check the gas quality* on page 157.
- **A rapid blink rate (multiple blinks per second) indicates a “torch stuck closed” (TSC) condition.** Check the consumables, including the swirl ring. Make sure they are not worn or damaged. Next, check the gas line. See *Check the gas pressure* on page 156 and *Check the gas quality* on page 157.
- If the fault persists, change all of the consumables, including the swirl ring. If the consumables are in good condition and appear to be installed correctly, the torch may be damaged. If possible, test with a known working torch.
- Perform *Test 7 – torch stuck open (TSO) or torch stuck closed (TSC)* on page 201.

Generator considerations

- If a fault occurs while using a generator, turning the power switch quickly to OFF and then to ON again (a quick restart) may not clear the fault. Instead, turn OFF the power supply and wait 60 to 70 seconds before turning it ON again.
- Issues with input line voltage (fault codes 0-13-0, 0-60-n, and 0-61-0) can be more difficult to troubleshoot when you are operating the plasma system off of a generator. Disconnect the plasma system from the generator, and connect it to an appropriately sized power outlet.



See page 35 for generator specifications.

Troubleshooting guide

This guide suggests solutions for several common issues.

- Refer to *Fault LEDs and fault codes* on page 163 to troubleshoot any fault LEDs and fault codes that display on the front panel.
- Before troubleshooting, study the schematics on page 343 and understand the *Theory of operation* on page 145.
- Before purchasing any major replacement component, verify the problem with Hypertherm Technical Service or the nearest Hypertherm repair facility listed in the front of this manual.
- See *System tests* on page 181 for detailed test procedures.

Problem	Meaning	Causes	Solution
The Power ON LED is illuminated and no fault codes or fault LEDs display, but no gas flows when the torch is fired.	The start signal is not reaching the power board.	<ul style="list-style-type: none"> ▪ The torch or torch lead may be damaged. ▪ The power board may be faulty. 	<ul style="list-style-type: none"> ▪ Inspect the torch and torch lead for damage. ▪ Make sure the red start signal LED (under J8 on the power board) illuminates when the torch is fired. If it does not, perform <i>Test 8 – plasma start</i> on page 204.
The Power ON LED blinks or goes out while cutting.	A power component is shorted.	<ul style="list-style-type: none"> ▪ The fan is faulty. 	<ul style="list-style-type: none"> ▪ Perform <i>Test 10 – fan</i> on page 209.
		<ul style="list-style-type: none"> ▪ The solenoid valve is faulty. 	<ul style="list-style-type: none"> ▪ Perform <i>Test 6 – solenoid valve pressure sensor</i> on page 197.
		<ul style="list-style-type: none"> ▪ The power board is faulty. 	<ul style="list-style-type: none"> ▪ Perform <i>Test 2 – power board voltage checks</i> on page 187.
The arc does not transfer to the workpiece.	Poor continuity exists between the work lead and the workpiece.	<ul style="list-style-type: none"> ▪ The workpiece is dirty. ▪ The work clamp is damaged. ▪ The pierce height distance is too large. 	<ul style="list-style-type: none"> ▪ Clean the area where the work clamp contacts the workpiece or cutting table. Remove any rust, paint, or other residue. Make sure there is good metal-to-metal contact. ▪ Inspect the work clamp for damage. Repair or replace it if necessary. ▪ Make sure the cutting table is properly grounded and is making good contact with the workpiece. ▪ Decrease the torch-to-work distance (cut height). Refer to the cut charts starting on page 131.
Gas flows from the torch at power-up when neither the torch trigger nor a remote start is activated.	The incoming gas pressure is too high.	<ul style="list-style-type: none"> ▪ The gas pressure from the compressor or cylinder may be too high. 	<ul style="list-style-type: none"> ▪ Check the gas supply to make sure that it does not exceed 9.3 bar (135 psi). If necessary, reduce the pressure.
	The system is not properly regulating pressure.	<ul style="list-style-type: none"> ▪ The solenoid valve or the power board is faulty. 	<ul style="list-style-type: none"> ▪ Perform <i>Test 5 – solenoid valve – low gas pressure</i> on page 195. ▪ Perform <i>Test 6 – solenoid valve pressure sensor</i> on page 197. ▪ Perform <i>Test 2 – power board voltage checks</i> on page 187.

Problem	Meaning	Causes	Solution
When you press the torch trigger or start switch, gas flows from the torch, but the torch does not fire or fires for only a short duration.	The consumables are worn or damaged.	<ul style="list-style-type: none"> The consumables are overused or improperly installed. 	<ul style="list-style-type: none"> Install new consumables. Make sure the consumables match and are installed correctly. See page 48.
	The torch or torch lead is damaged.	<ul style="list-style-type: none"> The electrode is not moving properly in the torch, or the torch lead is damaged. 	<ul style="list-style-type: none"> Perform <i>Test 7 – torch stuck open (TSO) or torch stuck closed (TSC)</i> on page 201.
	The gas flow is insufficient or excessive.	<ul style="list-style-type: none"> Gas pressure is too high or too low. The gas supply is leaking or restricted. 	<ul style="list-style-type: none"> Set the inlet pressure is 5.5 to 6.9 bar (80 to 100 psi). Make sure the pressure does not exceed 9.3 bar (135 psi). Repair gas leaks or restrictions. Manually adjust the gas pressure on the power supply. See page 56.
	The gas quality is poor.	<ul style="list-style-type: none"> The air filter element is dirty. Oil, moisture, or other contaminants are in the gas supply line. 	<ul style="list-style-type: none"> Replace the air filter element. See page 212. Purge the gas supply line with nitrogen to flush out oil and moisture. Add external filtration appropriate for the work environment. See page 41.
	The input power is insufficient.	<p>The electrical supply installation is undersized.</p> <ul style="list-style-type: none"> Circuit breaker or fuse Supply wire Extension cord 	<ul style="list-style-type: none"> Make sure the external electrical power is installed according to the specifications on page 23 and page 29.
	An internal power component is faulty.	<ul style="list-style-type: none"> The power cord, power switch, or power board is faulty. 	<ul style="list-style-type: none"> Perform <i>Test 1 – voltage input</i> on page 183 to determine whether to replace the power cord, power switch, or power board.
	There is a capacitor voltage imbalance on the power board.	<ul style="list-style-type: none"> The capacitors are faulty. Resistors on the power board are faulty. 	<ul style="list-style-type: none"> Perform <i>Test 3 – VBUS and voltage balance on power board</i> on page 189 to determine whether to replace the capacitors or the power board.

Problem	Meaning	Causes	Solution
The arc goes out while cutting or intermittently will not fire.	The arc is losing contact with the workpiece.	<ul style="list-style-type: none"> ▪ The work lead or work lead connection may be faulty. 	<ul style="list-style-type: none"> ▪ Check for loose connections at the work clamp and at the power supply. ▪ Reposition the work lead on the workpiece or cutting table. ▪ Clean the cutting surface to allow a better connection with the work lead.
	The fan is faulty.	<ul style="list-style-type: none"> ▪ The fan could be overloading the flyback circuit. 	<ul style="list-style-type: none"> ▪ Perform <i>Test 2 – power board voltage checks</i> on page 187 and <i>Test 10 – fan</i> on page 209.
The arc sputters and hisses.	The air filter element is contaminated, or the input gas line contains moisture.	<ul style="list-style-type: none"> ▪ The air filter element needs to be replaced. ▪ The input gas supply needs to be cleaned. 	<ul style="list-style-type: none"> ▪ Replace the air filter element if it is contaminated or clogged. See page 212. ▪ Inspect the gas line for moisture. If necessary, install or repair the gas filtration to the power supply. See <i>Connect the gas supply</i> on page 36. ▪ Purge the gas supply line with nitrogen to flush out oil and moisture. Add external filtration appropriate for the work environment. See page 41.
The system does not cut well (does not appear to be cutting at full cutting power) and the arc does not time out after 5 seconds.	The system is not grounded adequately.	<ul style="list-style-type: none"> ▪ The work lead connection is poor. ▪ The work lead is damaged. ▪ The power board may be faulty. 	<ul style="list-style-type: none"> ▪ Make sure the work lead is attached to the workpiece and the workpiece is free of rust, paint, or other coatings. ▪ Check the resistance across the work lead (J23). If the resistance is greater than 5 kΩ, repair or replace the work lead. ▪ A sensor on the power board may be faulty, or a component on the board may have shorted. Replace the power board if needed. See page 253.
	There is low output from the power supply.	<ul style="list-style-type: none"> ▪ The output current is set too low. 	<ul style="list-style-type: none"> ▪ Increase the output current as needed.

Issues with cut quality

Problem	Solution
The cut quality is poor.	<ul style="list-style-type: none"> ▪ Make sure the correct consumables are installed. See page 64 for hand cutting consumables. See page 113 for mechanized cutting consumables. See page 77 for gouging consumables. See page 121 for marking consumables. ▪ Loosen the consumables about 1/8th of a turn and try again. Never tighten the consumables more than finger-tight. See page 48. It is normal for some gas to escape between the torch shell and the retaining cap during use. This is part of the torch design. ▪ Inspect and replace the consumable parts if they are worn or damaged, including the swirl ring. Always replace the nozzle and electrode together. ▪ Make sure that the correct mode is selected: cut mode for cutting and piercing applications or gouge/mark mode for gouging and marking applications. See page 53. ▪ Make sure that the work lead connection to the plasma power supply is secure. Make sure that there is no damage to the work lead. ▪ Make sure that the torch is being used correctly. See <i>Cut with the Hand Torch</i> on page 61 or <i>Cut with the Machine Torch</i> on page 113. ▪ Check the gas pressure and the gas supply hose. See page 156. ▪ Inspect the gas filtration system for signs of contaminants that may be interfering with system performance. See page 157. Replace the air filter element if it is contaminated or clogged. See page 212. If there are signs of moisture in the gas supply line, purge the line with nitrogen to flush out oil and moisture. Add external filtration appropriate for the work environment. See page 41. ▪ Adjust the cut speed. ▪ Operate the system without using an extension cord. If you must use an extension cord, use a heavy conductor cord of the shortest possible length. See page 35.
The plasma arc blows out but re-ignites when the torch trigger is pulled again.	<ul style="list-style-type: none"> ▪ Decrease the length of the arc stretch. Whenever possible, drag the torch on the workpiece. See page 73. ▪ If you are using the Maximum Control gouging consumables, make sure the system is set to gouge/mark mode and the output current is set to 26 – 45 A. Setting the output current below 26 A with these consumables can cause the arc to extinguish. ▪ Inspect and replace the consumable parts if they are worn or damaged. Always replace the nozzle and electrode together. ▪ Make sure the incoming gas supply hose has an internal diameter of 9.5 mm (3/8 inch) or greater. ▪ Inspect the gas filtration system for signs of contaminants that may be interfering with system performance. See page 157. ▪ If you manually adjusted the gas pressure before this issue occurred, reset the gas pressure to the default setting. See page 58.

Problem	Solution
Hand cutting: The torch does not cut completely through the workpiece.	<ul style="list-style-type: none"> ▪ Make sure the system is set to cut mode, not gouge/mark mode. See page 53. ▪ Decrease your cut speed. ▪ Inspect and replace the consumable parts if they are worn or damaged. Always replace the nozzle and electrode together. ▪ Make sure that the torch is being used correctly. See <i>Cut with the Hand Torch</i> on page 61. ▪ Make sure the consumables installed on the torch match the selected mode. For example, do not use gouging consumables when the system is set to cut mode. See page 53. ▪ Increase the output current (amperage) on the plasma power supply. See page 53. ▪ If the output current cannot be increased, determine if the metal being cut exceeds the maximum capacity for this system. See <i>Cutting specifications</i> on page 24. ▪ Clean the area where the work clamp contacts the workpiece. Remove any rust, paint, or other residue. Make sure there is good metal-to-metal contact. ▪ Inspect the torch lead. Straighten it out if it is twisted or kinked. Replace it if it is damaged. ▪ Check the gas pressure and the gas supply hose. See page 156. ▪ Adjust the gas flow rate. See <i>Gas supply source</i> on page 37.
Mechanized cutting: The torch does not completely pierce the workpiece, and there is excessive sparking on the top of the workpiece.	<ul style="list-style-type: none"> ▪ Clean the metal surface of any rust, paint, or other residue that may prevent a good metal-to-metal connection. ▪ Make sure that the work lead is making good contact with the cutting table. Make sure that the cutting table is properly grounded and is making good contact with the workpiece. ▪ Inspect and replace the consumable parts if they are worn or damaged. Always replace the nozzle and electrode together. ▪ Make sure the cut chart parameters or the program code values are correct. Try decreasing the cut speed. Refer to the cut charts starting on page 131. ▪ Increase the output current (amperage) on the plasma power supply. See page 53. ▪ If the output current cannot be increased, determine if the metal being cut exceeds the maximum capacity for this system. See <i>Cutting specifications</i> on page 24. ▪ Inspect the torch lead. Straighten it out if it is twisted or kinked. Replace it if it is damaged. ▪ Make sure the incoming gas supply hose has an internal diameter of 9.5 mm (3/8 inch) or greater.

Torch-related faults

Continuity check

Check for continuity between the points listed in the following table. If there is no continuity between any 2 test points, replace the torch FastConnect receptacle. See page 277.

Torch FastConnect receptacle	J19 on power board	Wire color
5	1	Blue
7	2	Orange
6	3	Violet
8	4	Yellow
9	5	White
10	6	Red

Torch-disable switch and warning puffs of air

The first time you pull the torch trigger or send a start signal to the torch after you set the torch-disable switch to the “ready to fire” (✓) position, the torch may emit multiple puffs of air in quick succession. With each puff of air, the torch vibrates slightly, and the plasma power supply emits a pressure-release sound. This is a warning that occurs when you lock and then unlock the torch without turning OFF the power supply. (The Torch Cap LED also illuminates – see page 171.) **This does not indicate a fault condition.** The purpose of the warning is to alert you that the torch is activated and will fire a plasma arc the next time you fire the torch. See page 47.

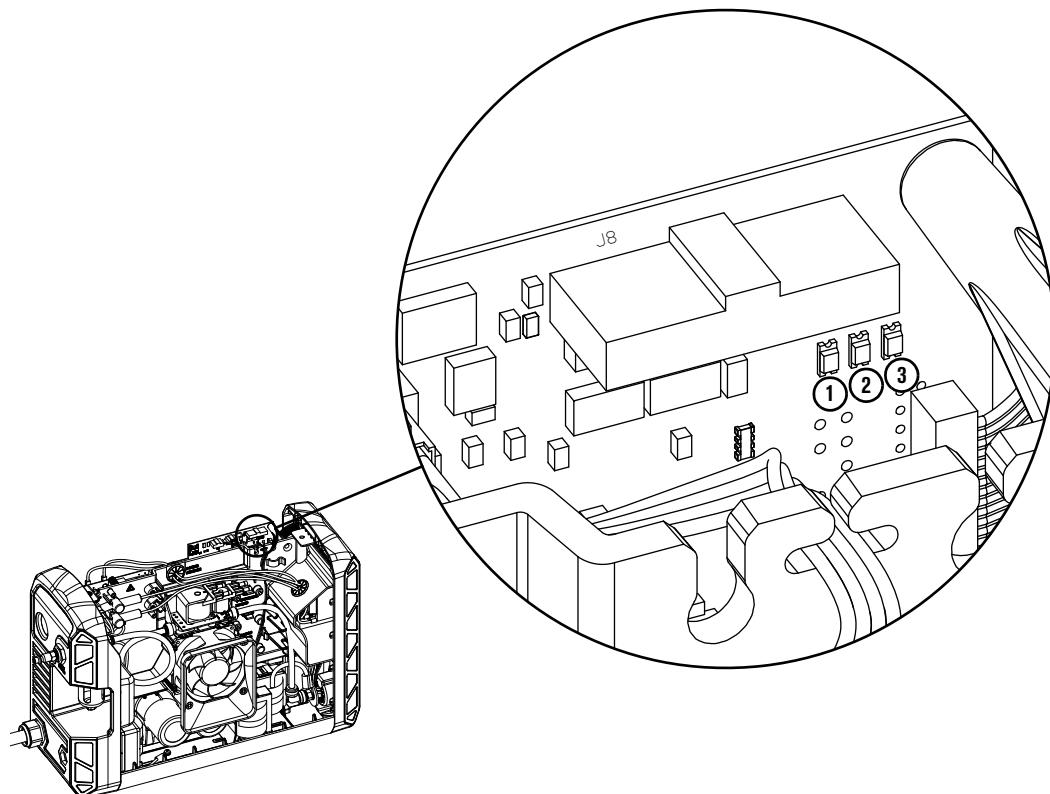
If the torch does not fire an arc after repeated attempts, and there are no apparent issues with incoming power or gas supply and no fault LEDs or fault codes displayed, test the torch-disable switch to see if it is working properly. Replace the switch if it is broken or not working correctly. See page 299 for hand torches or page 314 for machine torches.

Power board LEDs

The main power board has 3 diagnostic LEDs located under the J8 connector:

- ① **Start** This LED illuminates when the power supply receives a start signal and remains illuminated when the torch is firing.
- ② **Transfer** This LED illuminates when there is proper arc transfer between the torch and the workpiece.
- ③ **Reset** This LED illuminates when the system is powered ON. The LED then turns off. If the LED remains illuminated, this indicates a DSP-related fault condition. See *When the Reset LED indicates a DSP fault* on page 180.

Figure 5 – Diagnostic LEDs on power board



When the Reset LED indicates a DSP fault

During normal operation, the Reset LED illuminates briefly when the system is powered ON, then shuts off. If the LED remains illuminated, certain voltages on the DSP section of the main power board may be out of range.

Measure the following voltages at J3 on the power board. See *Test 2 – power board voltage checks* on page 187.

- Measure pin 1 to ground for 3.3 VDC ($\pm 10\%$).
- Measure pin 2 to ground for 3.3 VDC ($\pm 10\%$).
- Measure pin 4 to ground for 5.0 VDC ($\pm 10\%$).

If the voltage readings are not within $\pm 10\%$ of the 3 values listed above, disconnect the display board ribbon cable from J3 on the power board. Measure the voltage again from pin 1, pin 2, and pin 4 on J3 to ground. Are the voltages now correct?

- If yes, replace the display board. See page 234.
- If no, replace the power board. See page 253.

System tests

WARNING



Use extreme caution when working near live electrical circuits. Dangerous voltages exist inside the power supply that can cause serious injury or death.

Live voltages can continue to be present on the DC bus for at least 30 seconds after disconnecting the input power. Allow bus voltages to dissipate before performing any tests.

While testing, do not touch the nozzle at the end of the torch. Dangerous voltages can cause serious injury.

See the *WARNING* on page 149 before proceeding.

Before performing any tests, complete:

- *Internal inspection* on page 151
- *Initial resistance check* on page 152

These tests should only be performed by a qualified service technician. Wear the proper personal protective equipment and use approved tools and measurement equipment.

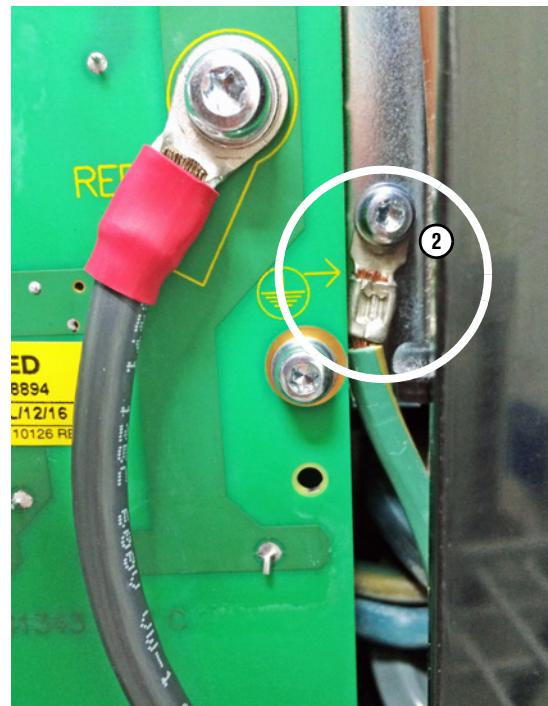
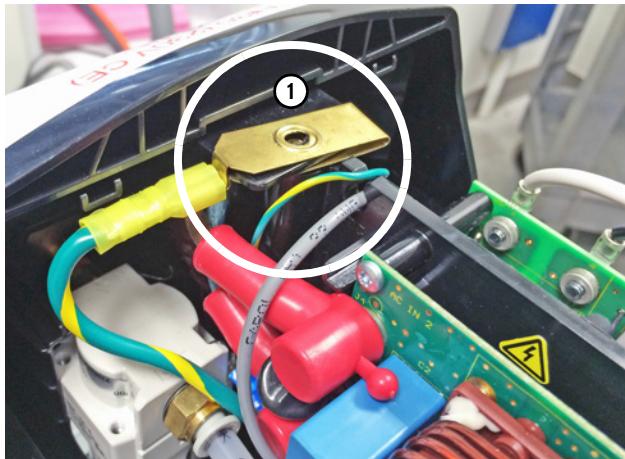
Before purchasing a major replacement component, verify the problem with Hypertherm Technical Service or the nearest Hypertherm repair facility.

System test	Associated fault codes and fault LEDs
<i>Test 1 – voltage input</i> on page 183	0-60-0, 0-60-1, 0-60-2
<i>Test 2 – power board voltage checks</i> on page 187	
<i>Test 3 – VBUS and voltage balance on power board</i> on page 189	3-00-0
<i>Test 4 – solenoid valve – no gas input</i> on page 192	Gas Pressure fault LED blinks
<i>Test 5 – solenoid valve – low gas pressure</i> on page 195	Gas Pressure fault LED illuminates
<i>Test 6 – solenoid valve pressure sensor</i> on page 197	2-11-0, 2-11-1
<i>Test 7 – torch stuck open (TSO) or torch stuck closed (TSC)</i> on page 201	Torch Cap fault LED blinks
<i>Test 8 – plasma start</i> on page 204	0-51-0
<i>Test 9 – torch cap sensor</i> on page 206	0-50-0
<i>Test 10 – fan</i> on page 209	3-10-0, 3-10-1
<i>Test 11 – power switch trip coil (1-phase models)</i> on page 210	System shuts down unexpectedly

Grounding options

You can use either the ground clip near the top of the rear panel ① or the ground screw on the heatsink ② for any tests that require the multimeter to be attached to ground.

Figure 6 – Grounding options



Test 1 – voltage input

! WARNING



ELECTRIC SHOCK CAN KILL

Allow internal voltages to discharge before touching any components on the EMI board (CE/CCC 1-phase models only). Live voltages can be present on the EMI board for several minutes after the system is turned OFF.

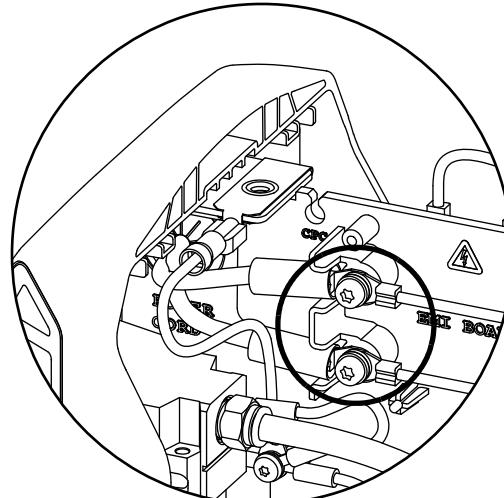
Check the incoming voltage and the line voltage to the power switch (S1).

1. Set the power switch to OFF (O), and disconnect the power cord from the power source.
2. Remove the power supply cover and handle. See page 215.
3. Remove the component barrier. See page 218.
4. From the fan side of the power supply, pull the red insulating covers off of the power cord and power switch wires.

Check the incoming voltage

5. Reconnect the electrical power. Leave the power switch set to OFF (O).
6. From the fan side of the power supply, check the line voltage on the power switch wires with the power switch in the OFF (O) position.
 - **1-phase CSA models:** Measure the voltage at the blue and brown wire connections on the center panel.

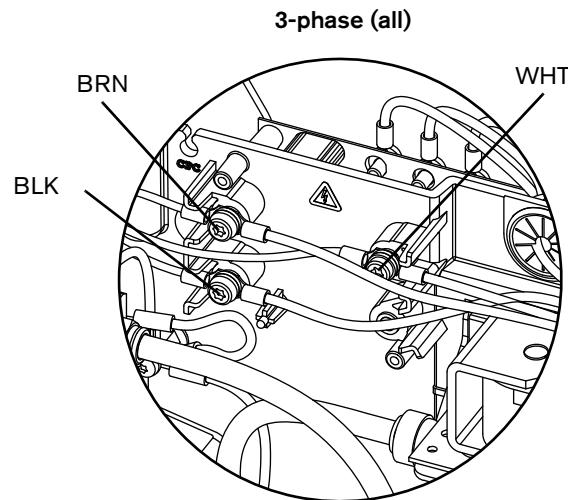
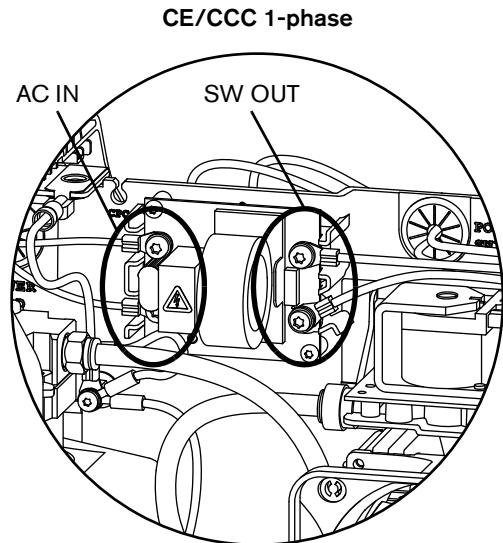
CSA 1-phase



- **1-phase CE/CCC models:** Wait approximately 10 minutes for internal voltages to discharge. Measure the voltage at the blue and brown power switch wire connections on the right side of the EMI board. These are labeled **SW OUT** on the board.
 - If you get a voltage reading, continue with the next step.
 - If you get no voltage reading, or if the voltage reading is very low, measure the voltage at the blue and brown power cord wire connections on the left side of the EMI board. These are labeled **AC IN** on the board.
 - If the voltage is correct on the power cord wires but incorrect on the power switch wires, replace the EMI board. See page 243.
 - **3-phase models:** Measure the voltage at the wire connections on the center panel as follows:
 - White wire (WHT) to black wire (BLK)
 - White wire (WHT) to brown wire (BRN)
 - Black wire (BLK) to brown wire (BRN)
- 7.** Does the voltage equal the line voltage of the incoming circuit, based on the model of the power supply? See page 23 for the voltage requirements of each power supply configuration.
- If yes, continue with the next step.
 - If no, check to see that you have power to the unit. If you do have power, inspect the power cord and its plug for damage and replace if necessary. See page 239 (1-phase models) or page 241 (3-phase models).



All values can be $\pm 15\%$.



Check the voltage at the power switch

8. If the power source and power cord are functioning correctly, set the power switch to ON (I).
9. Measure the AC voltage as follows. The value should be the same as the incoming line voltage.
 - **1-phase models:** Measure the voltage from J1 (WHT) to J2 (BLK). See *Figure 7*.
 - **3-phase models:** Measure the voltage as follows. See *Figure 8*.
 - J1 (WHT – white wire with black stripe) to J2 (BLK – black wire with white stripe)
 - J2 to J4 (BRN – brown wire with white stripe)
 - J1 to J4

Figure 7 – AC input on 1-phase models

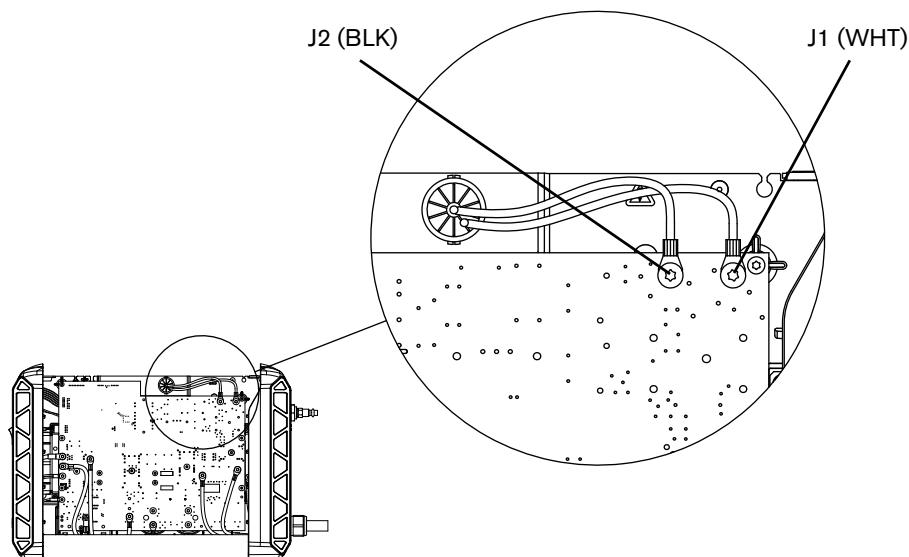
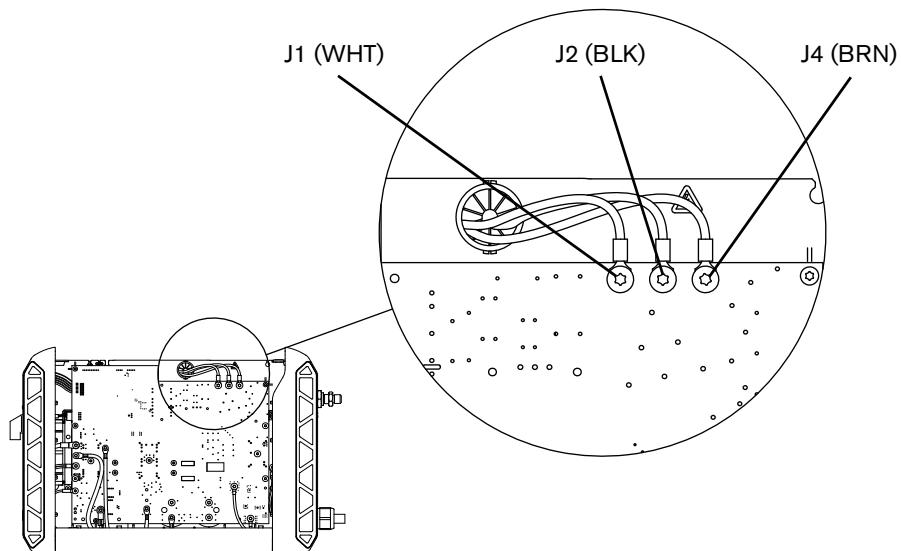


Figure 8 – AC input on 3-phase models



10. If the voltage reading is too high or too low, set the power switch to OFF (O), and disconnect the power cord from the power source.

11. Inspect the wires that run from:

- The power switch to the power board
- The power switch to the center panel (or EMI board)

Replace any wires that are frayed or damaged. See page 245 (1-phase models) or page 249 (3-phase models).

12. If the wires are in good condition and connected securely, inspect the power switch:

- Make sure none of the wire connections or screws are loose or damaged.
- Make sure the contacts on the power switch are not damaged.
- Perform a mechanical check of the power switch by turning it ON and OFF multiple times.
Does the switch engage properly when you turn it ON? Does it stay in the ON position?

Replace the power switch if necessary. See page 236 (1-phase models) or page 237 (3-phase models).

13. If the system still does not operate properly, continue with *Test 2 – power board voltage checks* on page 187.

Test 2 – power board voltage checks

WARNING

Always wear proper personal protective equipment (PPE) before testing powered equipment.

1. Set the power switch to OFF (O), and disconnect the power cord from the power source.
2. Remove the power supply cover and handle. See page 215.
3. Remove the component barrier. See page 218.
4. Reconnect the electrical power, and set the power switch to ON (I).

NOTICE

Do not use -VBus (TP1) as ground. Doing so could destroy the power supply. Instead ground to either the ground wire clip on the rear panel or to the heatsink. See page 182.

5. Use a multimeter to measure the voltages listed in *Table 8* to make sure the power board (PCB3) is functioning correctly. See *Figure 9* on page 188.

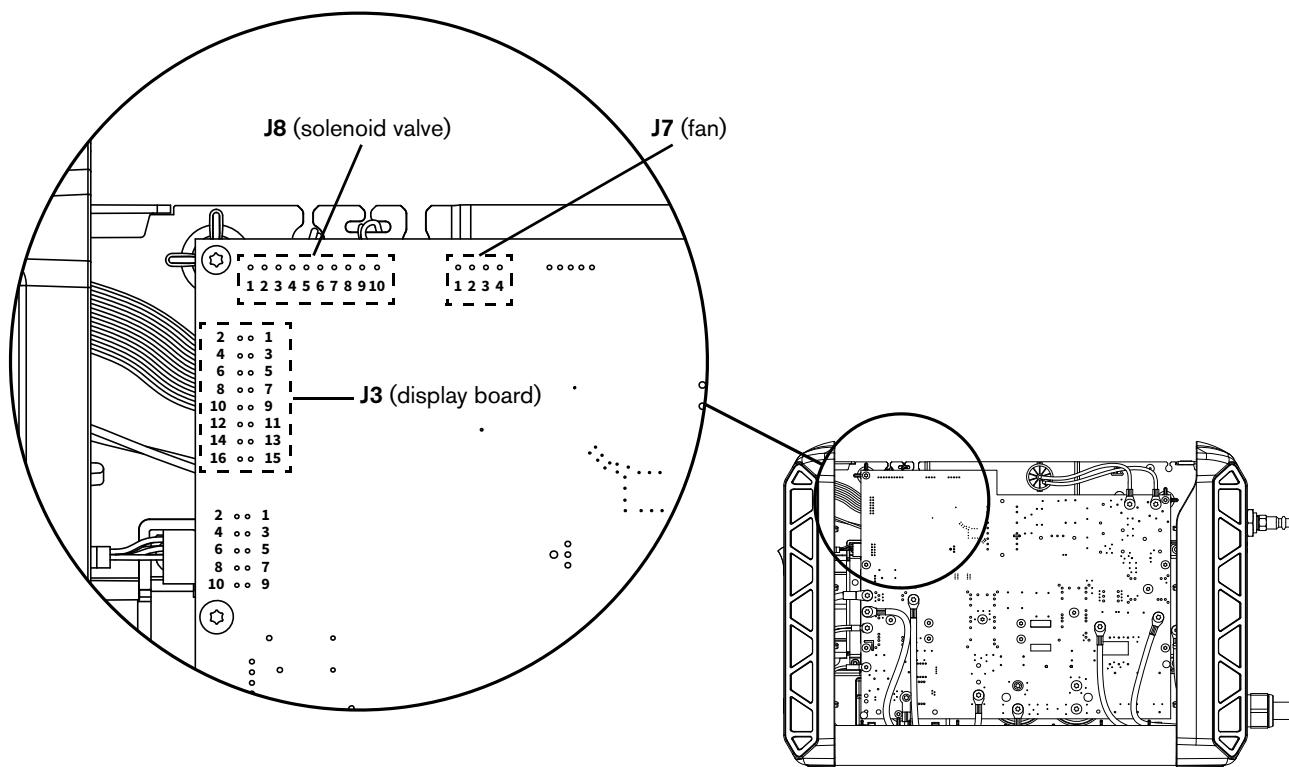
Table 8

Component	Pin number to ground	Test	Expected value
Fan	Pin 1 on J7	48 VDC	48 VDC \pm 10%
Solenoid valve	Pin 7 on J8	48 VDC	48 VDC \pm 10%
	Pin 5 on J8	24 VDC	24 VDC \pm 10%
Display board	Pin 1 on J3	3.3 VDC	3.3 VDC \pm 10%
	Pin 2 on J3	3.3 VDC	3.3 VDC \pm 10%
	Pin 4 on J3	5.0 VDC	5.0 VDC \pm 10%

6. Is the 48 VDC voltage for the fan correct?
 - If yes, continue with the next step.
 - If no, disconnect the fan's J7 connector from the power board. Measure the voltage again from pin 1 on J7 to ground. Is the voltage now correct?
 - If yes, replace the fan. See page 264.
 - If no, continue with the next step.

7. Is the 48 VDC voltage for the solenoid valve correct?
 - If yes, continue with the next step.
 - If no, disconnect the valve's J8 connector from the power board. Measure the voltage again from pin 7 on J8 to ground. Is the voltage now correct?
 - If yes, replace the solenoid valve. See page 271.
 - If no, continue with the next step.
8. If the 24 VDC voltage for the solenoid valve is not correct, continue with the next step.
9. If the 3.3 VDC or 5.0 VDC voltage readings at J3 are not correct, disconnect the display board ribbon cable from J3 on the power board. Measure the voltage again from pin 1, pin 2, and pin 4 on J3 to ground. Are the voltages now correct?
 - If yes, replace the display board. See page 234.
 - If no, replace the power board. See page 253.

Figure 9 – J3, J7, and J8 on power board



Test 3 – VBUS and voltage balance on power board

Test the power board (PCB3) to make sure the circuits are balanced. You can use the test points, or you can test on the capacitor screws. The test points are labeled on the back of the power board, as are the positive and negative capacitor terminals. See *Figure 10* on page 190 for locations of test points.

NOTICE

Do not use a multimeter with test leads for this test. This can cause a short-circuit between the BUS and the heatsink. Use mini-banana plugs instead, and attach them to the test point (TP) openings in the power board.

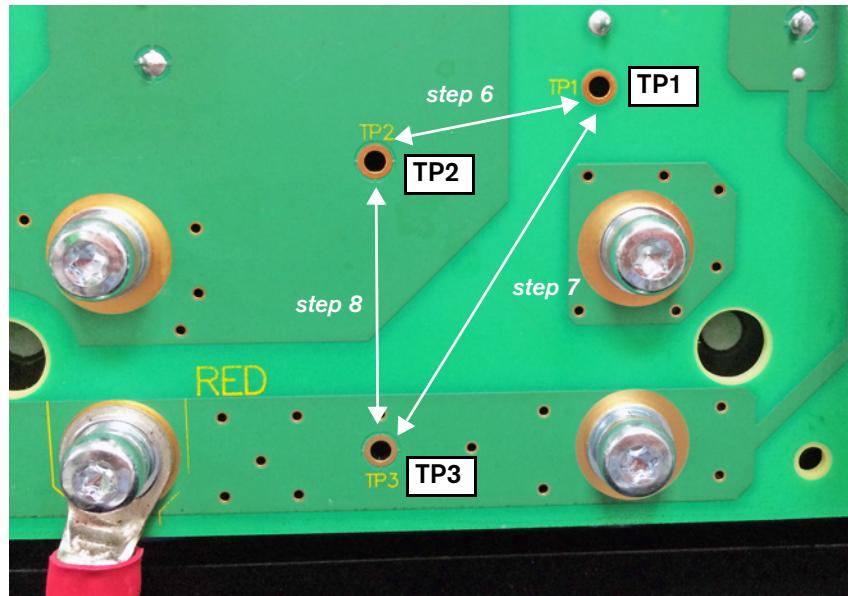
Never connect -VBus (TP1) to ground. Doing so could destroy the power supply.

1. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
2. Remove the power supply cover and handle. See page 215.
3. Remove the component barrier. See page 218.
4. Reconnect the electrical power. Leave the power switch set to OFF (O).
5. Use miniature banana plugs (for example, Pamona® 2945 plugs) to connect to the test points on the power board (TP1, TP2, TP3) as described in the following steps.



If miniature banana plugs are not available, use small test clips that you can attach to the copper contacts in the test point openings on the power board.



Figure 10 – Test points on power board

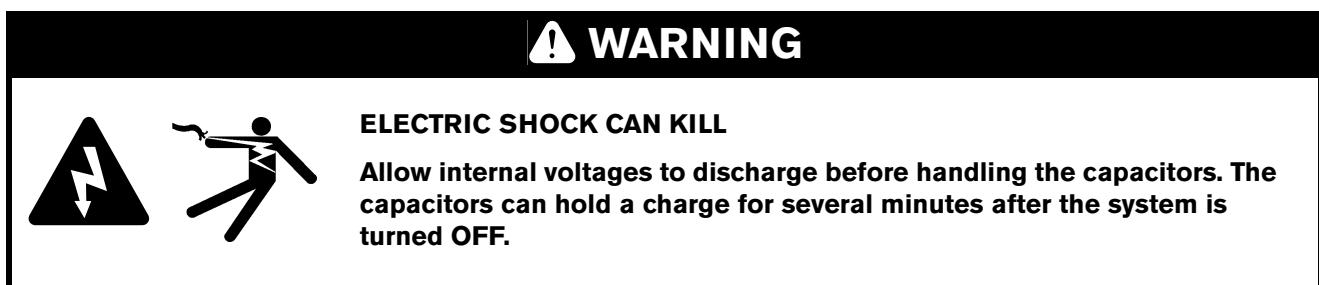
6. Measure the voltage from **TP1** to **TP2**. See *Figure 10* above.
 - a. Position the mini-banana plugs at the TP1 and TP2 test points on the power board.
 - b. Turn the power ON (I).
 - c. The voltage should read approximately:
 - 200 – 240 V 1-phase models: 400 VDC
 - 400 V CE/CCC 3-phase models: 560 VDC
 - 480 V CSA 3-phase models: 670 VDC
7. Measure the voltage from **TP1** to **TP3**.
 - a. Turn the power OFF (O).
 - b. Move the mini-banana plugs to TP1 and TP3.
 - c. Turn the power ON (I).
 - d. This value should read approximately one-half of the value you found in step 6:
 - 200 – 240 V 1-phase models: 200 VDC
 - 400 V CE/CCC 3-phase models: 280 VDC
 - 480 V CSA 3-phase models: 335 VDC



All values can be $\pm 10\%$.

8. Measure the voltage from TP2 to TP3.

- Turn the power OFF (O).
- Move the mini-banana plugs to TP2 and TP3.
- Turn the power ON (I).
- This value should read approximately one-half of the value you found in step 6:
 - 200 – 240 V 1-phase models: 200 VDC
 - 400 V CE/CCC 3-phase models: 280 VDC
 - 480 V CSA 3-phase models: 335 VDC



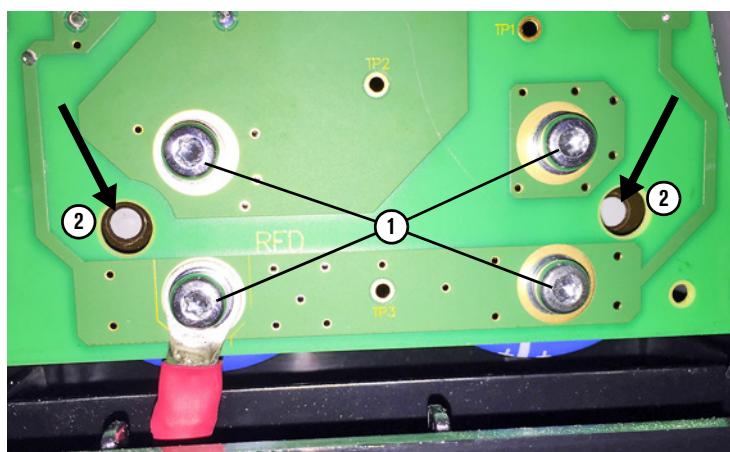
9. Wait approximately 10 minutes for internal voltages to discharge. Loosen the capacitor screws ① enough that you can disconnect the capacitors from the power board. Measure the resistance across the capacitors. The resistance should be approximately 13.5 kΩ for 1-phase models or 18 kΩ for 3-phase models.

10. Perform a visual inspection of the capacitors. You should see white dots in the vent holes ② next to the capacitors, as shown in *Figure 11*. If you do not see the white dots, replace the capacitors. See page 261.



Always replace both capacitors together at the same time.

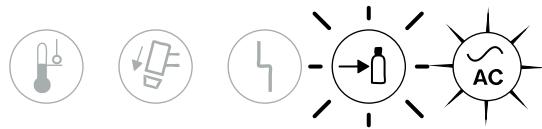
Figure 11 – Capacitor screws and vent holes



11. The values found in *step 7* and *step 8* should be approximately equal. If they differ by more than 30 V, and if the capacitor resistance is out of range, replace the power board. See page 253.

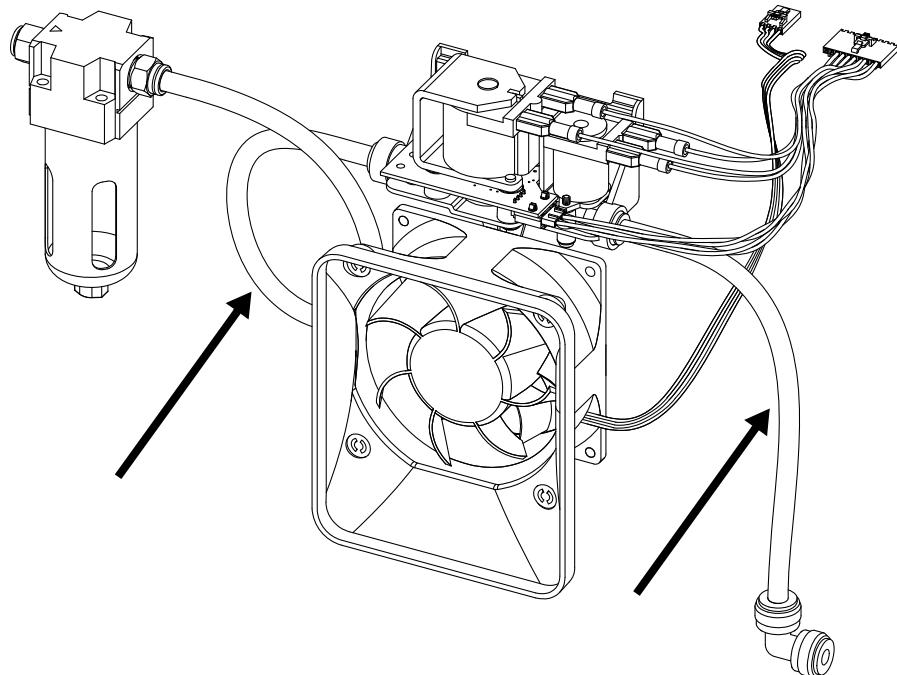
Test 4 – solenoid valve – no gas input

If the Gas Pressure fault LED blinks, test the solenoid valve (V1) and power board (PCB3) for proper operation.



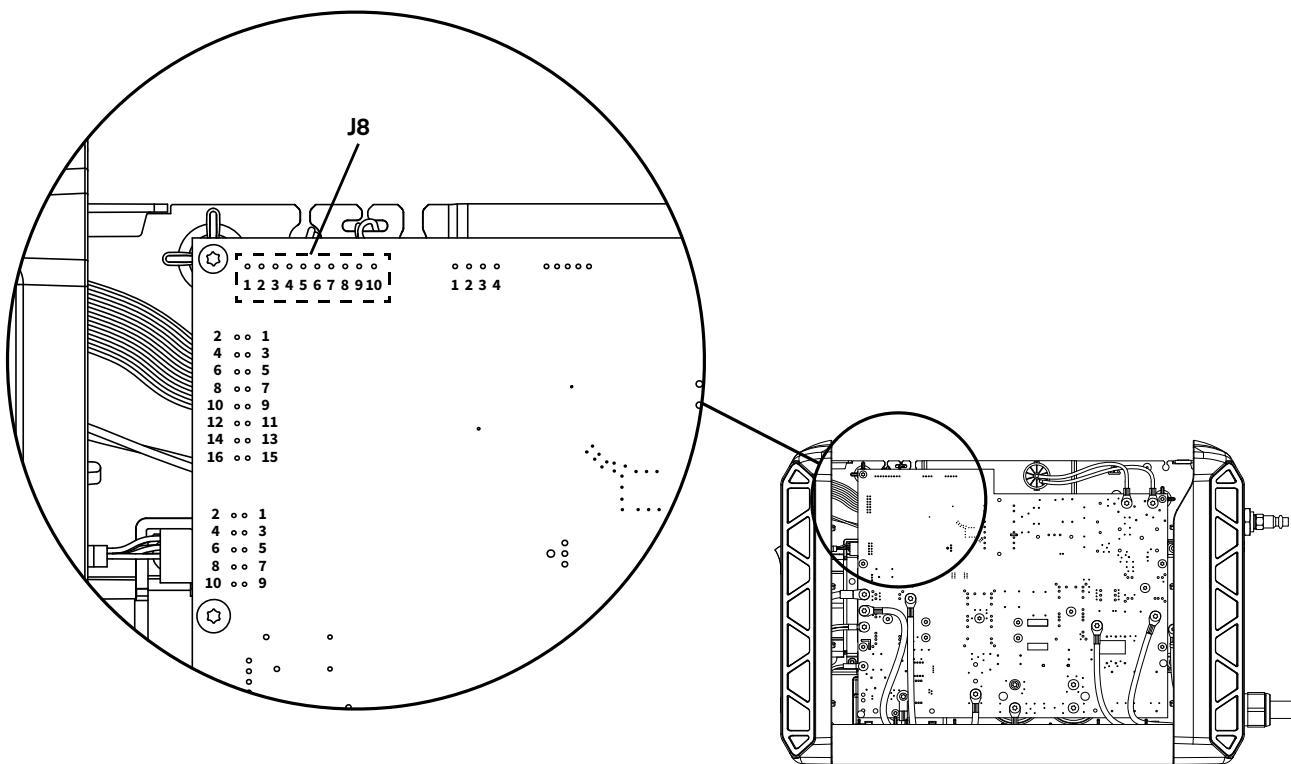
1. Set the power switch to OFF (O), and disconnect the power cord from the power source.
2. Remove the power supply cover and handle. See page 215.
3. Disconnect the gas supply.
4. Set the power switch to ON (I). Does the solenoid valve make an audible clicking sound with the gas disconnected and the power supply ON?
 - If yes, examine the gas hoses that connect to the solenoid valve. If either hose is kinked or damaged, replace it. See page 274. Reconnect the gas supply. Set the power switch to ON (I), and fire the torch.
 - If no, continue with the next step.

Figure 12



5. Measure the voltage between pin 1 and pin 7 on J8. Is the voltage approximately 48 VDC?
 - If yes, continue with *Test valve after cold restart* below.
 - If no, skip to *Test valve after disconnecting from power board* on page 194.

Figure 13 – J8 on power board



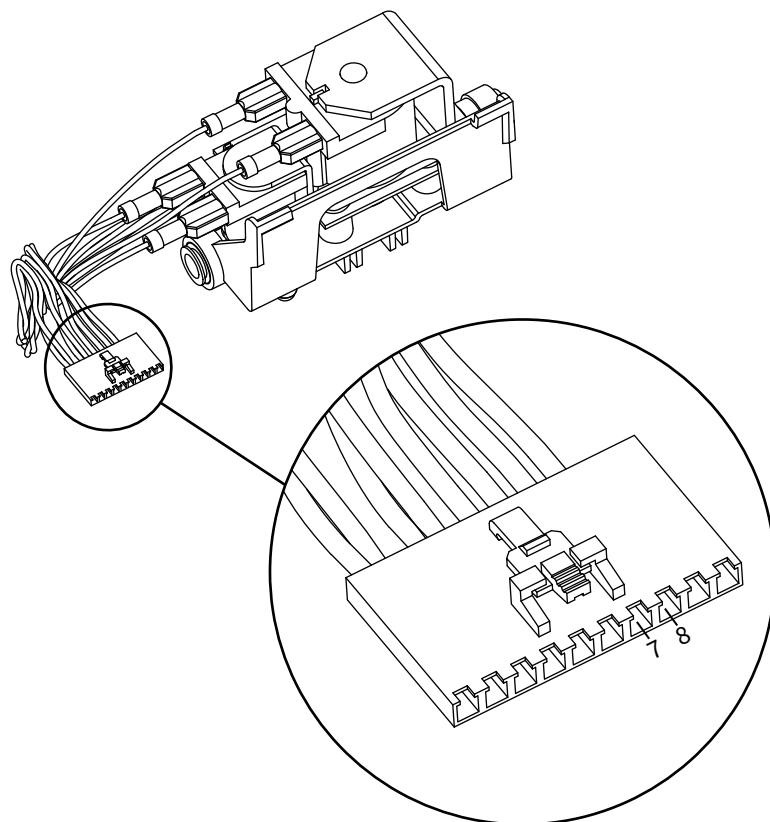
Test valve after cold restart

1. Place test leads at pin 7 and pin 8 on J8. Perform a cold restart. (Leave the power supply OFF for approximately 30 seconds before turning it back ON.)
2. Hold the test leads in place for approximately 3–5 seconds after restarting the power supply.
3. Was there a spike in voltage after restarting the power supply?
 - If yes, replace the solenoid valve. See page 271.
 - If no, replace the power board. See page 253.

Test valve after disconnecting from power board

- 1.** Disconnect the J8 connector from the power board.
- 2.** Measure the voltage again between pin 1 and pin 7 on J8. Is the voltage approximately 48 VDC?
 - If yes, continue with the next step.
 - If no, replace the power board. See page 253.
- 3.** Perform a resistance check to confirm that the solenoid valve is faulty. Measure the resistance between pin 7 and pin 8 on the valve J8 connector. If the resistance is lower than 44Ω ($\pm 5 \Omega$), replace the solenoid valve. See page 271.

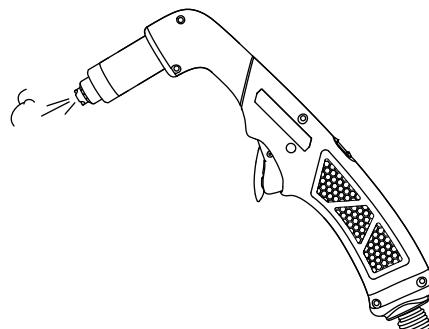
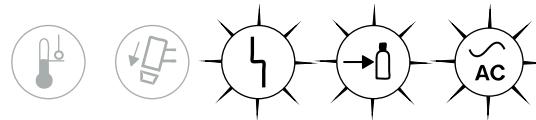
Figure 14



Test 5 – solenoid valve – low gas pressure

If the Gas Pressure fault LED and System Fault LED illuminate while the system is powered ON, check the entire gas supply line for possible causes of pressure loss.

First, run a gas test. See page 158. Let the gas flow for 3–5 minutes – long enough to determine if the system is maintaining gas pressure. If the actual pressure differs from the set pressure by more than 0.2 bar (3 psi) at any point during this test, perform the following external and internal checks on the gas supply line.



Run gas test for 3 – 5 minutes

External checks

Before performing these checks, set the power switch to OFF (O).

- Make sure you have performed the low gas pressure checks listed under *Gas Pressure fault LED* on page 170.
- Check the consumables. Are the nozzle and electrode worn? Are the holes in the swirl ring blocked? Is the set of consumables mismatched? Replace if needed.
- Check the torch lead. Is it kinked, damaged, or severely twisted? Replace if damaged. See page 295 (hand torches) or page 311 (machine torch).
- Check the torch lead connection to the power supply. Is there any damage to the pins on the torch lead or to the receptacle on the power supply? Replace if needed.
 - Power supply: See *Replace the torch quick-disconnect receptacle* on page 277.
 - Hand torches: See *Replace the torch body or the torch lead* on page 295.
 - Machine torches: See *Replace the torch body or the torch lead* on page 311.
- Is the power supply sharing the gas supply with other devices? If so, make sure those devices do not prevent sufficient gas supply to the plasma power supply.
- If the system is using external filtration, check that filter to see if it is clogged or in need of cleaning or repair.
- Is the system connected to an undersized air compressor? See page 37 and page 39 for gas supply requirements.
- Electrical interference could be disrupting proper operation of the solenoid valve (V1). Move the power supply to another location, and see if the problem persists.

Internal checks

Before performing these checks, set the power switch to OFF (**O**), and disconnect the power cord from the power source. Remove the power supply cover and handle. See page 215.

From the fan side of the power supply:

- Check all connection points on the gas supply line. Make sure there are no leaks or loose connections.
- Examine the gas hoses that connect to the solenoid valve (V1). If either hose is kinked or damaged, replace it. See page 274.
- Check the connection to the torch lead at the back of the quick-disconnect receptacle. Is the connection secure? Are the wires from the receptacle pinched, twisted, or damaged? Replace if needed. See page 277.
- Check the wire connections on the solenoid valve. Are all of the wire connections secure?

Cold restart

After performing all of the external and internal checks listed above, perform a cold restart, and fire the torch.

If the Gas Pressure fault LED and System Fault LED still illuminate, replace the solenoid valve (V1). See page 271.

Test 6 – solenoid valve pressure sensor

If you get a 2-11-0 or 2-11-1 fault code, perform this test to determine if the solenoid valve (V1) or power board (PCB3) may be faulty. The 2-11 fault codes indicate that the problem is electrical and most likely not related to the gas supply.

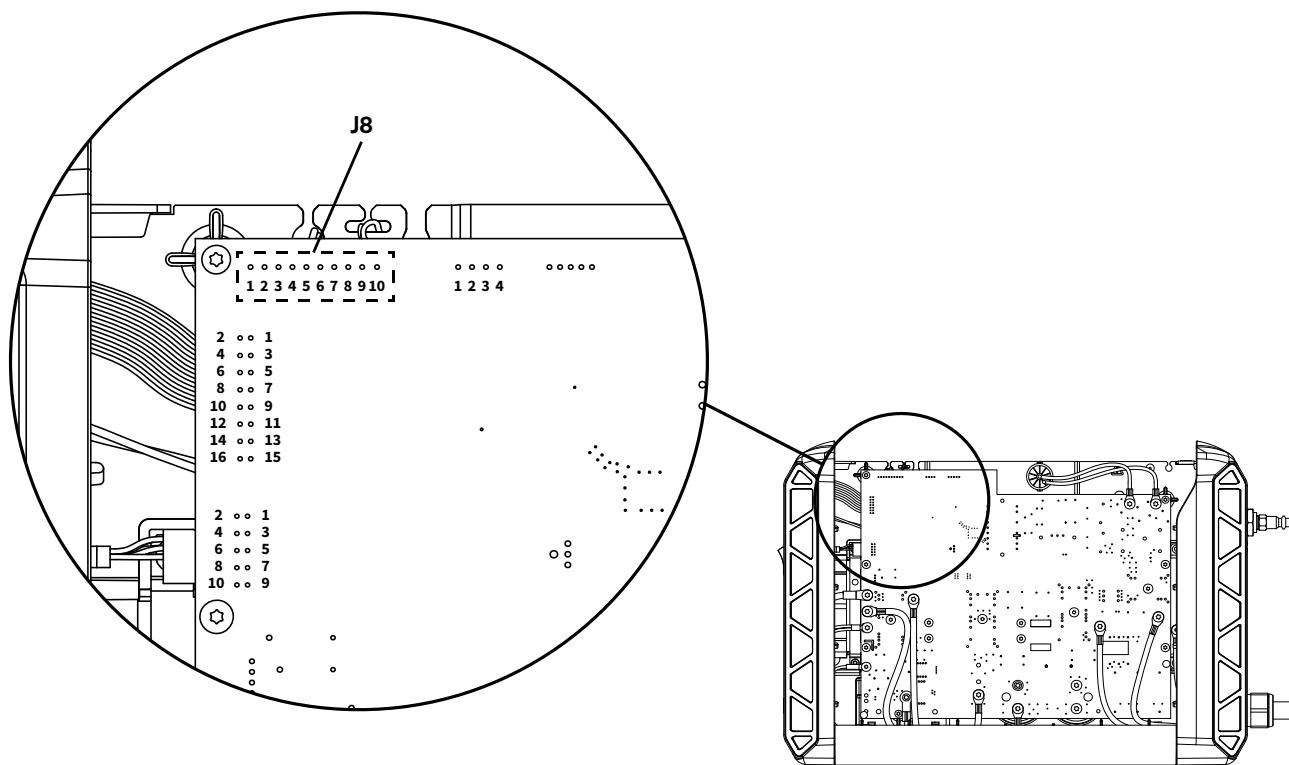
Check for electrical interference and pinched wires

- 1.** Electrical interference could be disrupting proper operation of the solenoid valve. Move the power supply to another location, and see if the problem persists.
- 2.** Set the power switch to OFF (**O**), and disconnect the power cord from the power source.
- 3.** Remove the power supply cover and handle. See page 215.
- 4.** Remove the component barrier. See page 218.
- 5.** Check the connection to the torch lead at the back of the quick-disconnect receptacle. Is the connection secure? Are the wires from the receptacle pinched, twisted, or damaged? Replace if needed. See page 277.

Check the power input and solenoid valve coils

6. Disconnect the solenoid valve from J8 on the power board.
7. Reconnect the electrical power. Set the power switch to ON (I).
8. Measure the voltage between pin 1 and pin 4 at J8 on the power board. Is the voltage approximately 5 VDC?
 - If yes, continue with the next step.
 - If no, replace the power board. See page 253.

Figure 15 – J8 on power board



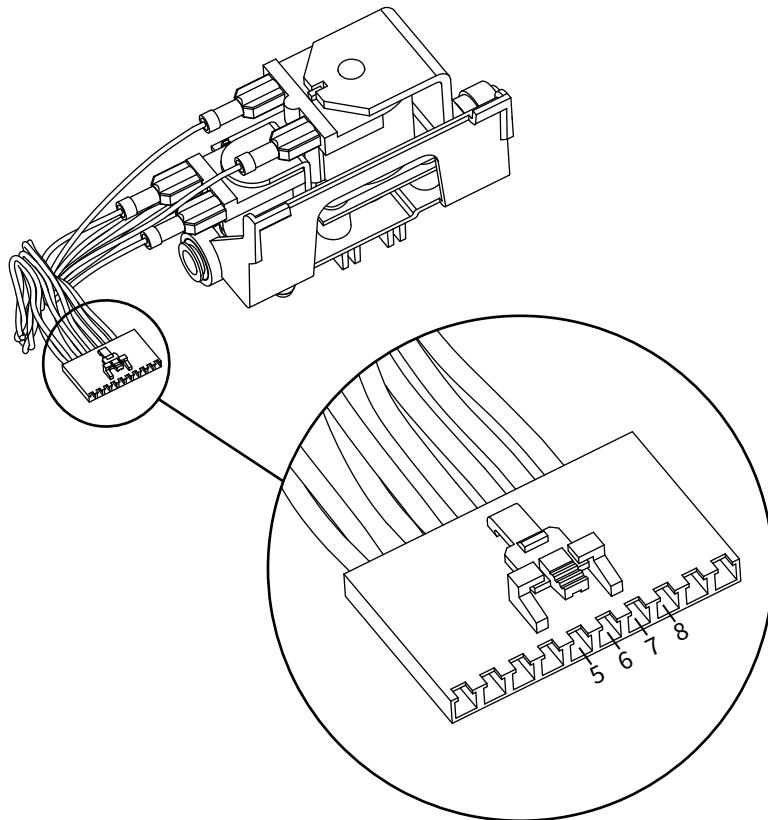
9. Measure the resistance on the solenoid valve J8 connector as follows:

- The resistance between pin 5 and pin 6 should be approximately $22\ \Omega$ ($\pm 3\ \Omega$).
- The resistance between pin 7 and pin 8 should be approximately $44\ \Omega$ ($\pm 5\ \Omega$).

Are the resistance values correct?

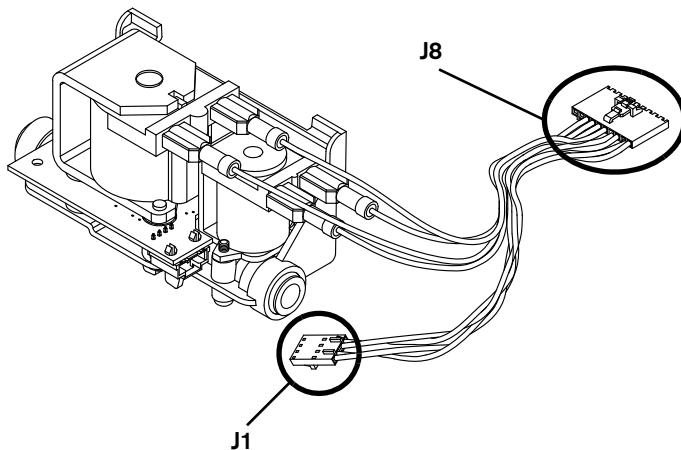
- If yes, continue with the next step.
- If no, replace the solenoid valve. See page 271.

Figure 16



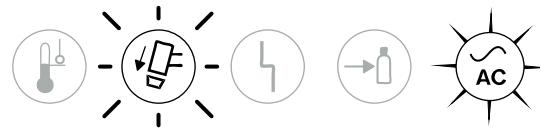
Check the solenoid valve sensor and power board sensor input

10. Set the power switch to OFF (O).
11. Disconnect the solenoid valve from J8 on the power board.
12. Disconnect the J1 connector from the solenoid valve board.
13. Are any of the pins on the connectors or on the solenoid valve board damaged?
 - If yes, replace the solenoid valve. See page 271.
 - If no, continue with the next step.
14. Reconnect the valve to J8 on the power board.
15. Reconnect J1 to the solenoid valve board.
16. Disconnect the gas supply.
17. Set the power switch set to ON (I).
18. Measure the voltage between pin 1 and pin 2 on J8. See *Figure 15* on page 198. Is the voltage approximately 0.18 – 0.22 V?
 - If yes, replace the power board. See page 253.
 - If no, replace the solenoid valve. See page 271.



Test 7 – torch stuck open (TSO) or torch stuck closed (TSC)

If the nozzle and electrode are not in contact before the torch trigger is pulled, the power supply detects a “torch stuck open” (TSO) fault. If the nozzle and electrode remain in contact after the torch trigger is pulled, the power supply detects a “torch stuck closed” (TSC) fault. TSO and TSC faults cause the Torch Cap fault LED to blink.

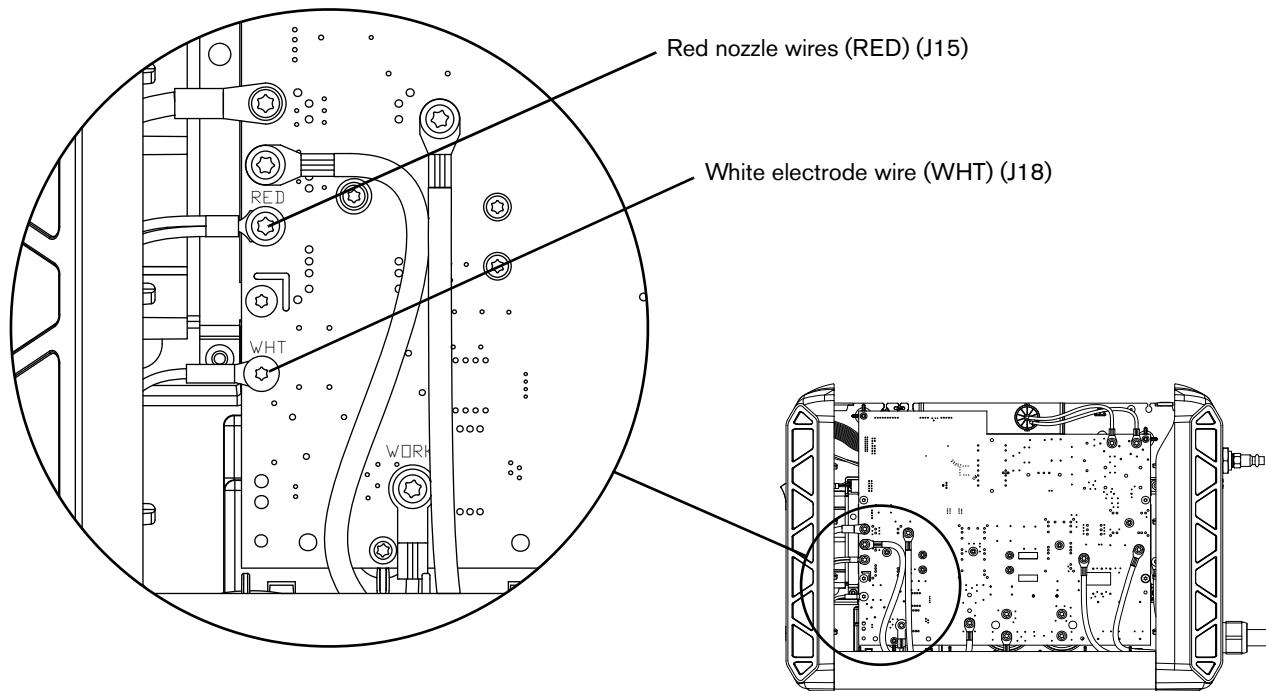


Use the following test to determine if the torch is stuck in either position.

1. Set the power switch to OFF (**O**), and disconnect the power cord from the power source.
2. Remove the power supply cover and handle. See page 215.
3. Remove the component barrier. See page 218.
4. Measure the resistance between the red wire group and the white wire from the torch receptacle. These are labeled RED and WHT on the power board. See *Figure 17* on page 202. The resistance should read very low, a closed circuit.
 - If the resistance reads as open with the power OFF, the nozzle and electrode are not in contact, or one of the wires in the lead is broken. Skip to step 7.

NOTICE

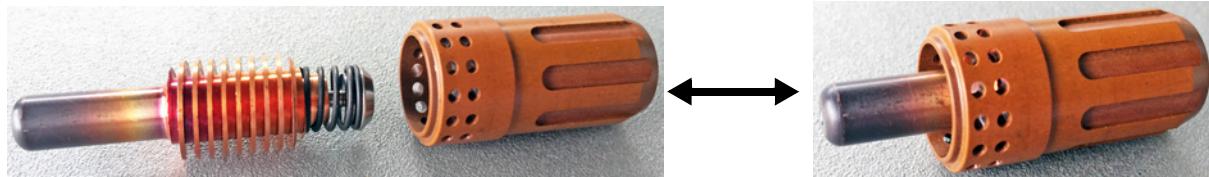
To avoid causing a short or damage to the multimeter, do not fire the torch with the multimeter connected to the red wire group and white wire from the torch receptacle while the system is powered ON.

Figure 17 – Torch lead wires on power board

5. Reconnect the electrical power. Set the power switch to ON (I).
6. Enter gas test mode. See page 158. Is gas flowing?
 - If yes, measure the resistance again between the red wire group (RED) and the white wire (WHT) from the torch receptacle. The resistance should read very high – an open circuit – when gas is flowing.
If the resistance reads as very low (closed circuit) with the gas flowing, the nozzle and electrode are in contact or a short-circuit occurred in one of the wires in the torch lead. Continue with step 7.
 - If no, check the solenoid valve to make sure it is operating properly. Perform *Test 4 – solenoid valve – no gas input* on page 192 and *Test 5 – solenoid valve – low gas pressure* on page 195.
7. Set the power switch to OFF (O). Remove the consumables from the torch.

- 8.** Can you slide the electrode freely through the swirl ring? Does the spring on the electrode work well, and is the spring in good condition?
- If yes, replace the torch lead.
 - Hand torch: See page 295.
 - Machine torch: See page 311.
 - If no, replace the swirl ring and electrode. See page 48.

Figure 18

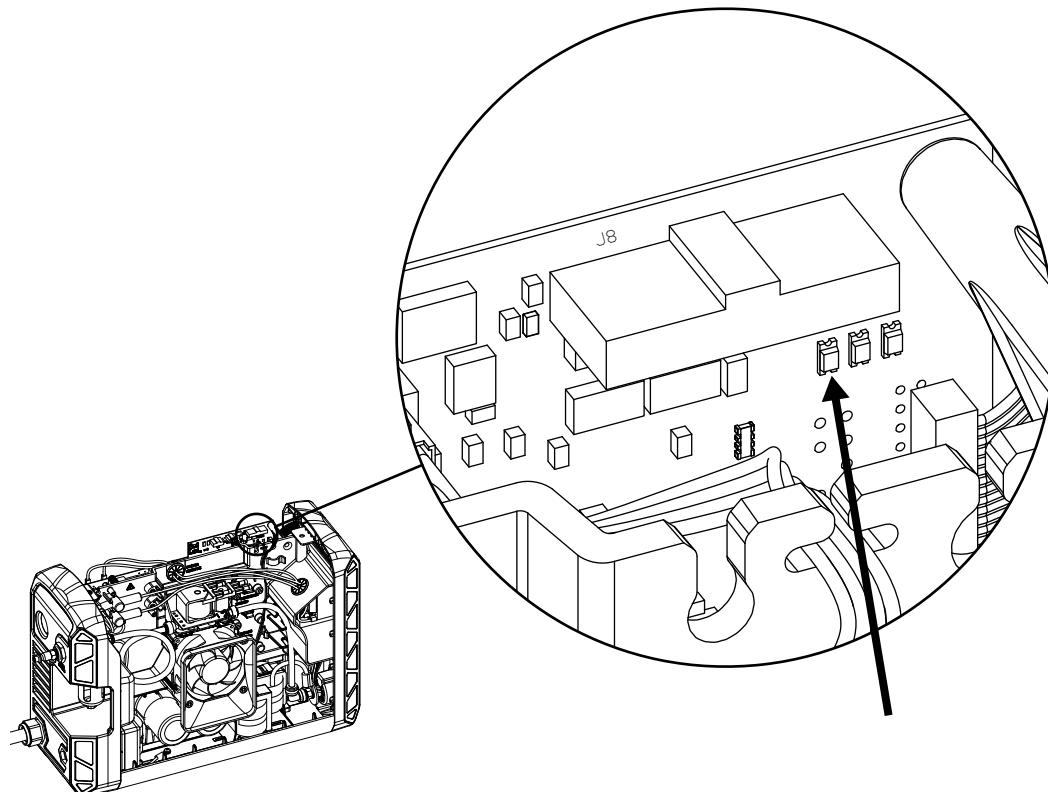


- 9.** Because “torch stuck open” and “torch stuck closed” failures can be intermittent, repeat the steps above several times.
- 10.** If the fault persists, test with another torch if possible. If you continue to get the same result, the problem may be due to a shorted pilot arc IGBT. Replace the power board. See page 253.

Test 8 – plasma start

1. Set the power switch to OFF (O), and disconnect the power cord from the power source.
2. Remove the power supply cover and handle. See page 215.
3. Remove the component barrier. See page 218.
4. Reconnect the electrical power. Set the power switch set to ON (I).
5. Point the torch away from yourself and others. Fire the torch and watch the red Start LED on the power board (left-most LED below the solenoid valve J8 connector). The LED should illuminate when the torch is firing.

Figure 19 – Start LED on power board



6. Set the power switch to OFF (O), and disconnect the power cord from the power source.
7. Check the resistance between pin 2 and pin 3 of J19 on the power board. See *Figure 20* on page 205.
 - When the torch is firing, the resistance should read approximately $1\ \Omega$ or less.
 - When the torch is not firing, the circuit should read approximately $3\ k\Omega$.

8. If this test fails, check the start switch and the torch wires inside the torch. Replace the following components if necessary.

- Hand torches:

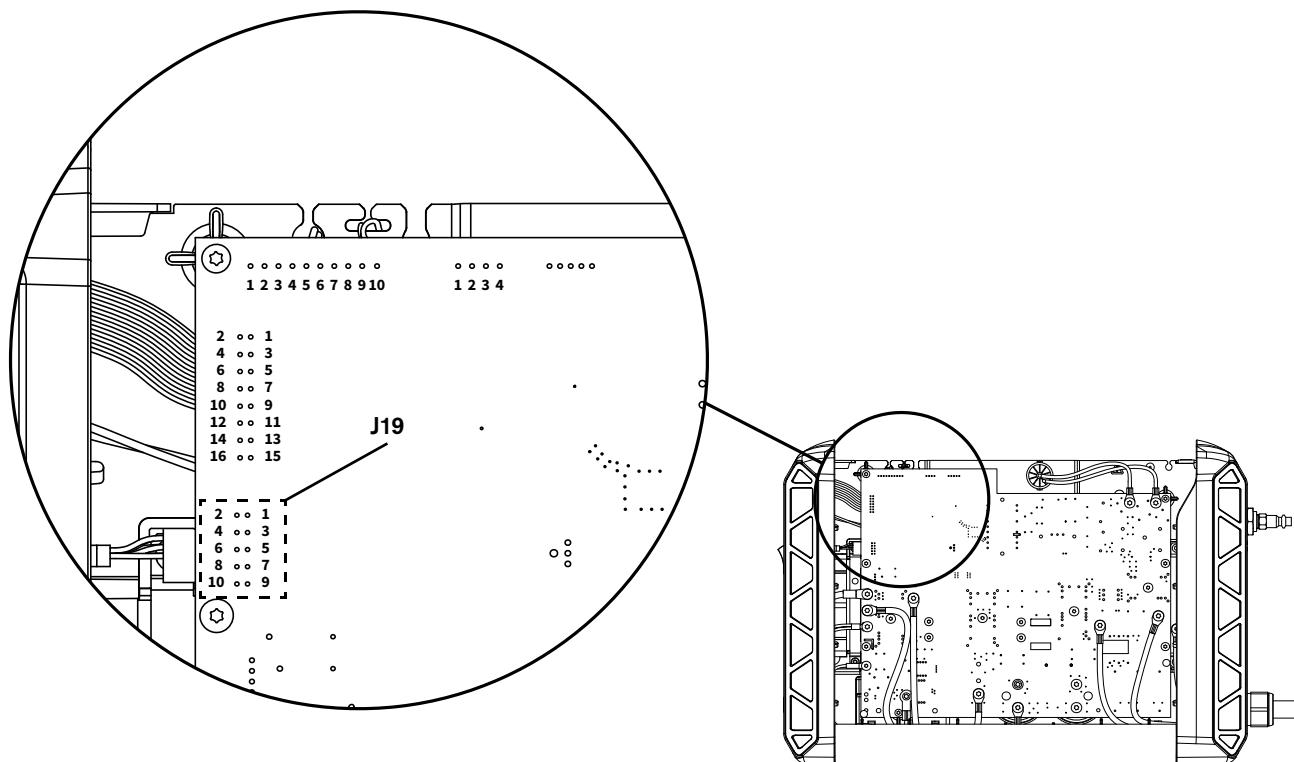
- See *Replace the start switch* on page 298.
 - See *Replace the cap-sensor switch/torch-disable switch assembly* on page 299.
 - See *Replace the torch body or the torch lead* on page 295.

- Machine torches:

- See *Replace the cap-sensor switch/torch-disable switch assembly* on page 314.
 - See *Replace the torch body or the torch lead* on page 311.

9. If the problem persists, replace the power board. See page 253.

Figure 20 – J19 on power board



Test 9 – torch cap sensor

Test the torch cap-sensor switch/torch-disable switch assembly and the torch lead.

Check the torch and the torch lead

1. Disconnect the torch from the power supply.
2. Make sure the consumables are correctly installed and are not mismatched. Adjust or replace the consumables if necessary. Make sure the retaining cap is not worn.

 When the consumables are properly installed and fully tightened, the retaining cap should sit slightly inside the torch handle or shell.
3. Move the torch-disable switch to the green “ready to fire” (✓) position.
4. Check the resistance between pin 5 and pin 7 in the torch plug.
 - ❑ The resistance should read very low, approximately $1\ \Omega$ or less. If the resistance is very low, continue with the next step.
 - ❑ If it measures high resistance, the cap-sensor switch circuit is open. Continue with step 7 on page 207.

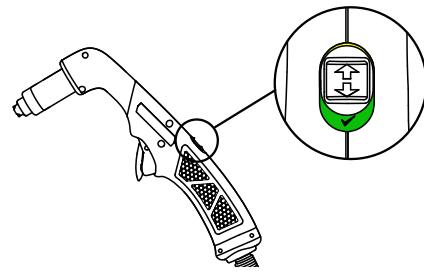
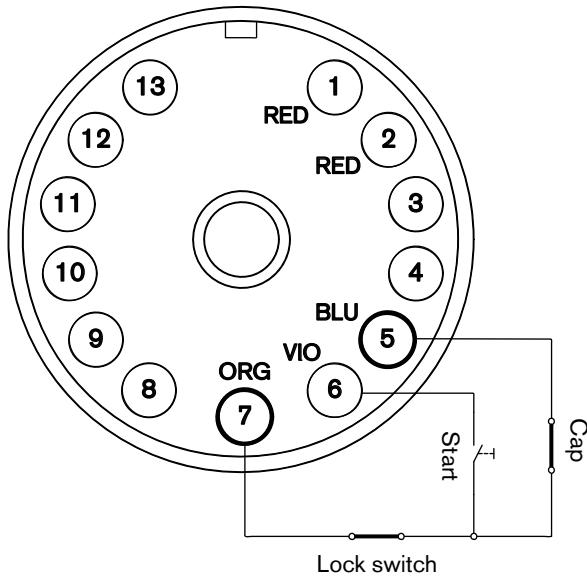
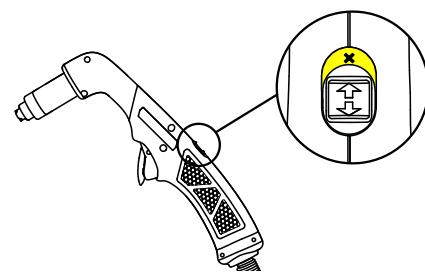


Figure 21 – Torch plug pins



- 5.** Move the torch-disable switch to the yellow lock (**X**) position.
- 6.** Check the resistance between pin 5 and pin 7 in the torch plug again.
 - The resistance should read open (OL). If the resistance is open, continue with step 9.
 - If it measures low resistance (approximately $1\ \Omega$ or less), the cap-sensor switch circuit is closed. Continue with the next step.



- 7.** Perform a continuity check on the torch wires.
 - Remove the left side of the torch handle or shell.
 - Perform a continuity check on the blue wire and on the orange wire. Test the blue wire (BLU) against pin 5 in the torch plug. Test the orange wire (ORG) against pin 7.
- 8.** Do both torch wires have continuity?
 - If yes, replace the cap-sensor switch/torch-disable switch assembly.
 - For hand torches, see page 299.
 - For machine torches, see page 314.
 - If no, replace the torch lead.
 - For hand torches, see page 295.
 - For machine torches, see page 311.

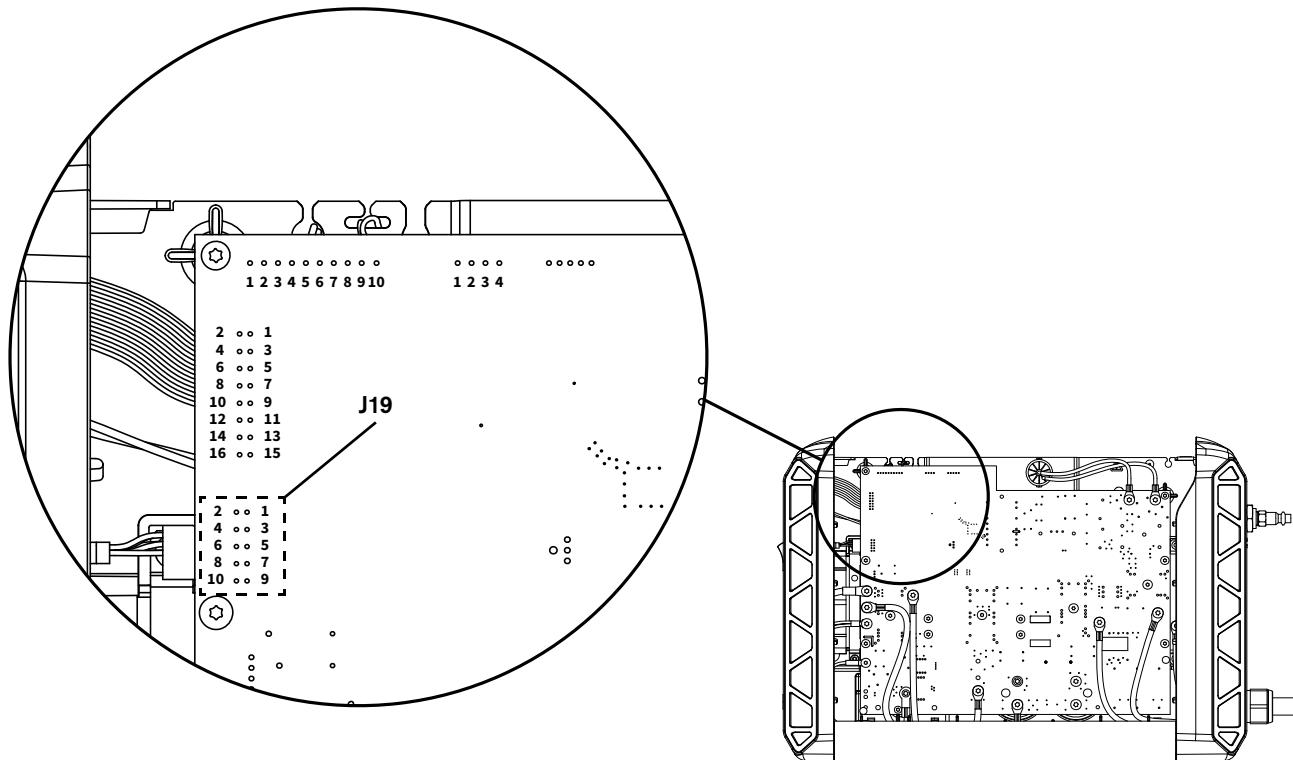
Check the power supply (torch receptacle and power board)

- 9.** Set the power switch to OFF (**O**), and disconnect the power cord from the power source.
- 10.** Remove the power supply cover and handle. See page 215.
- 11.** Remove the component barrier. See page 218.
- 12.** Perform a continuity check on the torch receptacle. See *Continuity check* on page 178.
- 13.** Does each torch receptacle wire have continuity?
 - If yes, continue with the next step.
 - If no, replace the torch receptacle. See page 277.
- 14.** Plug the torch back into the power supply. Make sure:
 - The consumables are still installed correctly on the torch.
 - The torch-disable switch is set to the green “ready to fire” (**✓**) position.

15. Check the resistance between pin 1 and pin 2 of J19 on the power board. See *Figure 22*.

- ❑ The resistance should read very low, approximately 1 Ω or less.
- ❑ If it measures high resistance, the cap-sensor switch circuit is open. Replace the power board. See page 253.

Figure 22 – J19 on power board

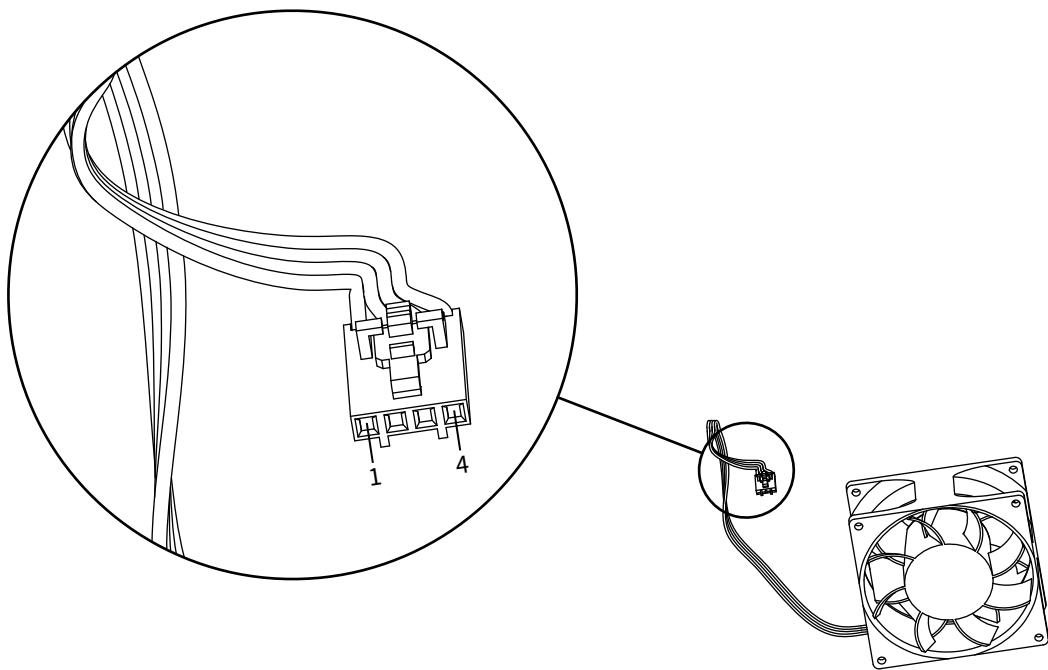


Test 10 – fan

Test the fan (M1) for proper operation.

1. Set the power switch to OFF (O), and disconnect the power cord from the power source.
2. Remove the power supply cover and handle. See page 215.
3. Remove the component barrier. See page 218.
4. Remove the fan from the power supply. See page 264.
5. Connect the fan to an external 12 V or 24 V power source. Use pin 1 (red) and pin 4 (black) on the fan J7 connector. Does the fan run?
 - If yes, replace the power board. See page 253.
 - If no, replace the fan. See page 264.

Figure 23

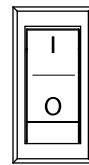


Test 11 – power switch trip coil (1-phase models)

The 200–240 V CSA/CE/CCC 1-phase power supplies have over-voltage protection on the power switch (S1) in the form of a mechanical trip coil (which connects to the component side of the power board at J10). If voltage provided by the incoming circuit is greater than the maximum voltage, the trip coil turns OFF the power switch.

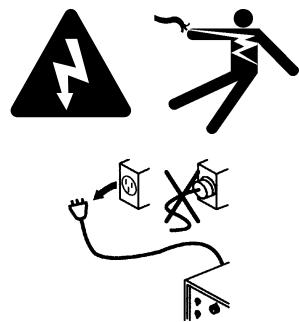
If the power supply is shutting down unexpectedly, do the following check to determine if the power switch is faulty.

1. With the power switch in the OFF (O) position, disconnect the electrical power.
2. Set the power switch to the ON (I) position. Does the switch stay in position?
 - If yes, the trip coil mechanism is functioning properly.
 - If no, replace the power switch. See page 236.



Power Supply Component Replacement

! WARNING



ELECTRIC SHOCK CAN KILL

Disconnect electrical power before performing any maintenance.

All work requiring removal of the power supply cover must be performed by a qualified technician.

See the *Safety and Compliance Manual (80669C)* for more safety precautions.

NOTICE



Static electricity can damage circuit boards. Use proper precautions when handling printed circuit boards.

Store PC boards in anti-static containers.

Wear a grounded wrist strap when handling PC boards.

Install a machine interface cable for raw arc voltage

Kit number	Description
428689	<i>Kit: Machine interface for raw arc voltage (kit contains strain relief and instructions)</i>

To access divided raw arc voltage, refer to Field Service Bulletin 809520.

Replace the air filter bowl and filter element

Kit number	Description
428673	<i>Kit: Air filter bowl (polycarbonate) with metal guard</i>
428378	<i>Kit: Air filter element</i>

It is extremely important to maintain a clean, dry gas supply line in order to:

- Prevent oil, water, dirt, and other contaminants from damaging internal components.
- Achieve optimal cut quality and consumable life.

Check the filter element inside the air filter bowl regularly, especially in environments that are very dusty or very warm and humid. Replace the filter element when it is dirty or starts to deteriorate. See page 319 for part numbers.



NOTICE

Synthetic lubricants containing esters that are used in some air compressors will damage polycarbonates used in the air filter bowl.

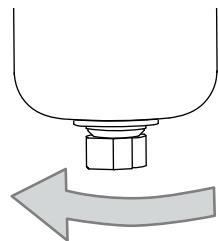
Keep the filter bowl and O-ring free from oil, chemicals, dirt, and other contaminants. These contaminants can prevent a good seal, causing gas to leak and additional contaminants to go through the gas line in the power supply and torch. Over time, these contaminants can damage internal components.



If you are using an external filtration system – such as the Eliminizer filter kit (128647) – also check that filter regularly for required maintenance or cleaning.

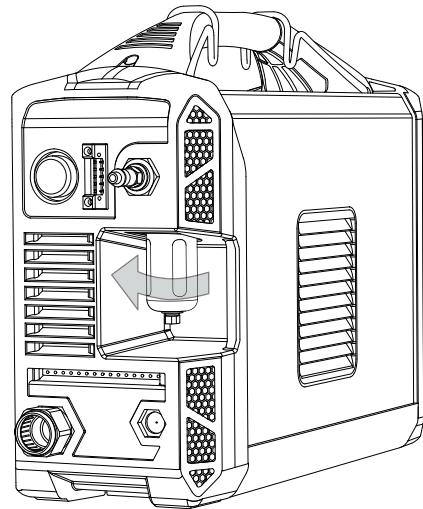
You may see a small amount of water in the bottom of the filter bowl. The filter bowl automatically purges excess moisture when enough water accumulates to engage the float mechanism inside the bowl.

To manually drain water from the bowl, unscrew the nut at the bottom of the bowl by hand. To avoid damaging the plastic nut, do not use a wrench or other tool.



Unscrew nut to remove

1. Set the power switch on the power supply to OFF (O). Disconnect the power cord from the power source.
2. Disconnect the gas supply from the back of the power supply.
3. Remove the air filter bowl by unscrewing the metal guard ① until it detaches from the air filter assembly inside the power supply.
4. Remove the air filter bowl ② from the metal guard.
5. Gently pry the filter element ③ out of the filter bowl. Be careful not to damage the O-ring at the top of the bowl.



6. Twist the plastic fittings ④ until they come apart, approximately a 1/4 turn. Set the fittings aside.



7. Enclose the new air filter element in the plastic fittings. Twist the plastic fittings until they lock together, approximately a 1/4 turn.



8. Clean the air filter bowl by wiping away any oil, dirt, or other contaminants.



A yellow residue on the filter bowl often indicates that oil is getting into the gas supply line.

9. Examine the O-ring. Replace it if it is cracked or damaged. Place the O-ring at the top of the filter bowl.



10. Place the filter element inside the air filter bowl. Press down on the top plastic fitting until you hear it snap into place.

11. Place the air filter bowl inside the metal guard.

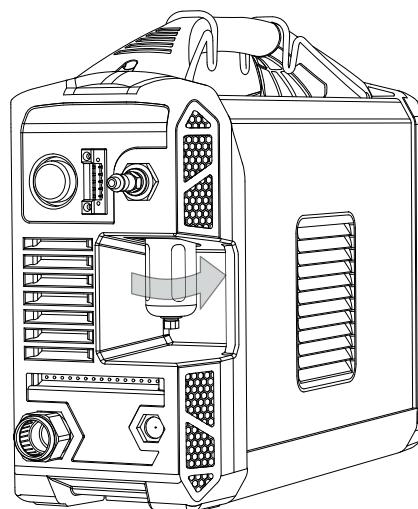
12. Put the air filter bowl back into place by screwing the metal guard into the air filter assembly that is inside the power supply.



Make sure the air filter bowl and metal guard remain straight as you install them. Otherwise, you may damage the threads on the metal guard.

13. Reconnect the gas supply to the back of the power supply.

14. Reconnect the power cord, and set the power switch to ON (I).



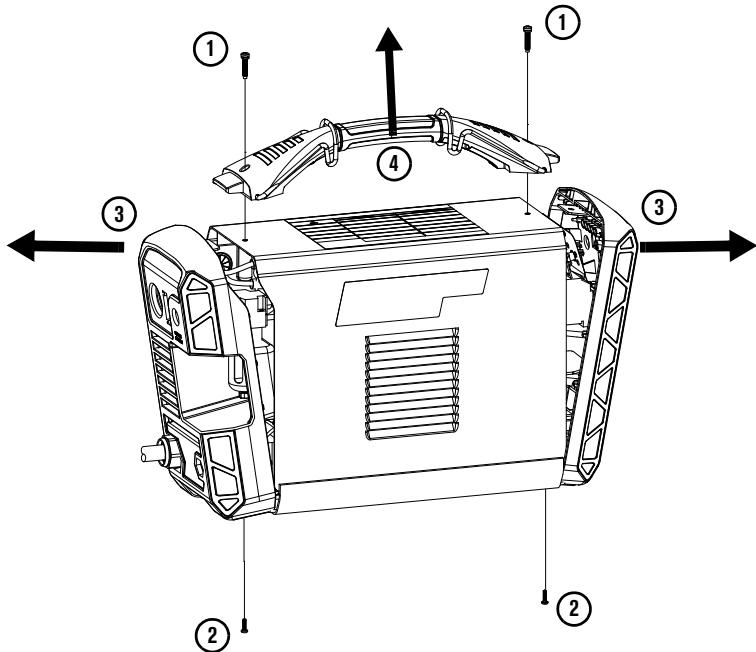
Replace the power supply cover and handle

Kit number	Description
428657	Kit: Power supply cover with labels, CSA (no screws included)
428658	Kit: Power supply cover with labels, CE/CCC (no screws included)
428663	Kit: Power supply handle with screws (includes clips for shoulder straps)

Remove the power supply cover and handle

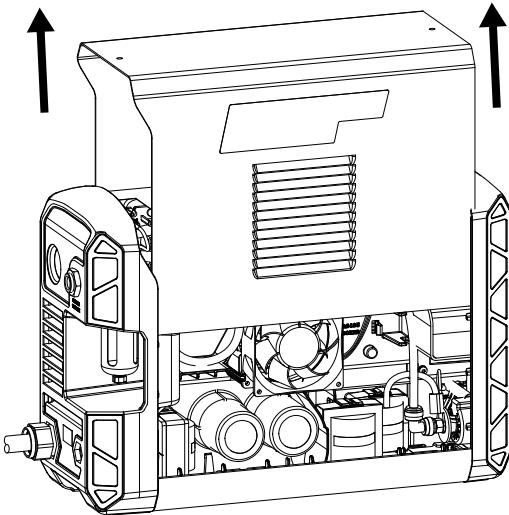
1. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
2. Remove the 2 screws from the power supply handle ①. You may need to gently pull up on the handle to remove the screws.
3. Remove the 2 screws ② from the bottom of the front and rear panels. Gently tilt the tops ③ of the front and rear panels away from the unit to pull the handle ④ out.

Figure 24



4. Slide the cover off.

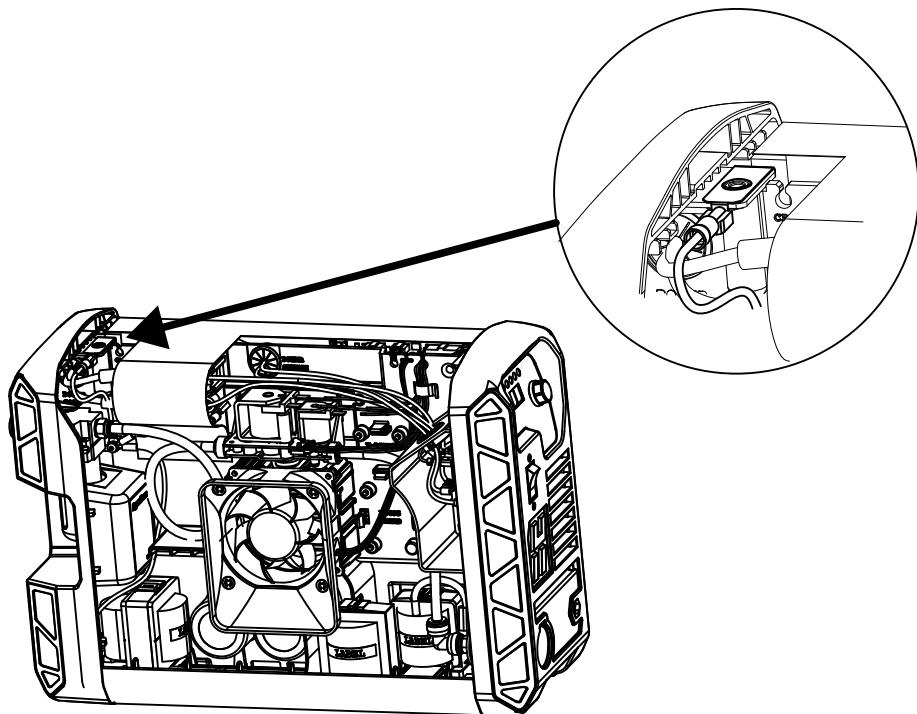
Figure 25



Install the power supply cover and handle

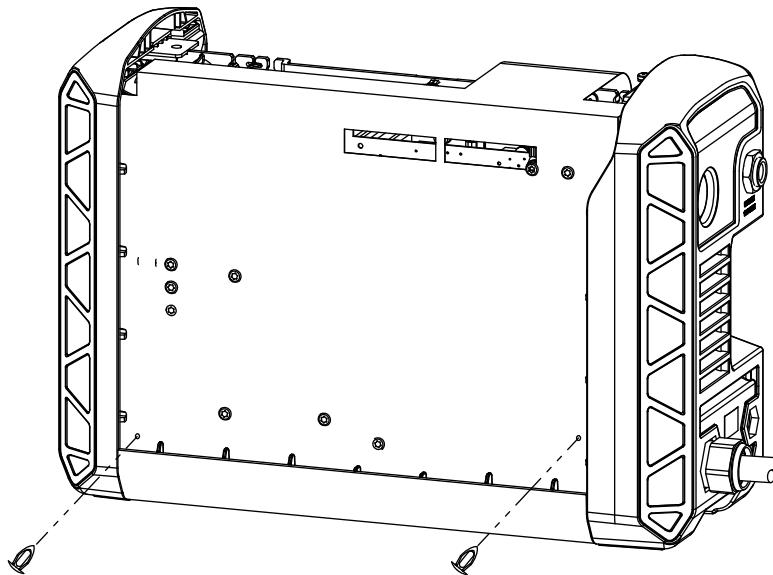
1. Set the front and rear panels in place.
2. Make sure the ground clip is connected to the ground wire. The clip should be set in place to accept the screw from the handle.

Figure 26



- 3.** Make sure the component barrier is in place and secured to the main power board with 2 plastic pins.

Figure 27



- 4.** Slide the cover back on.
 - Make sure the louvers in the cover align with the fan.
 - Be careful not to pinch any wires.
- 5.** Tilt the front and rear panels to reattach the handle. Position the handle over the holes in the top of the cover, and position the ends of the handle underneath the edges of the panels.
- 6.** Install the 2 screws that secure the bottom of the front panel and rear panel. Tighten to 17.3 kg·cm (15 inch·pounds).
- 7.** Install the 2 screws that attach the cover and handle. Tighten to 23 kg·cm (20 inch·pounds).
- 8.** Reconnect the gas supply and the power cord.

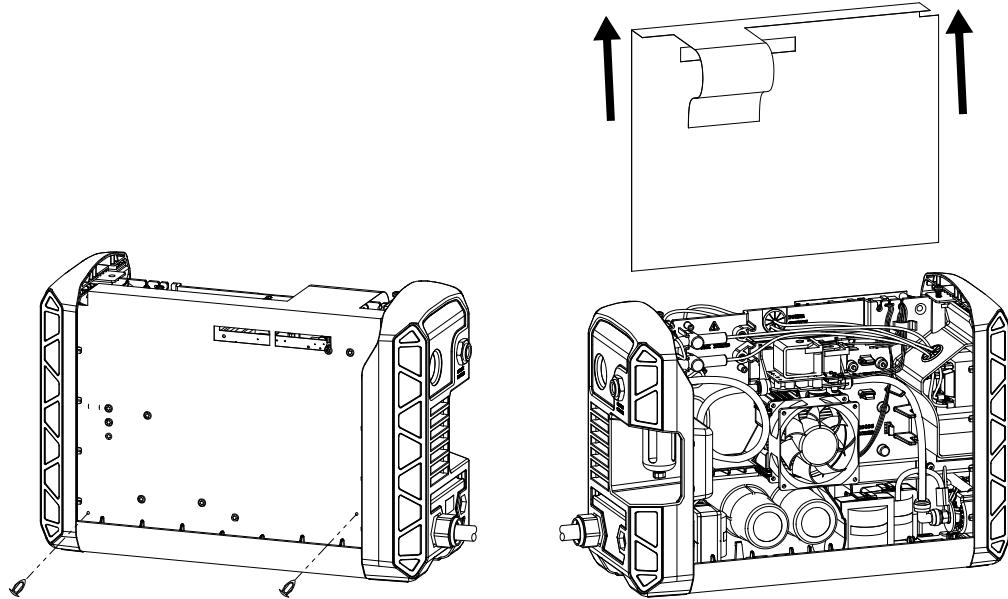
Replace the component barrier

Kit number	Description
428672	<i>Kit: Component barrier (insulator)</i>

Remove the component barrier

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. *Remove the power supply cover and handle* on page 215.
2. Remove the 2 plastic pins that secure the component barrier to the main power board. Slide the component barrier off.

Figure 28



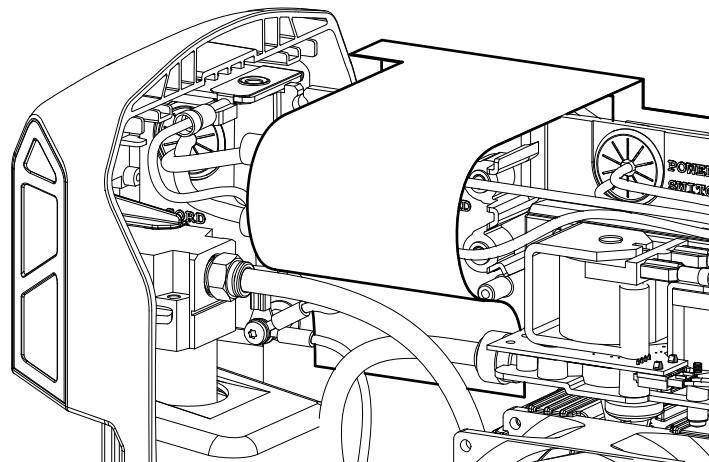
Install the component barrier

1. Set the component barrier in place. See *Figure 28* on page 218.
2. Secure the component barrier to the main power board with the 2 plastic pins.
3. Wrap the extended portion over the power cord connection points and behind the air hose.



If the machine interface (CPC port) and RS-485 serial interface are installed, it may be easier to tuck the extended portion of the barrier into the middle of the gas hose loop.

Figure 29



4. Complete the following procedures:
 - a. *Install the power supply cover and handle* on page 216
 - b. Reconnect the gas supply and the power cord.

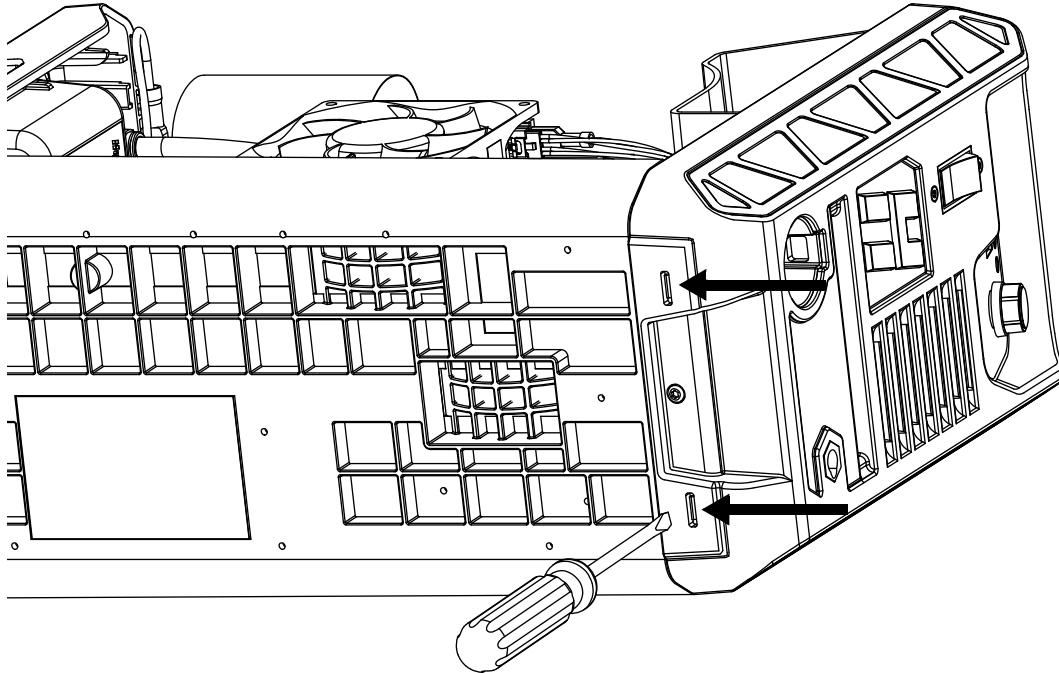
Detach and reattach the front panel

Some repairs are easier to make if you first detach the front panel from the power supply. To replace an old front panel with a new one, complete this procedure, then continue with *Replace the front panel* on page 276.

Detach the front panel

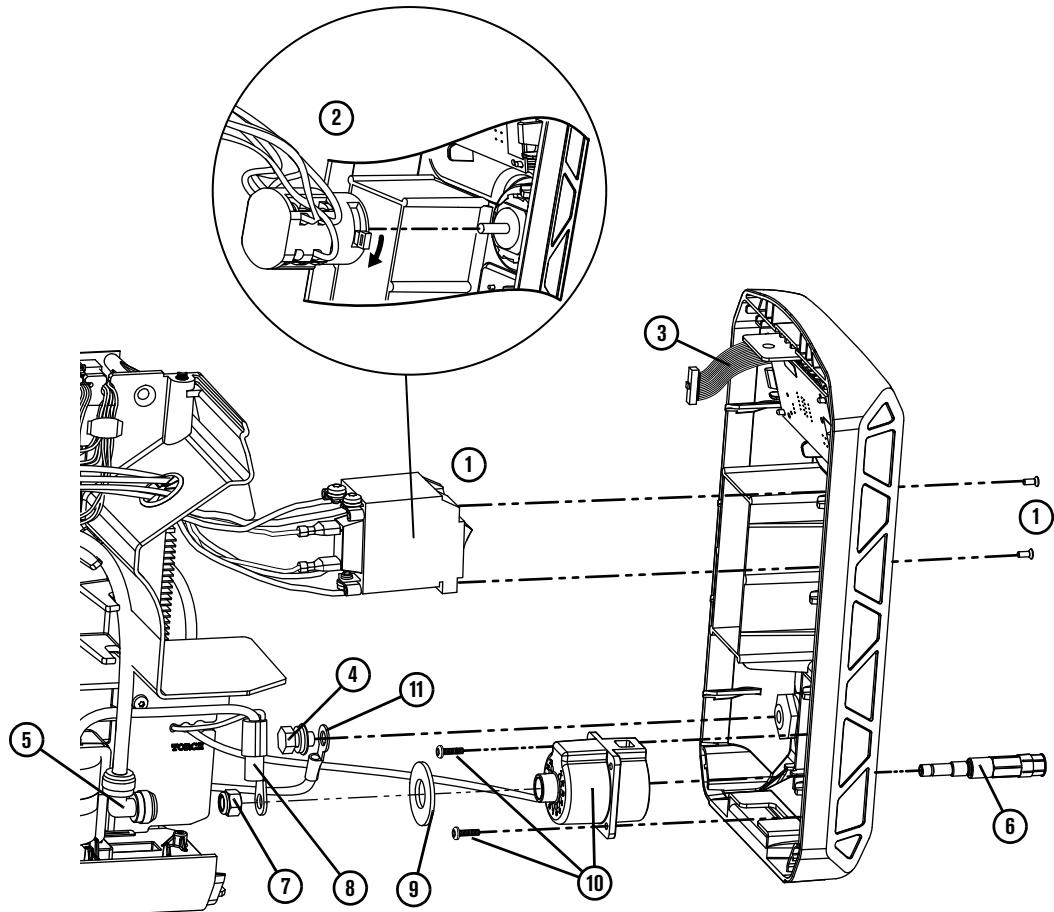
1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Disconnect the torch and the work lead from the front panel.
 - c. Remove the power supply cover and handle on page 215.
2. Use a blade screwdriver to push in the 2 tabs at the bottom of the panel until the panel detaches from the base. Pull the front panel slightly away from the unit.

Figure 30



3. Separate the power switch from the front panel. See *Figure 31* on page 221.
 - **1-phase models:** Remove the 2 screws that secure the power switch to the panel.
 - **3-phase models:** Hold down the red latch on the power switch body, and pull the assembly out from the shaft on the knob.
4. Disconnect the display board ribbon cable from the main power board.

5. Push-to-disconnect the gas supply hose 90° fitting from the brass torch fitting. Unscrew the nut, and remove the transformer wire and the large plastic washer from the fitting.
6. Remove the 2 screws that secure the torch receptacle to the front panel.
7. Remove the screw and washers that secure the work lead wire to the work lead receptacle.

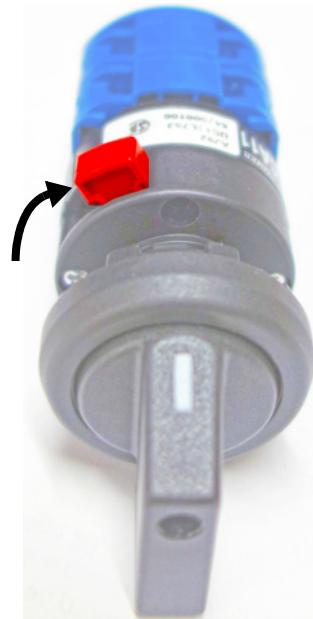
Figure 31

- | | |
|-------------------------------|-----------------------------------|
| 1 1-phase power switch | 7 Torch receptacle nut |
| 2 3-phase power switch | 8 Transformer wire |
| 3 Display board ribbon cable | 9 Torch receptacle plastic washer |
| 4 Work lead screw and washers | 10 Torch receptacle and screws |
| 5 Gas supply hose 90° fitting | 11 Work lead |
| 6 Brass torch fitting | |

Reattach the front panel

For these steps, refer to *Figure 31* on page 221.

1. Attach the screw and washers to secure the work lead wire to the work lead receptacle. Tighten to 104 kg·cm (90 inch·pounds).
2. Put the torch receptacle into place in the front panel so the red wires are at the top.
3. Screw the torch receptacle to the front panel. If there are only 2 screws, mount them at opposite corners. Tighten to 17.3 kg·cm (15 inch·pounds).
4. Place the brass torch fitting into the torch receptacle. The fitting slides in from the front of the connector.
5. Slide the large plastic washer over the brass torch fitting.
6. Slide the transformer wire ring terminal over the brass torch fitting.
7. Screw the nut onto the brass torch fitting. Tighten to 92 kg·cm (80 inch·pounds).
8. Push-to-connect the gas supply hose 90° fitting to the brass torch fitting.
9. Attach the power switch to the front panel:
 - **1-phase models:** Attach the power switch assembly to the front panel using 2 screws. Tighten to 11.5 kg·cm (10 inch·pounds).
 - **3-phase models:** Set the knob to the ON (I) position. Press the switch assembly onto the shaft of the power switch knob. The red latch should be in the “LOCK” position as shown. Press until the assembly clicks and is securely held in place.
10. Connect the display board ribbon cable to the main power board.
11. Set the front panel into place so the tabs at the bottom snap into place. Make sure no wires are pinched as you put the panel back in place.
12. Complete the following procedures:
 - a. *Install the power supply cover and handle* on page 216.
 - b. Reconnect the torch and the work lead to the front panel.
 - c. Reconnect the gas supply and the power cord.



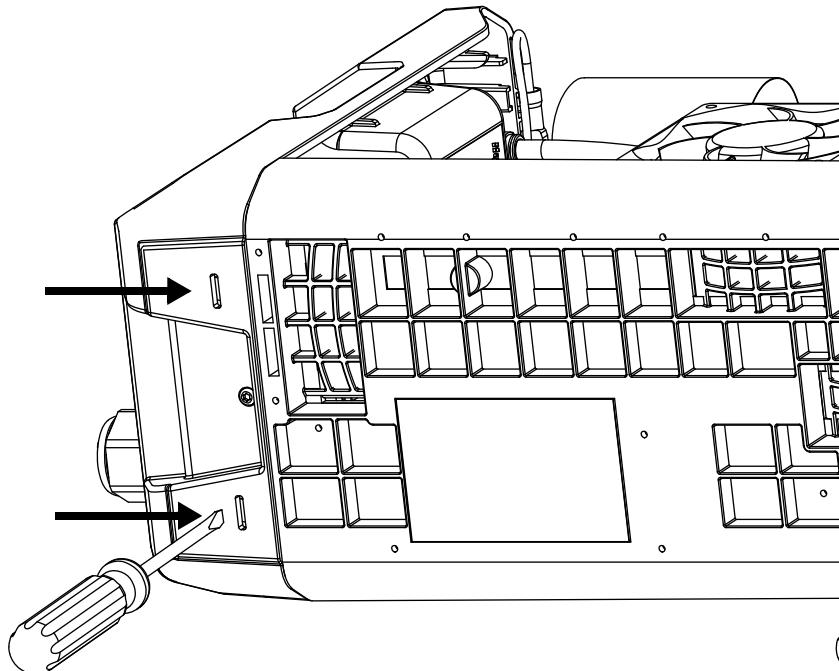
Detach and reattach the rear panel

Some repairs are easier to make if you first detach the rear panel from the power supply. To replace an old rear panel with a new one, complete this procedure, then continue with *Replace the rear panel* on page 282.

Detach the rear panel

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. *Remove the power supply cover and handle* on page 215.
2. Use a blade screwdriver to push in the 2 tabs at the bottom of the panel until the panel detaches from the base. Pull the rear panel slightly away from the unit.

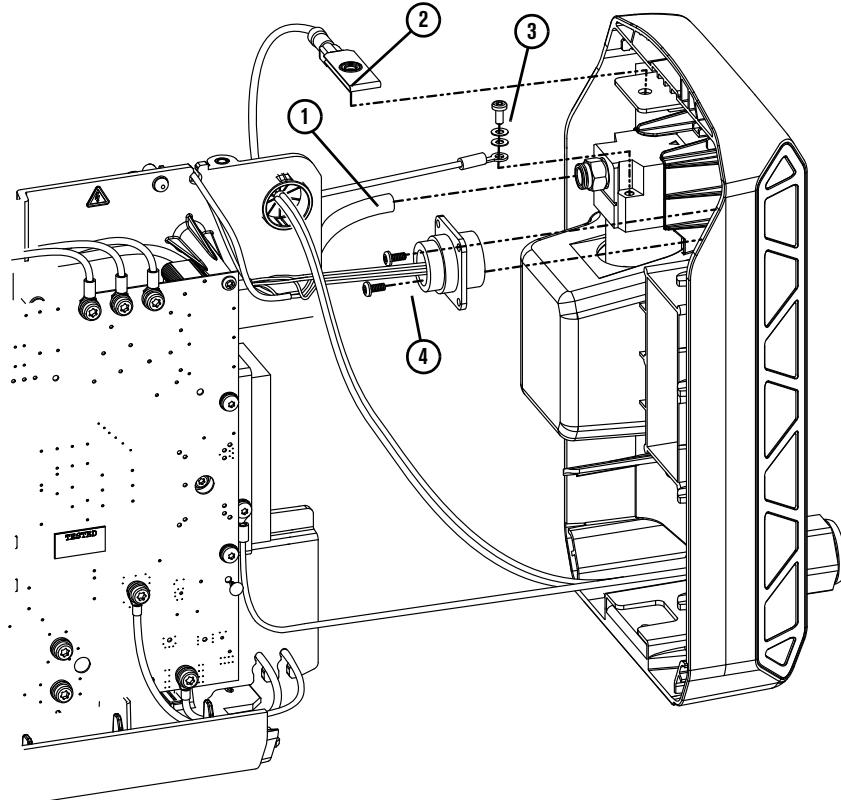
Figure 32



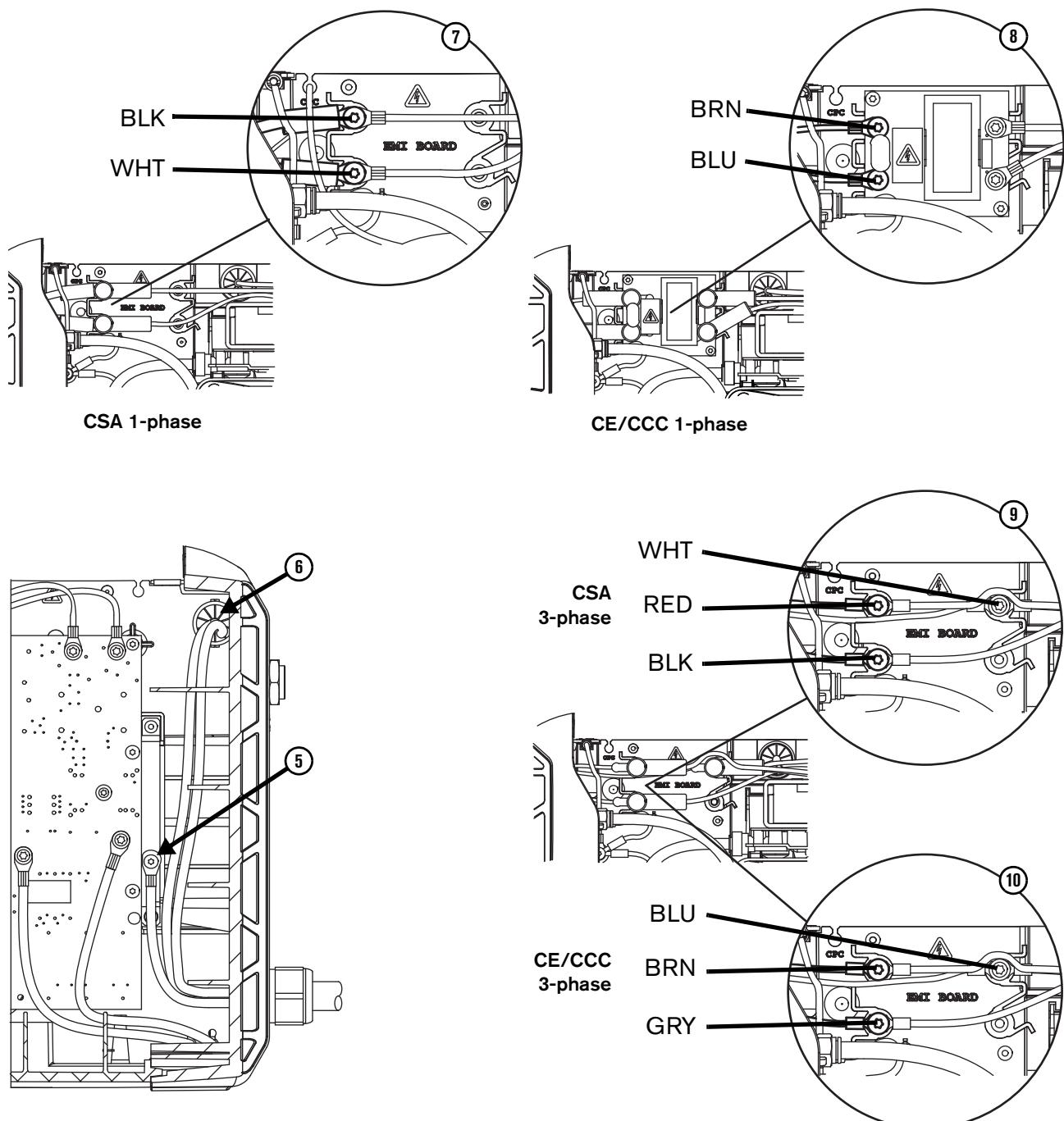
3. Push-to-disconnect the gas supply hose ① from the air filter assembly. See *Figure 33* on page 224.
4. Disconnect the ground clip ② from the rear panel tab.
5. Disconnect the ground wire ③ from the air filter assembly.
6. Unplug the serial cable from the RS-485 board if installed (not shown in *Figure 33*).

7. Remove the 2 screws that secure the CPC connector ④ to the rear panel if installed. Remove the connector from the panel.

Figure 33



8. Remove the power cord ground wire ⑤ from the heatsink. See *Figure 34* on page 225.
9. Remove the red insulating covers, and unscrew the power cord connection points. Pull the wires through the center panel grommet ⑥.
 - a. Disconnect 2 wires for the 1-phase models:
 - ⑦ CSA models: wires are black (BLK) and white (WHT).
 - ⑧ CE/CCC models: wires are brown (BRN) and blue (BLU).
 - b. Disconnect 3 wires for the 3-phase models:
 - ⑨ CSA models: wires are white (WHT), red (RED), and black (BLK).
 - ⑩ CE/CCC models: wires are blue (BLU), brown (BRN), and gray (GRY).
10. Separate the rear panel assembly from the unit.

Figure 34 – Power cord connection points

Reattach the rear panel

For these steps, refer to *Figure 34* on page 225 and *Figure 33* on page 224.

1. Attach the power cord ground wire ⑤ to the heatsink. Tighten to 23 kg·cm (20 inch·pounds).
2. Run the remaining power cord wires through the center panel grommet ⑥ labeled POWER CORD.
3. Attach the power cord leads to the appropriate terminal. Tighten to 23 kg·cm (20 inch·pounds).
 - a. Connect 2 wires for the 1-phase models:
 - ⑦ CSA models: wires are black (BLK) and white (WHT).
 - ⑧ CE/CCC models: wires are brown (BRN) and blue (BLU).
 - b. Connect 3 wires for the 3-phase models:
 - ⑨ CSA models: wires are white (WHT), red (RED), and black (BLK).
 - ⑩ CE/CCC models: wires are blue (BLU), brown (BRN), and gray (GRY).
4. Connect the CPC interface ④ using 2 screws if installed. Tighten to 11.5 kg·cm (10 inch·pounds).
5. Plug the serial interface cable into the RS-485 board if installed.
6. Connect the ground wire ③ to the air filter assembly. Tighten to 23 kg·cm (20 inch·pounds).
7. Snap the rear panel assembly back into place. Make sure no wires are pinched as you put the panel back in place.
8. Push-to-connect the looped gas supply hose ① to the air filter assembly. Insert the hose far enough so the marked line reaches the connector. The bottom of the loop should rest on the plastic shelf to the left of the fan.
9. Make sure the looped gas supply hose is not kinked.

 If the gas supply hose is kinked, discard it and replace it with a new hose.
 The integrity of the hose is compromised once the hose is kinked.
10. Place the ground clip ② back onto the plastic tab on the rear panel.
11. Complete the following procedures:
 - a. *Install the power supply cover and handle* on page 216
 - b. Reconnect the gas supply and the power cord.

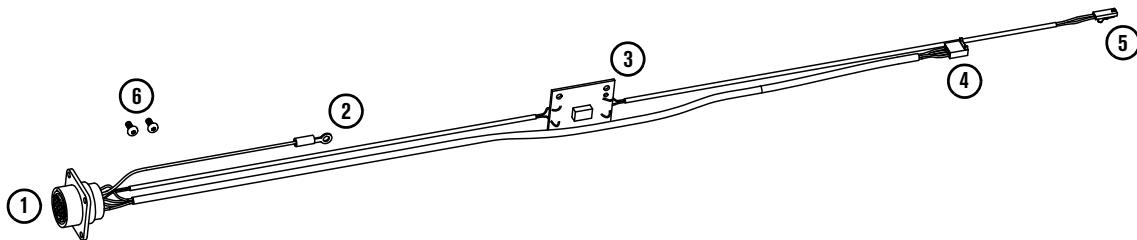
Replace the machine interface (CPC) port and voltage divider board

Kit number	Description
428653	<i>Kit: Machine interface (CPC) port with internal cables and voltage divider board (does not include cover for receptacle)</i>



See page 104 for more information on each type of signal available through the machine interface port and for the part numbers of the various external machine interface cables that Hypertherm offers.

Figure 35 – Machine interface (CPC) port with cables and voltage divider board



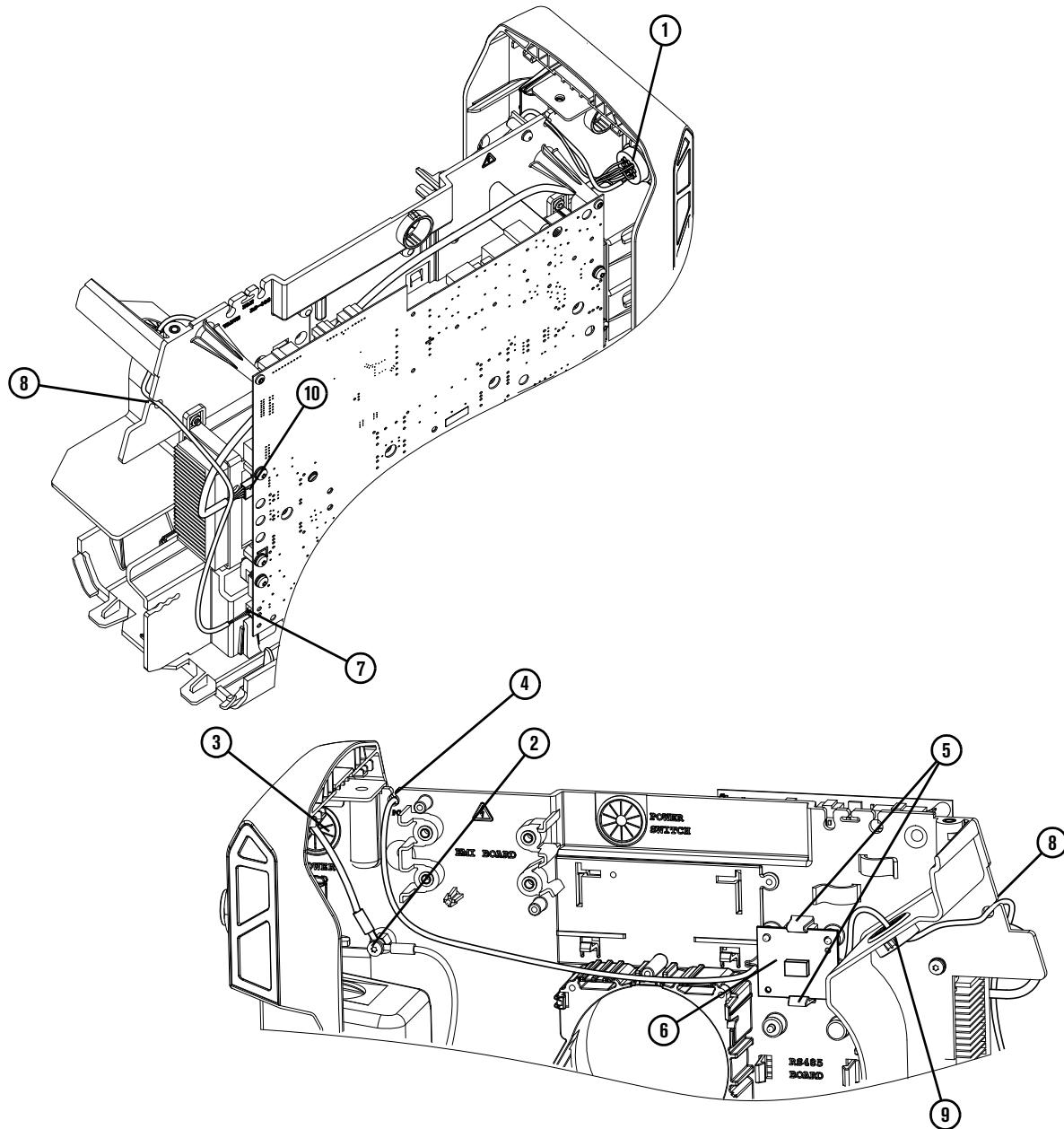
- | | |
|--------------------------------|--|
| 1 Machine interface (CPC) port | 4 Main power board 4-pin connector (J21) |
| 2 Ground wire | 5 Main power board 2-pin connector (J17) |
| 3 Voltage divider board | 6 Screws (2) |

Remove the machine interface port with voltage divider board

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Remove the component barrier on page 218.
 - d. Detach the rear panel on page 223.
2. Remove the 2 screws from the machine interface (CPC) connector ① on the rear panel. See *Figure 36* on page 228.
3. From the fan side, remove the connector's ground wire from the ground stud ②. From the power board side, pull the ground wire through the power cord grommet ③.
4. Remove the voltage divider board cable from the center panel pass-through that is labeled "CPC" ④.
5. Push back the plastic tabs ⑤ and remove the voltage divider board ⑥ from its mount.

6. Disconnect the voltage diver board 2-pin connector ⑦ from the main power board at J17. Route the cable out through the center panel pass-through ⑧ and the power switch grommet ⑨.
7. Disconnect the 4-pin connector ⑩ from the main power board at J21.
8. Remove the assembly from the unit.

Figure 36 – Machine interface (CPC port) cable routing (internal components omitted for clarity)



Install the machine interface port with voltage divider board

For these steps, refer to *Figure 36* on page 228.

1. Attach the machine interface (CPC) connector ① to the rear panel using the 2 screws. Tighten to 11.5 kg·cm (10 inch·pounds).
 Units that did not have the machine interface port installed at the factory will have a protective cover in the connector location. Remove the cover to install the machine interface (CPC) port.
2. Route the ground wire through the power cord grommet ③.
3. Connect the ground wire to the ground stud ②. Tighten the screw to 17.3 kg·cm (15 inch·pounds).
 Make sure all other ground wires remain connected to the ground stud. Rotate the ground wire terminals on the stud so that each wire points in a different direction.
4. Route the voltage divider board wire through the center panel pass-through that is labeled "CPC" ④.
5. Snap the voltage divider board ⑥ into place.
6. Route the 2-pin connector wire from the voltage divider board through the power switch grommet ⑨ and center panel pass-through ⑧.
7. Plug the 2-pin connector ⑦ into the power board at J17.
8. Route the 4-pin connector wire along the top of the heatsink. Route the wire under the plastic mounting posts from the center panel but over any components that stick out from the main power board.
9. Plug the 4-pin connector ⑩ into the power board at J21.
10. Complete the following procedures:
 - a. *Reattach the rear panel* on page 226.
 - b. *Install the component barrier* on page 219.
 - c. *Install the power supply cover and handle* on page 216.
 - d. Reconnect the gas supply and the power cord.

Set the voltage divider board

The factory presets the voltage divider to 50:1.

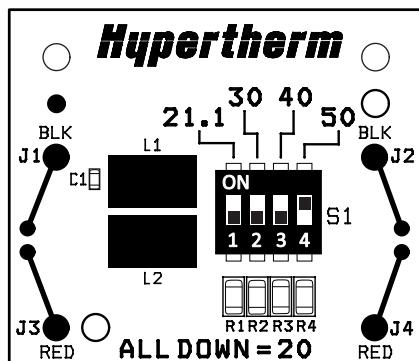
NOTICE

The factory-installed internal voltage divider provides a maximum of 16 V under open circuit conditions. This is an impedance-protected functional extra low voltage (ELV) output to prevent shock, energy, and fire under normal conditions at the machine interface receptacle and under single fault conditions with the machine interface wiring. The voltage divider is not fault tolerant and ELV outputs do not comply with safety extra low voltage (SELV) requirements for direct connection to computer products.

1. To change the voltage divider to a different setting:

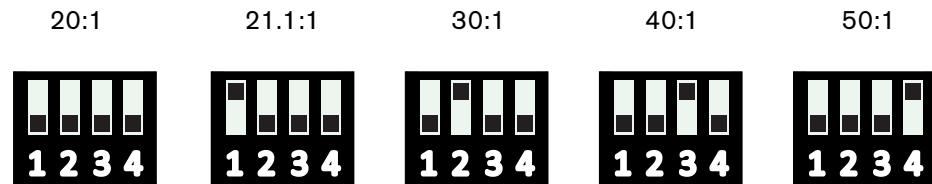
- a. Locate the voltage divider DIP switches on the fan side of the power supply. *Figure 37* shows the default setting (50:1) with the number 4 switch up.

Figure 37 – Voltage divider board



- b. Set the DIP switches to one of the settings shown in *Figure 38*.

Figure 38 – Voltage divider board settings



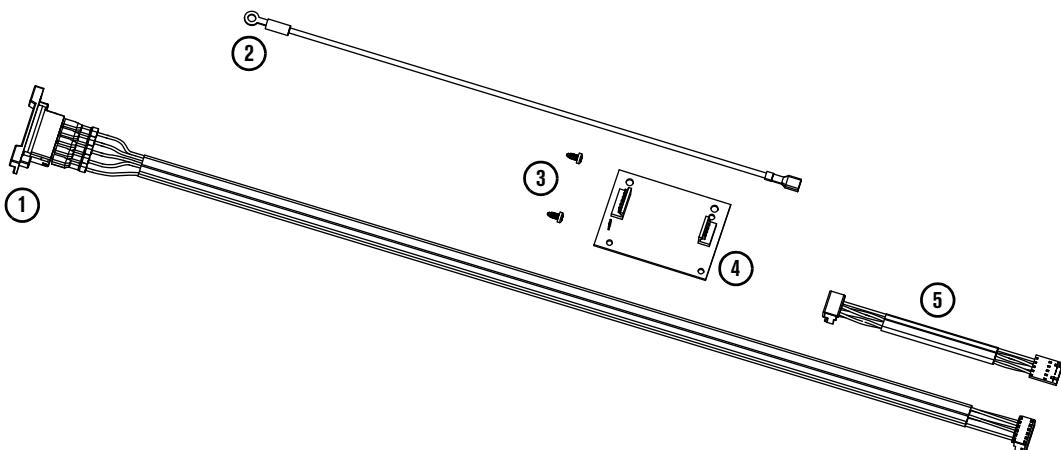
Install the RS-485 serial interface port

Kit number	Description
428654	<i>Kit: Serial interface port with internal cables and RS-485 board</i>



See page 111 for more information on connecting an external device to the RS-485 serial interface connector and for the part numbers of the external RS-485 serial cables that Hypertherm offers.

Figure 39



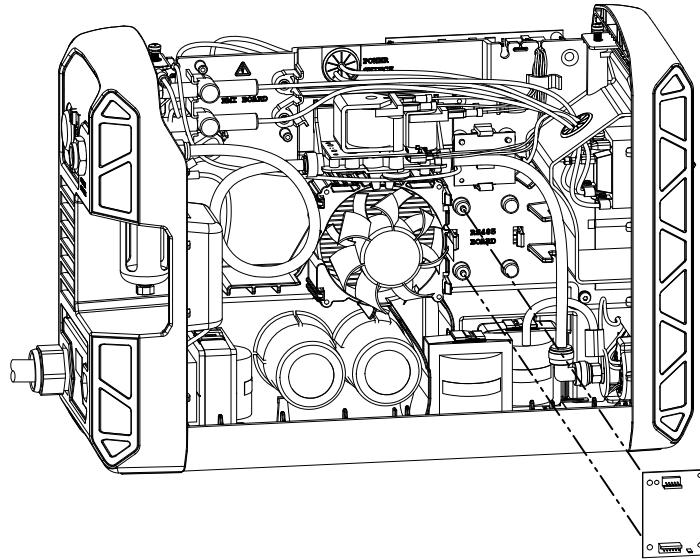
- | | |
|--|---|
| 1 Rear panel connector cable
2 Ground wire
3 Screws for rear panel connector (2) | 4 RS-485 board
5 Interface cable (J11) |
|--|---|

2. Complete the following procedures:

- Set the power switch to OFF (**O**), disconnect the power cord from the power source, and disconnect the gas supply.
- Remove the power supply cover and handle* on page 215.
- Remove the component barrier* on page 218.

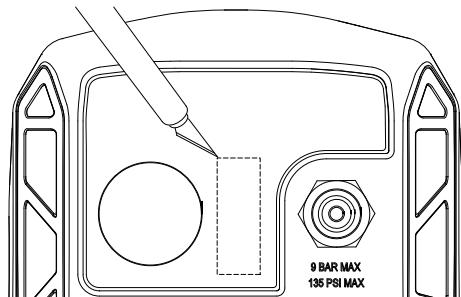
3. Snap the RS-485 board into place on the center panel. Make sure the plastic tabs secure the board.

Figure 40



4. Use a sharp knife to carefully cut out the rectangle marked by perforation on the rear panel label. This exposes the mounting hole for the connector.

Figure 41



NOTICE

Do not route the ground wire and the longer cable from the RS-485 board below the fan. Doing so can cause the wires to be pinched by the fan. If any wires get pinched behind the fan, this can not only damage the wires but also prevent the fan from functioning correctly.

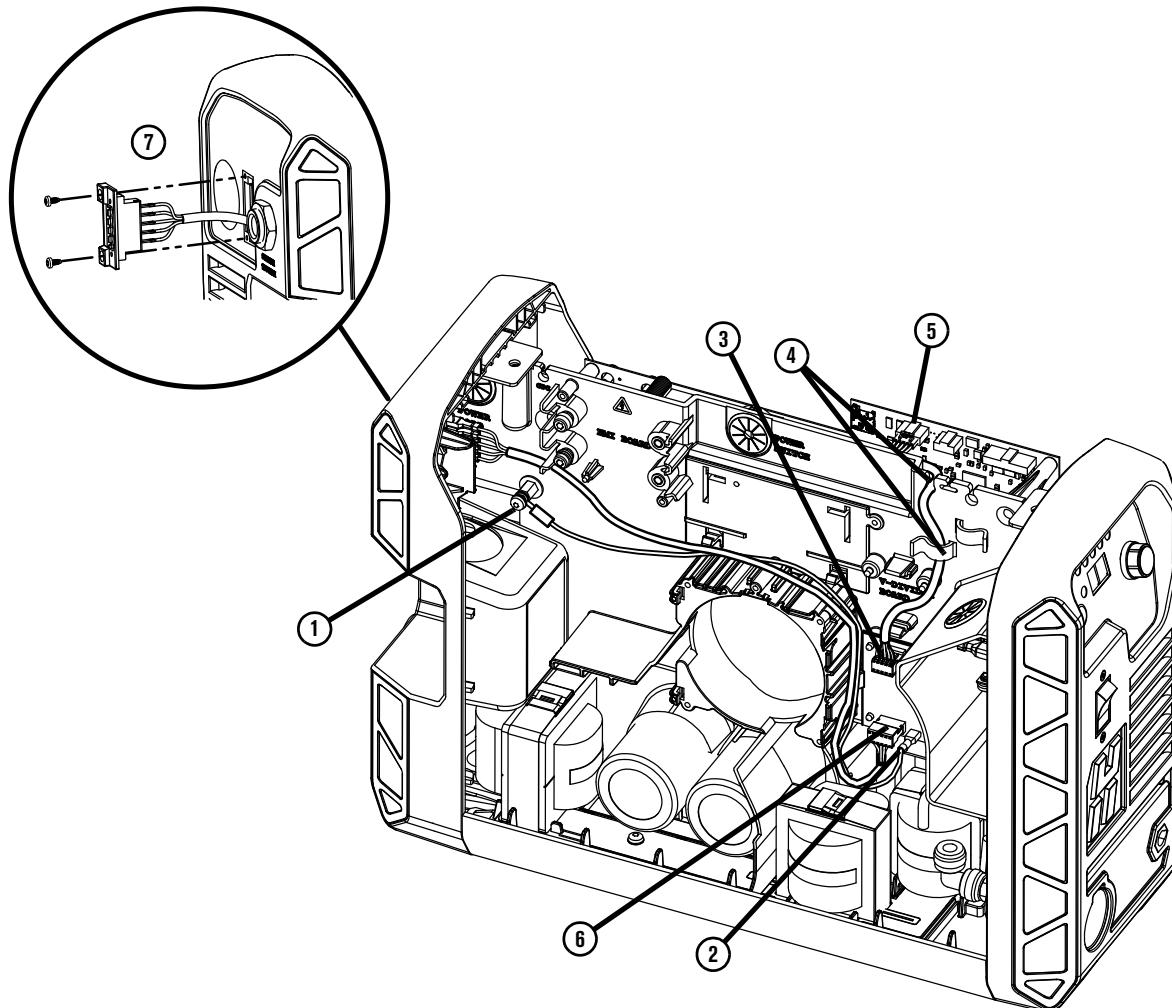
5. Attach the ground wire ring terminal to the ground stud ①. See *Figure 42* on page 233. Tighten the ground stud screw to 17.3 kg·cm (15 inch·pounds).



Make sure all other ground wires remain connected to the ground stud. Rotate the ground wire terminals on the stud so that each wire points in a different direction.

6. Route the ground wire between the fan and the solenoid valve as shown in *Figure 42*. Plug the quick-connect end of the ground cable into the blade terminal on the RS-485 board ②.
7. Plug the short interface cable into J2 ③ on the RS-485 board. Route the other end toward the main power board. Run the cable through the plastic clip and the center panel pass-through that is labeled "RS-485" ④. Plug it into J11 ⑤ on the main power board.
8. Route the longer cable between the fan and the solenoid valve. Route one end of the cable through the mounting hole in the rear panel. Plug the other end into J1 ⑥ on the RS-485 board.
9. Attach the rear panel connector ⑦ using 2 screws. Tighten the screws to 7 kg·cm (6 inch·pounds).
10. Complete the following procedures:
 - a. *Install the component barrier* on page 219.
 - b. *Install the power supply cover and handle* on page 216.
 - c. Reconnect the gas supply and the power cord.

Figure 42 – RS-485 serial interface cable routing (internal components omitted for clarity)



Replace the display board and ribbon cable

Kit number	Description
428679	<i>Kit: Display board with adjustment knob (does not include ribbon cable) (designator: PCB1)</i>
428709	<i>Kit: Ribbon cable for display board</i>

Remove the display board and ribbon cable

For these steps, refer to *Figure 43* on page 235.

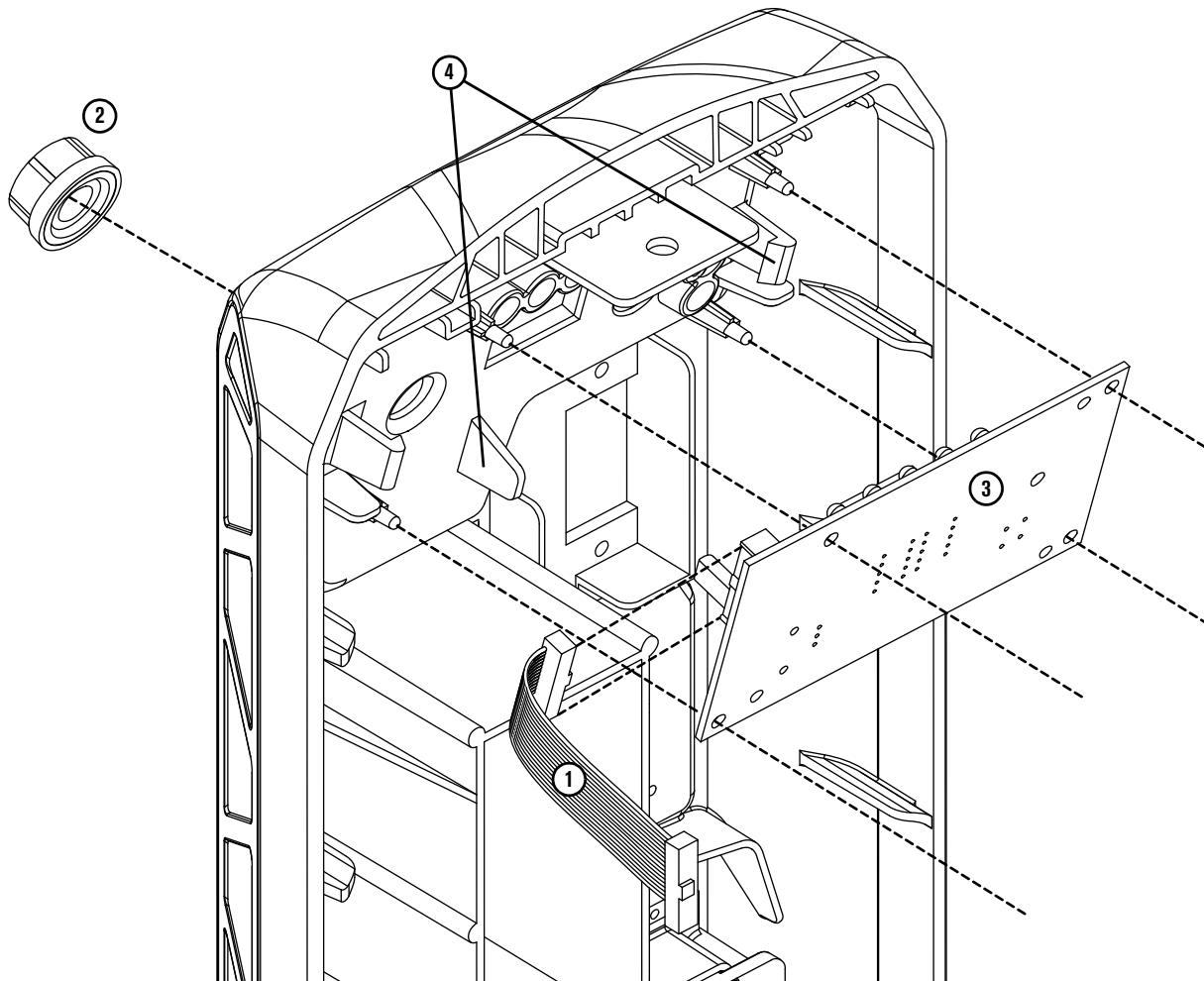
1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. *Remove the power supply cover and handle* on page 215.
 - c. *Detach the front panel* on page 220.
2. Make sure the ribbon cable ① is disconnected from the main power board.
3. Pull the adjustment knob ② off of the front panel.
4. Disconnect the ribbon cable from the display board ③.
5. Pull back the plastic clips ④, and slide the display board out of the front panel until it is clear of the 4 mounting posts.

Install the display board and ribbon cable

For these steps, refer to *Figure 43* on page 235.

1. Connect the ribbon cable ① to the display board ③.
2. Put the new display board into place in the front panel by pushing it onto the 4 mounting posts. Make sure the clips ④ in the front panel snap into place over the board.
3. Push the adjustment knob ② onto the post on the front panel.
4. Make sure you plug the ribbon cable into the main power board as you reattach the front panel.
5. Complete the following procedures:
 - a. *Reattach the front panel* on page 222.
 - b. *Install the power supply cover and handle* on page 216.
 - c. Reconnect the gas supply and the power cord.

Figure 43



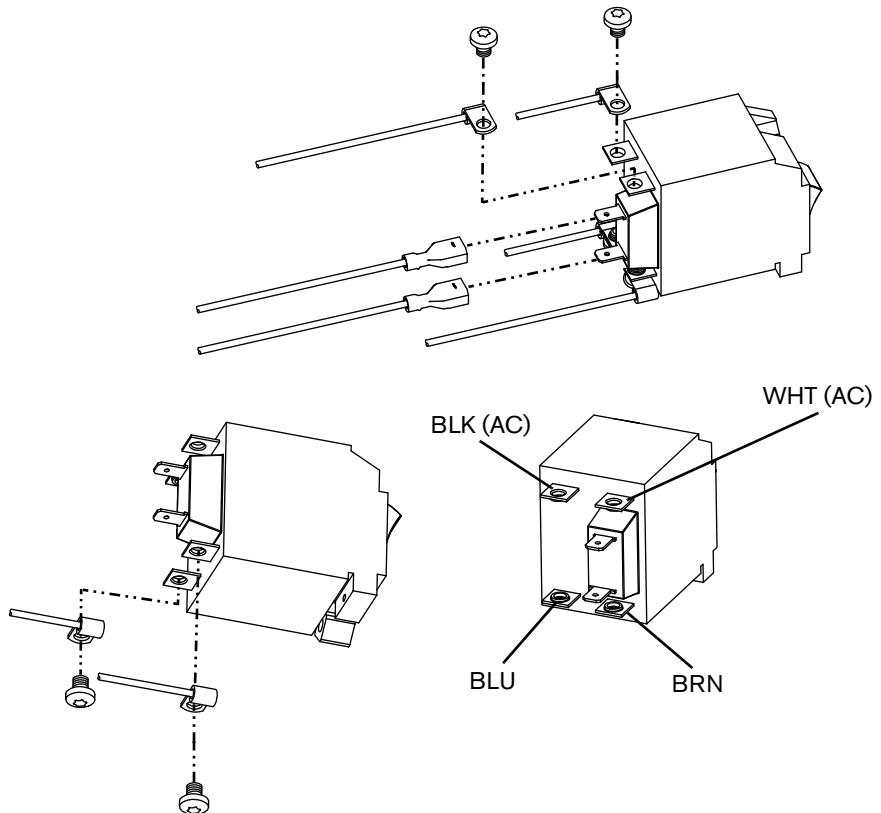
Replace the power switch – 1-phase models

Kit number	Description
428680	<i>Kit: Power switch for 1-phase models (rocker switch) (designator: S1)</i>

Remove the power switch

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Detach the front panel on page 220.
2. Remove the 2 quick-connect terminals from the back of the power switch. See *Figure 44*.
3. Remove the black (BLK) and white (WHT) AC input wires from the screw terminals near the top of the switch.
4. Remove the blue (BLU) and brown (BRN) power wires from the screw terminals near the base of the switch.

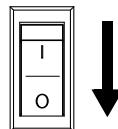
Figure 44 – 1-phase power switch wiring



Install the power switch

Refer to *Figure 44* on page 236 for proper wiring.

1. Connect the blue (BLU) and brown (BRN) wires from the power cord (CSA models) or EMI board (CE/CCC models) to the bottom screw terminal posts on the new power switch assembly. Tighten to 23 kg·cm (20 inch·pounds).
2. Connect the black (BLK) and white (WHT) AC input wires from the main power board to the appropriate screw terminal post on the power switch assembly. Tighten to 23 kg·cm (20 inch·pounds).
3. Plug the 2 quick-connect terminals onto the tabs on the power switch assembly.
4. Position the switch assembly against the front panel so that the **I** is at the top and the **O** is at the bottom. Secure with 2 screws. Tighten to 11.5 kg·cm (10 inch·pounds).
- 5. Set the power switch to the OFF (O) position.**
- 6. Complete the following procedures:**
 - a. *Reattach the front panel* on page 222.
 - b. *Install the power supply cover and handle* on page 216.
 - c. Reconnect the gas supply and the power cord.



Replace the power switch – 3-phase models

Kit number	Description
428681	<i>Kit: Power switch and knob for 3-phase models (dial switch) (designator: S1)</i>

Remove the power switch

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. *Remove the power supply cover and handle* on page 215.
 - c. *Detach the front panel* on page 220.
2. Remove the nut that secures the front panel power switch knob to the front panel. Push the knob out from the rear of the panel.
3. Loosen the screws on the power switch assembly to remove the 6 wires.

Install the power switch

1. Align the tab on the knob with the notch on the front panel. Secure the knob to the front panel using the plastic nut. Tighten to 23 kg·cm (20 inch·pounds).
2. Connect the wires to the power switch assembly. Tighten to 23 kg·cm (20 inch·pounds).
 - Solid white wire (WHT) to contact 3.
 - Black (BLK) to contact 5.
 - Brown (BRN) to contact 1.
 - Brown wire with white stripe (BRN/WHT) to contact 2.
 - Black wire with white stripe (BLK/WHT) to contact 6.
 - White wire with black stripe (WHT/BLK) to contact 4.

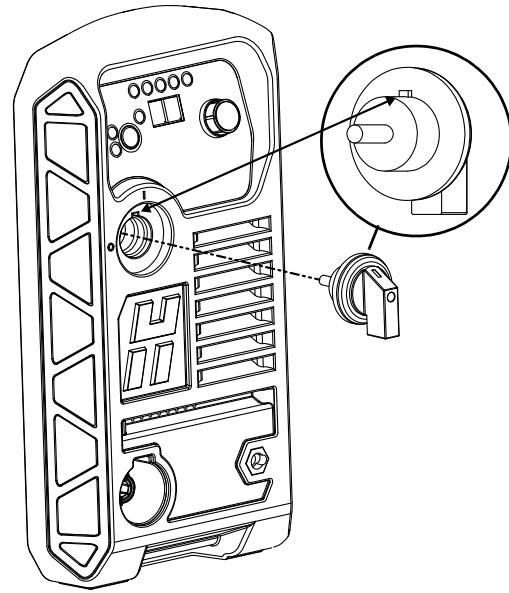
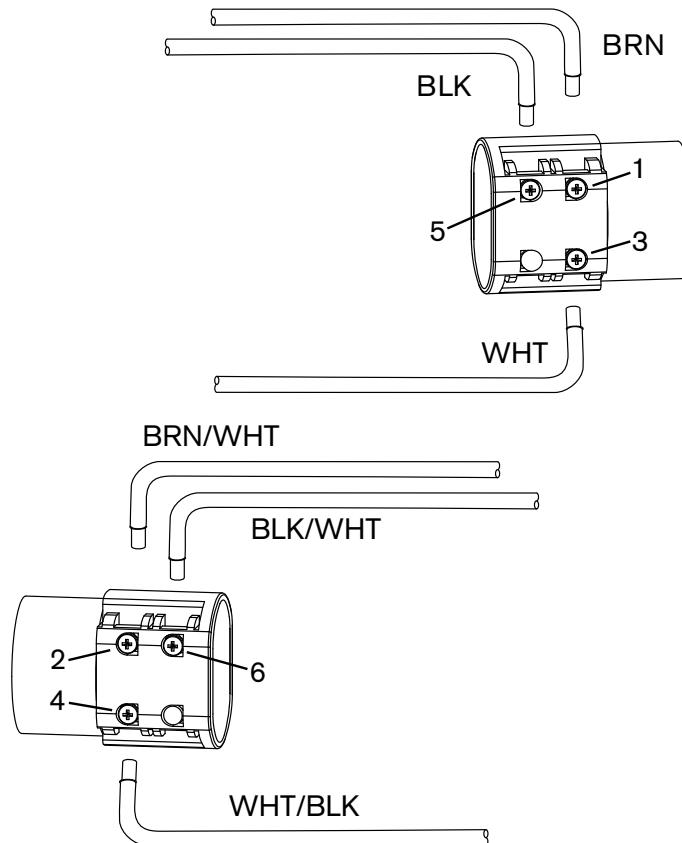
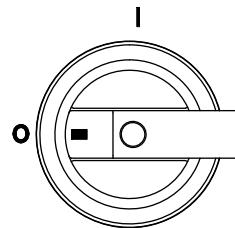


Figure 45 – 3-phase power switch wiring



- 3. Set the power switch to the OFF (O) position.**
- 4. Complete the following procedures:**
 - a. Reattach the front panel** on page 222.
 - b. Install the power supply cover and handle** on page 216.
 - c. Reconnect the gas supply and the power cord.**



Replace the power cord and strain relief – 1-phase models

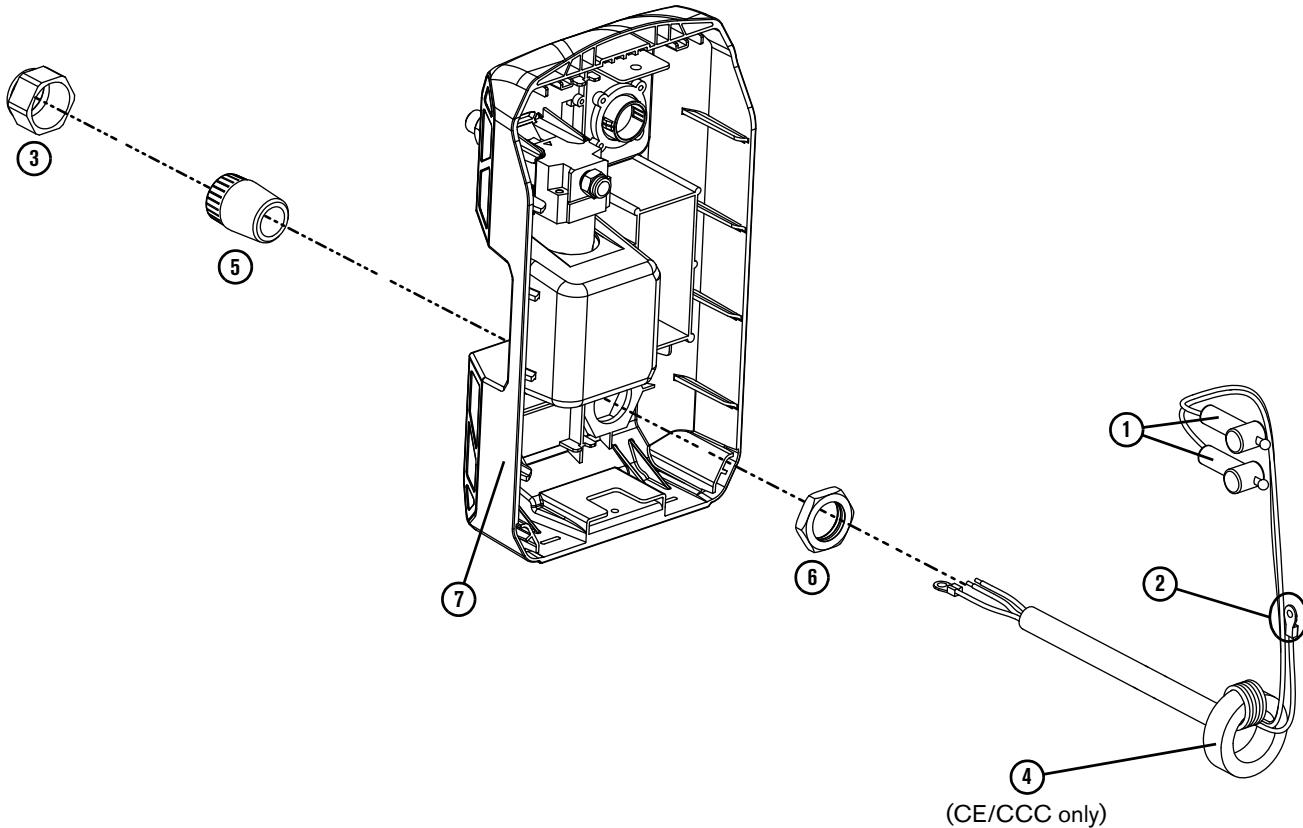
Kit number	Description
428664	<i>Kit: CSA power cord with strain relief, 1-phase, 3 m (10 foot) (includes NEMA 6-50P power plug)</i>
428667	<i>Kit: CE/CCC power cord with strain relief, 1-phase, 3 m (10 foot) (no power plug included)</i>
228680	<i>Kit: Strain relief for power cords</i>

Remove the power cord and strain relief

For these steps, refer to *Figure 46* on page 240.

- 1. Complete the following procedures:**
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.**
 - b. Remove the power supply cover and handle** on page 215.
 - c. Remove the component barrier** on page 218.
 - d. Detach the rear panel** on page 223.
- 2. Make sure the 2 power cord wires ① are disconnected from the center panel (CSA models) or EMI board (CE/CCC models).**
- 3. Make sure the power cord ground wire ② is disconnected from the heatsink.**
- 4. Remove the strain relief outer nut ③ to loosen the grip on the cord.**
- 5. CE/CCC models:** Unwrap the power cord wires from the toroid ④.
- 6. Pull the wires out through the strain relief ⑤.**
- 7. If you are not installing a new power cord strain relief, remove the strain relief inner nut ⑥. Separate the strain relief from the rear panel ⑦.**

Figure 46



Install the power cord and strain relief

For these steps, refer to *Figure 46*.

1. Put the strain relief (5) into place in the rear panel (7). Tighten the inner nut (6) to 92 kg·cm (80 inch·pounds).
2. Loosely tighten the outer nut (3) onto the strain relief.
3. Pass the power cord wires through the outer nut and the strain relief:
 - **CSA models (kit 428664):** Pass the wires through the outside end of the strain relief into the rear panel. Orient the power cord so the green ground wire is below the other 2 wires, closer to the bottom of the rear panel.
 - **CE/CCC models (kit 428667):** Take the end of the cord opposite the toroid (4). Pass the wires through the strain relief from inside of the rear panel. Pull the cord through the strain relief until the toroid end of the cord reaches the strain relief. **Do not remove the toroid from the new power cord.**
4. Make sure there is enough wire length inside the power supply to reach the power cord connection points. Tighten the outer strain relief nut (3) to secure the cord.

- 5.** Complete the following procedures:
 - a.** *Reattach the rear panel* on page 226.
 - b.** *Install the component barrier* on page 219.
 - c.** *Install the power supply cover and handle* on page 216.
 - d.** Reconnect the gas supply and the power cord.

Replace the power cord and strain relief – 3-phase models

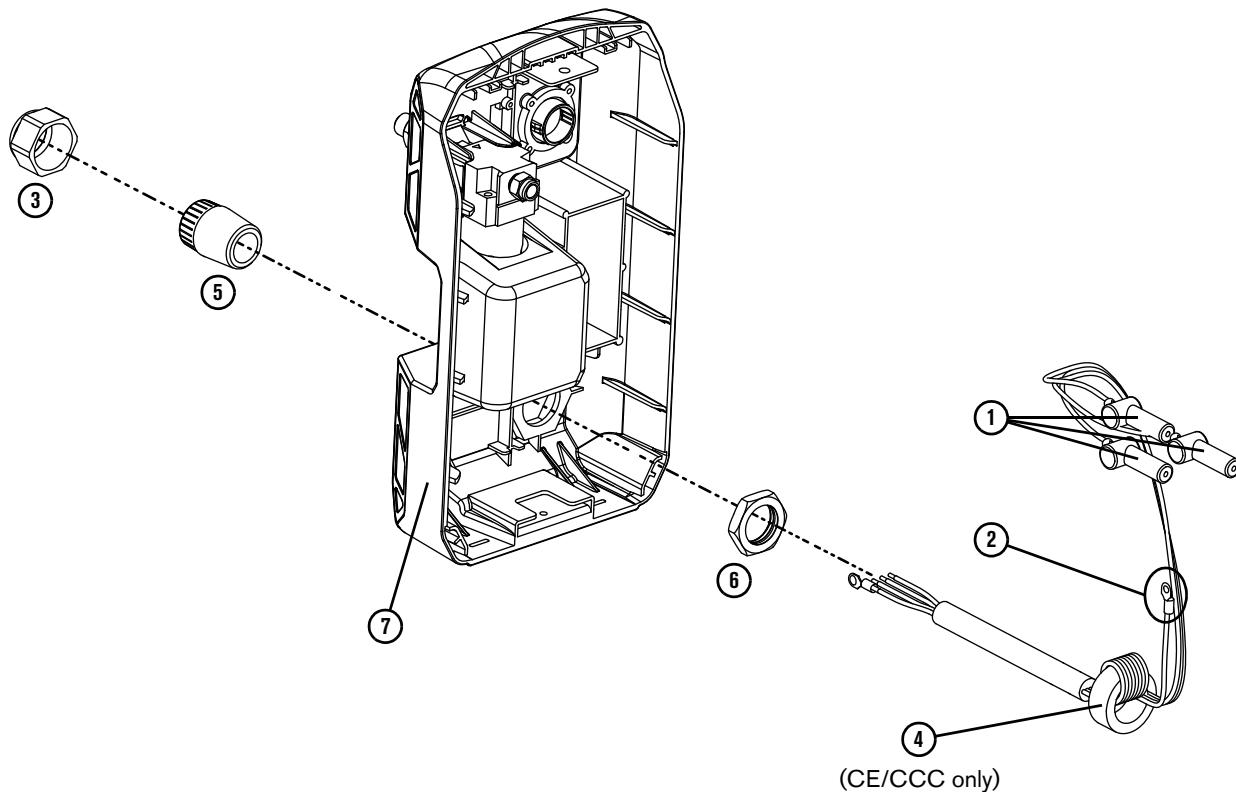
Kit number	Description
428665	<i>Kit: CSA power cord with strain relief, 3-phase, 3.5 m (11 foot) (no power plug included)</i>
428666	<i>Kit: CE/CCC power cord with strain relief, 3-phase, 3 m (10 foot) (no power plug included)</i>
228680	<i>Kit: Strain relief for power cords</i>

Remove the power cord and strain relief

For these steps, refer to *Figure 47* on page 242.

- 1.** Complete the following procedures:
 - a.** Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b.** *Remove the power supply cover and handle* on page 215.
 - c.** *Remove the component barrier* on page 218.
 - d.** *Detach the rear panel* on page 223.
- 2.** Make sure the 3 power cord wires ① are disconnected from the center panel.
- 3.** Make sure the power cord ground wire ② is disconnected from the heatsink.
- 4.** Remove the strain relief outer nut ③ to loosen the grip on the cord.
- 5. CE/CCC models:** Unwrap the power cord wires from the toroid ④.
- 6.** Pull the wires out through the strain relief ⑤.
- 7.** If you are not installing a new power cord strain relief, remove the strain relief inner nut ⑥. Separate the strain relief from the rear panel ⑦.

Figure 47



Install the power cord and strain relief

For these steps, refer to *Figure 47*.

1. Put the strain relief ⑤ into place in the rear panel ⑦. Tighten the inner nut ⑥ to 92 kg·cm (80 inch·pounds).
2. Loosely tighten the outer nut ③ onto the strain relief.
3. Pass the power cord wires through the outer nut and the strain relief:
 - **CSA models (kit 428665):** Take the end of the cord terminated with ring terminals. Pass it through the outside end of the strain relief into the rear panel. Orient the power cord so the green ground wire is below the other 3 wires, closer to the bottom of the rear panel.
 - **CE/CCC models (kit 428666):** Take the end of the cord opposite the toroid ④. Pass the wires through the strain relief from inside of the rear panel. Pull the cord through the strain relief until the toroid end of the cord reaches the strain relief. **Do not remove the toroid from the new power cord.**

4. Make sure there is enough wire length inside the unit to reach the power cord connection points. Tighten the outer strain relief nut ③ to secure the cord.
5. Complete the following procedures:
 - a. *Reattach the rear panel* on page 226.
 - b. *Install the component barrier* on page 219.
 - c. *Install the power supply cover and handle* on page 216.
 - d. Reconnect the gas supply and the power cord.

Replace the EMI board (CE/CCC 1-phase models only)

Kit number	Description
428721	<i>Kit: EMI board for CE/CCC 1-phase models only (includes screws but not wires) (designator: PCB2)</i>

WARNING



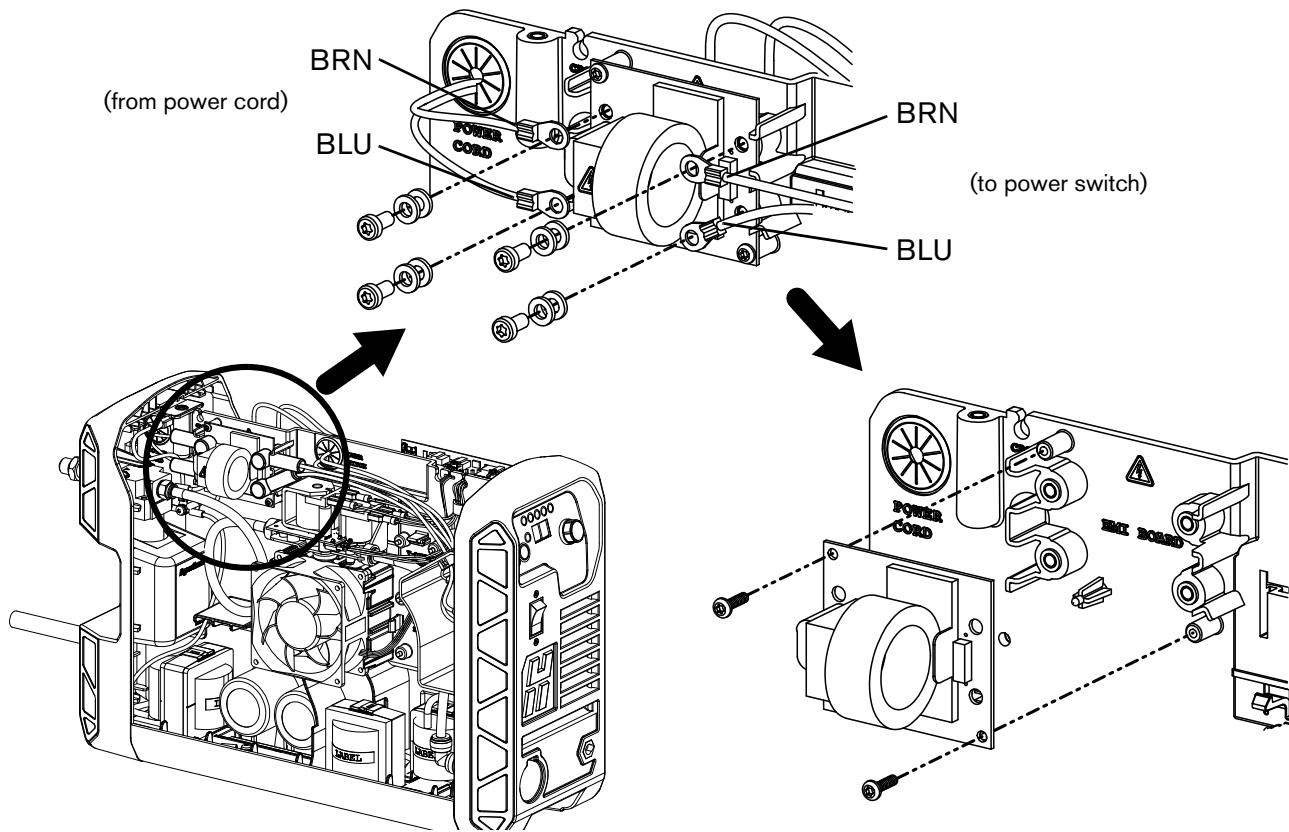
ELECTRIC SHOCK CAN KILL

Allow internal voltages to discharge before touching any components on the EMI board (CE/CCC 1-phase models only). Live voltages can be present on the EMI board for several minutes after the system is turned OFF.

Remove the EMI board

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. *Remove the power supply cover and handle* on page 215.
 - c. *Remove the component barrier* on page 218.
2. Pull back the 4 insulating covers to expose the power wire screws. Slide the covers down the wires out of the way.
3. Remove the screws securing the 4 power wire ring terminals. See *Figure 48* on page 244.
4. Remove the 2 screws that secure the EMI board to the center panel.

Figure 48



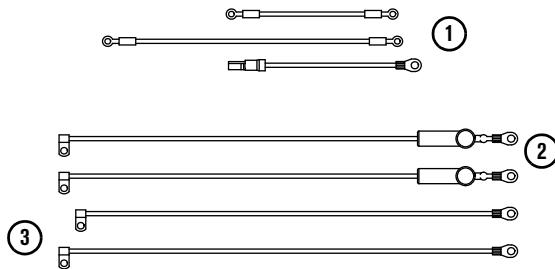
Install the EMI board

1. Place the new EMI board into position at the location marked "EMI BOARD" on the center panel. See *Figure 48*. Make sure the screw holes align and the placement pin aligns with the board.
2. Secure the board to the center panel with 2 screws. Tighten the screws to 17.3 kg·cm (15 inch·pounds).
3. Connect the 4 power wires. Tighten the screws to 23 kg·cm (20 inch·pounds).
 - a. Brown wire (BRN) from the power switch to the top right terminal.
 - b. Blue wire (BLU) from the power switch to the bottom right terminal.
 - c. Brown wire (BRN) from the power cord to the top left terminal.
 - d. Blue wire (BLU) from the power cord to the bottom left terminal.
4. Slide the 4 insulating covers back into place over the power wire screws.
5. Complete the following procedures:
 - a. *Install the component barrier* on page 219.
 - b. *Install the power supply cover and handle* on page 216.
 - c. Reconnect the gas supply and the power cord.

Replace internal wires – 1-phase models

Kit number	Description
428686	<p><i>Kit: Wire group for 1-phase models:</i></p> <ul style="list-style-type: none"> ▪ 3 ground wires ▪ 2 wires from power switch to power board (black and white) ▪ 2 wires from power switch to power cord (CSA) or EMI board (CE/CCC) (blue and brown) with protective covers for wire terminals

Figure 49



- | | |
|---|--|
| <p>1 Ground wires</p> <p>2 Wires that go from power switch to power board</p> | <p>3 Wires that go from power switch to power cord (CSA) or EMI board (CE/CCC)</p> |
|---|--|

Remove internal wires

For these steps, refer to *Figure 50* on page 247 and *Figure 51* on page 248.

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. *Remove the power supply cover and handle* on page 215.
 - c. *Remove the component barrier* on page 218.
 - d. *Remove the power switch* on page 236.
2. From the power board side, disconnect the power switch black wire and white wire from the power board.
3. From the fan side, disconnect the power switch brown wire and blue wire from the:
 - **CSA models:** Power cord connection points on the center panel
 - **CE/CCC models:** “SW OUT” side of the EMI board

4. Disconnect the 3 ground wires from the ground stud on the center panel.



If there are ground wires from the machine interface (CPC port) or RS-485 connector, leave those terminals in place on the ground stud.

5. Disconnect the other end of each ground wire from:

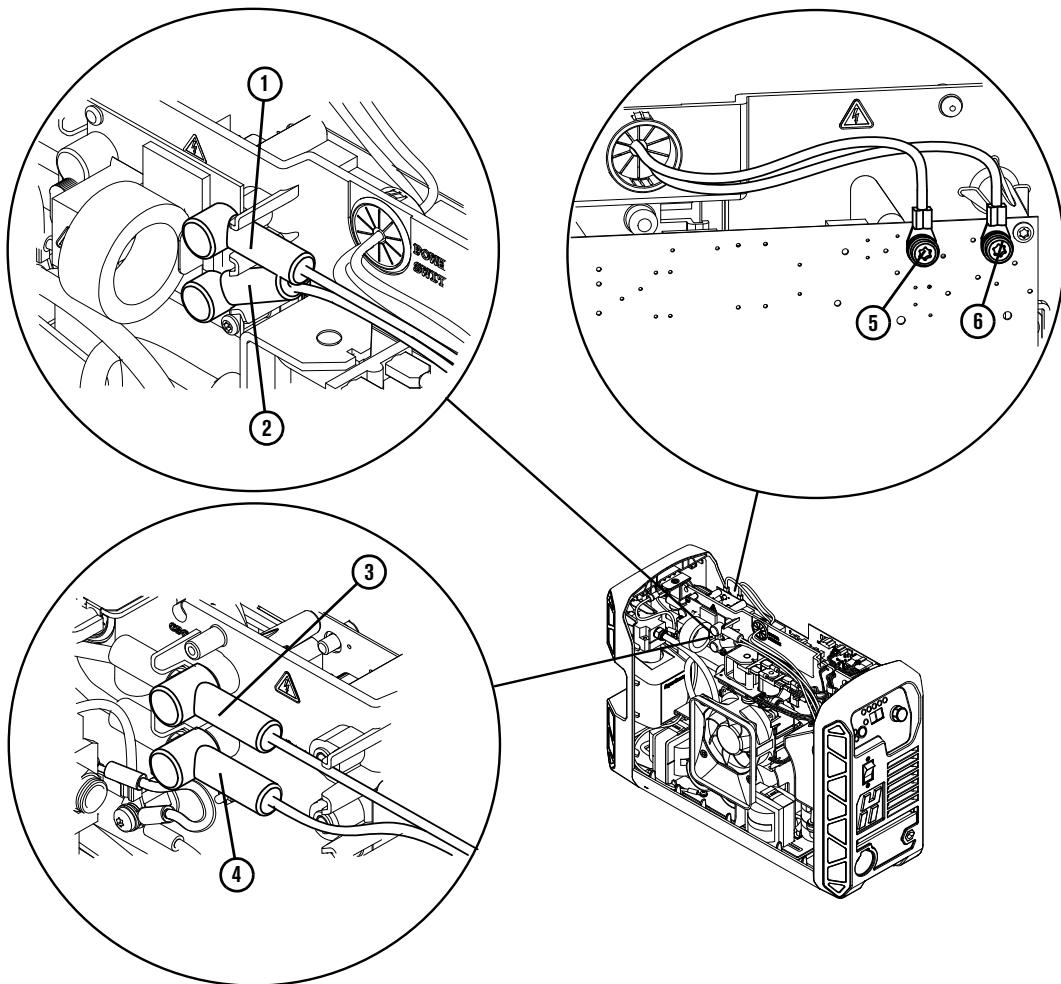
- Air filter assembly
- Ground clip on the rear panel
- Magnetics assembly base plate

Install internal wires

For these steps, refer to *Figure 50* on page 247 and *Figure 51* on page 248.

1. Slide the red insulating covers onto the new brown wire and blue wire.
2. Connect the brown wire and blue wire to the:
 - **CSA models:** Power cord connection points on the center panel
 - **CE/CCC models:** “SW OUT” side of the EMI boardTighten to 23 kg·cm (20 inch·pounds).
3. Slide the red insulating covers up into place so that they cover the screws.
4. Route the wires through the grommet to the power switch area behind the front panel.
5. Connect the black wire and white wire to the power board. Tighten to 23 kg·cm (20 inch·pounds).
6. Route the wires through the grommet in the middle of the center panel and then through the grommet near the power switch.
7. Wrap a cable tie around the 4 new wires (brown, blue, black, and white) above the solenoid valve.

Figure 50



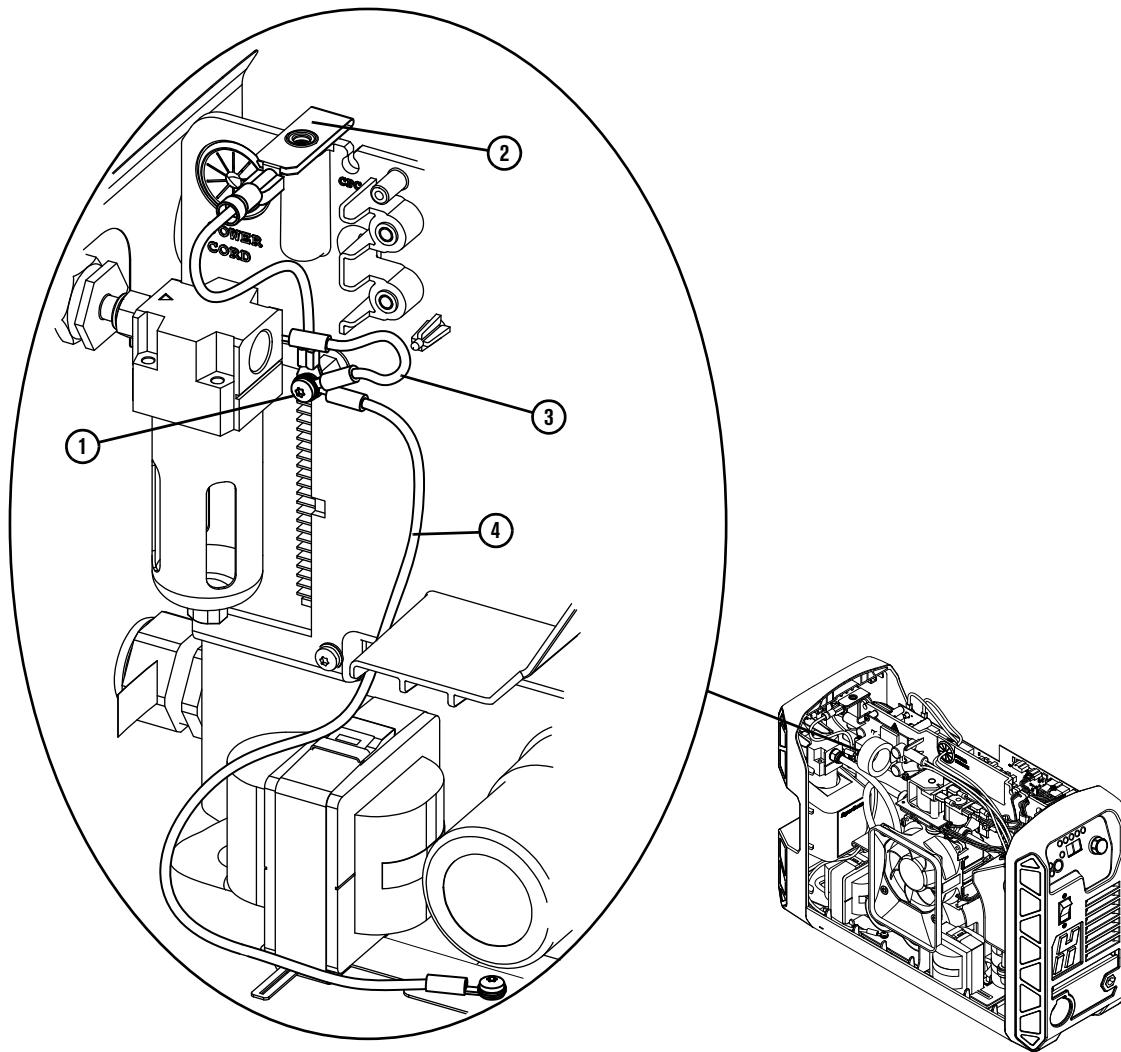
- | | | | |
|---|---|---|-------------------------|
| 1 | Brown wire on CE/CCC models (EMI board) | 4 | Blue wire on CSA models |
| 2 | Blue wire on CE/CCC models (EMI board) | 5 | Black power board wire |
| 3 | Brown wire on CSA models | 6 | White power board wire |

- 8.** Connect the 3 green ground wires to the ground stud on the center panel. Tighten the screws to 17.3 kg·cm (15 inch·pounds).



Rotate the ground wire terminals on the stud so that each wire points in a different direction.

- 9.** Connect the short ground wire to the air filter assembly. Tighten to 23 kg·cm (20 inch·pounds).
- 10.** Connect the long ground wire to the metal base plate for the magnetics assembly. Tighten to 17.3 kg·cm (15 inch·pounds).
- 11.** Connect the push-on connector for the third ground wire to the ground clip on the rear panel.

Figure 51 – Internal ground wire connections

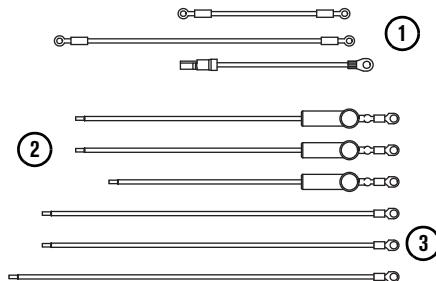
- 1 Ground stud
2 Ground clip
3 Air filter ground
4 Magnetics assembly ground

- 12.** Complete the following procedures:
- Install the power switch on page 237.*
 - Install the component barrier on page 219.*
 - Install the power supply cover and handle on page 216.*
 - Reconnect the gas supply and the power cord.

Replace internal wires – 3-phase models

Kit number	Description
428731	<p><i>Kit: Wire group for 3-phase models:</i></p> <ul style="list-style-type: none"> ▪ 3 ground wires ▪ 3 wires from power switch to power board (brown with white stripe, white with black stripe, and black with white stripe) ▪ 3 wires from power switch to power cord (black, white, and brown) with protective covers for wire terminals

Figure 52



- | | |
|---|---|
| 1 Ground wires
2 Wires that go from the power switch to the power cord | 3 Wires that go from the power switch to the power board |
|---|---|

Remove internal wires

For these steps, refer to *Figure 53* on page 252 and *Figure 51* on page 248.

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Remove the component barrier on page 218.
 - d. Remove the power switch on page 237.
2. From the power board side, disconnect the 3 wires that go from the power switch to the power board:
 - Brown wire with white stripe
 - Black wire with white stripe
 - White wire with black stripe



If your system contains a white wire with brown stripe, replace it with the brown wire with white stripe contained in the kit.

3. From the fan side, disconnect the 3 wires that go from the power switch to the power cord connection points on the center panel:

- Brown wire
- White wire
- Black wire

4. Disconnect the 3 ground wires from the ground stud on the center panel.



If there are ground wires from the machine interface (CPC port) or RS-485 connector, leave those terminals in place on the ground stud.

5. Disconnect the other end of each ground wire from:

- Air filter assembly
- Ground clip on the rear panel
- Magnetics assembly base plate

Install internal wires

For these steps, refer to *Figure 53* on page 252 and *Figure 51* on page 248.

1. From the power board side, connect the following 3 wires to the power board as shown in *Figure 53*. Tighten to 23 kg·cm (20 inch·pounds).
 - Brown wire with white stripe
 - Black wire with white stripe
 - White wire with black stripe
2. Route the wires through the grommet in the middle of the center panel and then through the grommet near the power switch.
3. Slide the red insulating covers onto the new brown wire, white wire, and black wire.
4. From the fan side, connect the following 3 wires to the power cord connection points on the center panel. Tighten to 23 kg·cm (20 inch·pounds).
 - Brown wire
 - White wire
 - Black wire
5. Slide the red insulating covers up into place so that they cover the screws. Route the wires through the grommet to the power switch area behind the front panel.
6. Wrap a cable tie around the 6 new wires above the solenoid valve.

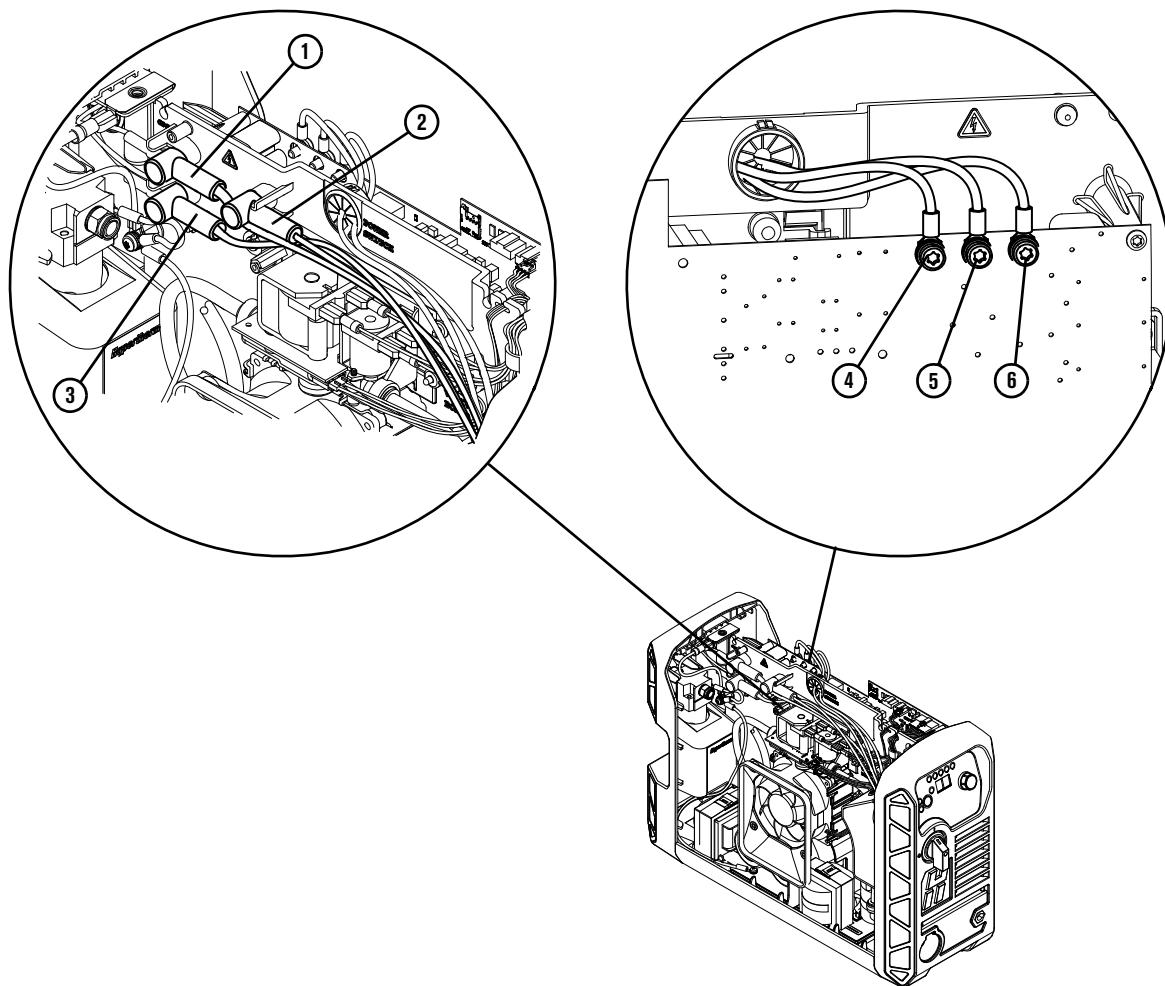
7. Connect the 3 green ground wires to the ground stud on the center panel as shown in *Figure 51*. Tighten to 17.3 kg·cm (15 inch·pounds).



Rotate the ground wire terminals on the stud so that each wire points in a different direction.

8. Connect the short ground wire to the air filter assembly. Tighten to 23 kg·cm (20 inch·pounds).
9. Connect the long ground wire to the metal base plate for the magnetics assembly. Tighten to 17.3 kg·cm (15 inch·pounds).
10. Connect the push-on connector for the third ground wire to the ground clip on the rear panel.
11. Complete the following procedures:
 - a. *Install the power switch* on page 238.
 - b. *Install the component barrier* on page 219.
 - c. *Install the power supply cover and handle* on page 216.
 - d. Reconnect the gas supply and the power cord.

Figure 53



- 1** Brown wire
- 2** White wire
- 3** Black wire

- 4** Brown wire with white stripe
- 5** Black wire with white stripe
- 6** White wire with black stripe

Replace the power board

Kit number	Description
428682	<i>Kit: Power board for 200 – 240 V CSA/CE/CCC 1-phase models (designator: PCB3)</i>
428683	<i>Kit: Power board for 400 V CE/CCC 3-phase models (designator: PCB3)</i>
428708	<i>Kit: Power board for 480 V CSA 3-phase models (designator: PCB3)</i>



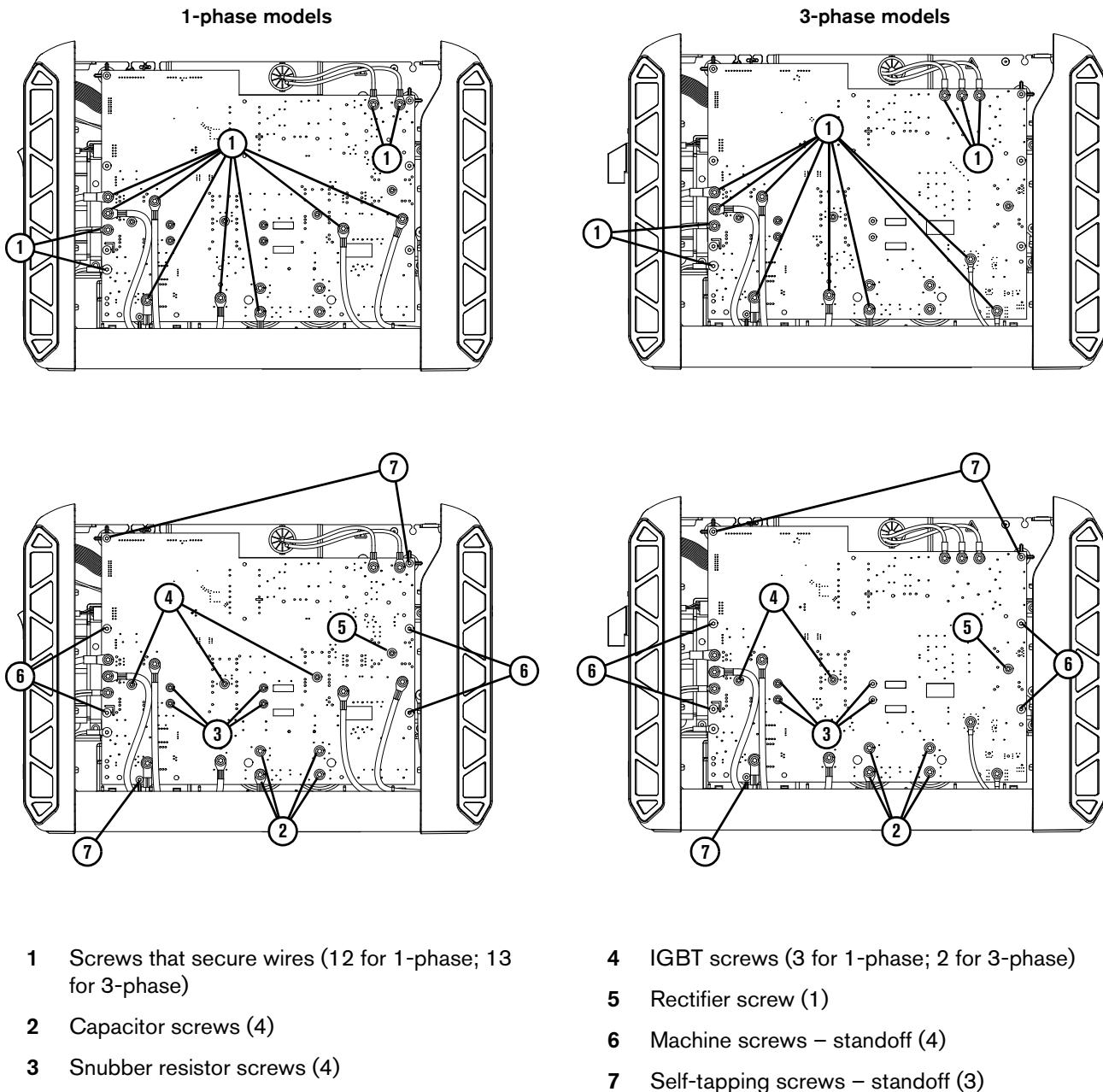
When replacing the power board, also check the snubber resistors. Refer to *Check the power switch and snubber resistors* on page 152.

Remove the power board

For these steps, refer to *Figure 54* on page 254.

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Remove the component barrier on page 218.
2. Remove the screw-secured wires from the power board.
 - 1-phase models have 12 wires.
 - 3-phase models have 13 wires.
3. Remove the 3 remaining capacitor screws.
4. Remove the 4 snubber resistor screws.
5. Remove the IGBT screws.
 - 1-phase models have 3 IGBT screws.
 - 3-phase models have 2 IGBT screws.
6. Remove the rectifier screw.
7. Remove the standoff screws. There are 3 self-tapping screws and 4 machine screws.
8. Unplug all the connectors from the power board. See *Figure 55* on page 256.
9. Slowly pull the power board straight back and away from the unit.
 - 1-phase models: Unplug the J10 2-wire connector from the power board.
 - 3-phase models: There is no J10 connection.
10. Remove the power board from the unit.

Figure 54



Install the power board

NOTICE

Do not apply too much thermal grease to the components on the power board. Too much grease can damage the power board and the power supply.

Apply only a very thin layer of thermal grease as described in this procedure. Do not apply the entire 1/8 ounce of grease that is provided in the kit.

For these steps, refer to *Figure 56* on page 258.

1. Make sure you have the correct power board for your system.
 - The replacement kit number for a 200 – 240 V CSA/CE/CCC system is **428682**.
 - The replacement kit number for a 400 V CE/CCC system is **428683**.
 - The replacement kit number for a 480 V CSA system is **428708**.
2. Move out of the way any wires from where the power board will be mounted to avoid any interference when replacing the board.
3. Clean the area where the IGBTs were mounted. Use isopropyl alcohol to remove the old thermal grease from the heatsink.
4. Evenly apply a 0.0762 mm (0.003 inch) layer of thermal grease, about the thickness of a sheet of paper, on each IGBT and on the rectifier mounting surface.

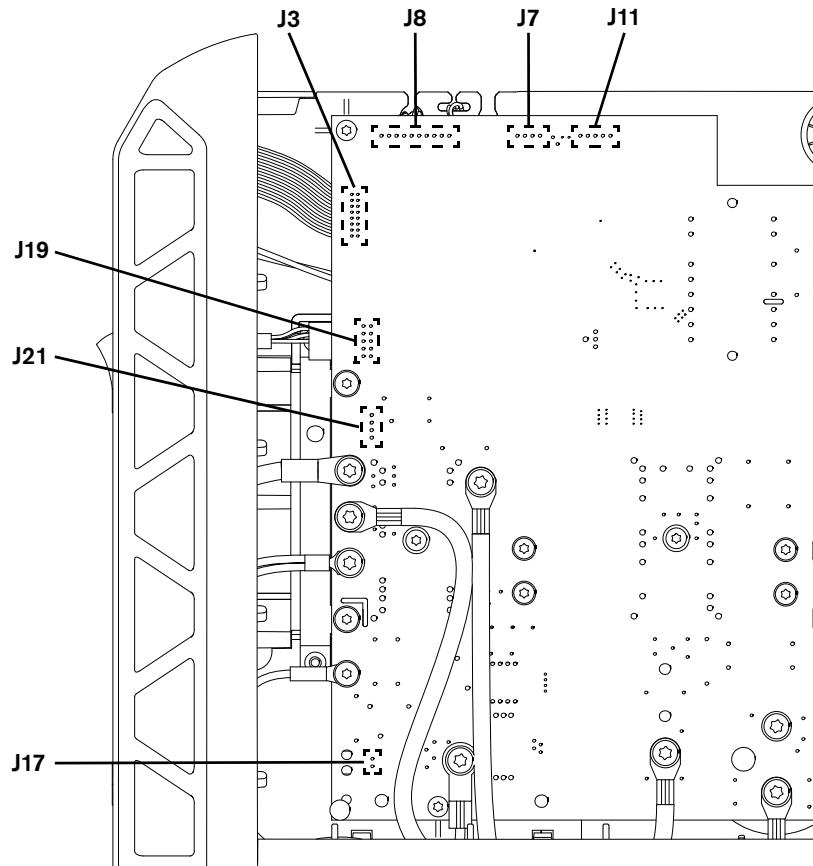
 There are 3 IGBTs for 1-phase models. There are 2 IGBTs for 3-phase models.
5. **1-phase models:** Plug the 2-wire connector from the power switch assembly into J10 on the main power board. There is no J10 connection on 3-phase models.

 The J10 connection is for the trip coil on the power switch. There is no trip coil on 3-phase models.
6. Install the 4 machine screws and the 3 self-tapping standoff screws.

7. Make the following connections to the power board. See *Figure 55*.

Component	Connector on power board	Connector type
Solenoid valve assembly	J8	8-pin
Fan	J7	4-pin
RS-485 serial interface	J11	5-pin
Machine interface (CPC) port	J21	4-pin
Voltage divider board (CPC option)	J17	2-pin
Torch receptacle	J19	10-pin
Display board	J3	Ribbon cable

Figure 55



J3 Display board

J19 Torch receptacle

J21 Machine interface (CPC)

J17 Voltage divider board

J11 RS-485 serial interface

J7 Fan

J8 Solenoid valve assembly

8. Connect the 4 snubber resistor screws. Tighten to 17.3 kg·cm (15 inch·pounds).
9. Connect the IGBT and rectifier screws. Tighten to 23 kg·cm (20 inch·pounds).
10. Connect the screw-secured wires to the power board. Tighten to 23 kg·cm (20 inch·pounds).



The white electrode wire (J18) ③ is secured by an M4 screw. All the other wires are secured by M5 screws.

11. Connect the remaining 3 screws to the capacitors. Tighten to 23 kg·cm (20 inch·pounds). As you connect the capacitors to the power board, rotate each capacitor until the polarity dot aligns with the viewing hole on the power board.
12. Complete the following procedures:
 - a. *Install the component barrier* on page 219.
 - b. *Install the power supply cover and handle* on page 216.
 - c. Reconnect the gas supply and the power cord.

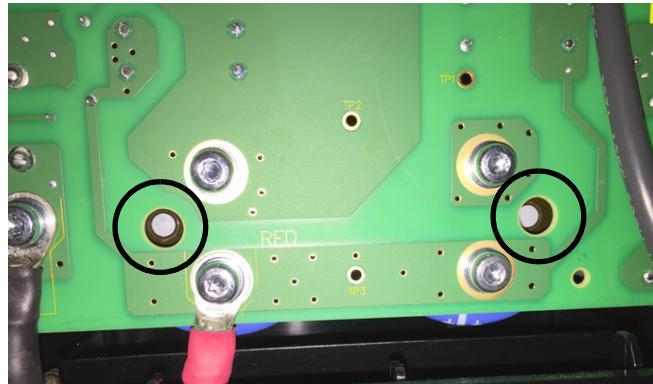
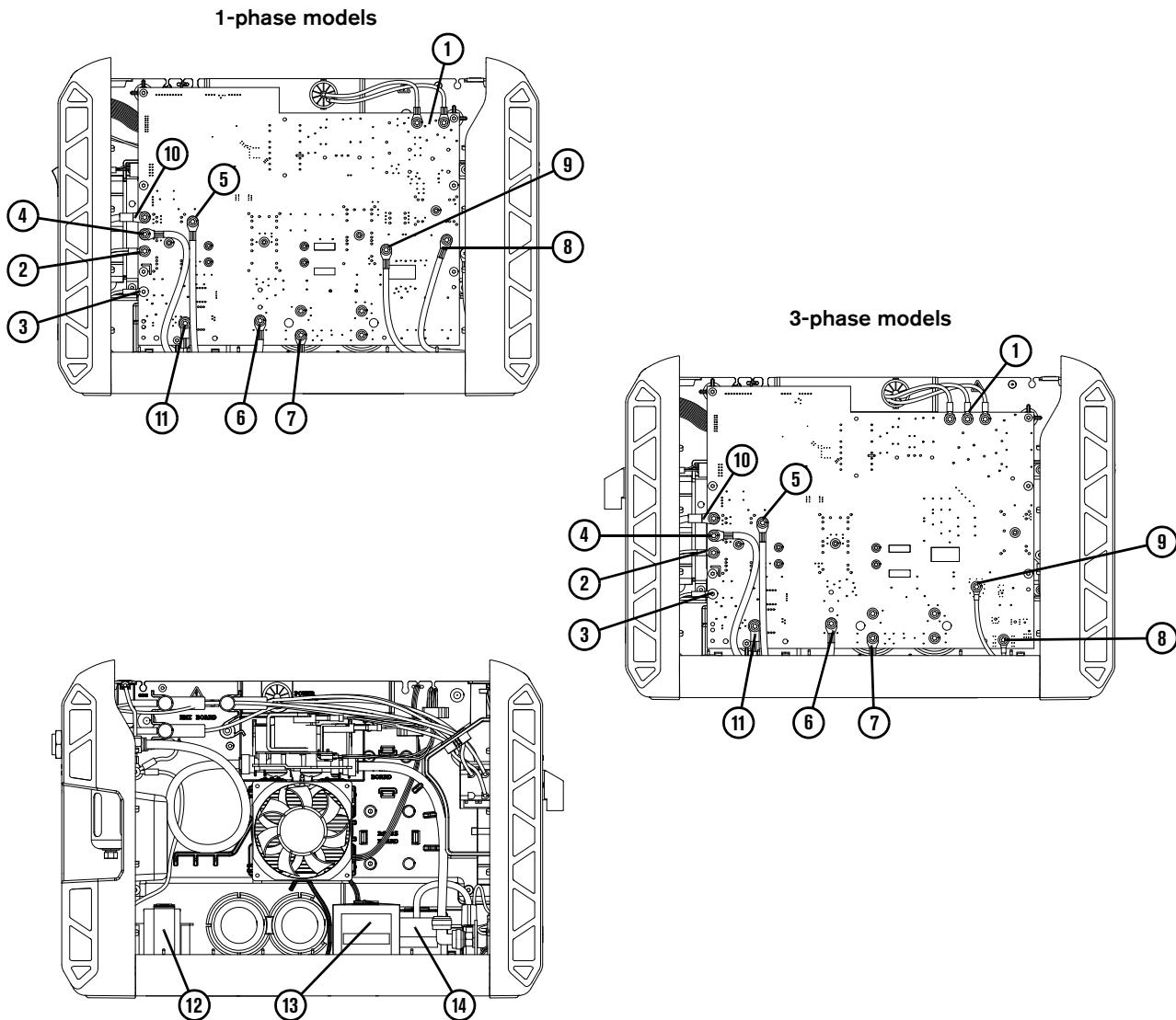


Figure 56

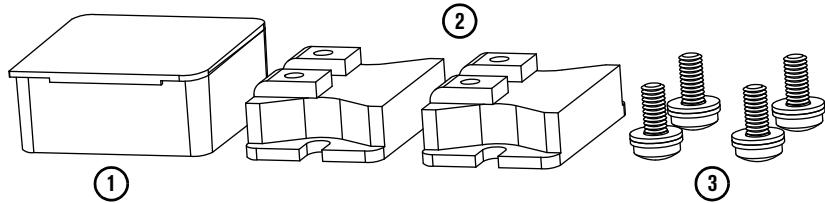


- | | | | |
|---|--|----|--|
| 1 | Power switch connections (J1 and J2 for 1-phase; J1, J2, and J4 for 3-phase) | 8 | PFC inductor – red (J5) |
| 2 | Dual red nozzle wires from torch receptacle (J15) | 9 | PFC inductor – black (J4 for 1-phase; J26 for 3-phase) |
| 3 | White electrode wire from torch socket (J18) | 10 | Output inductor – yellow (J13) |
| 4 | Power transformer secondary – black (J14) | 11 | Work lead wire (J23) |
| 5 | Power transformer secondary – red (J12) | 12 | PFC inductor |
| 6 | Power transformer primary – black (J6) | 13 | Power transformer |
| 7 | Power transformer primary – red | 14 | Output inductor |

Replace the snubber resistors

Kit number	Description
428065	Kit: Snubber resistors (2) 10 Ω with thermal grease

Figure 57

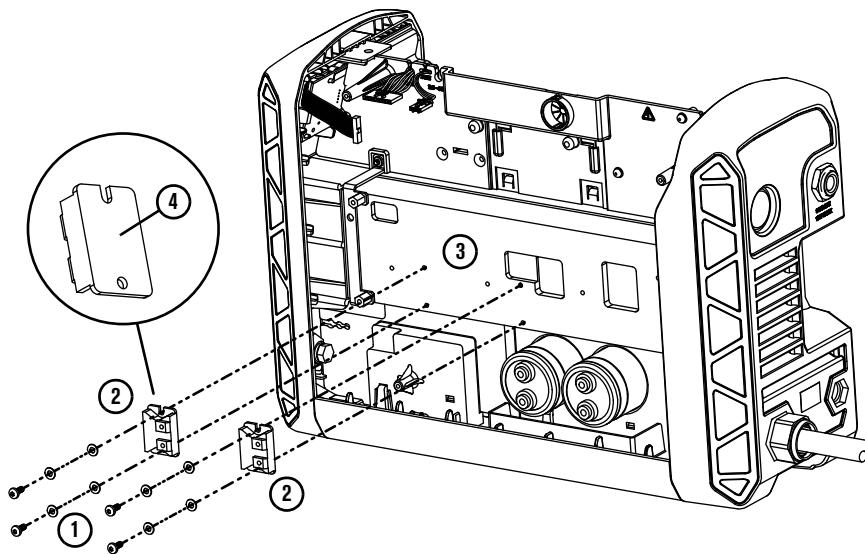


- 1 Thermal grease
- 2 Snubber resistors
- 3 M4 X 10 screws

Remove the snubber resistors

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Remove the component barrier on page 218.
 - d. Remove the power board on page 253.
2. Remove the mounting screws and washers ① from the snubber resistors ②. See Figure 58 on page 260.
3. Remove the snubber resistors from the heatsink ③.

Figure 58



Install the snubber resistors

NOTICE

Do not apply too much thermal grease to the components on the power board. Too much grease can damage the power board and the power supply.

Apply only a very thin layer of thermal grease as described in this procedure. Do not apply the entire 1/8 ounce of grease that is provided in the kit.

1. Clean the area where the snubber resistors ② were mounted. Use isopropyl alcohol to remove the old thermal grease from the heatsink ③. See *Figure 58*.
2. Apply a 0.0762 mm (0.003 inch) layer of thermal grease, about the thickness of a sheet of paper, evenly on the new snubber resistor mounting surface ④.
3. Mount the snubber resistors to the heatsink. Step-torque the mounting screws ① to 23 kg·cm (20 inch·pounds).
4. Complete the following procedures:
 - a. *Install the power board* on page 255.
 - b. *Install the component barrier* on page 219.
 - c. *Install the power supply cover and handle* on page 216.
 - d. Reconnect the gas supply and the power cord.

Replace the capacitors

Kit number	Description
228301	Kit: Capacitors (2) for 200 – 240 V CSA/CE/CCC 1-phase power boards
228426	Kit: Capacitors (2) for 400 V CE/CCC 3-phase power boards
428080	Kit: Capacitors (2) for 480 V CSA 3-phase power boards

WARNING



ELECTRIC SHOCK CAN KILL

Allow internal voltages to discharge before handling the capacitors. The capacitors can hold a charge for several minutes after the system is turned OFF.

Remove the capacitors

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Remove the component barrier on page 218.
2. Carefully remove the plenum ① from the fan casing. Release the clips in the top 2 corners of the plenum before releasing the bottom 2 clips. See *Figure 59* on page 262.



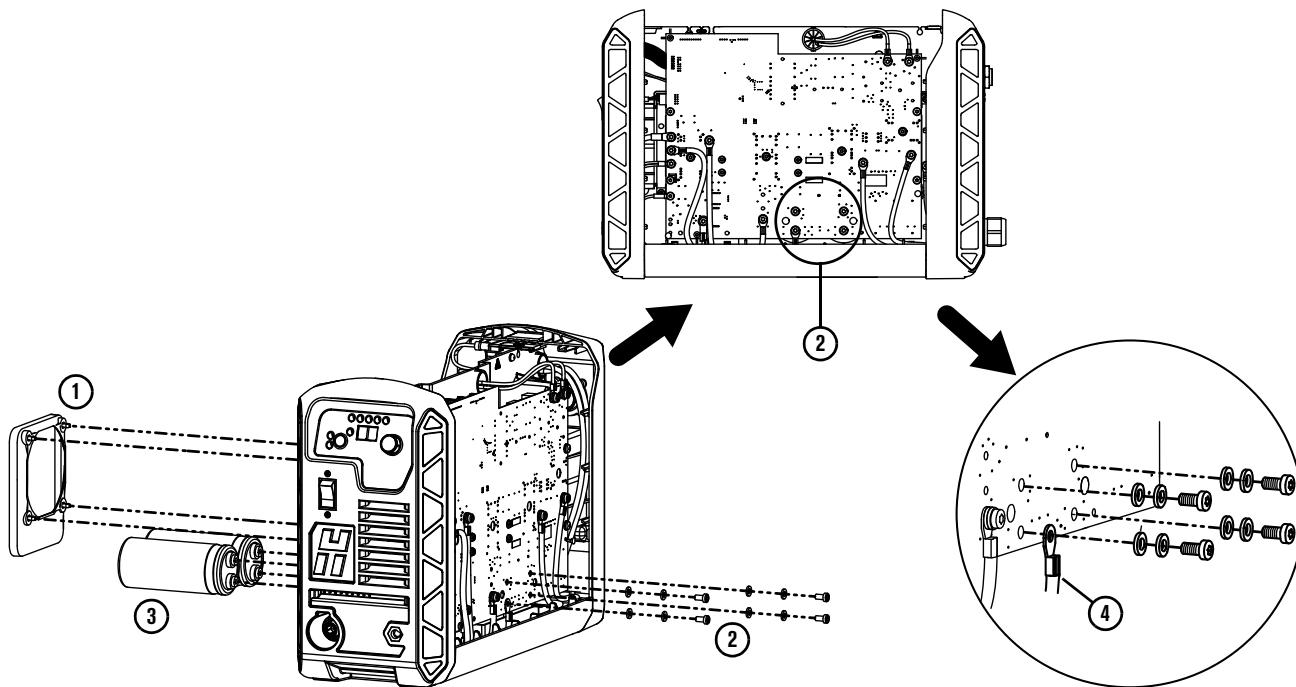
If necessary, use needle-nose pliers to compress and release the top 2 corner clips before working the bottom 2 clips free from the fan casing.

NOTICE

Be careful not to apply too much pressure to any of the clips as you detach the plenum from the fan.

3. Remove the 4 capacitor mounting screws ② from the power board.
4. From the opposite side of the power supply (fan side), remove the capacitors ③ by pulling them straight out.

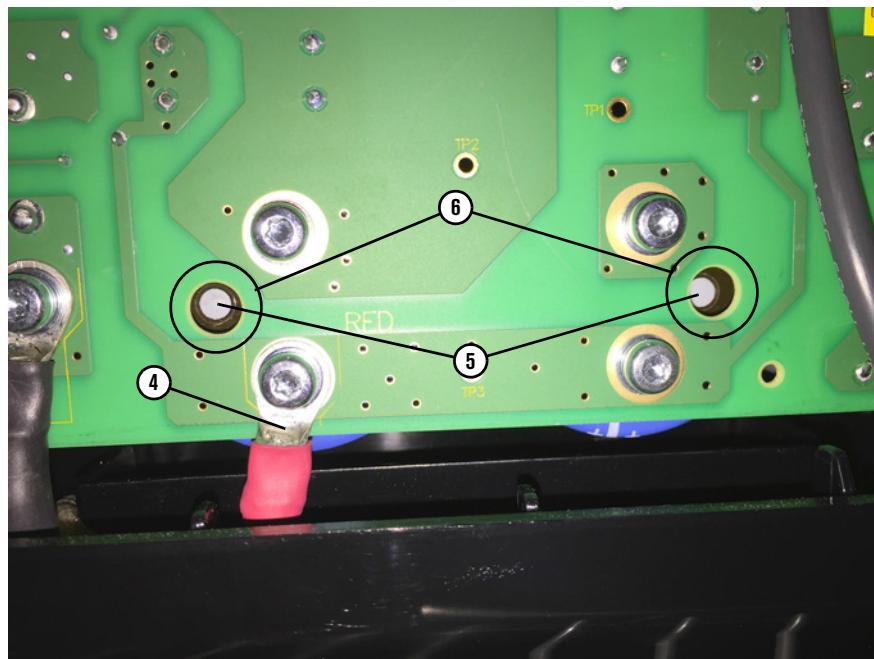
Figure 59



Install the capacitors

1. Insert the new capacitors ③ from the fan side of the power supply. See *Figure 59*.
2. Rotate each capacitor until the polarity dot ⑤ aligns with the viewing hole ⑥ on the power board. See *Figure 60* on page 263.
3. Attach the capacitors to the power board with the 4 mounting screws ②. Secure the transformer wire ④ to the RED location. Start the 4 screws by hand then tighten to 23 kg·cm (20 inch·pounds).
4. Align the 4 clips on the fan plenum ① to the slot locations on the fan and press it into place.
5. Complete the following procedures:
 - a. *Install the component barrier* on page 219.
 - b. *Install the power supply cover and handle* on page 216.
 - c. Reconnect the gas supply and the power cord.

Figure 60



Replace the fan

Kit number	Description
428687	<i>Kit: Fan assembly for 1-phase models (designator: M1)</i>
428688	<i>Kit: Fan assembly for 3-phase models (designator: M1)</i>
428734	<i>Kit: Plenum for fan</i>



To confirm you have the right fan, check the barcode sticker on the side of the fan. Fans for 3-phase models have a 6-digit Hypertherm part number (229845) on the sticker. Fans for 1-phase models have only the barcode on the sticker.

Remove the fan

1. Complete the following procedures:
 - a. Set the power switch to OFF (**O**), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
2. Detach the fan wire connector ① from J7 on the power board. Lift the top edge of the component barrier to see the connector. See *Figure 61* on page 265.
3. Remove the fan wires from the pass-through at the top of the center panel and from the clip on the center panel.



If you have the RS-485 serial port installed, you may need to disconnect the RS-485 board from J11 on the power board in order to untangle the wires from the board and the fan.

4. Carefully remove the plenum ② from the fan casing. Release the clips in the top 2 corners of the plenum before releasing the bottom 2 clips.



If necessary, use needle-nose pliers to compress and release the top 2 corner clips before working the bottom 2 clips free from the fan casing.

NOTICE

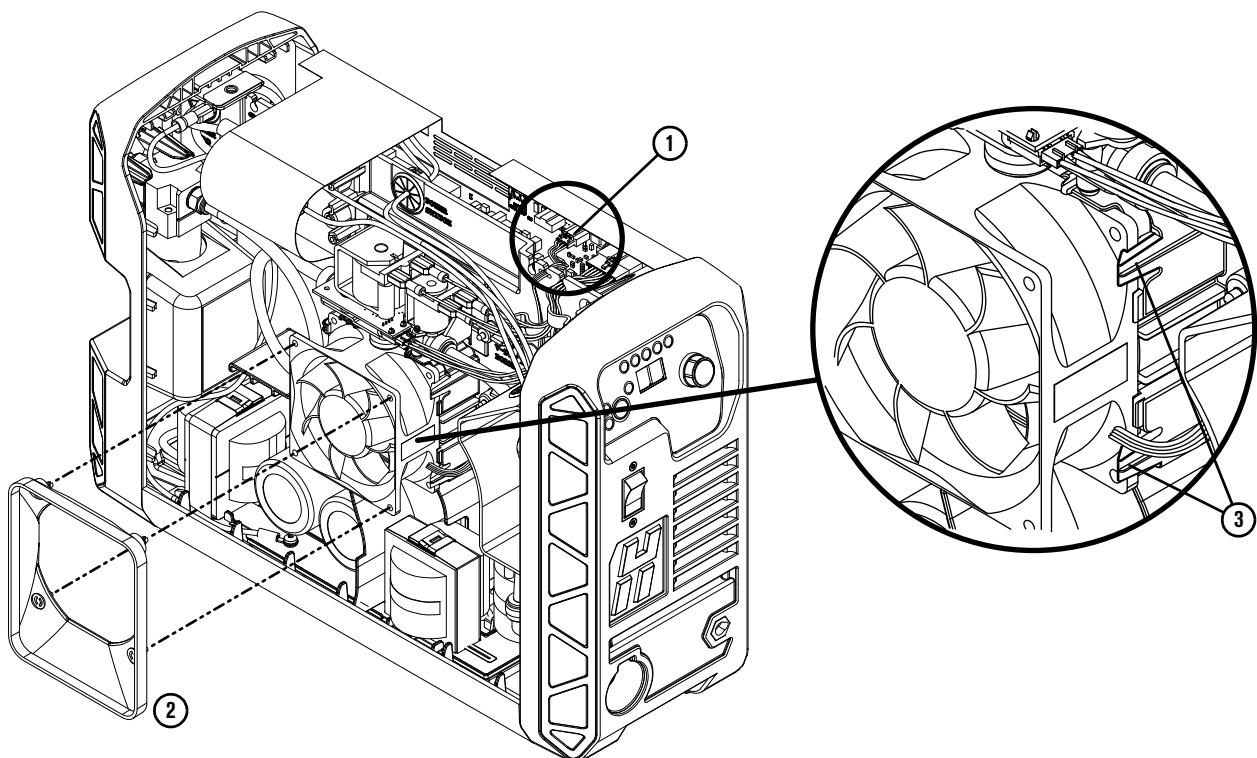
Be careful not to apply too much pressure to any of the clips as you detach the plenum from the fan.

5. Remove the fan by pushing back the 2 clips ③ on the right side of the fan until the fan assembly is released.



The fan does not use any mounting screws to attach to the center panel.

Figure 61



Install the fan

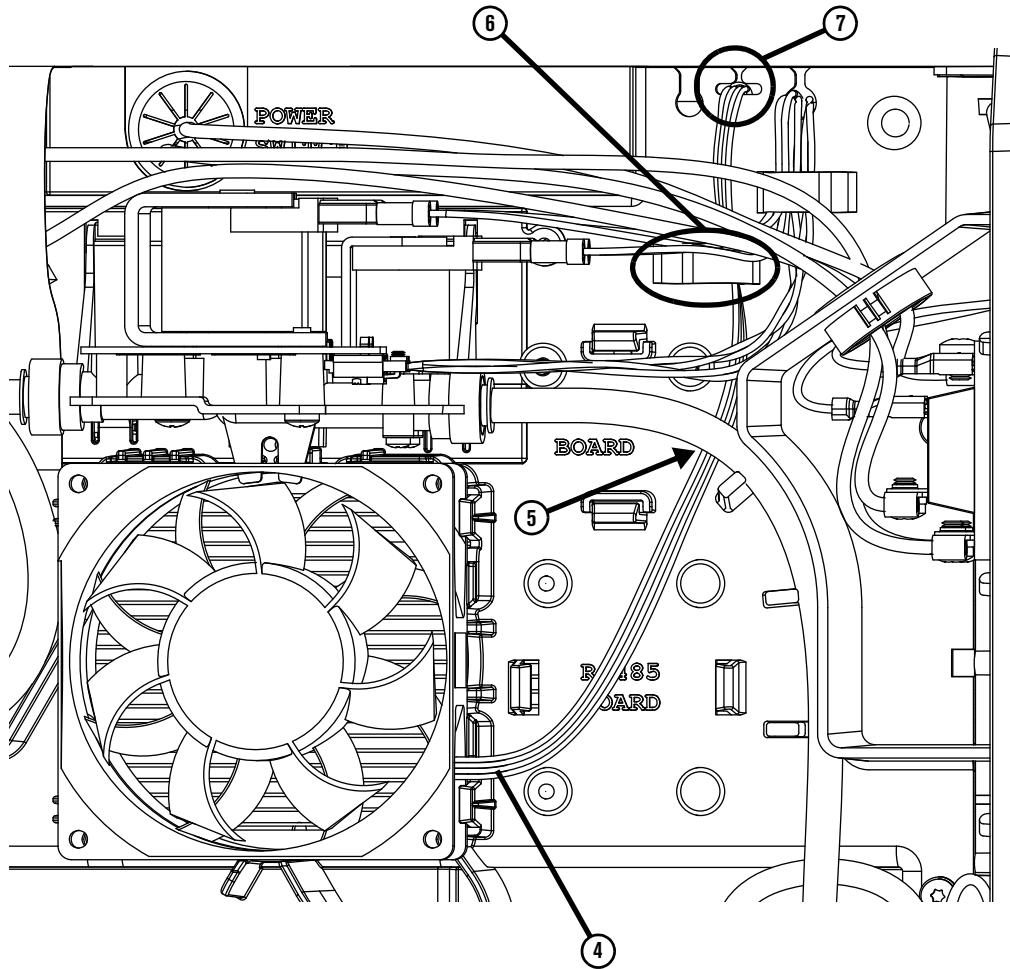
NOTICE

Do not route any wires below the fan. If any wires get pinched behind the fan, this can not only damage the wires but also prevent the fan from functioning correctly.

1. Snap the new fan into place on the center panel.
 - a. Position the fan so the wires extend from the bottom right corner ④ as shown in *Figure 62* on page 266.
 - b. Put the left side of the fan into place first, then push in the right side of the fan until it snaps into place.
 - c. **Make sure no wires are pinched behind the fan.** Check each side and corner around the fan.
2. Route the wires for the fan as follows. See *Figure 62*.
 - Behind the gas tube ⑤ and the wires from the solenoid valve.
 - Through the clip ⑥ on the center panel.
 - Through the pass-through labeled "FAN" at the top of the center panel ⑦.

3. Plug the wire connector ① into J7 on the power board. See *Figure 61* on page 265.
4. Align the 4 clips on the new fan plenum ② to the slot locations on the fan and press it into place.
5. Complete the following procedures:
 - a. *Install the power supply cover and handle* on page 216.
 - b. Reconnect the gas supply and the power cord.

Figure 62



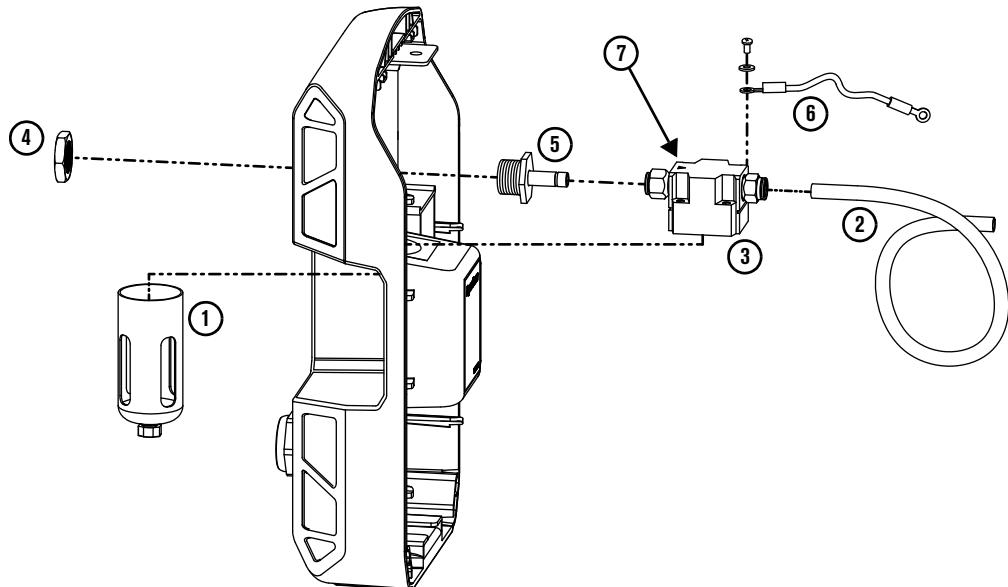
Replace the air filter assembly

Kit number	Description
428684	Kit: Air filter assembly (includes metal guard, filter bowl, filter element, and gas hose)

Remove the air filter

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
2. Remove the air filter bowl ①. See page 212.
3. Push-to-disconnect the gas hose ② from the side of the air filter ③. See Figure 63.
4. From the outside of the rear panel, remove the nut ④ from the brass bulkhead fitting ⑤.
5. Pull out the air filter assembly from inside the rear panel.
6. Disconnect the ground wire ⑥ from the air filter.
7. Push-to-disconnect the brass bulkhead fitting from the side of the air filter.

Figure 63



Install the air filter

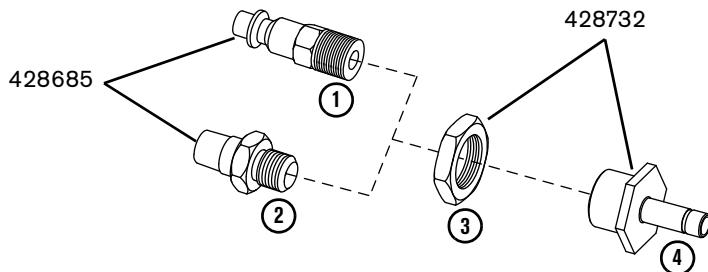
For these steps, refer to *Figure 63* on page 267.

1. Put the brass bulkhead fitting ⑤ into place inside of the rear panel. Make sure the fitting is pushed all the way in against the rear panel.
2. Attach the nut ④ onto the brass bulkhead fitting from the outside of the rear panel. Tighten to 138 kg·cm (120 inch·pounds).
3. Connect the ground wire ⑥ to the back right corner of the new air filter ③. Make sure the other end of the wire is connected to the ground stud on the center panel. Tighten to 23 kg·cm (20 inch·pounds).
4. Put into place the new air filter with filter bowl and metal guard ① attached. Connect the end with the embossed arrow ⑦ to the brass bulkhead fitting. Push-to-connect the air filter to the brass bulkhead fitting.
5. Push-to-connect the looped gas supply hose ② into the side of the air filter. Make sure the hose retains a looped shape and is not kinked or cracked.
 -  If the gas supply hose is kinked, discard it and replace it with a new hose.
The integrity of the hose is compromised once the hose kinks.
6. Complete the following procedures:
 - a. *Install the power supply cover and handle* on page 216.
 - b. Reconnect the gas supply and the power cord.

Replace the gas inlet fittings

Kit number	Description
428685	<i>Kit: Gas inlet fittings:</i> <ul style="list-style-type: none"> ▪ Industrial interchange quick-disconnect nipple with 1/4 NPT threads ▪ British Pipe Thread adapter G-1/4 BSPP with 1/4 NPT threads
428732	<i>Kit: 1/4 NPT bulkhead fitting and nut for air filter</i>

Figure 64



- 1** Quick-disconnect nipple 1/4 NPT
2 G-1/4 BSPP adapter with 1/4 NPT threads

- 3** Hex nut
4 1/4 NPT x 8 mm brass bulkhead fitting

Remove the gas inlet fittings

For these steps, refer to *Figure 65* on page 270.

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
2. Remove the gas inlet fitting (① or ②) from the back of the power supply.
3. From the outside of the rear panel, remove the nut ③ from the brass bulkhead fitting ④.
4. Push-to-disconnect the brass bulkhead fitting from the side of the air filter ⑤.
5. Discard the fittings that need to be replaced.

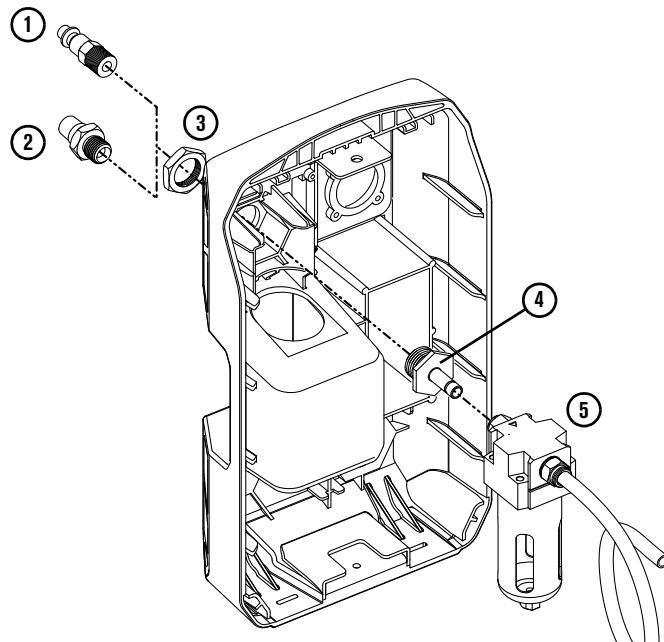
Install the gas inlet fittings

NOTICE

Never use PTFE tape on any joint preparation. Use only a liquid or paste thread sealant on male threads.

1. Put the brass bulkhead fitting ④ into place inside of the rear panel. Make sure the fitting is pushed all the way in against the rear panel. See *Figure 65*.
2. Attach the nut ③ onto the brass bulkhead fitting from the outside of the rear panel. Tighten to 138 kg·cm (120 inch·pounds).
3. Push-to-connect the air filter ⑤ to the brass bulkhead fitting.
4. **G-1/4 BSPP adapter** ②: Lightly apply thread sealant. Apply a bead of thread sealant on 2 – 3 threads. To avoid gas line contamination, do not apply too much sealant.
1/4 NPT quick-disconnect nipple ①: Thread sealant is preapplied.
5. Attach the gas inlet fitting to the brass bulkhead fitting.
 - Tighten the 1/4 NPT quick-disconnect nipple to 115 kg·cm (100 inch·pounds).
 - Tighten the G-1/4 BSPP adapter to 104 kg·cm (90 inch·pounds).
6. Complete the following procedures:
 - a. *Install the power supply cover and handle* on page 216.
 - b. Reconnect the gas supply and the power cord.

Figure 65



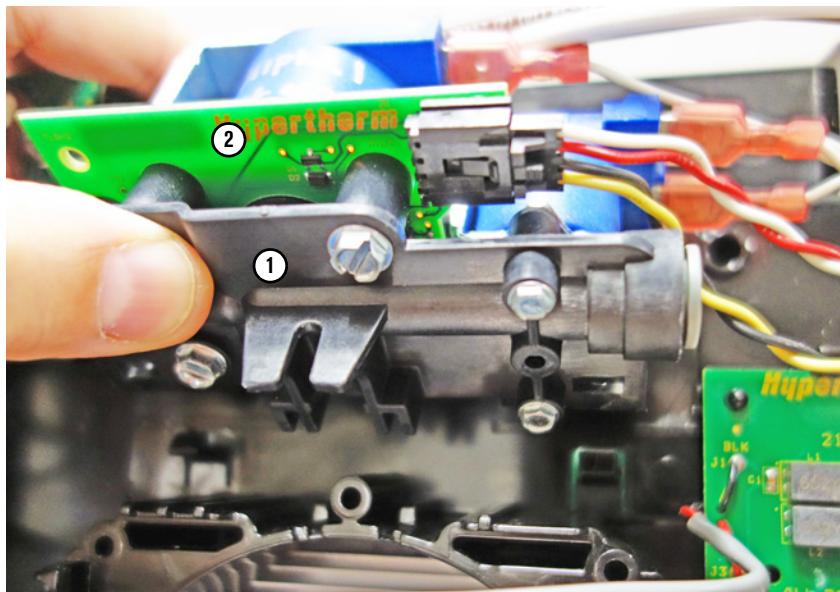
Replace the solenoid valve assembly

Kit number	Description
428630	Kit: Solenoid valve assembly (includes valve PCB, wiring harness, and both gas supply hoses) (designator: V1)

Remove the solenoid valve

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Remove the fan on page 264.
 2. Push-to-disconnect the 2 gas supply hoses from the solenoid valve assembly.
-  Disconnect the gas supply hoses from the air filter assembly and 90° fitting if you are also replacing the hoses.
3. Unplug the solenoid valve connector from J8 on the power board. Work the wires free from the center panel pass-through labeled "VALVE" and from the plastic clip.
 4. Press up from underneath the solenoid valve assembly to release it from the center panel. Press on the plastic housing ① to remove the valve. **Do not press on the circuit board ② on the valve assembly.**

Figure 66



Install the solenoid valve

1. Align the top corner tabs of the solenoid valve assembly to the slots in the center panel ③. Hold the valve at approximately a 45° angle.
2. Push the top corner tabs into the center panel slots, then rotate the bottom of the valve assembly down until it snaps into place.
3. Route the wires behind the plastic clip ④ and through the center panel pass-through that is labeled "VALVE" ⑤.
4. Plug the solenoid valve connector ⑥ into J8 on the power board.

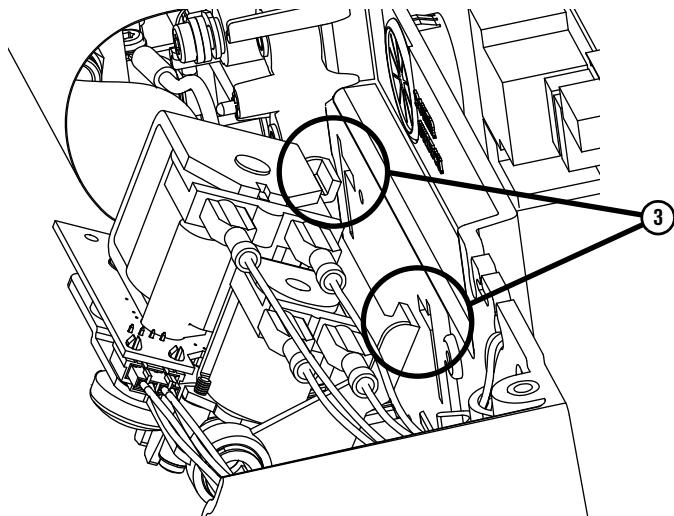
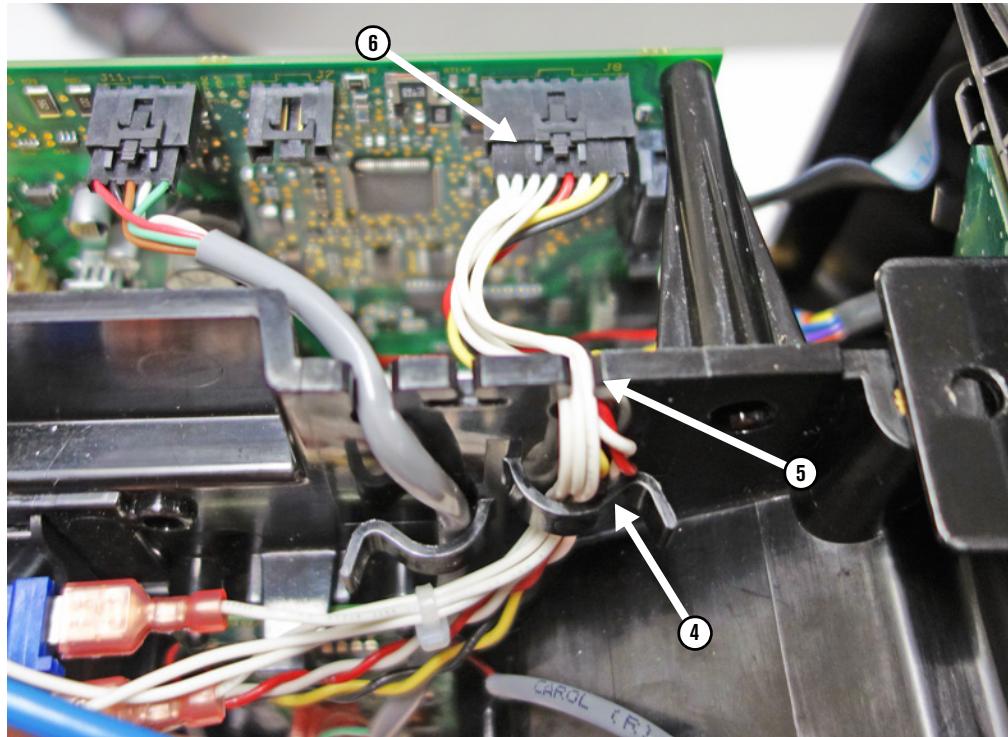


Figure 67



5. Make sure the 4 push-on wire connections on the valve are secure. The wire length should allow easy routing to the power board and should not be taut.

6. Push-to-connect the 2 gas supply hoses to the solenoid valve assembly. Insert each gas supply hose so the marked line reaches the connector. See *Figure 69* on page 275.

If you are replacing the hoses, connect the new hoses to the air filter assembly and to the 90° fitting. Make sure the gas supply hose from the air filter assembly has a looped shape and is not kinked or cracked. See page 274.



If a gas supply hose is kinked, discard it and replace it with a new hose.
The integrity of the hose is compromised once the hose is kinked.

7. Complete the following procedures:

- a. *Install the fan* on page 265.
- b. *Install the power supply cover and handle* on page 216.
- c. Reconnect the gas supply and the power cord.

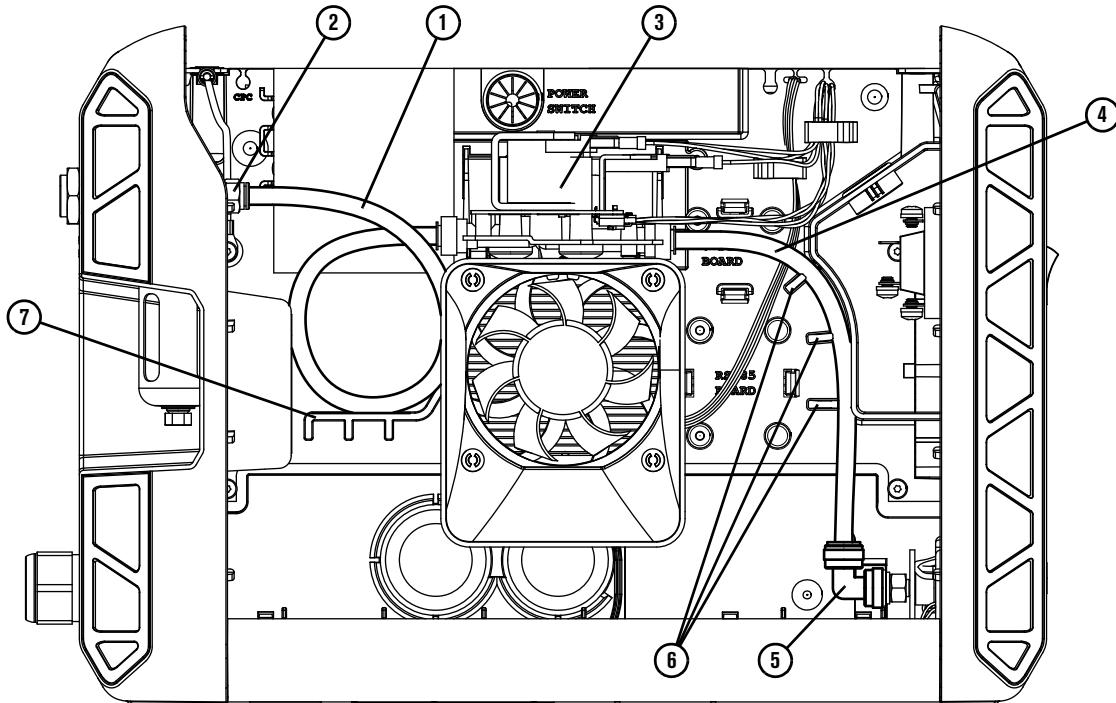
Replace the gas supply hoses and 90° fitting

Kit number	Description
428675	Kit: 2 gas supply hoses
428250	Kit: 90° fitting

Remove the gas supply hoses and 90° fitting

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
2. Push-to-disconnect the looped gas supply hose ① from the air filter assembly ② and from the solenoid valve assembly ③. See Figure 68.
3. Push-to-disconnect the gas supply hose ④ from the solenoid valve assembly and from the 90° fitting ⑤.
4. Push-to-disconnect the 90° fitting from the brass torch fitting.

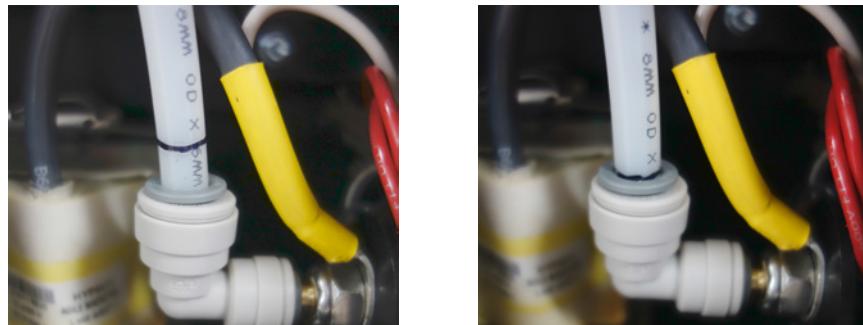
Figure 68



Install the gas supply hoses and 90° fitting

1. Push-to-connect the smaller diameter end of the 90° fitting ⑤ onto the brass torch fitting. See *Figure 68* on page 274.
2. Take the shorter gas supply hose ④. Push-to-connect one end of the hose to the larger diameter end on the 90° fitting. Insert the hose far enough so the marked line reaches the connector, as shown in *Figure 69*.

Figure 69



3. Push-to-connect the other end of the shorter gas supply hose to the solenoid valve assembly ③. Insert the hose far enough so the marked line reaches the connector.
4. Press the gas supply hose into the plastic chassis divider guides ⑥.
5. Push-to-connect one end of the longer or looped gas supply hose ① to the solenoid valve assembly. Insert the hose far enough so the marked line reaches the connector.
6. Loop the gas supply hose around (if needed) and push-to-connect the other end to the air filter assembly ②. Insert the hose far enough so the marked line reaches the connector. The bottom of the loop should rest on the plastic shelf ⑦ to the left of the fan.
7. Make sure the looped gas supply hose is not kinked.



If the gas supply hose is kinked, discard it and replace it with a new hose.
The integrity of the hose is compromised once the hose is kinked.

8. Complete the following procedures:
 - a. *Install the power supply cover and handle* on page 216.
 - b. Reconnect the gas supply and the power cord.

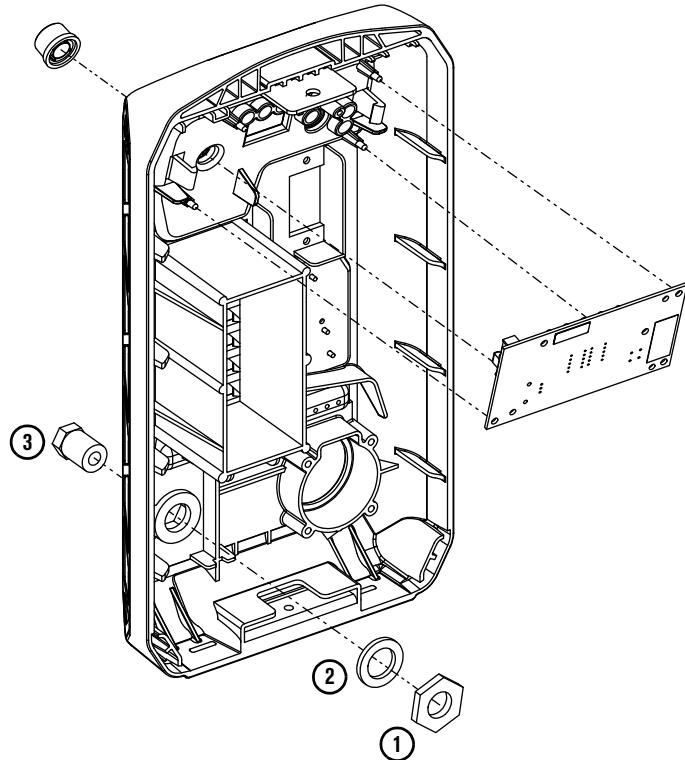
Replace the front panel

Kit number	Description
428659	<i>Kit: Front panel for CSA/CE/CCC 1-phase models</i>
428660	<i>Kit: Front panel for CSA/CE/CCC 3-phase models</i>

Remove the front panel

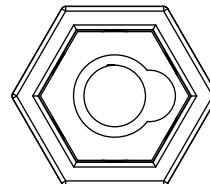
1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Detach the front panel on page 220.
 - d. Remove the display board and ribbon cable on page 234.
2. Remove the nut ① and washer ② that secure the work lead receptacle to the front panel. See Figure 70.
3. Separate the work lead receptacle ③ from the front panel.

Figure 70



Install the front panel

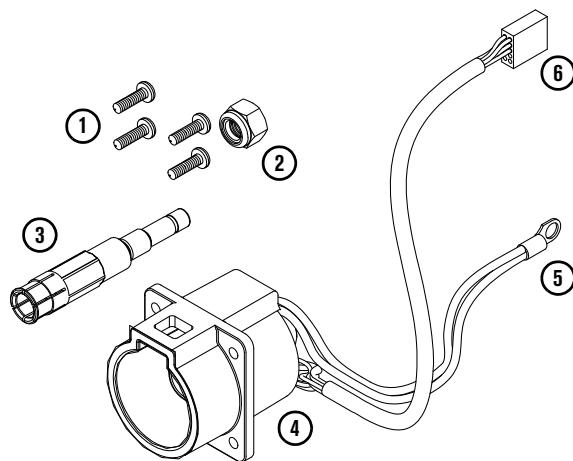
1. Attach the front panel label to the front panel if the label is not preapplied.
2. Set the new work lead receptacle ③ into place in the front panel. Position the receptacle so the notch faces to the right (when you face the front of the power supply.) See *Figure 70* on page 276.
3. Install the nut ① and washer ② onto the back of the work lead receptacle. Use a 1/2 inch wrench to tighten.
4. Complete the following procedures:
 - a. *Install the display board and ribbon cable* on page 234.
 - b. *Reattach the front panel* on page 222.
 - c. *Install the power supply cover and handle* on page 216.
 - d. Reconnect the gas supply and the power cord.



Replace the torch quick-disconnect receptacle

Kit number	Description
428677	Kit: Quick-disconnect receptacle for torch lead

Figure 71



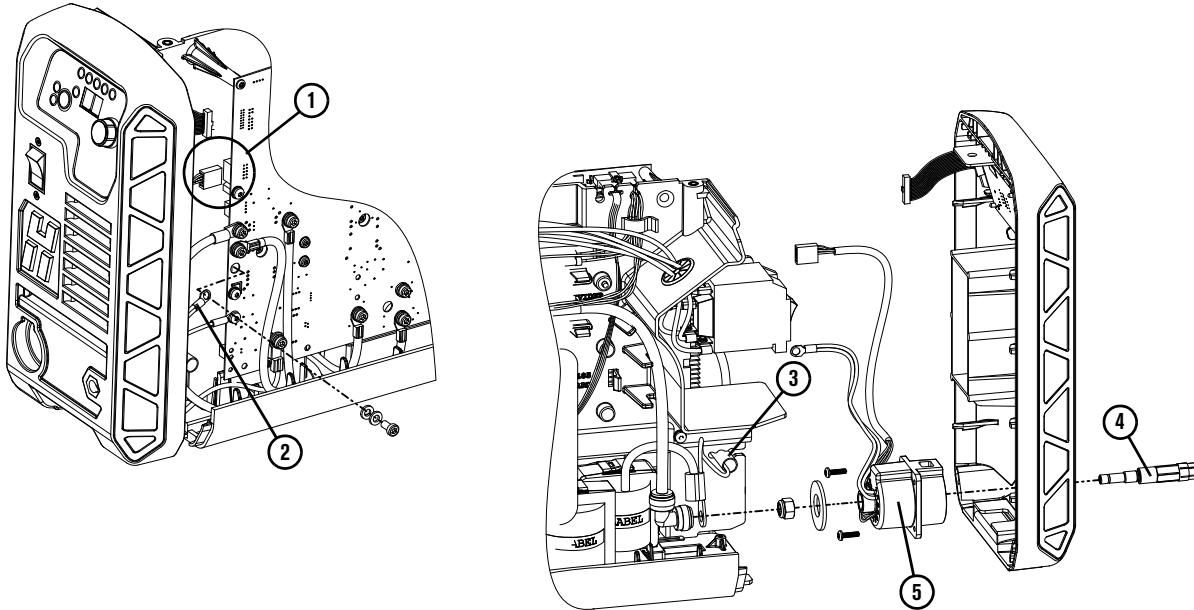
- | | | | |
|---|---------------------|---|-----------------------------------|
| 1 | Screws | 4 | Torch quick-disconnect receptacle |
| 2 | Nylon lock nut | 5 | Red wire pair (J15 connection) |
| 3 | Brass torch fitting | 6 | Power board J19 connection |

Remove the torch quick-disconnect receptacle

For these steps, refer to *Figure 72*.

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Remove the component barrier on page 218.
 - d. Detach the front panel on page 220.
2. Unplug the connector from J19 ① on the power board.
3. Remove the screw from the RED connection point (J15) ② on the main power board. This is the red wire pair from the torch quick-disconnect receptacle.
4. Pull the red wire pair through the braided fiberglass sleeve and the pass-through slot in the center panel ③.
5. Push the brass torch fitting ④ out through the torch quick-disconnect receptacle ⑤.
6. Separate the torch quick-disconnect receptacle from the front panel.

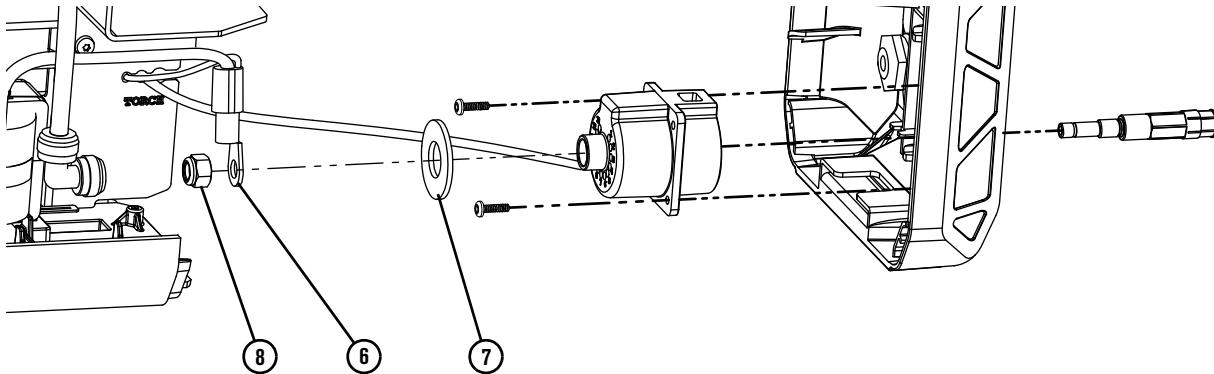
Figure 72



Install the torch quick-disconnect receptacle

1. Slide the red wire pair from the new quick-disconnect receptacle ⑤ through the braided fiberglass sleeve ③. See *Figure 72* on page 278.
-  It may be easier to remove the sleeve from the center panel pass-through slot when sliding the red wires through it.
2. Make sure the braided fiberglass sleeve is set in the center panel pass-through slot ③.
 3. Connect the red wire pair to the RED (J15) connection point on the power board ②. Tighten to 23 kg·cm (20 inch·pounds).
 4. Connect the cable to J19 ① on the power board. Route the cable through the same center panel pass-through as the braided fiberglass sleeve.
 5. As you install the new receptacle:
 - Position the receptacle so the red wires are at the top.
 - Place the transformer wire ring terminal ⑥ between the large plastic washer ⑦ and the nut ⑧. See *Figure 73*.
 - Check all wires to make sure no wires are pinched or frayed.
 6. Complete the following procedures using the new parts:
 - a. *Reattach the front panel* on page 222.
 - b. *Install the component barrier* on page 219.
 - c. *Install the power supply cover and handle* on page 216.
 - d. Reconnect the gas supply and the power cord.

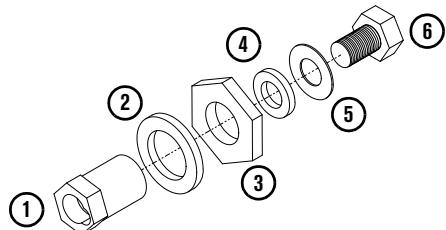
Figure 73



Replace the work lead receptacle

Kit number	Description
428070	<i>Kit: Work lead receptacle</i>

Figure 74

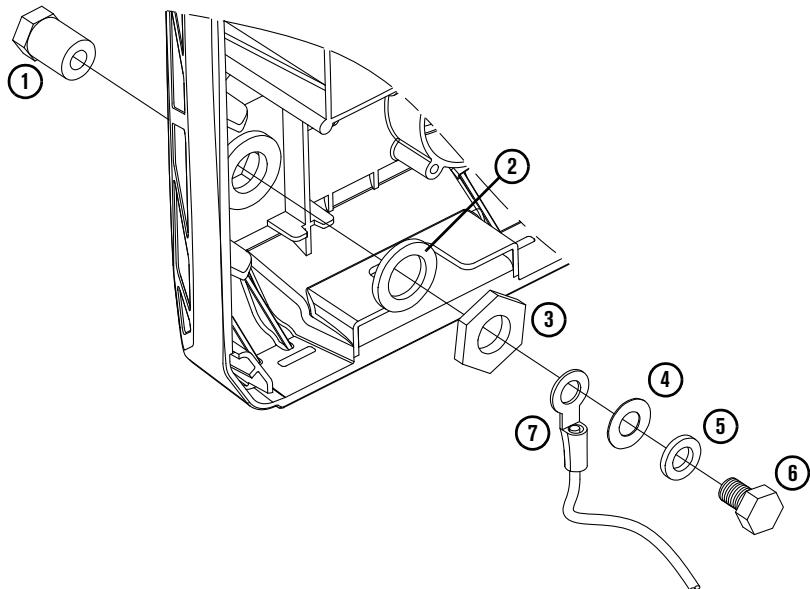


- | | |
|------------------------------|----------|
| 1 Work lead receptacle | 4 Washer |
| 2 Internal tooth lock washer | 5 Washer |
| 3 Nut | 6 Screw |

Remove the work lead receptacle

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the power supply cover and handle on page 215.
 - c. Remove the component barrier on page 218.
 - d. Detach the front panel on page 220.
2. Remove the nut that secures the work lead receptacle to the front panel. See Figure 75 on page 281.
3. Separate the work lead receptacle from the front panel.

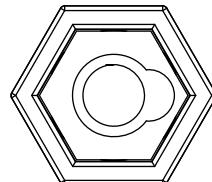
Figure 75



- | | |
|------------------------------|--|
| 1 Work lead receptacle | 5 Washer |
| 2 Internal tooth lock washer | 6 Screw |
| 3 Nut | 7 Work lead wire from power supply board |
| 4 Washer | |

Install the work lead receptacle

1. Set the new work lead receptacle into place in the front panel.
Position the receptacle so the notch faces to the right
(when you face the front of the power supply.) See *Figure 75*.
2. Install the nut and washer onto the back of the work lead receptacle. Use a 1/2 inch wrench. Tighten to 104 kg·cm (90 inch·pounds).
3. Complete the following procedures:
 - a. *Reattach the front panel* on page 222.
 - b. *Install the component barrier* on page 219.
 - c. *Install the power supply cover and handle* on page 216.
 - d. Reconnect the gas supply and the power cord.



Replace the rear panel

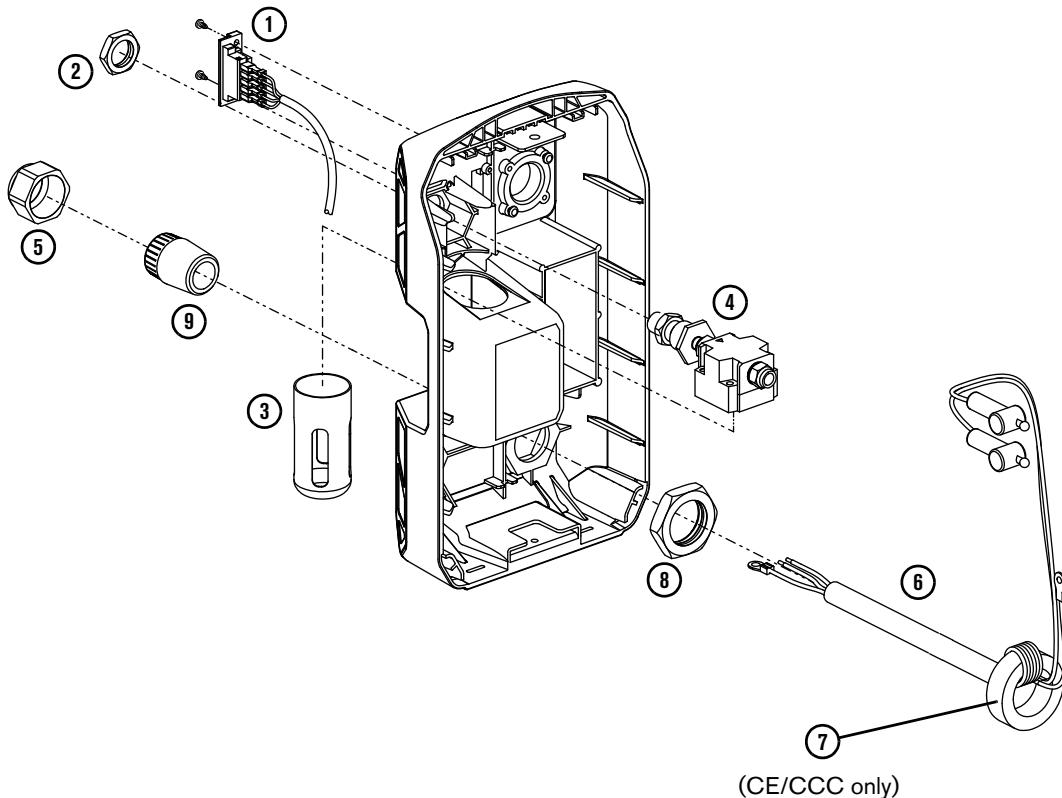
Kit number	Description
428661	<i>Kit: Rear panel</i>

Remove the rear panel

For these steps, refer to *Figure 76* on page 283.

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. *Remove the power supply cover and handle* on page 215.
 - c. *Remove the component barrier* on page 218.
 - d. *Detach the rear panel* on page 223.
2. Remove the RS-485 serial connector ① if installed.
3. From the outside of the rear panel, remove the nut ② from the air filter brass bulkhead fitting.
4. Remove the air filter bowl and metal guard ③. See page 212.
5. Pull out the air filter assembly ④ from inside the rear panel.
6. Remove the outer nut ⑤ from the power cord strain relief.
7. Separate the power cord ⑥ from the rear panel:
 - **CSA models:** From outside the rear panel, pull the power cord wires through the strain relief to remove them.
 - **CE/CCC models:** The toroid ⑦ on the power cord wires prevents you from pulling the wires out through the strain relief. Instead, remove the power plug from the power cord. Then you can pull the power cord wires through the strain relief from inside the rear panel. **Do not remove the toroid from the power cord.**
8. Remove the inner nut ⑧ from the power cord strain relief ⑨, and separate the strain relief from the rear panel.

Figure 76



Install the rear panel

For these steps, refer to *Figure 76*.

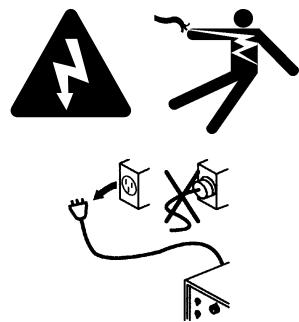
1. Attach the rear panel label to the rear panel if the label is not preapplied.
 - If the RS-485 serial interface option ① is installed, cut out the perforated section of the label to accommodate the connector. See *Figure 41* on page 232.
1. Put the strain relief ⑨ into place in the rear panel. Tighten the inner nut ⑧ to 92 kg·cm (80 inch·pounds).
2. Loosely tighten the outer nut ⑤ onto the strain relief.
3. Pass the power cord wires ⑥ through the outer nut and the strain relief:
 - **CSA models:** Pass the wires through the outside end of the strain relief into the rear panel. Orient the power cord so the green ground wire is below the other wires, closer to the bottom of the rear panel.
 - **CE/CCC models:** Take the end of the cord opposite the toroid ⑦. Pass the wires through the strain relief from inside of the rear panel. Pull the cord through the strain relief until the toroid end of the cord reaches the strain relief. **Do not remove the toroid from the power cord.**

- 4.** Make sure there is enough wire length inside the power supply to reach the power cord connection points. Tighten the outer strain relief nut **(5)** to secure the cord.
- 5.** Place the brass bulkhead fitting and air filter assembly **(4)** into place inside of the rear panel. Make sure the fitting is pushed all the way in against the rear panel.
- 6.** Attach the nut **(2)** onto the brass bulkhead fitting from the outside of the rear panel. Tighten to 138 kg·cm (120 inch·pounds).
- 7.** Attach the air filter bowl and metal guard **(3)**. See page 212.
- 8.** Attach the RS-485 connector **(1)** to the rear panel if the option is installed.
- 9.** Complete the following procedures:
 - a.** *Reattach the rear panel* on page 226.
 - b.** *Install the component barrier* on page 219.
 - c.** *Install the power supply cover and handle* on page 216.
 - d.** Reconnect the gas supply and the power cord.

12

Hand Torch Component Replacement

! WARNING



ELECTRIC SHOCK CAN KILL

Disconnect electrical power before performing any maintenance.

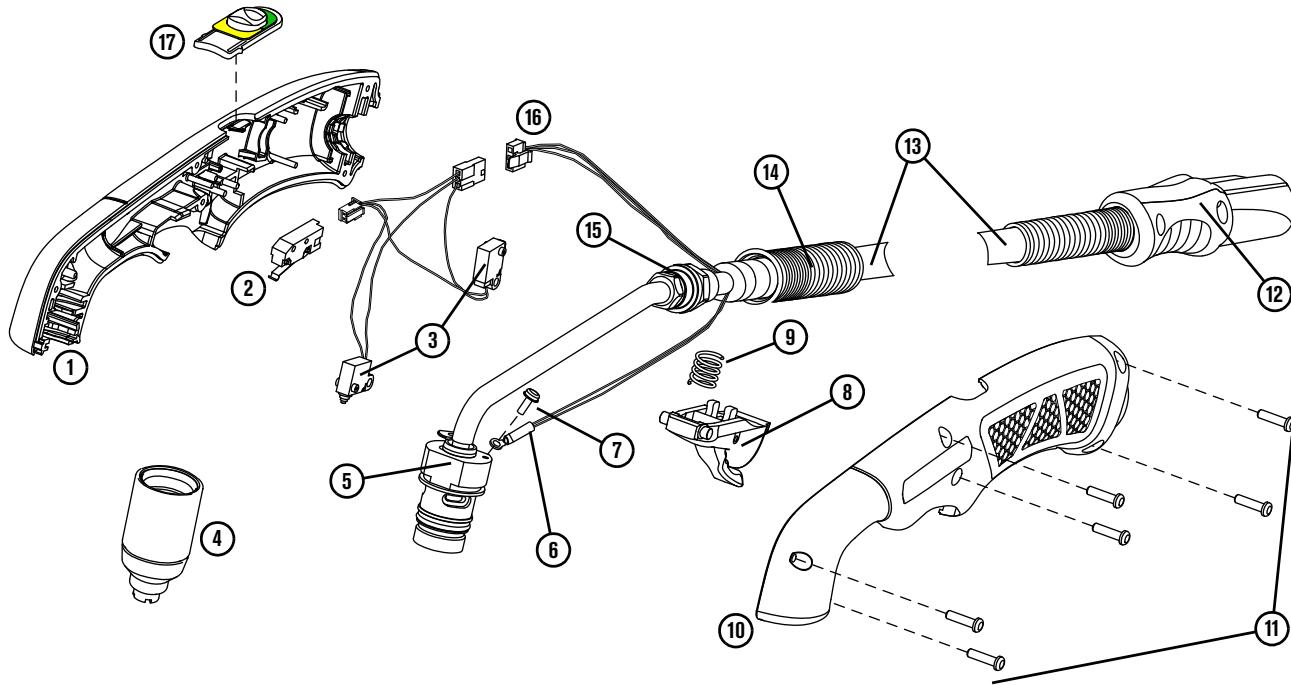
All work requiring removal of the power supply cover must be performed by a qualified technician.

See the *Safety and Compliance Manual* (80669C) for more safety precautions.

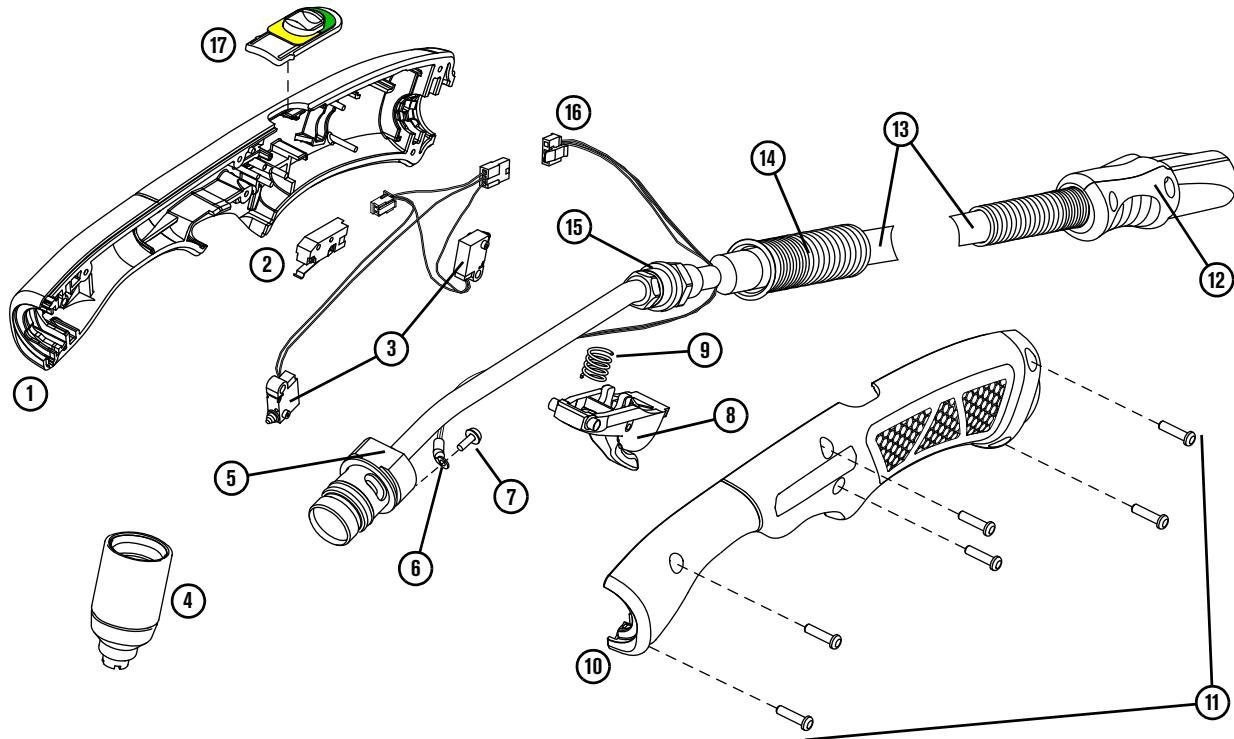
Torch components

75° hand torch

Figure 77



- | | |
|---|---|
| 1 Right side of the handle | 10 Left side of the handle |
| 2 Start switch | 11 Screws (6) |
| 3 Cap-sensor switch/torch-disable switch assembly | 12 Quick-disconnect shell |
| 4 Consumables | 13 Torch lead with connector |
| 5 Torch body | 14 Strain relief |
| 6 Pilot arc wire | 15 Gas hose fitting flange |
| 7 Pilot terminal screw | 16 Connector for cap-sensor switch/torch-disable switch |
| 8 Trigger | 17 Torch-disable slider |
| 9 Spring for trigger | |

15° hand torch**Figure 78**

- | | |
|---|---|
| 1 Right side of the handle | 10 Left side of the handle |
| 2 Start switch | 11 Screws (6) |
| 3 Cap-sensor switch/torch-disable switch assembly | 12 Quick-disconnect shell |
| 4 Consumables | 13 Torch lead with connector |
| 5 Torch body | 14 Strain relief |
| 6 Pilot arc wire | 15 Gas hose fitting flange |
| 7 Pilot terminal screw | 16 Connector for cap-sensor switch/torch-disable switch |
| 8 Trigger | 17 Torch-disable slider |
| 9 Spring for trigger | |

Replace the handle

Kit number	Description
428590	<i>Kit: 75° hand torch handle (with screws)</i>
428591	<i>Kit: 15° hand torch handle (with screws)</i>

Many repairs require the removal of the handle and other components. To remove the old handle and install a new handle, you need to remove all components from the handle. Several other procedures in this section reference this procedure.

Remove the handle

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the consumables.
2. Place the torch on a flat surface with the left side of the handle facing up.

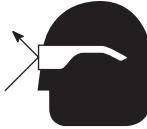


The left side of the handle is the side with the screws.

3. Remove the screws from the torch handle. See *Figure 79* on page 289.

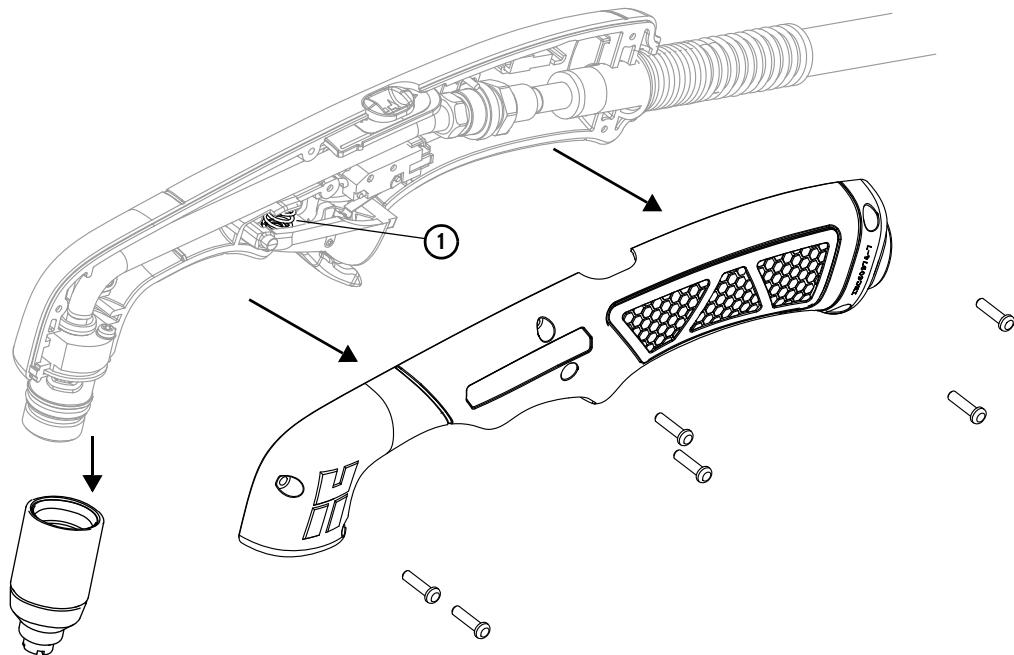
! CAUTION

Wear eye protection, as the trigger spring can launch out of the handle.



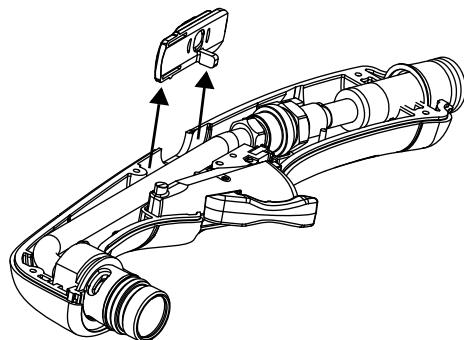
4. Being careful to keep the trigger spring ① from launching out of the handle, lift the left side of the handle away from the torch. See *Figure 79*.

Figure 79



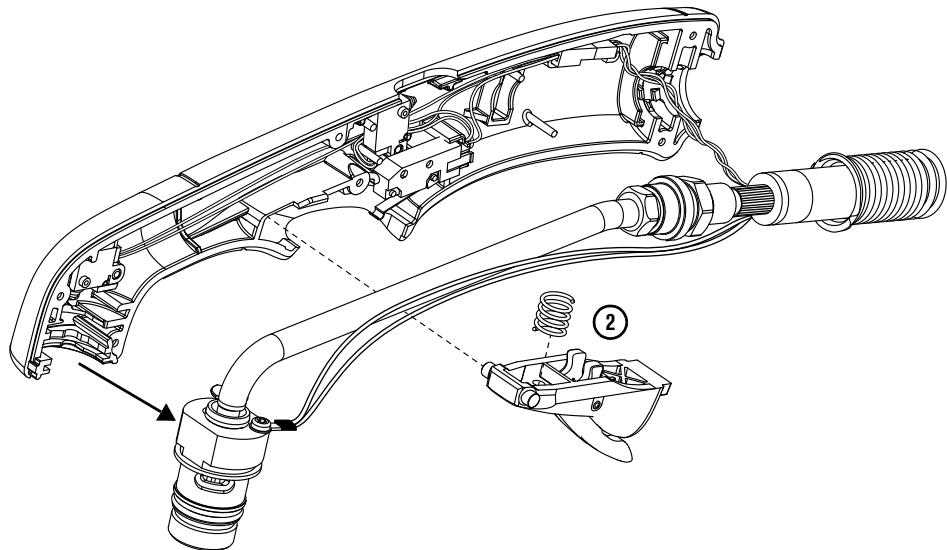
5. While holding the spring in place, slide the trigger and spring ② up and out of the handle. Set them aside. See *Figure 81* on page 290.
6. Remove the torch-disable slider and set it aside. See *Figure 80*.

Figure 80



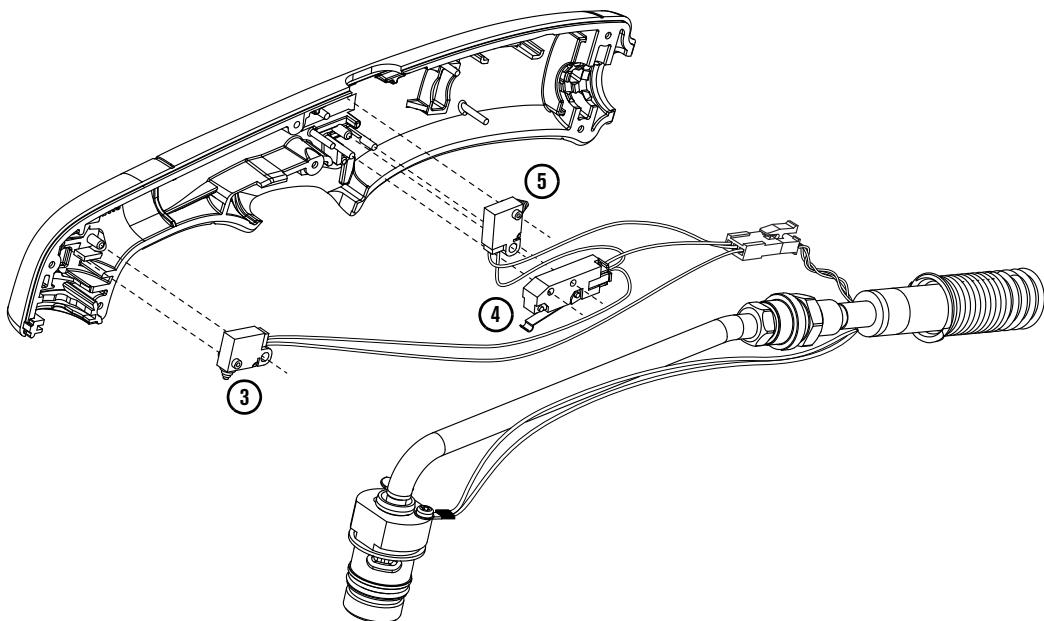
- 7.** The torch body fits snugly into the right side of the shell. Gently pry the head of the torch body out and away from the right side of the shell to remove it. See *Figure 81*.

Figure 81



- 8.** Slide the cap-sensor switch **③**, the start switch **④**, and the torch-disable switch **⑤** off the mounting posts. See *Figure 82*.

Figure 82



Install the handle

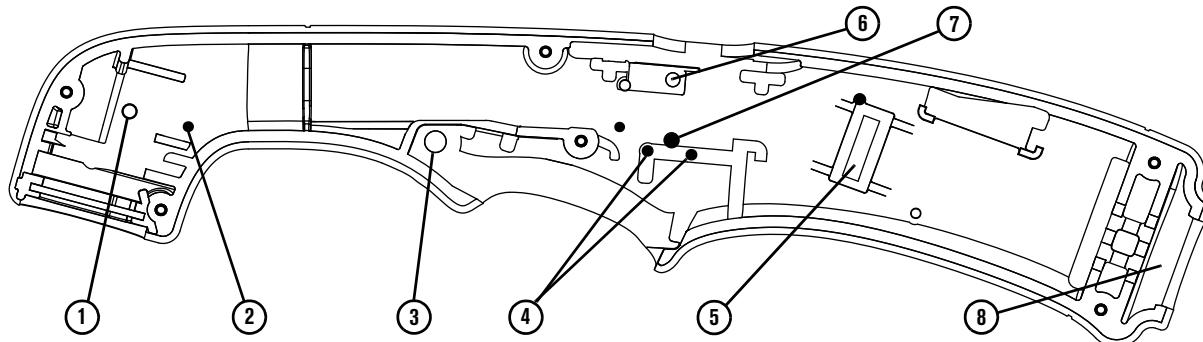
1. Lay the right side of the handle on a flat surface with the inside facing up.
2. Press the cap-sensor switch into the post hole and onto its mounting post. See *Figure 83*.
3. Route the cap-sensor switch wires behind the torch-disable switch. See *Figure 84* on page 292.

NOTICE

Be careful to avoid pinching the wires between components, the torch handles, or the screw bosses. This can damage the wires and prevent the torch from operating properly.

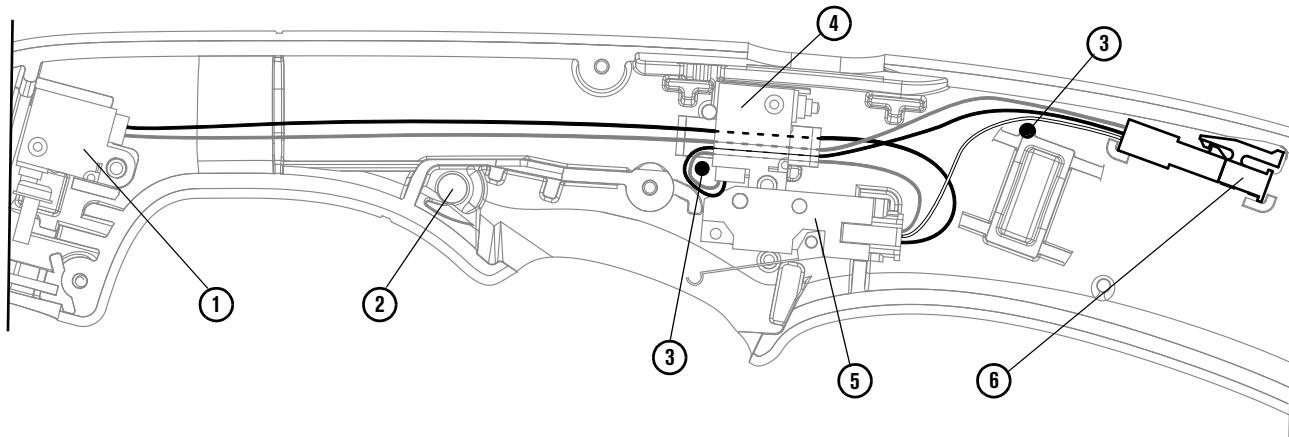
4. Loop the wires coming from the torch-disable switch around the wire routing post. Route the wires below the switch as you press the switch into the post hole and onto the mounting post. See *Figure 83* and *Figure 84* on page 292.
5. Press the start switch onto the 2 mounting posts. See *Figure 83*. Position the wire to the torch lead connector above the wire routing post. See *Figure 84* on page 292.

Figure 83



- | | |
|-----------------------------------|--|
| 1 Cap-sensor switch post hole | 5 Slot for the gas hose fitting flange |
| 2 Cap-sensor switch mounting post | 6 Torch-disable switch post hole |
| 3 Trigger pivot hole | 7 Torch-disable switch mounting post |
| 4 Start switch mounting posts | 8 Strain relief slot |

Figure 84

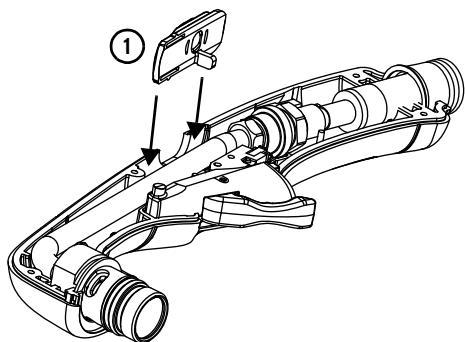


6. Press the torch body into the torch handle with the gas hose fitting flange aligned with the slot in the handle. See *Figure 83* on page 291 for the location of the gas hose fitting slot.
7. Align the strain relief with the strain relief slot in the handle. See *Figure 83* on page 291 for the location of the strain relief slot.
8. Put the torch-disable slider ① for the torch-disable switch into place in the yellow lock (X) position.

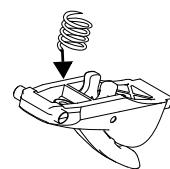


If you try to put the torch back together with the slider in the green “ready to fire” (✓) position, you can damage the torch-disable switch that is inside the shell behind the torch body.

Figure 85



9. Compress the trigger spring into the front half of the trigger. Slide the trigger and spring into place in the handle.
10. Being careful that the handle does not pinch the wires, align the left half of the handle with the right half. Make sure that the trigger pivots are both located in the trigger pivot holes by pulling the trigger a few times. See *Figure 84* on page 292 for the location of the trigger pivot hole.
11. Install the handle screws.
12. Install the consumables.
13. Reconnect the gas supply and the power cord.



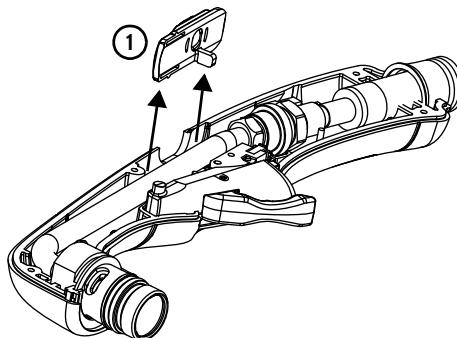
Replace the torch-disable slider

Kit number	Description
428595	<i>Kit: Torch-disable slider for hand torch (with yellow/green label)</i>

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the consumables.
2. See *Remove the handle* and follow step 2 on page 288 through step 5 to remove the left side of the handle and the trigger assembly.

 The torch-disable slider can be removed without removing any other components except the trigger assembly.
3. Hold all the components in place with one hand and remove the torch-disable slider ① from the torch with the other hand. See *Figure 86*.

Figure 86



- Put the new torch-disable slider into place in the yellow lock (**X**) position.



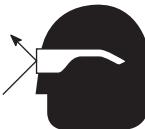
If you try to put the torch back together with the slider in the green “ready to fire” (✓) position, you can damage the torch-disable switch that is inside the shell behind the torch body. See *Figure 86* on page 293.

- See *Install the handle* and follow step 9 on page 293 through step 13 to complete the installation.

Replace the trigger assembly

Kit number	Description
428156	<i>Kit: Hand torch trigger and spring – includes start switch and screws for torch handle</i>

! CAUTION



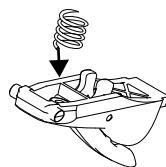
Wear eye protection, as the trigger spring can launch out of the handle.

- Complete the following procedures:
 - Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - Remove the consumables.
- See *Remove the handle* and follow step 2 on page 288 through step 4.



The trigger assembly can be replaced without removing any other components.

- While holding the spring in place, slide the trigger and spring up and out of the handle.
- Compress the new trigger spring into the front half of the trigger. Slide the trigger and spring into place in the handle.
- See *Install the handle* and follow step 10 on page 293 through step 13 to complete the installation.



Replace the torch body or the torch lead

Torch body replacement kits

Kit number	Description
428588	Kit: 75° hand torch main body (with O-ring)
428589	Kit: 15° hand torch main body (with O-ring)

Torch lead replacement kits

Kit number	Description
428592	Kit: Hand torch lead replacement, 6.1 m (20 foot)
428593	Kit: Hand torch lead replacement, 15 m (50 foot)

1. Complete the following procedures:

a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.

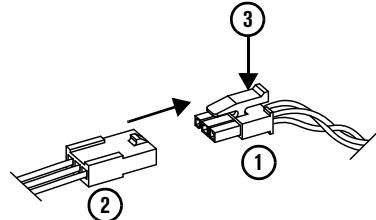
b. Remove the consumables.

2. See *Remove the handle* and follow step 2 on page 288 through step 7 to remove the left side of the handle and the torch body.

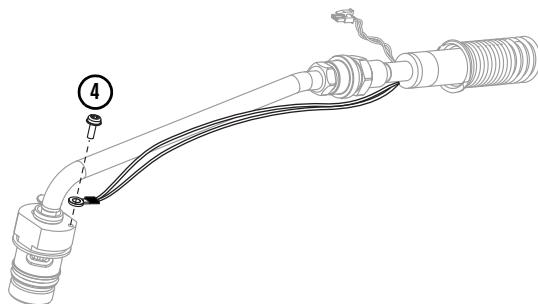


The torch body/torch lead can be replaced without removing any components except the trigger assembly.

3. Disconnect the torch lead wire connector ① from the torch wire harness connector ② by pushing on the tab ③ and pulling the torch lead wire connector from the mating socket. See *Figure 84* on page 292 for the location of the connector.



4. Remove the screw ④ that attaches the torch power wires to the torch body. Set the screw aside.



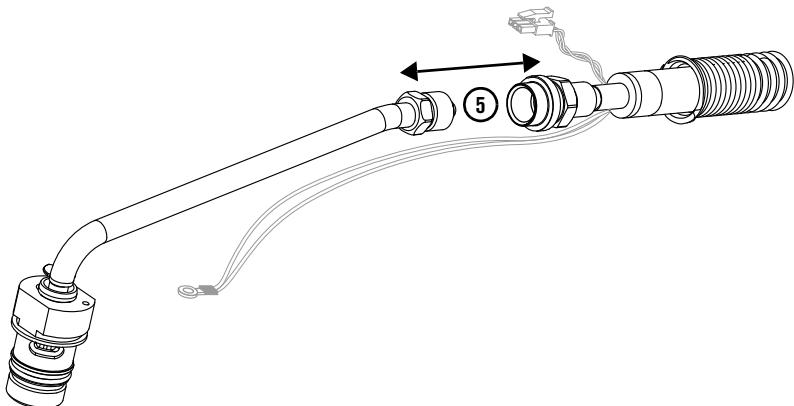
5. Use 2 wrenches to loosen the gas fitting ⑤ that attaches the torch body to the torch lead. The gas fitting is assembled using a thread locker so it will take some force to loosen the fitting. See *Figure 87*.

NOTICE



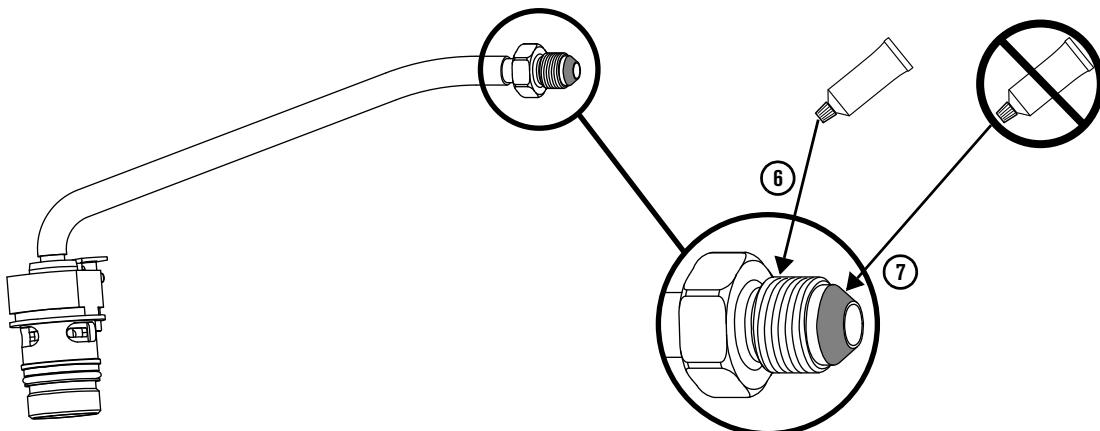
Always use 2 wrenches to properly loosen and tighten the gas fitting mentioned in this procedure to prevent damage to the torch.

Figure 87



6. Lightly apply thread locker to the first 2 or 3 threads of the gas fitting ⑥ before installation. **Do not get thread locker on the conical surface ⑦ of the fitting.** See *Figure 88*.

Figure 88

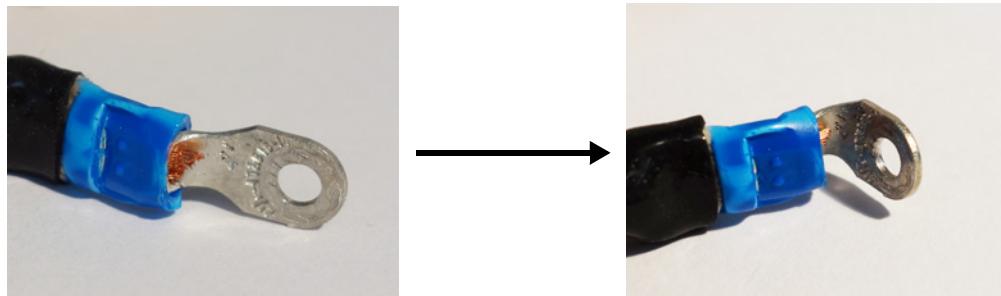


7. Install the new torch body.

- Thread the new torch body into the torch lead and use 2 wrenches to gently tighten the fitting. Do not overtighten. See *Figure 87*.
- Continue with step c on page 297.

8. Install the new torch lead.

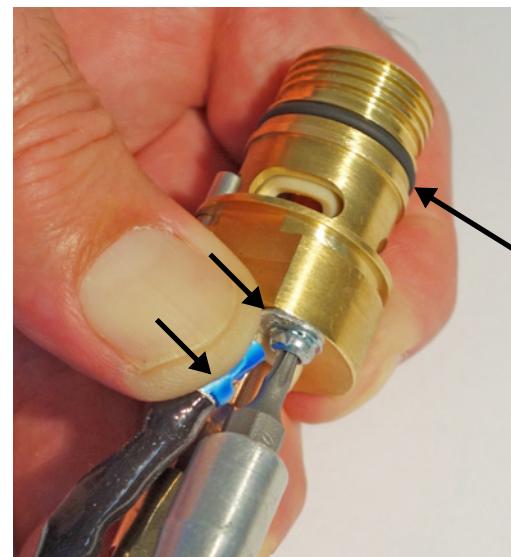
- a. Thread the torch body into the new torch lead and use 2 wrenches to gently tighten the fitting. Do not overtighten. See *Figure 87* on page 296.
- b. Use pliers to gently bend the ring terminal on the new torch lead 90°. See *Figure 89*.

Figure 89

- c. While holding the ring terminal in place as shown, tighten the screw that attaches the wire from the torch lead to the torch body until the terminal is snug against the torch body.

9. Apply a thin film of silicone lubricant on the O-ring. The O-ring should look shiny, but there should not be any excess or built-up lubricant.

If the O-ring is cracked or worn, replace it (428180).

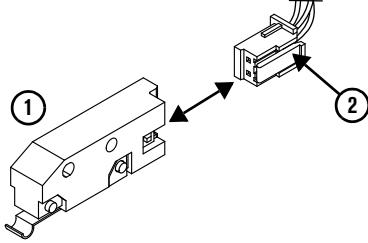
10. See *Install the handle* and follow step 6 on page 292 through step 13 to complete the installation.

Replace the start switch

Kit number	Description
428162	<i>Kit: Hand torch start switch</i>

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the consumables.
2. See *Remove the handle* and follow step 2 on page 288 through step 5 to remove the left side of the handle and the trigger and spring.

 The start switch can be removed without removing any components except the trigger assembly.
3. Remove the start switch from the mounting posts. See *Figure 82* on page 290.
4. Remove the start switch ① from the connector by pushing on the tab ② and pulling the start switch away from the connector.
5. Connect the new start switch by pushing the mating plug into the socket.
6. Press the new start switch onto the 2 mounting posts in the handle. See *Figure 83* on page 291.
7. Position the start switch wire to the torch lead connector around the wire routing post. See *Figure 84* on page 292.
8. See *Install the handle* on page 291 and follow step 6 on page 292 through step 13 to complete the installation.



Replace the cap-sensor switch/torch-disable switch assembly

Kit number	Description
428594	Kit: Cap-sensor switch and torch-disable switch assembly for hand torch (includes wires and connectors)

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - a. Remove the consumables.
2. See *Remove the handle* and follow step 2 on page 288 through step 8 to remove the left side of the handle, the torch body, and the cap-sensor switch/torch-disable switch assembly.
3. Disconnect the start switch ① from the cap-sensor switch/torch-disable switch assembly by pushing on the tab ② and pulling the start switch away from the connector.
4. Connect the new cap-sensor switch/torch-disable switch assembly to the start switch.
5. See *Install the handle* and follow step 2 on page 291 through step 13 to complete the installation.

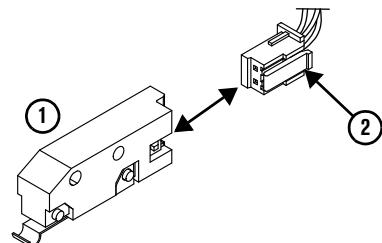
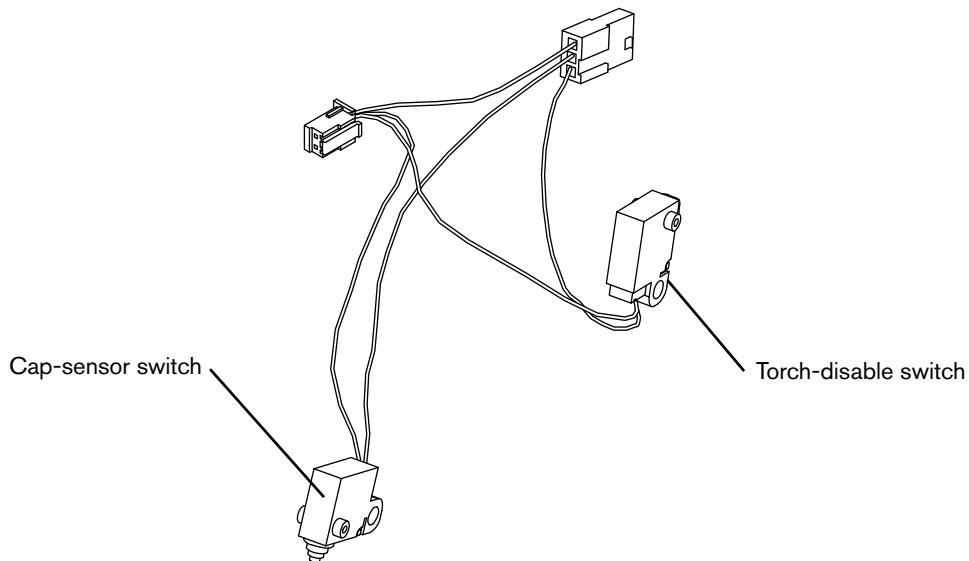


Figure 90 – Cap-sensor switch and torch-disable switch assembly



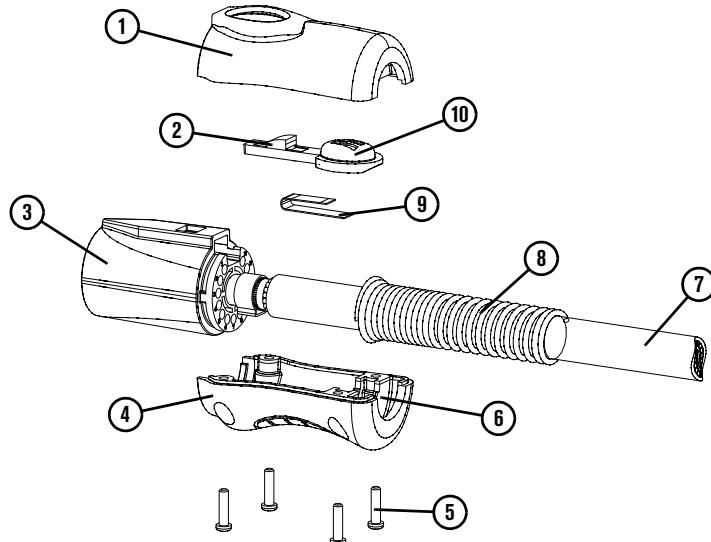
Replace the quick-disconnect shell

Kit number	Description
228314	<i>Kit: Torch quick-disconnect repair (shell with button – does not include torch lead or connector)</i>

For these steps, refer to *Figure 91*.

1. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
2. Remove the screws from the bottom half of the shell.
3. Remove the 2 shell halves.
4. Remove the latch by using a blade screwdriver to press down firmly on the latch tab while pushing the tab down and out toward the lead.
5. Pull the spring out of the quick-disconnect housing.

Figure 91



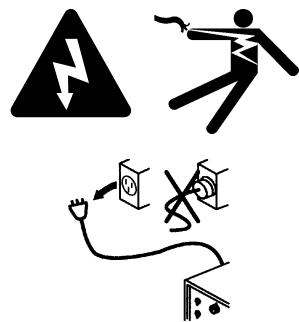
- | | |
|----------------------------|----------------------|
| 1 Top shell half | 6 Strain relief slot |
| 2 Latch tab | 7 Torch lead |
| 3 Quick-disconnect housing | 8 Strain relief |
| 4 Bottom shell half | 9 Spring |
| 5 Screws (4) | 10 Latch |

- 6.** Place the new latch into the quick-disconnect housing.
- 7.** Hold up the end of the latch and insert the new spring under the latch.
- 8.** Use a blade screwdriver to push the spring into the recess until it clicks into place.
- 9.** Install the new shell halves onto the torch lead, making sure the strain relief fits in the slot of the shell and the wires are not pinched or do not interfere with the latch.
- 10.** Install and tighten the screws.
- 11.** Reconnect the gas supply and reconnect the power cord.

13

Machine Torch Component Replacement

! WARNING



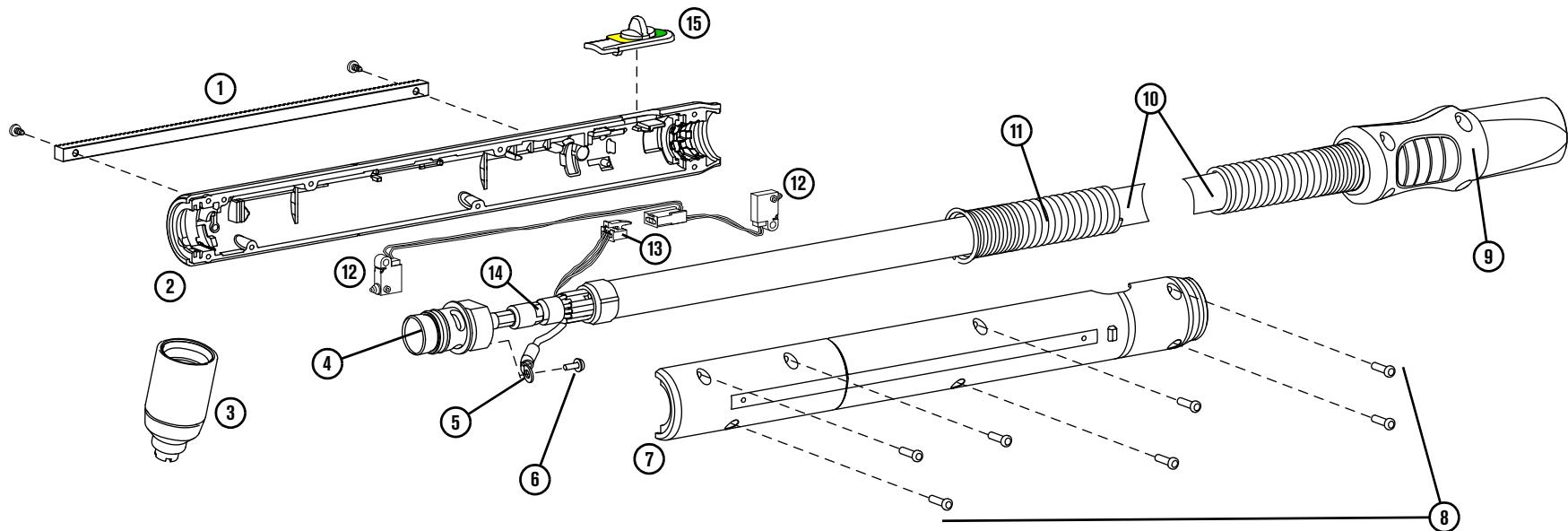
ELECTRIC SHOCK CAN KILL

Disconnect electrical power before performing any maintenance.

All work requiring removal of the power supply cover must be performed by a qualified technician.

See the *Safety and Compliance Manual* (80669C) for more safety precautions.

Torch components



- 809230 Service Manual **Powermax45 XP**
- 1 Gear rack
 - 2 Right side of torch shell
 - 3 Consumables
 - 4 Torch body
 - 5 Pilot arc wire
 - 6 Pilot terminal screw
 - 7 Left side of torch shell
 - 8 Screws (7)

- 9 Quick-disconnect shell
- 10 Torch lead
- 11 Strain relief
- 12 Cap-sensor switch/torch-disable switch assembly
- 13 Connector for cap-sensor switch/torch-disable switch
- 14 Gas hose fitting flange
- 15 Torch-disable slider

Replace the torch shell

Kit number	Description
428596	<i>Kit: Machine torch shell (with screws)</i>

Many repairs require the removal of the torch shell and other components. To remove the old shell and install a new shell, you need to remove all components from the shell. Several other procedures in this section reference this procedure.

NOTICE

While disconnecting and reconnecting the torch parts, do not twist the torch or the lead. Maintain the same orientation between the torch head and torch lead. Twisting the torch head in relation to the torch lead can damage the torch wires.

Remove the torch shell

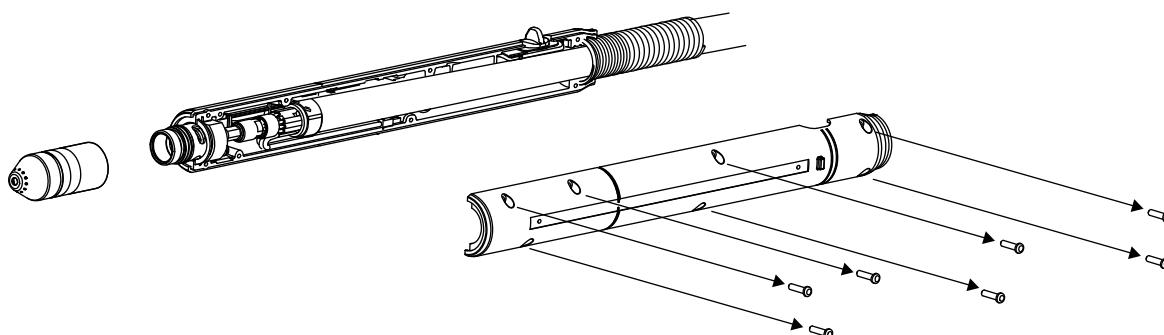
1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the consumables.
2. Place the torch on a flat surface with the left side of the shell facing up.



The left side of the shell is the side with the screws.

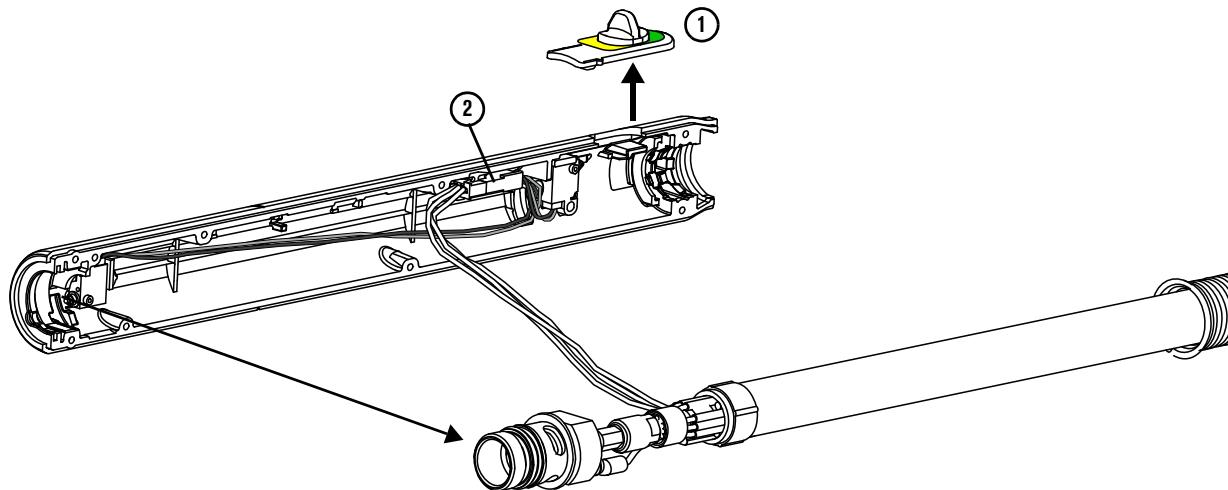
3. Remove the 7 screws from the torch shell. Set the screws aside. See *Figure 92*.
4. Carefully pry the left side of the shell away from the torch.

Figure 92



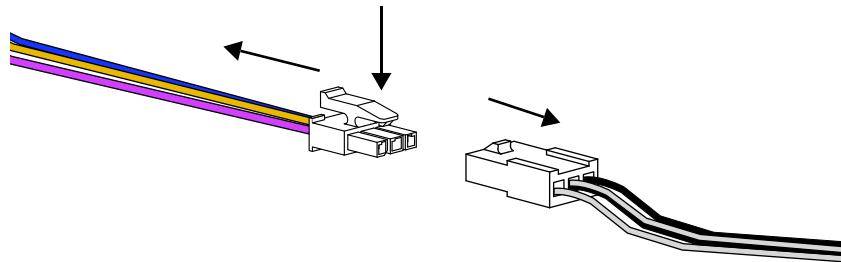
5. Remove the plastic slider ① for the torch-disable switch and set it aside.
6. The torch body fits snugly into the right side of the shell. Gently pry the head of the torch body out and away from the right side of the shell to remove it.

Figure 93



7. Disconnect the wires that sit in the right shell ②. Press down the tab on the wire connector to pull the 2 sides apart.

Figure 94



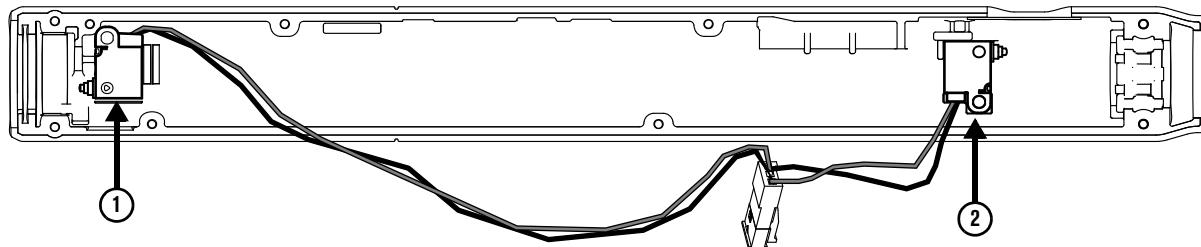
Install the torch shell

NOTICE

While disconnecting and reconnecting the torch parts, do not twist the torch or the lead. Maintain the same orientation between the torch head and torch lead. Twisting the torch head in relation to the torch lead can damage the torch wires.

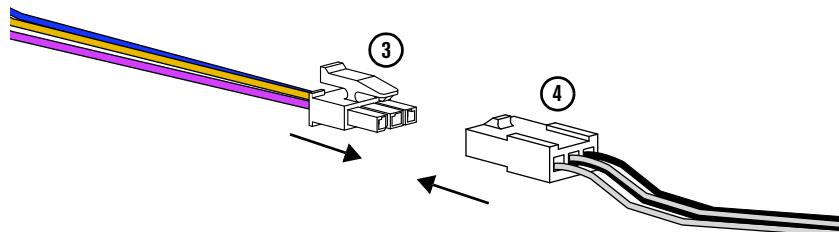
1. Place the right torch shell on a flat surface.
2. Make sure the cap-sensor switch ① and the torch-disable switch ② sit in the right torch shell as shown. Mounting posts in the torch shell hold each switch in place.

Figure 95



3. Connect the wires from the torch lead ③ to the wires from the cap-sensor switch/torch-disable switch assembly ④.

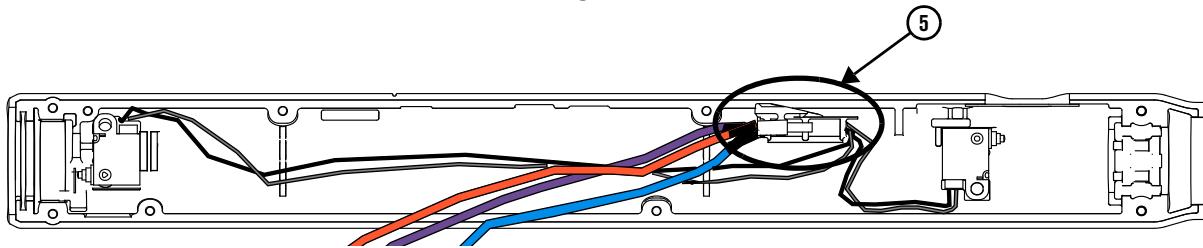
Figure 96



4. Place the wire connector ⑤ on the mounting shelf in the right torch shell as shown.

Route the blue and black wires from the cap-sensor switch and the torch-disable switch outside of and below the mounting shelf. This helps to prevent the wires from getting pinched and damaged when the torch is fully assembled.

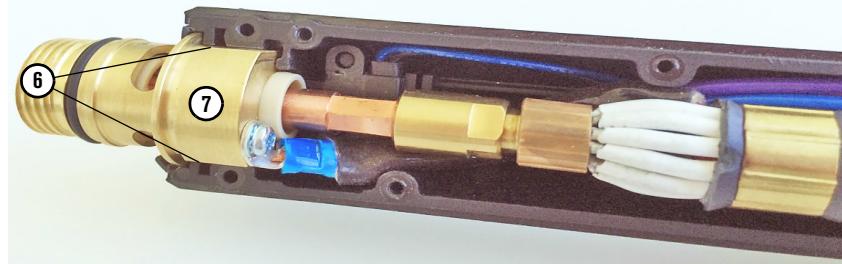
Figure 97



5. Push the head of the torch body into the right torch shell. See *Figure 98*. Make sure:

- The side of the torch body with the cap-sensor plunger must be inserted into the shell first. The torch shell fits over the flat edges of the torch head ⑥. The rounded edge ⑦ of the torch head should be facing up.
- The wire connector from the previous step remains in place on the mounting shelf. Hold the wire connector in place as you fit the torch body into the torch shell.

Figure 98



6. Fit the rest of the torch body into the right torch shell as shown. As you do, tuck all of the wires behind the torch body. Do not pinch or crimp the wires. Make sure none of the wires are covering the screw holes in the torch shell.
7. Fit the strain relief ⑧ into the base of the right torch shell.

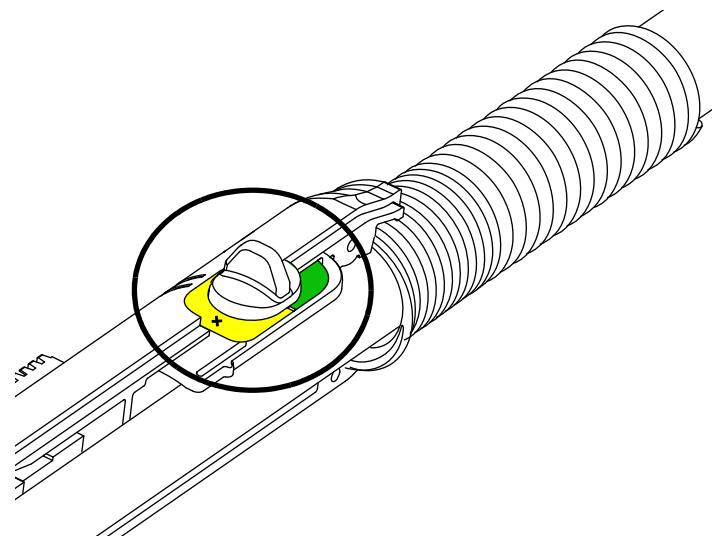
Figure 99



8. Put the torch-disable slider into place in the yellow lock (X) position.



If you try to put the torch back together with the slider in the green "ready to fire" (✓) position, you can damage the torch-disable switch that is inside the shell behind the torch body.



NOTICE

Be careful to avoid pinching the wires between the torch shells or screw bosses. This can damage the wires and prevent the torch from operating properly.

9. The torch lead must be pressed firmly into the torch shell. Attach the left torch shell to the right torch shell using the 7 screws. Firmly grasp the torch shells at the base near the strain relief and hold them together as you install the screws.
10. Examine the torch to make sure no wires are pinched where the torch shells meet.
11. Install the gear rack on the torch shell.
12. Attach the torch to the lifter per the manufacturer's instructions.
13. Install the consumables.

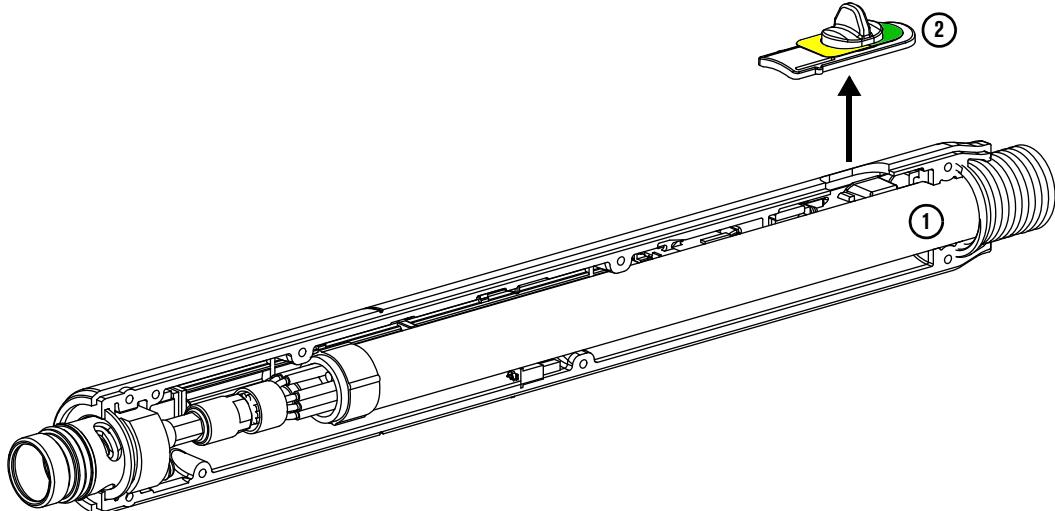
Replace the torch-disable slider

Kit number	Description
428706	Kit: Torch-disable slider for machine torch (with yellow/green label)

1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the consumables.
2. See *Remove the torch shell* and follow step 2 on page 305 through step 4 on page 305 to remove the left side of the handle.

 The torch-disable slider can be replaced without removing any other components.
3. Hold the torch lead ① in place and remove the torch-disable slider ②. See *Figure 100*.

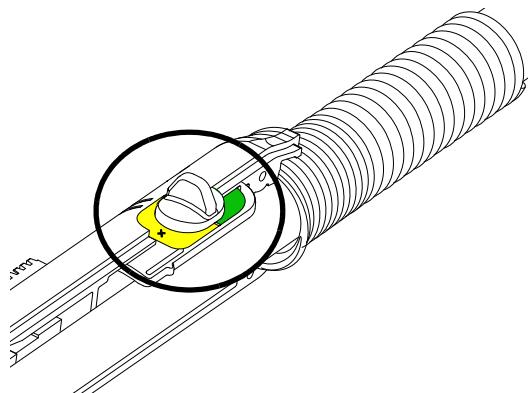
Figure 100



- Put the torch-disable slider into place in the yellow lock (X) position.



If you try to put the torch back together with the slider in the green "ready to fire" (✓) position, you can damage the torch-disable switch that is inside the shell behind the torch body.



- See *Install the torch shell* and follow step 9 on page 309 through step 13 on page 309 to complete the installation.

Replace the torch body or the torch lead

Torch main body replacement kit

Kit number	Description
428704	<i>Kit: Torch main body replacement for machine torch</i>

Torch lead replacement kits

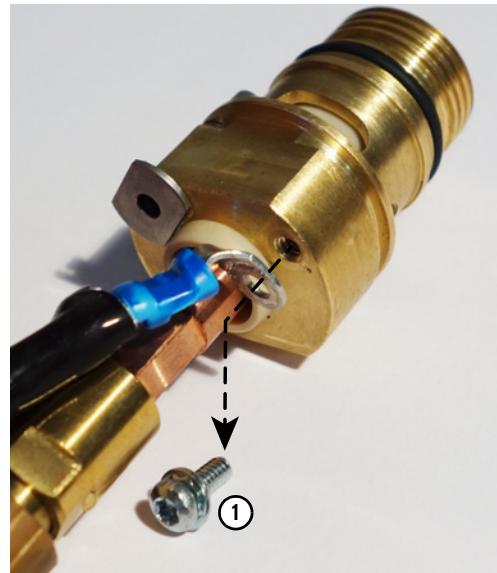
Kit number	Description
428699	<i>Kit: Machine torch lead replacement, 7.6 m (25 foot)</i>
428710	<i>Kit: Machine torch lead replacement, 10.7 m (35 foot)</i>
428700	<i>Kit: Machine torch lead replacement, 15 m (50 foot)</i>

- Complete the following procedures:
 - Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - Remove the consumables.
- See *Remove the torch shell* and follow step 2 on page 305 through step 7 on page 306.



The cap-sensor switch and the torch-disable switch can remain in place for this procedure.

3. Remove the screw ① that attaches the torch power wires to the torch body. Set the screw aside.



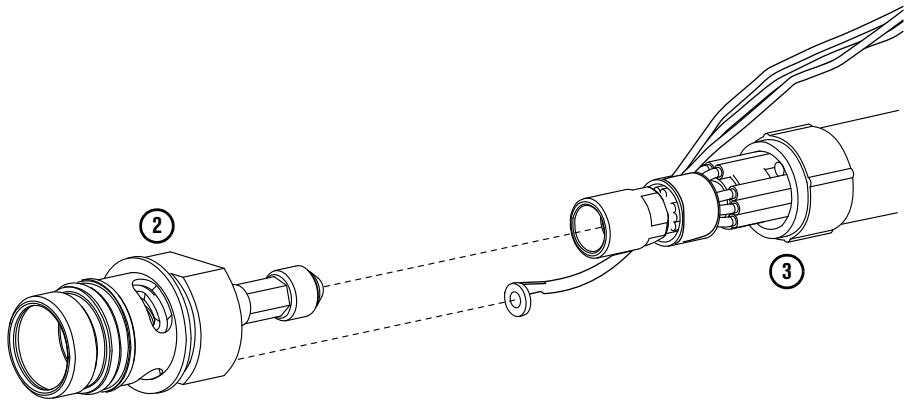
NOTICE



Always use 2 wrenches to properly loosen and tighten the hex nuts and bolts mentioned in this procedure to prevent damage to the torch.

4. Use 2 wrenches to loosen the gas fitting that attaches the torch body ② to the torch lead ③. See *Figure 101*.

Figure 101

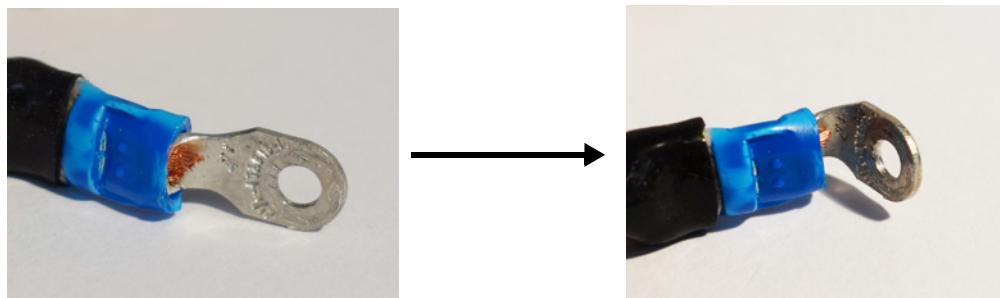


5. Install the new torch body.

- a. Thread the new torch body into the torch lead and use 2 wrenches to gently tighten the fitting. Do not overtighten. See *Figure 101*.
- b. Continue with step c on page 313.

6. Install the new torch lead.

- a. Thread the torch body into the new torch lead and use 2 wrenches to gently tighten the fitting. Do not overtighten. See *Figure 101* on page 312.
- b. Use pliers to gently bend the ring terminal on the new torch lead 90°. See *Figure 102*.

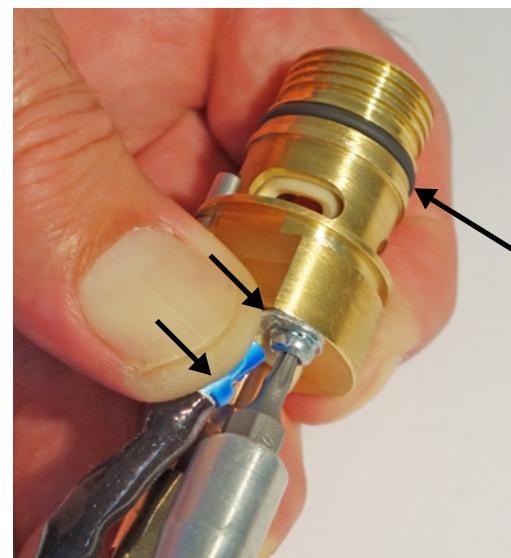
Figure 102

- c. While holding the ring terminal in place as shown, tighten the screw that attaches the wire from the torch lead to the torch body until the terminal is snug against the torch body.
7. Apply a thin film of silicone lubricant on the O-ring. The O-ring should look shiny, but there should not be any excess or built-up lubricant.



If the O-ring is cracked or worn, replace it (428180).

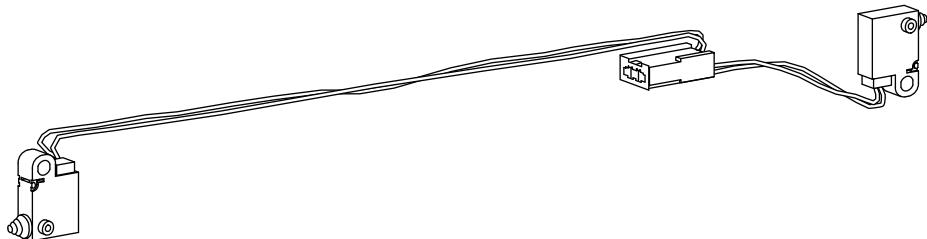
8. See *Install the torch shell* and follow step 2 on page 307 through step 13 on page 309 to complete the installation.



Replace the cap-sensor switch/torch-disable switch assembly

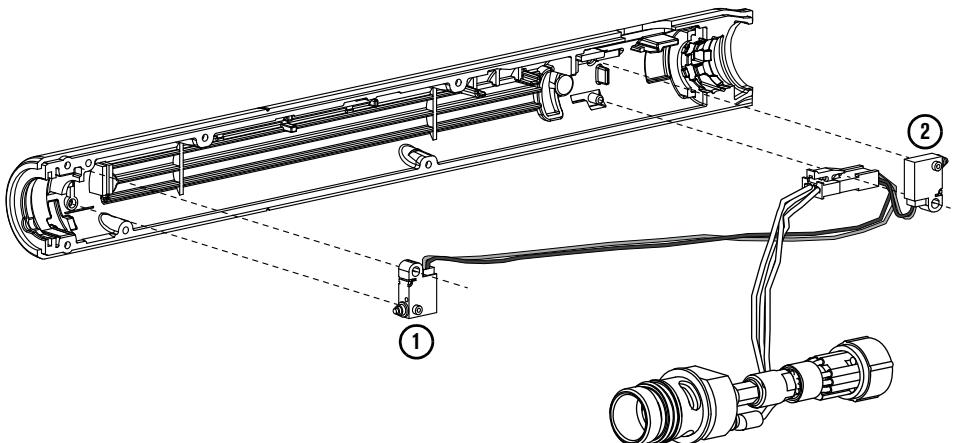
Kit number	Description
428705	Kit: Cap-sensor switch and torch-disable switch assembly for machine torch (includes wires and connector)

Figure 103 – Cap-sensor switch and torch-disable switch assembly



1. Complete the following procedures:
 - a. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
 - b. Remove the consumables.
2. See *Remove the torch shell* and follow step 2 on page 305 through step 7 on page 306.
3. Slide the cap-sensor switch ① and the torch-disable switch ② off the mounting posts. See *Figure 104*.

Figure 104



4. Press the new cap-sensor switch and torch-disable switch into the post holes and onto the mounting posts in the torch shell. See *Figure 104*.
5. See *Install the torch shell* and follow step 3 on page 307 through step 13 on page 309 to complete the installation.

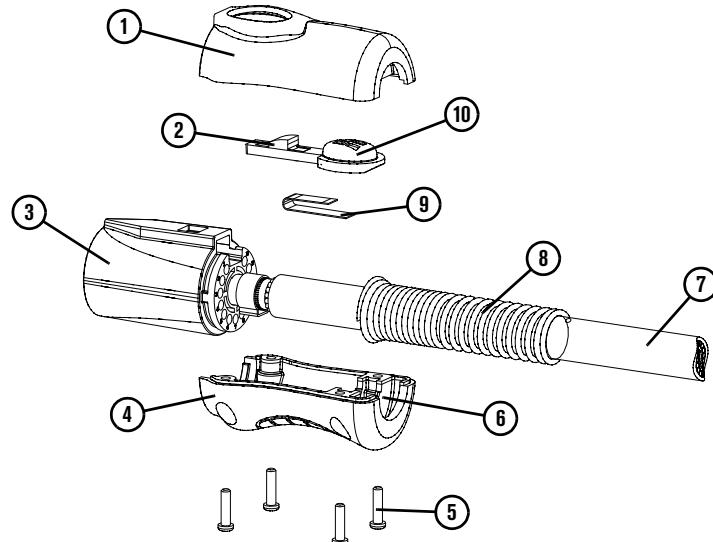
Replace the quick-disconnect shell

Kit number	Description
428260	<i>Kit: Torch quick-disconnect repair (shell with button – does not include torch lead or connector)</i>

For these steps, refer to *Figure 105*.

1. Set the power switch to OFF (O), disconnect the power cord from the power source, and disconnect the gas supply.
2. Remove the screws from the bottom half of the shell.
3. Remove the 2 shell halves.
4. Remove the latch by using a blade screwdriver to press down firmly on the latch tab while pushing the tab down and out toward the lead.
5. Pull the spring out of the quick-disconnect housing.

Figure 105



- | | |
|----------------------------|----------------------|
| 1 Top shell half | 6 Strain relief slot |
| 2 Latch tab | 7 Torch lead |
| 3 Quick-disconnect housing | 8 Strain relief |
| 4 Bottom shell half | 9 Spring |
| 5 Screws (4) | 10 Latch |

- 6.** Place the new latch into the quick-disconnect housing.
- 7.** Hold up the end of the latch and insert the new spring under the latch.
- 8.** Use a blade screwdriver to push the spring into the recess until it clicks into place.
- 9.** Install the new shell halves onto the torch lead, making sure the strain relief fits in the slot of the shell and the wires are not pinched or do not interfere with the latch.
- 10.** Install and tighten the screws.
- 11.** Reconnect the gas supply and reconnect the power cord.

14

Replacement Parts and Accessories

Use the part numbers and kit numbers in this section to order replacement parts and accessories for your plasma power supply and torches.

For consumable part numbers:

- **Hand torch cutting and piercing:** see page 64
- **Gouging:** see page 77
- **Machine torch cutting and piercing:** see page 113
- **Marking:** see page 121

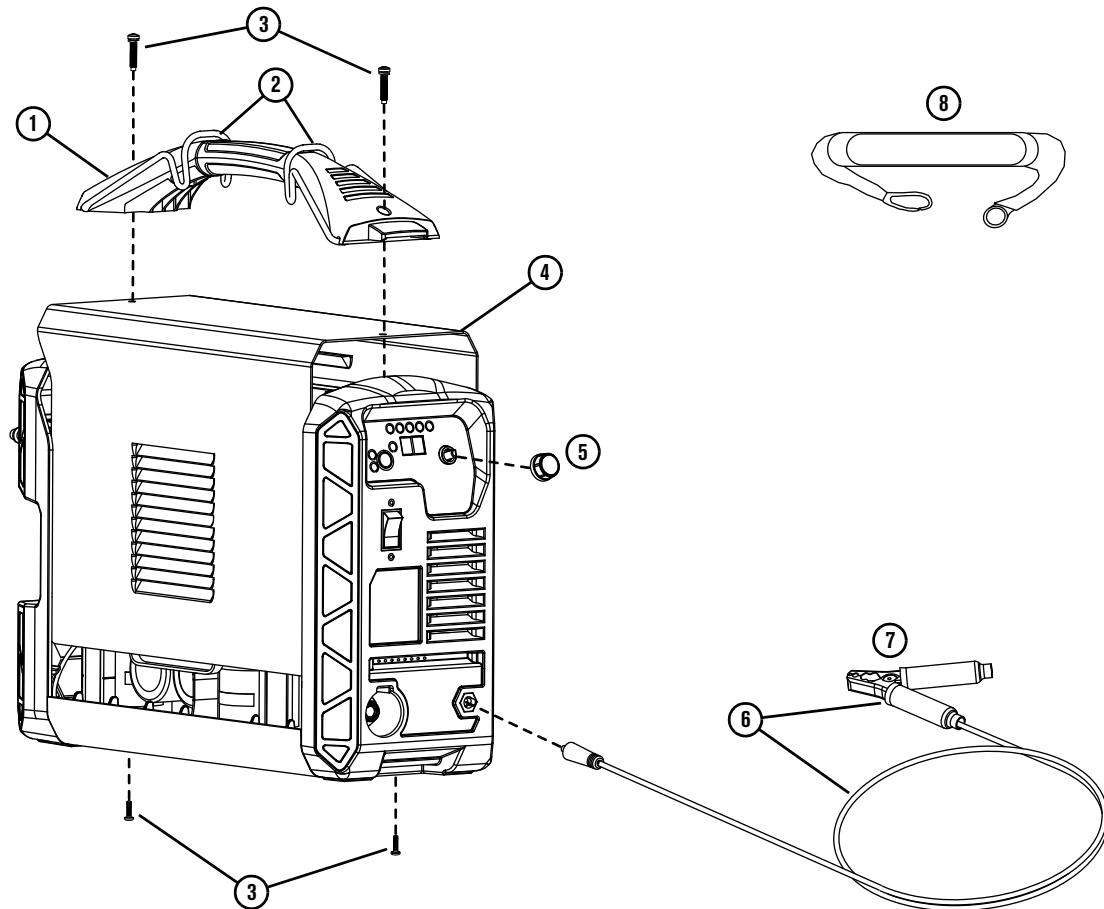


For instructions on installing the consumables, see *Step 1 – Install consumables and activate torch* on page 48.

For installation procedures:

- See *Power Supply Component Replacement* on page 211.
- See *Hand Torch Component Replacement* on page 285.
- See *Machine Torch Component Replacement* on page 303.

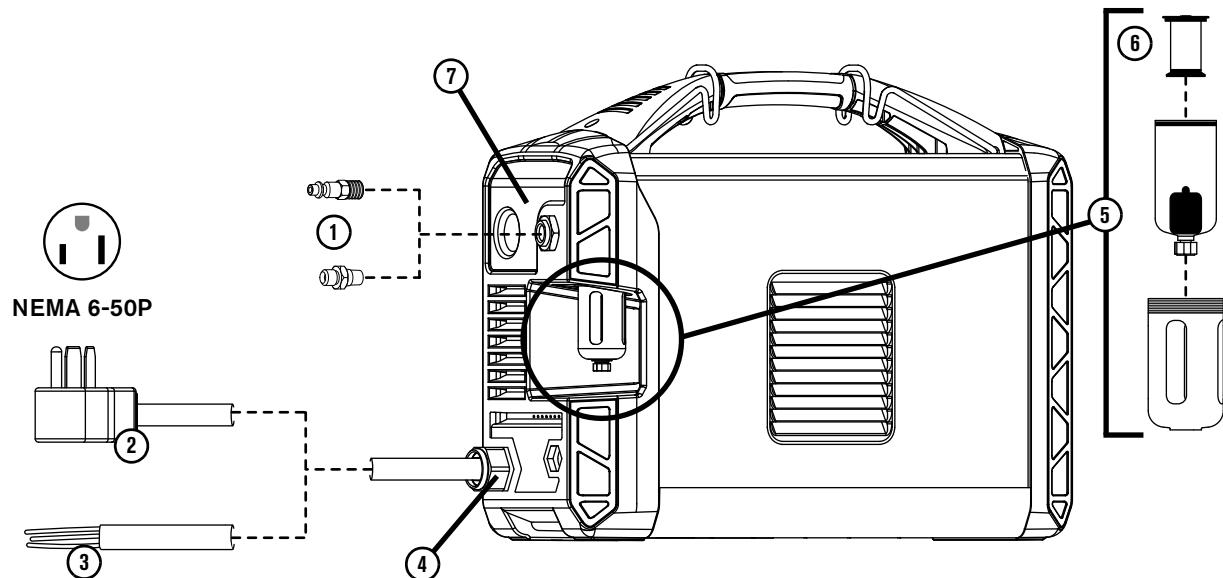
Plasma supply exterior, front



Item	Kit number	Description
1	428663	Kit: Power supply handle with screws (includes clips for shoulder straps)
2	104821	Replacement clips for shoulder strap*
3	428662	Kit: Replacement screws for power supply handle, front panel, and rear panel
4	428657	Kit: Power supply cover with labels, CSA (no screws included)
4	428658	Kit: Power supply cover with labels, CE/CCC (no screws included)
5	428143	Kit: Adjustment knob for control panel
6	223595	Work lead, 7.6 m (25 foot), with work clamp
6	223596	Work lead, 15 m (50 foot), with work clamp
7	228561	Kit: Work clamp, 200 A
8	127217	Shoulder strap (sold separately – not included with system)

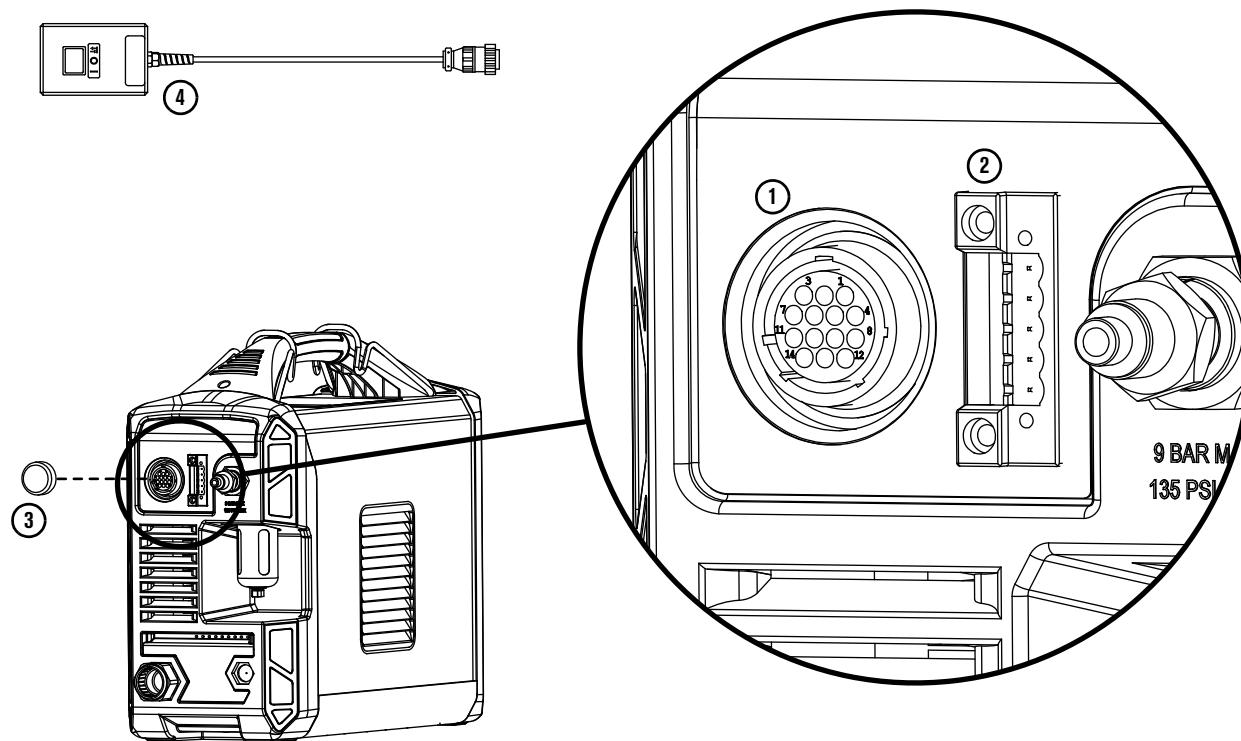
* The clips for the shoulder strap come with the system. They are also included in the replacement kit for the power supply handle. They do not come with the shoulder strap itself.

Plasma supply exterior, rear



Item	Kit number	Description
1	428685	Kit: Gas inlet fittings: <ul style="list-style-type: none"> Industrial interchange quick-disconnect nipple with 1/4 NPT threads British Pipe Thread adapter G-1/4 BSPP with 1/4 NPT threads
2	428664	Kit: CSA power cord with strain relief, 1-phase, 3 m (10 foot) (includes NEMA 6-50P power plug)
3	428667	Kit: CE/CCC power cord with strain relief, 1-phase, 3 m (10 foot) (no power plug included)
3	428665	Kit: CSA power cord with strain relief, 3-phase, 3.5 m (11 foot) (no power plug included)
3	428666	Kit: CE/CCC power cord with strain relief, 3-phase, 3 m (10 foot) (no power plug included)
4	228680	Kit: Strain relief for power cords
5	428673	Kit: Air filter bowl (polycarbonate) with metal guard
6	428378	Kit: Air filter element
7	428661	Kit: Rear panel

Machine interface (CPC) and serial interface upgrade kits



Item	Kit number	Description
1	428653	Kit: Machine interface (CPC) port with internal cables and voltage divider board (does not include cover for receptacle)
2	428654	Kit: Serial interface port with internal cables and RS-485 board
3	127204	Cover for machine interface (CPC) port
4	128650	Remote start pendant for machine torch, 7.6 m (25 feet)
4	128651	Remote start pendant for machine torch, 15 m (50 feet)
4	128652	Remote start pendant for machine torch, 23 m (75 feet)
4	128655	Remote start pendant for machine torch, 45 m (150 feet)
	428689	Kit: Machine interface for raw arc voltage (kit contains strain relief and instructions)



The remote start pendant connects to the CPC port.

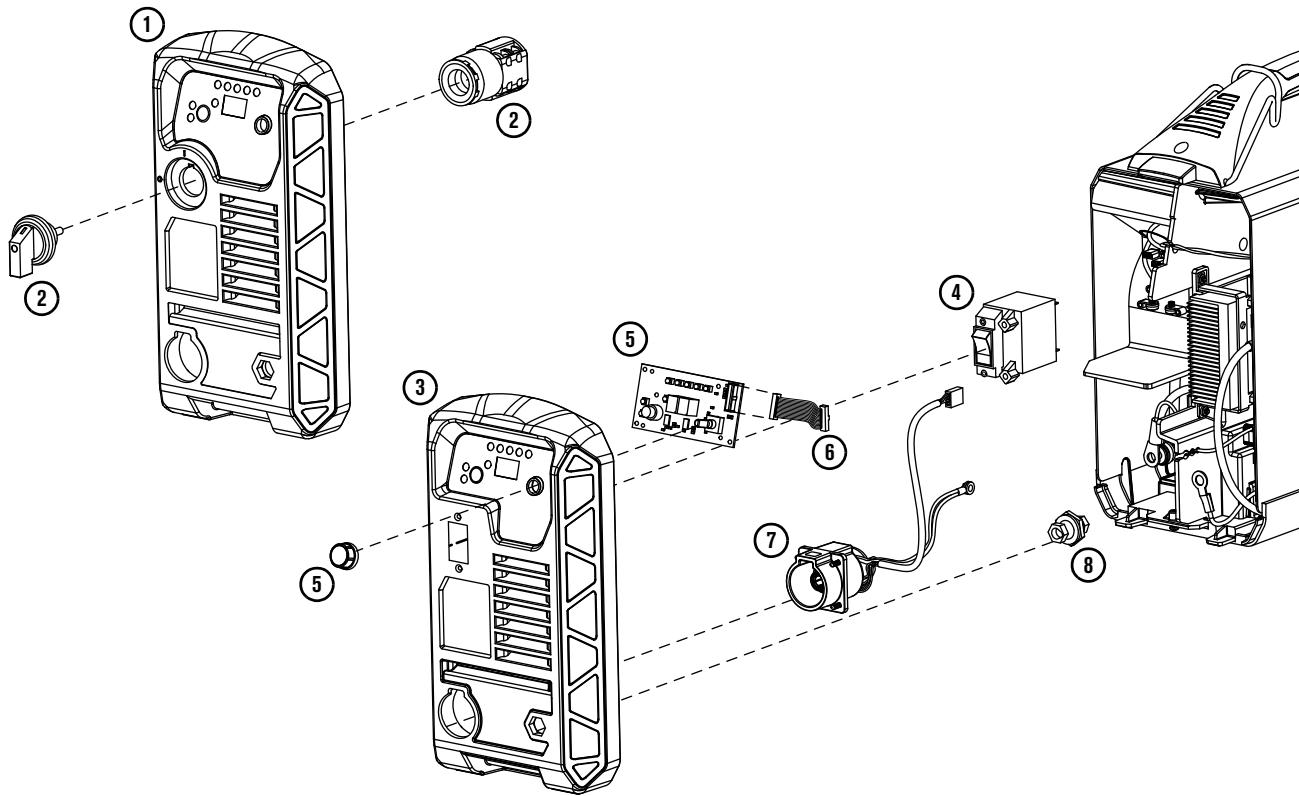
External cables for machine interface port and serial port

Hypertherm offers a variety of external cables that connect to the machine interface (CPC) port and the serial port. For pictures and for setup information, see:

- *Connect the machine interface cable* on page 104
- *Connect an optional RS-485 serial interface cable* on page 111

Part number	Description
023206	External machine interface cable (start, stop, arc transfer signals), 7.6 m (25 feet), spade connectors
023279	External machine interface cable (start, stop, arc transfer signals), 15 m (50 feet), spade connectors
228350	Kit: External machine interface cable (start, stop, arc transfer, and divided arc voltage signals), 7.6 m (25 feet), spade connectors
228351	Kit: External machine interface cable (start, stop, arc transfer, and divided arc voltage signals), 15 m (50 feet), spade connectors
223354	External machine interface cable (start, stop, arc transfer, and divided arc voltage signals), 3.0 m (10 feet), D-sub connector with screws
223355	External machine interface cable (start, stop, arc transfer, and divided arc voltage signals), 6.1 m (20 feet), D-sub connector with screws
223048	External machine interface cable (start, stop, arc transfer, and divided arc voltage signals), 7.6 m (25 feet), D-sub connector with screws
223356	External machine interface cable (start, stop, arc transfer, and divided arc voltage signals), 10.7 m (35 feet), D-sub connector with screws
123896	External machine interface cable (start, stop, arc transfer, and divided arc voltage signals), 15 m (50 feet), D-sub connector with screws
223733	External machine interface cable for PlasmaCAM® tables, 4.6 m (15 feet)
223734	External machine interface cable for PlasmaCAM tables, 6.1 m (20 feet)
223236	External RS-485 cable, unterminated, 7.6 m (25 feet)
223237	External RS-485 cable, unterminated, 15 m (50 feet)
223239	External RS-485 cable, 9-pin D-sub connector for Hypertherm controls, 7.6 m (25 feet)
223240	External RS-485 cable, 9-pin D-sub connector for Hypertherm controls, 15 m (50 feet)

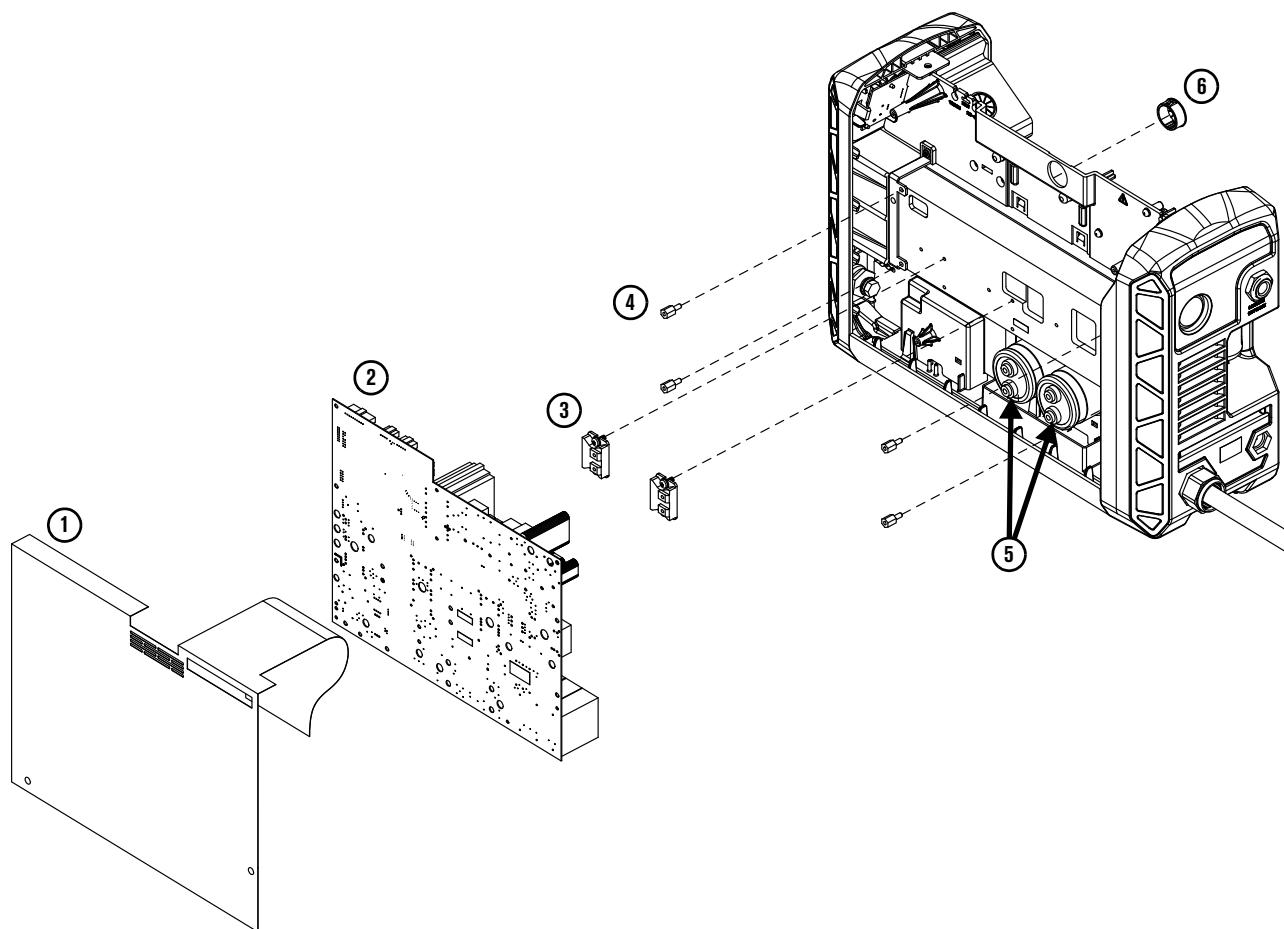
Front panel and receptacles, display board, power switch



Item	Kit number	Description
1	428660	Kit: Front panel for CSA/CE/CCC 3-phase models
2	428681	Kit: Power switch and knob for 3-phase models (dial switch) (designator: S1)
3	428659	Kit: Front panel for CSA/CE/CCC 1-phase models
4	428680	Kit: Power switch for 1-phase models (rocker switch) (designator: S1)
5	428679	Kit: Display board with adjustment knob (does not include ribbon cable) (designator: PCB1)
6	428709	Kit: Ribbon cable for display board
7	428677	Kit: Quick-disconnect receptacle for torch lead
8	428070	Kit: Work lead receptacle

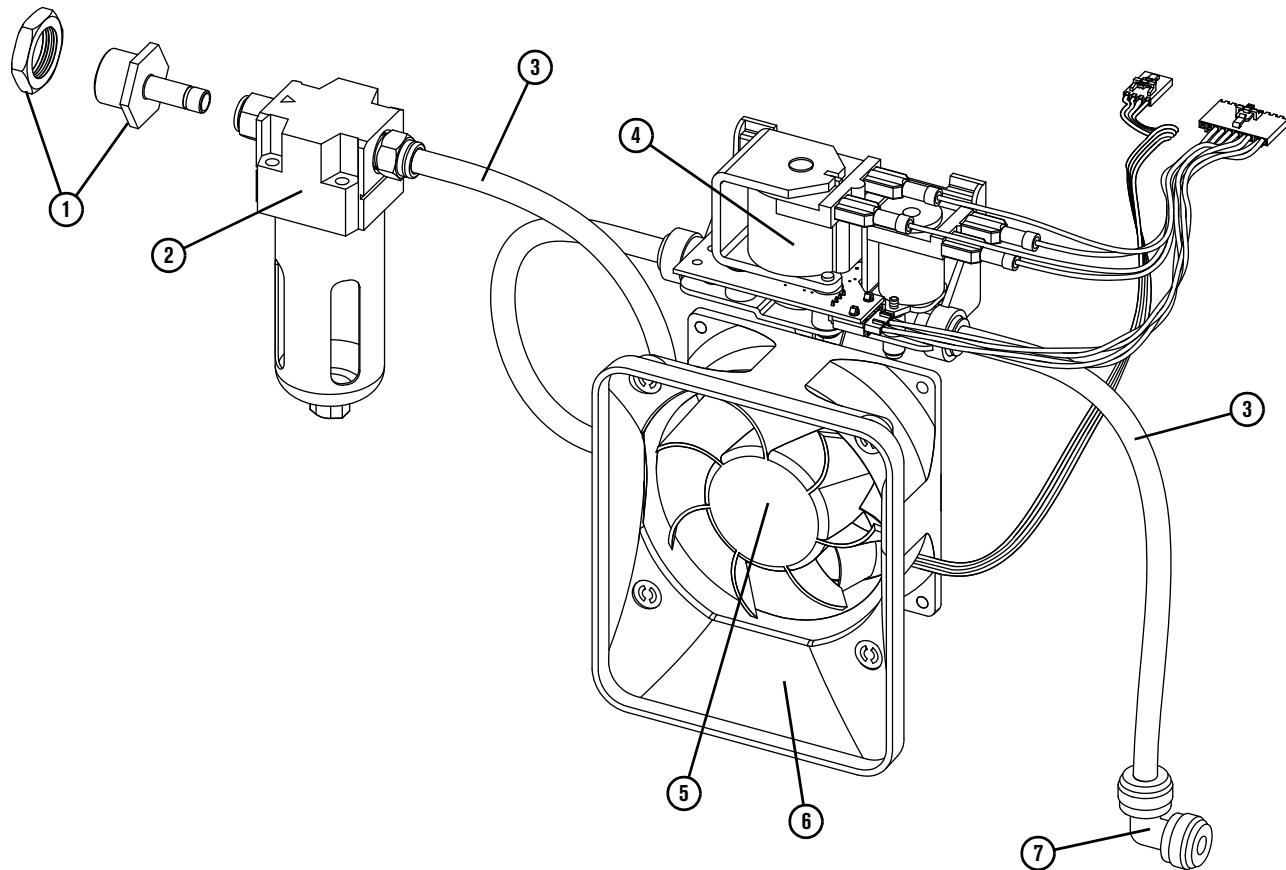
- 1 428660 Kit: Front panel for CSA/CE/CCC 3-phase models
- 2 428681 Kit: Power switch and knob for 3-phase models (dial switch) (designator: S1)
- 3 428659 Kit: Front panel for CSA/CE/CCC 1-phase models
- 4 428680 Kit: Power switch for 1-phase models (rocker switch) (designator: S1)
- 5 428679 Kit: Display board with adjustment knob (does not include ribbon cable) (designator: PCB1)
- 6 428709 Kit: Ribbon cable for display board
- 7 428677 Kit: Quick-disconnect receptacle for torch lead
- 8 428070 Kit: Work lead receptacle

Plasma supply interior, power board



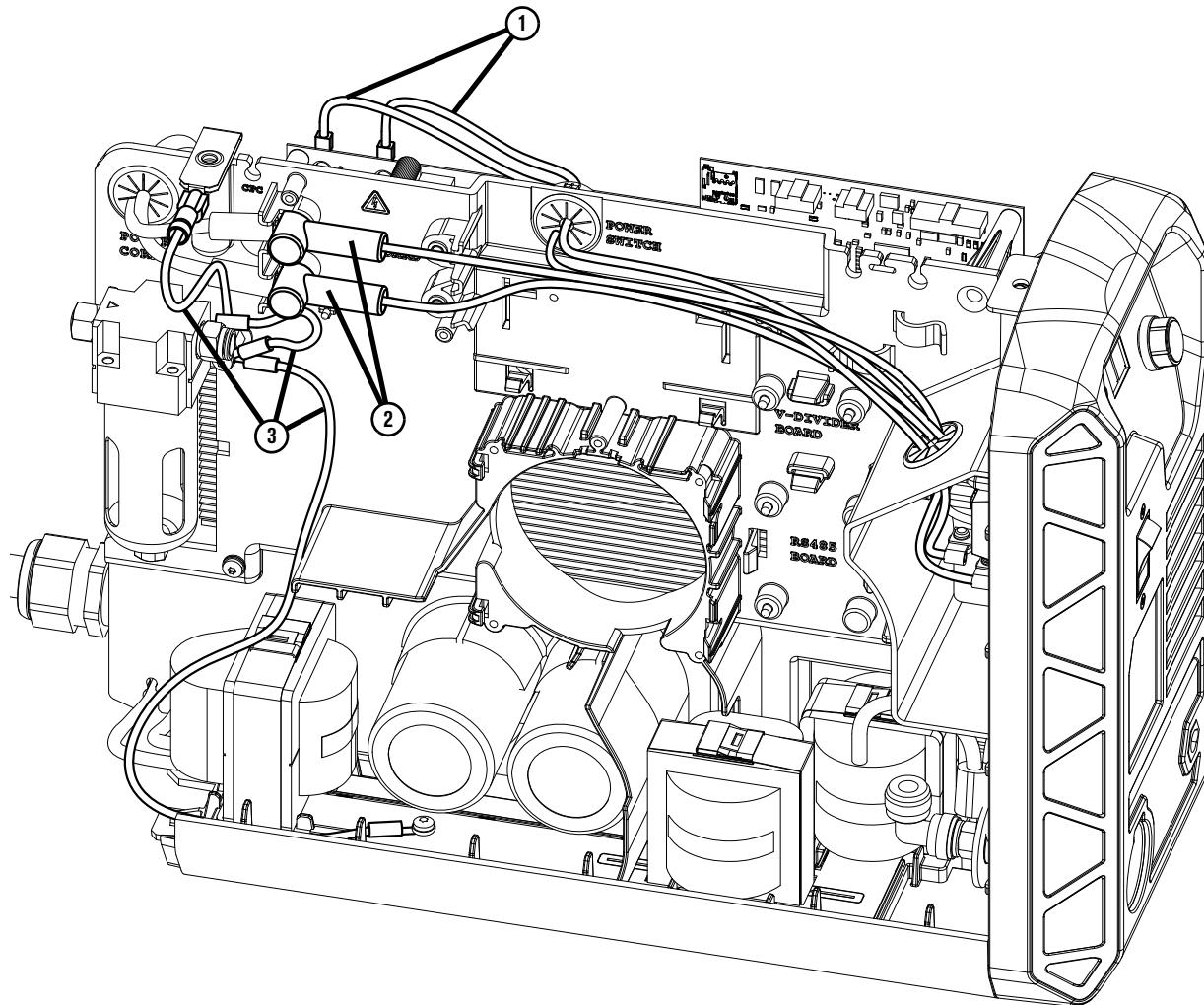
Item	Kit number	Description
1	428672	Kit: Component barrier (insulator)
2	428682	Kit: Power board for 200 – 240 V CSA/CE/CCC 1-phase models (designator: PCB3)
2	428683	Kit: Power board for 400 V CE/CCC 3-phase models (designator: PCB3)
2	428708	Kit: Power board for 480 V CSA 3-phase models (designator: PCB3)
3	428065	Kit: Snubber resistors (2) 10 Ω with thermal grease
4	428411	Kit: Replacement standoffs (5) for power board and ground wire
5	228301	Kit: Capacitors (2) for 200 – 240 V CSA/CE/CCC 1-phase power boards
5	228426	Kit: Capacitors (2) for 400 V CE/CCC 3-phase power boards
5	428080	Kit: Capacitors (2) for 480 V CSA 3-phase power boards
6	428407	Kit: Replacement grommets (5) for center panel
	128836	Thermal grease, 1/8 ounce (for electronic components that mount on the heatsink)

Plasma supply interior, pneumatics and fan



Item	Kit number	Description
1	428732	Kit: 1/4 NPT bulkhead fitting and nut for air filter
2	428684	Kit: Air filter assembly (includes metal guard, filter bowl, filter element, and gas hose)
3	428675	Kit: 2 gas supply hoses
4	428630	Kit: Solenoid valve assembly (includes valve PCB, wiring harness, and both gas supply hoses) (designator: V1)
5	428687	Kit: Fan assembly for 1-phase models (designator: M1)
5	428688	Kit: Fan assembly for 3-phase models (designator: M1)
6	428734	Kit: Plenum for fan
7	428250	Kit: 90° fitting

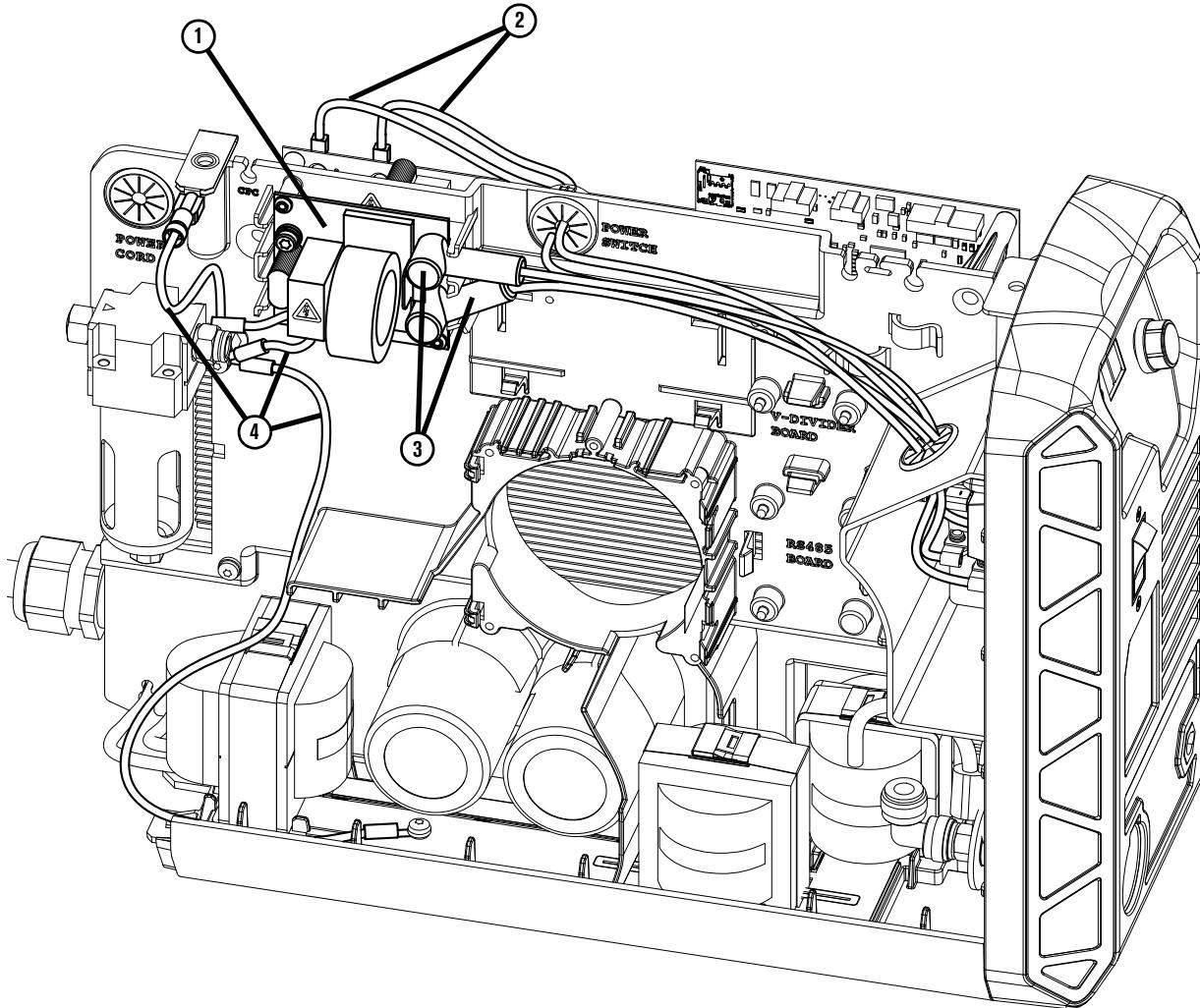
Plasma supply interior, wires, CSA 1-phase



Item	Kit number	Description
428686	Kit: Wire group for CSA 1-phase models:	
1		▪ 2 wires from power switch to power board (black and white)
2		▪ 2 wires from power switch to power cord (CSA) or EMI board (CE/CCC) (blue and brown) with protective covers for wire terminals
3		▪ 3 ground wires

- 1 ▪ 2 wires from power switch to power board (black and white)
- 2 ▪ 2 wires from power switch to power cord (CSA) or EMI board (CE/CCC) (blue and brown) with protective covers for wire terminals
- 3 ▪ 3 ground wires

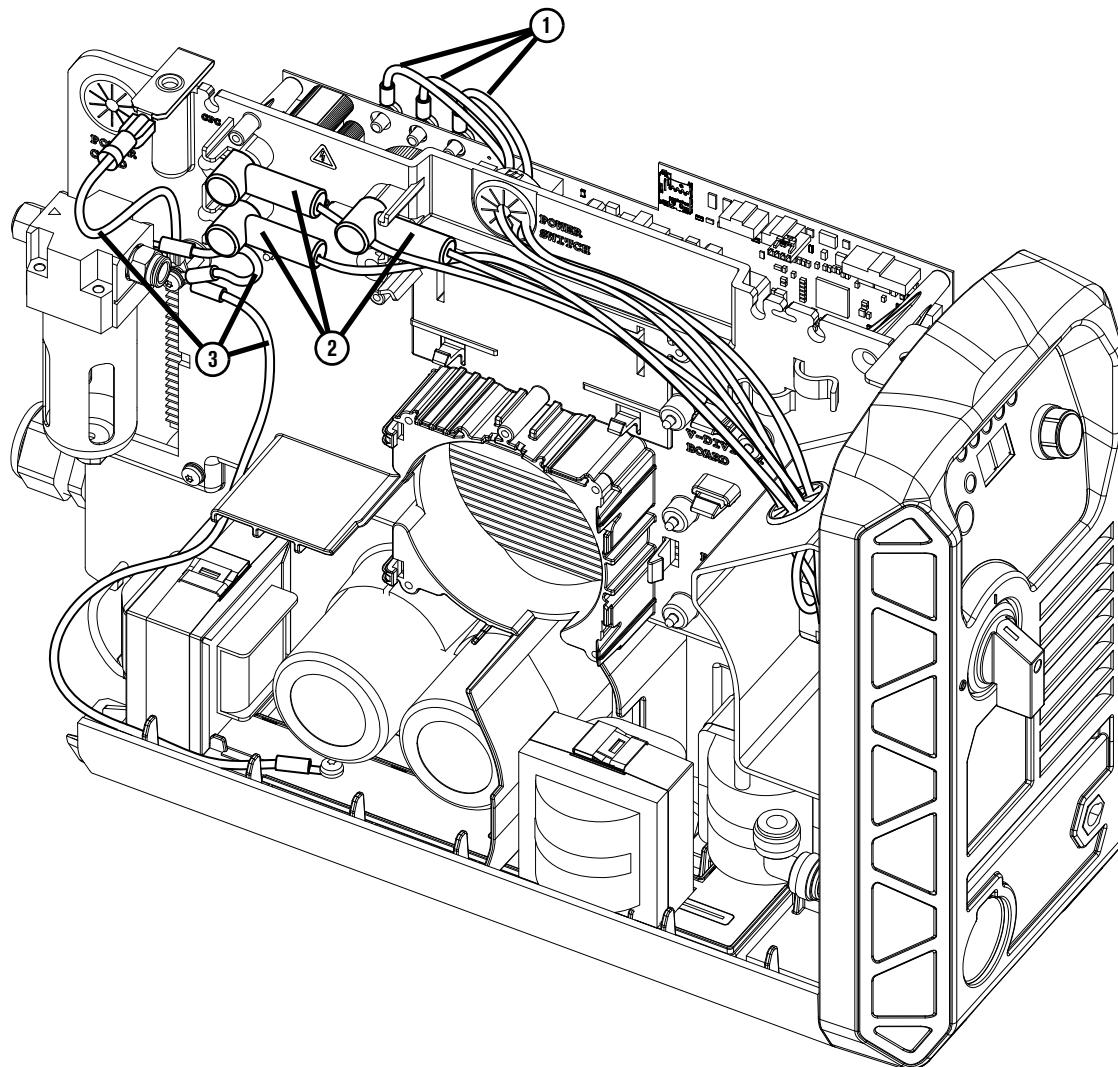
Plasma supply interior, wires and EMI board, CE/CCC 1-phase



Item	Kit number	Description
1	428721	Kit: EMI board for CE/CCC 1-phase models only (includes screws but not wires) (designator: PCB2)
	428686	Kit: Wire group for 1-phase models:
2		▪ 2 wires from power switch to power board (black and white)
3		▪ 2 wires from power switch to power cord (CSA) or EMI board (CE/CCC) (blue and brown) with protective covers for wire terminals
4		▪ 3 ground wires

- 1 428721 Kit: EMI board for CE/CCC 1-phase models only (includes screws but not wires)
(designator: PCB2)
- 2 428686 Kit: Wire group for 1-phase models:
 - 2 wires from power switch to power board (black and white)
 - 2 wires from power switch to power cord (CSA) or EMI board (CE/CCC) (blue and brown) with protective covers for wire terminals
 - 3 ground wires

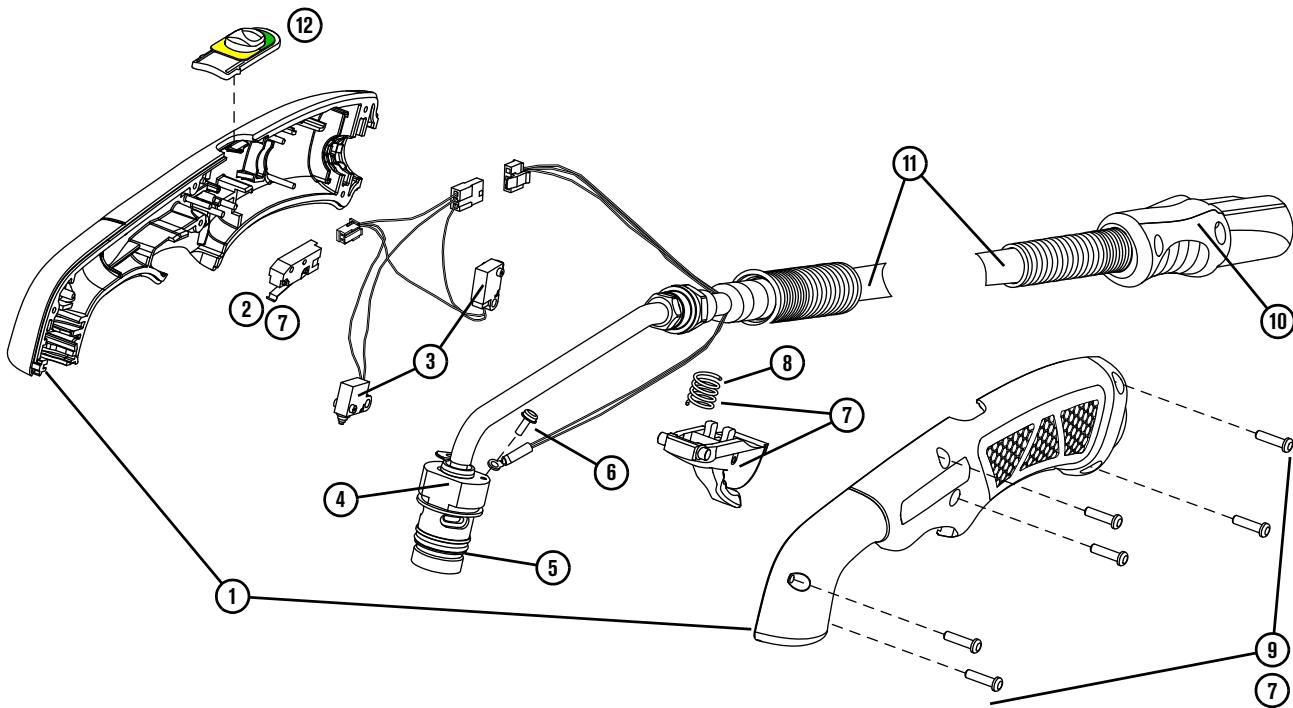
Plasma supply interior, wires, 3-phase



Item	Kit number	Description
428731	Kit: Wire group for 3-phase models:	
1		▪ 3 wires from power switch to power board (brown with white stripe, white with black stripe, and black with white stripe)
2		▪ 3 wires from power switch to power cord (black, white, and brown) with protective covers for wire terminals
3		▪ 3 ground wires

- 1 ▪ 3 wires from power switch to power board (brown with white stripe, white with black stripe, and black with white stripe)
- 2 ▪ 3 wires from power switch to power cord (black, white, and brown) with protective covers for wire terminals
- 3 ▪ 3 ground wires

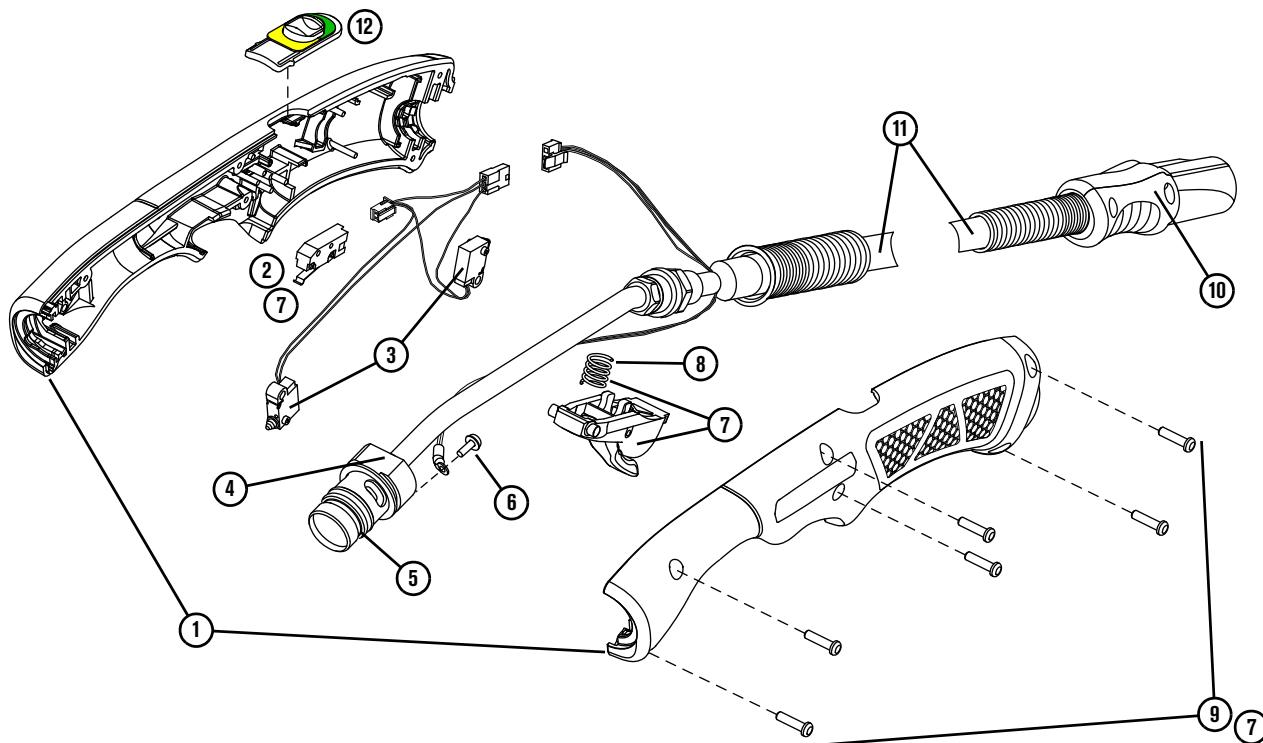
75° hand torch replacement parts



Item	Kit number	Description
	088164*	75° hand torch assembly with 6.1 m (20 foot) lead
	088165*	75° hand torch assembly with 15 m (50 foot) lead
1	428590	Kit: 75° hand torch handle (with screws)
2	428162	Kit: Hand torch start switch
3	428594	Kit: Cap-sensor switch and torch-disable switch assembly for hand torch (includes wires and connectors)
4	428588	Kit: 75° hand torch main body (with O-ring)
5	428180	Kit: Replacement O-rings for torch body
6	075504	Pilot terminal screw
7	428156	Kit: Hand torch trigger and spring – includes start switch and screws for torch handle
8	428182	Kit: Replacement springs for hand torch trigger
9	428148	Kit: Replacement screws for torch handle
10	228314	Kit: Torch quick-disconnect repair (shell with button – does not include torch lead or connector)
11	428592	Kit: Hand torch lead replacement, 6.1 m (20 foot)
11	428593	Kit: Hand torch lead replacement, 15 m (50 foot)
12	428595	Kit: Torch-disable slider for hand torch (with yellow/green label)

* The torch assembly does not include consumables. See page 64 (cutting) and page 77 (gouging) for consumable part numbers.

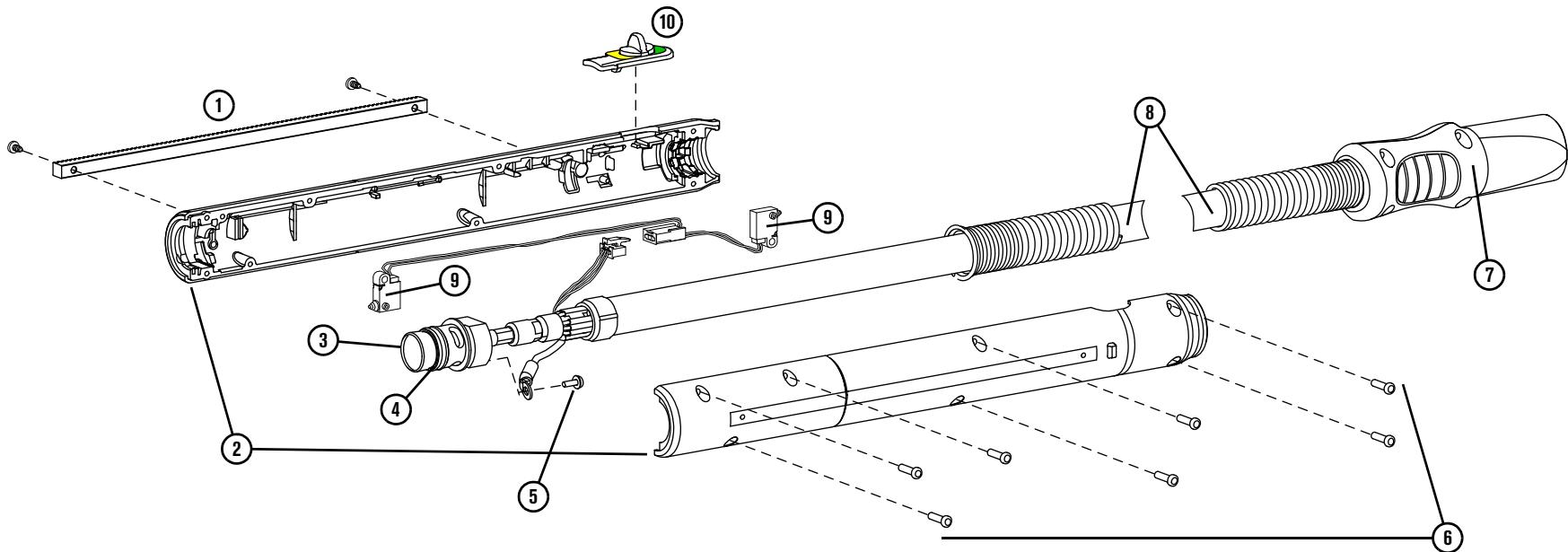
15° hand torch replacement parts



Item	Kit number	Description
	088162*	15° hand torch assembly with 6.1 m (20 foot) lead
	088163*	15° hand torch assembly with 15 m (50 foot) lead
1	428591	Kit: 15° hand torch handle (with screws)
2	428162	Kit: Hand torch start switch
3	428594	Kit: Cap-sensor switch and torch-disable switch assembly for hand torch (includes wires and connectors)
4	428589	Kit: 15° hand torch main body (with O-ring)
5	428180	Kit: Replacement O-rings for torch body
6	075504	Pilot terminal screw
7	428156	Kit: Hand torch trigger and spring – includes start switch and screws for torch handle
8	428182	Kit: Replacement springs for hand torch trigger
9	428148	Kit: Replacement screws for torch handle
10	228314	Kit: Torch quick-disconnect repair (shell with button – does not include torch lead or connector)
11	428592	Kit: Hand torch lead replacement, 6.1 m (20 foot)
11	428593	Kit: Hand torch lead replacement, 15 m (50 foot)
12	428595	Kit: Torch-disable slider for hand torch (with yellow/green label)

* The torch assembly does not include consumables. See page 64 (cutting) and page 77 (gouging) for consumable part numbers.

Machine torch replacement parts



Item	Kit number	Description
	088167*	Kit: Machine torch assembly with 7.6 m (25 foot) lead
	088168*	Kit: Machine torch assembly with 10.7 m (35 foot) lead
	088169*	Kit: Machine torch assembly with 15 m (50 foot) lead
1	428703	Kit: Removable 32-pitch gear rack (with screws)
2	428596	Kit: Machine torch shell (with screws)
3	428704	Kit: Torch main body replacement for machine torch
4	428180	Kit: Replacement O-rings for torch body
5	075504	Pilot terminal screw
6	428148	Kit: Replacement screws for torch shell

Item	Kit number	Description
7	428260	Kit: Torch quick-disconnect repair (shell with button – does not include torch lead or connector)
8	428699	Kit: Machine torch lead replacement, 7.6 m (25 foot)
8	428710	Kit: Machine torch lead replacement, 10.7 m (35 foot)
8	428700	Kit: Machine torch lead replacement, 15 m (50 foot)
9	428705	Kit: Cap-sensor switch and torch-disable switch assembly for machine torch (includes wires and connector)
10	428706	Kit: Torch-disable slider for machine torch (with yellow/green label)

* The torch assembly does not include consumables. See page 113 (cutting), page 77 (gouging), and page 121 (marking) for consumable part numbers.

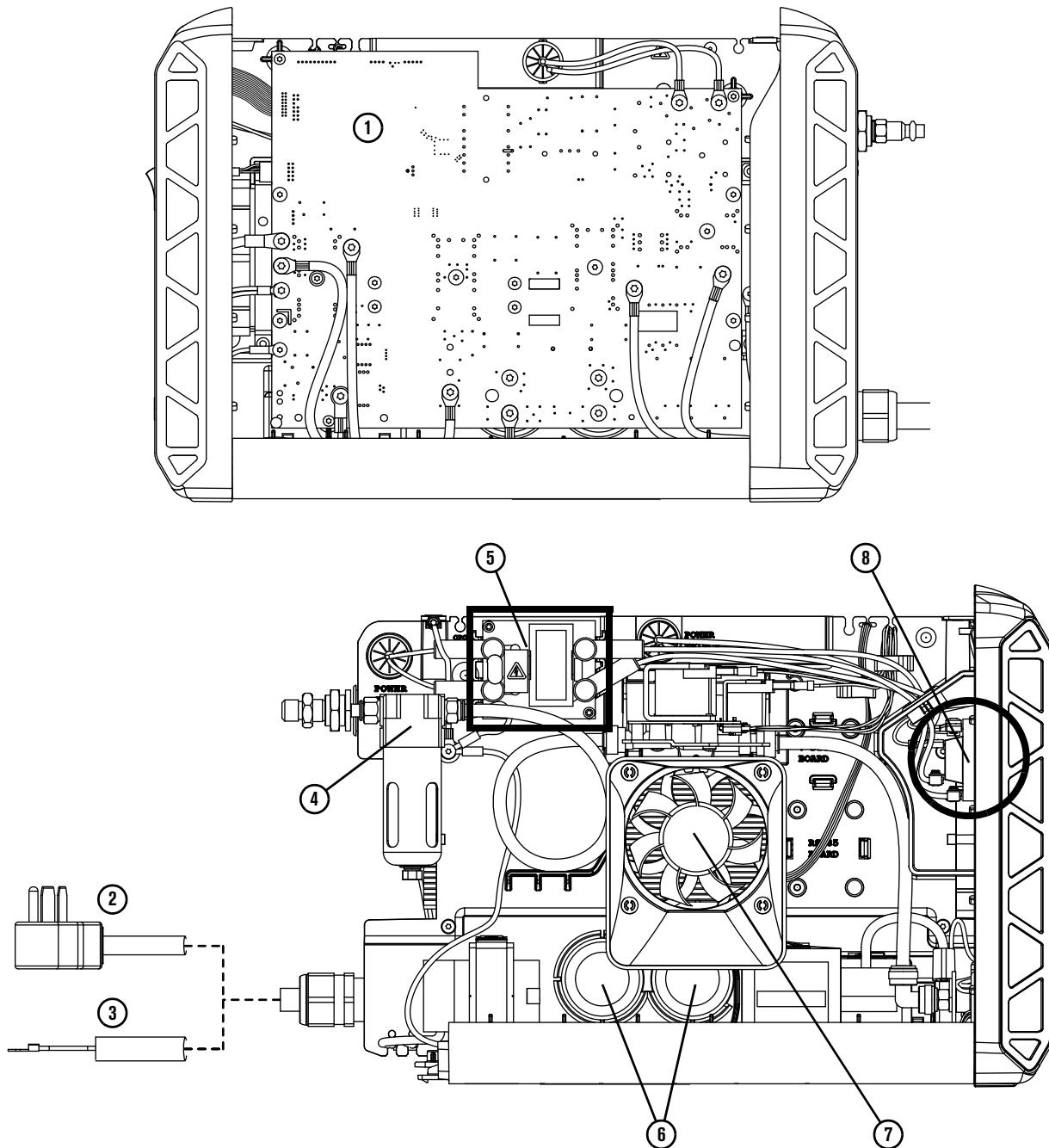
Accessory parts

Part number	Description
128647	Eliminizer air filter kit (for moisture removal)
011092	Replacement filter element for Eliminizer air filter
428719	Oil removal coalescing filter kit
428720	Replacement filter element for oil removal coalescing filter
428718	Mounting bracket for Eliminizer air filter or oil removal coalescing filter
127217	Shoulder strap (clips not included)
104821	Replacement clips for shoulder strap*
127169	Leather cutting gloves
127239	Face shield, shade 6 lens
127219	Dust cover for power supply
017060	Rolling tool bag (fits power supply, torch, consumables, and some accessories)
024877	Leather torch lead cover, black with Hypertherm logo, 7.6 m (25 feet)
127102	Basic plasma (circle) cutting guide, maximum diameter 70 cm (28 inches)
027668	Deluxe plasma (circle) cutting guide, maximum diameter 51 cm (20 inches)
017059	Bevel cutting guide
027055	Silicone lubricant, 1/4 ounce (for O-ring on torch body and air filter bowl)
128836	Thermal grease, 1/8 ounce (for electronic components that mount on heatsink)

* The clips for the shoulder strap come with the system. They are also included in the replacement kit for the power supply handle. They do not come with the shoulder strap itself. See page 318.

Safety critical parts

Genuine Hypertherm parts are factory-recommended parts for your Hypertherm system. Any damage caused by the use of parts that are not from Hypertherm may not be covered by the Hypertherm warranty. In addition, the following parts are safety-critical parts that must be replaced only with genuine Hypertherm parts to maintain the warranty and system certifications, including CE, CSA, and CCC certification.



Item	Kit number	Description
1	428682	<i>Kit: Power board for 200 – 240 V CSA/CE/CCC 1-phase models (designator: PCB3)</i>
1	428683	<i>Kit: Power board for 400 V CE/CCC 3-phase models (designator: PCB3)</i>
1	428708	<i>Kit: Power board for 480 V CSA 3-phase models (designator: PCB3)</i>
2	428664	<i>Kit: CSA power cord with strain relief, 1-phase, 3 m (10 foot) (includes NEMA 6-50P power plug)</i>
3	428667	<i>Kit: CE/CCC power cord with strain relief, 1-phase, 3 m (10 foot) (no power plug included)</i>
3	428665	<i>Kit: CSA power cord with strain relief, 3-phase, 3.5 m (11 foot) (no power plug included)</i>
3	428666	<i>Kit: CE/CCC power cord with strain relief, 3-phase, 3 m (10 foot) (no power plug included)</i>
4	428684	<i>Kit: Air filter assembly (includes metal guard, filter bowl, filter element, and gas hose)</i>
5	428721	<i>Kit: EMI board for CE/CCC 1-phase models only (includes screws but not wires) (designator: PCB2)</i>
6	228301	<i>Kit: Capacitors (2) for 200 – 240 V CSA/CE/CCC 1-phase power boards</i>
6	228426	<i>Kit: Capacitors (2) for 400 V CE/CCC 3-phase power boards</i>
6	428080	<i>Kit: Capacitors (2) for 480 V CSA 3-phase power boards</i>
7	428687	<i>Kit: Fan assembly for 1-phase models (designator: M1)</i>
7	428688	<i>Kit: Fan assembly for 3-phase models (designator: M1)</i>
8	428680	<i>Kit: Power switch for 1-phase models (rocker switch) (designator: S1)</i>
8	428681	<i>Kit: Power switch and knob for 3-phase models (dial switch) (designator: S1)</i>

Recommended spare parts

Hypertherm recommends that service centers keep the following spare parts on hand for repairs because these parts are critical or are usually exposed to heavy and repeated wear. You may need to revise or expand this list for your customers, based on the conditions and work environments in your region.

Kit number	Description	Reference
428143	<i>Kit: Adjustment knob for control panel</i>	page 318
223595	<i>Work lead, 7.6 m (25 foot), with work clamp</i>	page 318
223596	<i>Work lead, 15 m (50 foot), with work clamp</i>	page 318
428680	<i>Kit: Power switch for 1-phase models (rocker switch) (designator: S1)</i>	page 322
428681	<i>Kit: Power switch and knob for 3-phase models (dial switch) (designator: S1)</i>	page 322
428679	<i>Kit: Display board with adjustment knob (does not include ribbon cable) (designator: PCB1)</i>	page 322
428709	<i>Kit: Ribbon cable for display board</i>	page 322

Kit number	Description	Reference
428682	Kit: Power board for 200 – 240 V CSA/CE/CCC 1-phase models (designator: PCB3)	page 323
428683	Kit: Power board for 400 V CE/CCC 3-phase models (designator: PCB3)	page 323
428708	Kit: Power board for 480 V CSA 3-phase models (designator: PCB3)	page 323
428065	Kit: Snubber resistors (2) 10 Ω with thermal grease	page 323
428721	Kit: EMI board for CE/CCC 1-phase models only (includes screws but not wires) (designator: PCB2)	page 326
228301	Kit: Capacitors (2) for 200 – 240 V CSA/CE/CCC 1-phase power boards	page 323
228426	Kit: Capacitors (2) for 400 V CE/CCC 3-phase power boards	page 323
428080	Kit: Capacitors (2) for 480 V CSA 3-phase power boards	page 323
428684	Kit: Air filter assembly (includes metal guard, filter bowl, filter element, and gas hose)	page 324
428378	Kit: Air filter element	page 319
428687	Kit: Fan assembly for 1-phase models (designator: M1)	page 324
428688	Kit: Fan assembly for 3-phase models (designator: M1)	page 324
428630	Kit: Solenoid valve assembly (includes valve PCB, wiring harness, and both gas supply hoses) (designator: V1)	page 324
428180	Kit: Replacement O-rings for torch body	page 328
428148	Kit: Replacement screws for torch handle	page 328
428590	Kit: 75° hand torch handle (with screws)	page 328
428591	Kit: 15° hand torch handle (with screws)	page 329
428156	Kit: Hand torch trigger and spring – includes start switch and screws for torch handle	page 328
428594	Kit: Cap-sensor switch and torch-disable switch assembly for hand torch (includes wires and connectors)	page 329
428595	Kit: Torch-disable slider for hand torch (with yellow/green label)	page 329
428592	Kit: Hand torch lead replacement, 6.1 m (20 foot)	page 328
428593	Kit: Hand torch lead replacement, 15 m (50 foot)	page 328
428703	Kit: Removable 32-pitch gear rack (with screws)	page 330
428596	Kit: Machine torch shell (with screws)	page 330
428705	Kit: Cap-sensor switch and torch-disable switch assembly for machine torch (includes wires and connector)	page 331
428706	Kit: Torch-disable slider for machine torch (with yellow/green label)	page 331
428699	Kit: Machine torch lead replacement, 7.6 m (25 foot)	page 331
428710	Kit: Machine torch lead replacement, 10.7 m (35 foot)	page 331
428700	Kit: Machine torch lead replacement, 15 m (50 foot)	page 331
027055	Silicone lubricant, 1/4 ounce (for O-ring on torch body and air filter bowl)	page 332
128836	Thermal grease, 1/8 ounce (for electronic components that mount on heatsink)	page 332

Powermax45 XP Labels

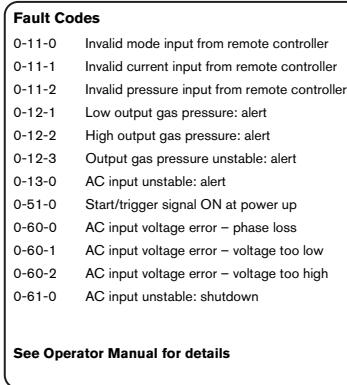
Kit number	Description
428655	Kit: Powermax45 XP labels for 1-phase models
428656	Kit: Powermax45 XP labels for 3-phase models

The label kits include:

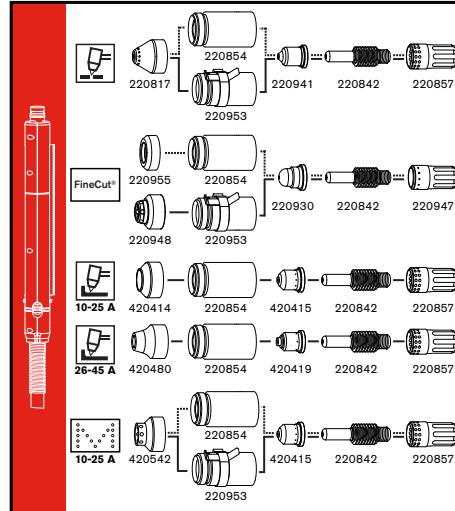
- Warning labels
- Decals for side panels
- Consumable labels

Consumable labels and fault codes label

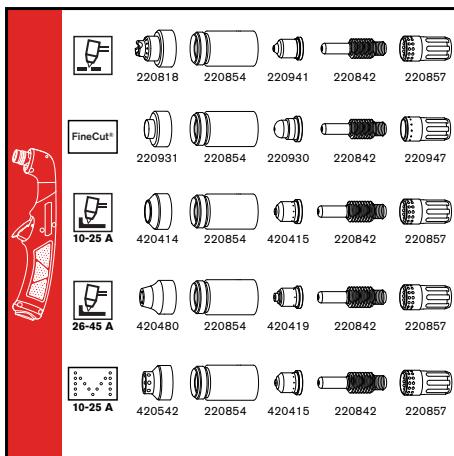
The consumable labels and the fault codes label are removable stickers. The fault codes label is found inside the front cover of the *Operator Manual*. The consumable labels are included in the literature package that comes with the system. Place the labels on the side of the power supply or near your work area for ease of reference.



Fault codes label



Consumable label – machine torch



Consumable label – hand torch

CSA warning label

This warning label is affixed to some power supplies. It is important that the operator and maintenance technician understand the intent of these warning symbols as described.

	Read and follow these instructions, employer safety practices, and material safety data sheets. Refer to ANS Z49.1, "Safety in Welding, Cutting and Allied Processes" from American Welding Society (http://www.aws.org) and OSHA Safety and Health Standards, 29 CFR 1910 (http://www.osha.gov).		WARNING		AVERTISSEMENT
1		1.1	1.2	1.3	Plasma cutting can be injurious to operator and persons in the work area. Consult manual before operating. Failure to follow all these safety instructions can result in death.
2		2.1	2.2	2.3	1. Cutting sparks can cause explosion or fire. <ul style="list-style-type: none"> 1.1 Do not cut near flammables. 1.2 Have a fire extinguisher nearby and ready to use. 1.3 Do not use a drum or other closed container as a cutting table. 2. Plasma arc can injure and burn; point the nozzle away from yourself. Arc starts instantly when triggered. <ul style="list-style-type: none"> 2.1 Turn off power before disassembling torch. 2.2 Do not grip the workpiece near the cutting path. 2.3 Wear complete body protection.
3		3.1	3.2	3.3	3. Hazardous voltage. Risk of electric shock or burn. <ul style="list-style-type: none"> 3.1 Wear insulating gloves. Replace gloves when wet or damaged. 3.2 Protect from shock by insulating yourself from work and ground. 3.3 Disconnect power before servicing. Do not touch live parts.
4		4.1	4.2	4.3	4. Plasma fumes can be hazardous. <ul style="list-style-type: none"> 4.1 Do not inhale fumes. 4.2 Use forced ventilation or local exhaust to remove the fumes. 4.3 Do not operate in closed spaces. Remove fumes with ventilation.
5		5.1			5. Arc rays can burn eyes and injure skin. <ul style="list-style-type: none"> 5.1 Wear correct and appropriate protective equipment to protect head, eyes, ears, hands, and body. Button shirt collar. Protect ears from noise. Use welding helmet with the correct shade of filter.
6		6	7		6. Become trained. Only qualified personnel should operate this equipment. Use torches specified in the manual. Keep non-qualified personnel and children away. 7. Do not remove, destroy, or cover this label. Replace if it is missing, damaged, or worn.
					5. Les rayons d'arc peuvent brûler les yeux et blesser la peau. <ul style="list-style-type: none"> 5.1 Porter un bon équipement de protection pour se protéger la tête, les yeux, les oreilles, les mains et le corps. Boutonner le col de la chemise. Protéger les oreilles contre le bruit. Utiliser un masque de soudeur avec un filtre de nuance appropriée. 6. Suivre une formation. Seul le personnel qualifié a le droit de faire fonctionner cet équipement. Utiliser exclusivement les torches indiquées dans le manuel. Le personnel non qualifié et les enfants doivent se tenir à l'écart. 7. Ne pas enlever, détruire ni couvrir cette étiquette. La remplacer si elle est absente, endommagée ou usée.

CE/CCC warning label

This warning label is affixed to some power supplies. It is important that the operator and maintenance technician understand the intent of these warning symbols as described. The numbered text corresponds to the numbered boxes on the label.



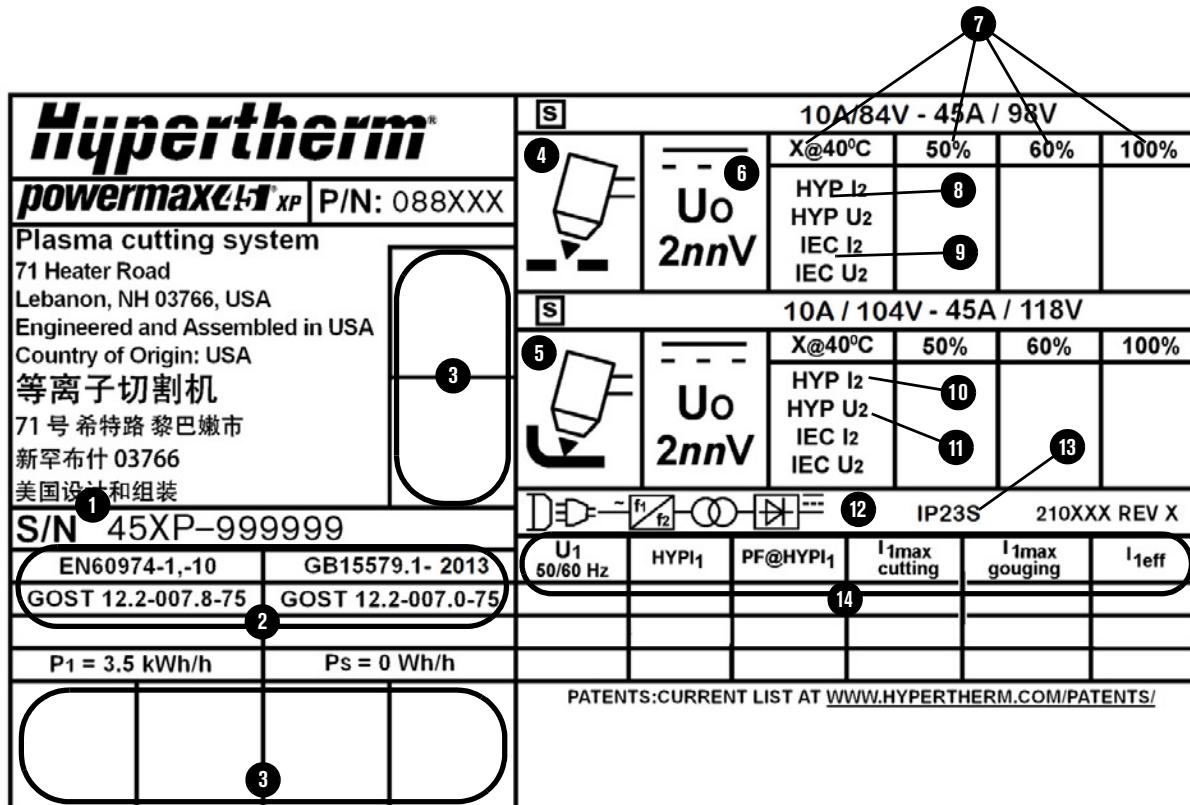
1. Cutting sparks can cause explosion or fire.
- 1.1 Do not cut near flammables.
- 1.2 Have a fire extinguisher nearby and ready to use.
- 1.3 Do not use a drum or other closed container as a cutting table.
2. Plasma arc can injure and burn; point the nozzle away from yourself. Arc starts instantly when triggered.
- 2.1 Turn off power before disassembling torch.
- 2.2 Do not grip the workpiece near the cutting path.
- 2.3 Wear complete body protection.
3. Hazardous voltage. Risk of electric shock or burn.
- 3.1 Wear insulating gloves. Replace gloves when wet or damaged.
- 3.2 Protect from shock by insulating yourself from work and ground.
- 3.3 Disconnect power before servicing. Do not touch live parts.
4. Plasma fumes can be hazardous.
- 4.1 Do not inhale fumes.
- 4.2 Use forced ventilation or local exhaust to remove the fumes.
- 4.3 Do not operate in closed spaces. Remove fumes with ventilation.
5. Arc rays can burn eyes and injure skin.
- 5.1 Wear correct and appropriate protective equipment to protect head, eyes, ears, hands, and body. Button shirt collar. Protect ears from noise. Use welding helmet with the correct shade of filter.
6. Become trained. Only qualified personnel should operate this equipment. Use torches specified in the manual. Keep non-qualified personnel and children away.
7. Do not remove, destroy, or cover this label. Replace if it is missing, damaged, or worn.

Data plate

The data plate on the bottom of the plasma power supply contains 2 sets of ratings:

- The **HYP** ratings are Hypertherm power supply ratings. They reflect the capability of the system based on Hypertherm's internal testing.
- The **IEC** ratings are predefined minimum thresholds that the system was required to meet to fulfill IEC standard 60974-1.

CSA and CE/CCC data plates differ slightly. The following sample is a CE/CCC data plate.



- | | |
|---|---|
| 1 S/N = serial number | 9 IEC = International Electrotechnical Commission rating |
| 2 Region-specific certification standards | 10 I₂ = Conventional welding current (A) |
| 3 Placeholders for region-specific certification symbols – see <i>Symbols and marks</i> on page 340 | 11 U₂ = Conventional welding voltage (V) |
| 4 Symbol for plasma cutting | 12 Symbol for inverter-based power source (1-phase or 3-phase) |
| 5 Symbol for plasma gouging | 13 Ingress Protection (IP) rating |
| 6 U₀ = Rated no load voltage (V) | 14 U₁ = Input voltage (V) |
| 7 X = Duty cycle (%) | I₁ = Input current (A) |
| 8 HYP = Hypertherm internal rating | PF = Power factor |

Symbols and marks

Your product may have one or more of the following marks on or near the data plate. Due to differences and conflicts in national regulations, not all marks are applied to every version of a product.



S mark

The S mark indicates that the power supply and torch are suitable for operations carried out in environments with increased hazard of electrical shock according to IEC 60974-1.



CSA mark

Products with a CSA mark meet the United States and Canadian regulations for product safety. The products were evaluated, tested, and certified by CSA-International. Alternatively, the product may have a mark by one of the other Nationally Recognized Testing Laboratories (NRTL) accredited in both the United States and Canada, such as UL or TÜV.



CE mark

The CE marking signifies the manufacturer's declaration of conformity to applicable European directives and standards. Only those versions of products with a CE marking located on or near the data plate have been tested for compliance with the European Low Voltage Directive and the European Electromagnetic Compatibility (EMC) Directive. EMC filters needed to comply with the European EMC Directive are incorporated within versions of the product with a CE marking.



Eurasian Customs Union (CU) mark

CE versions of products that include an EAC mark of conformity meet the product safety and EMC requirements for export to Russia, Belarus, and Kazakhstan.



GOST-TR mark

CE versions of products that include a GOST-TR mark of conformity meet the product safety and EMC requirements for export to the Russian Federation.



RCM mark

CE versions of products with a RCM mark comply with the EMC and safety regulations required for sale in Australia and New Zealand.



CCC mark

The China Compulsory Certification (CCC) mark indicates that the product has been tested and found compliant with product safety regulations required for sale in China.



UkrSEPRO mark

The CE versions of products that include a UkrSEPRO mark of conformity meet the product safety and EMC requirements for export to the Ukraine.



Serbian AAA mark

CE versions of products that include a AAA Serbian mark meet the product safety and EMC requirements for export to Serbia.

IEC symbols

The following symbols may appear on the data plate, control labels, and switches. For information on the front panel LEDs, see *Controls and indicators* on page 43.

	Direct current (DC)		The terminal for the external protective (earth) conductor
	Alternating current (AC)		Power is ON
	Plasma torch cutting	○	Power is OFF
	Gouging		A 1-phase or 3-phase inverter-based power source
	AC input power connection		Volt/amperage curve, "drooping" characteristic

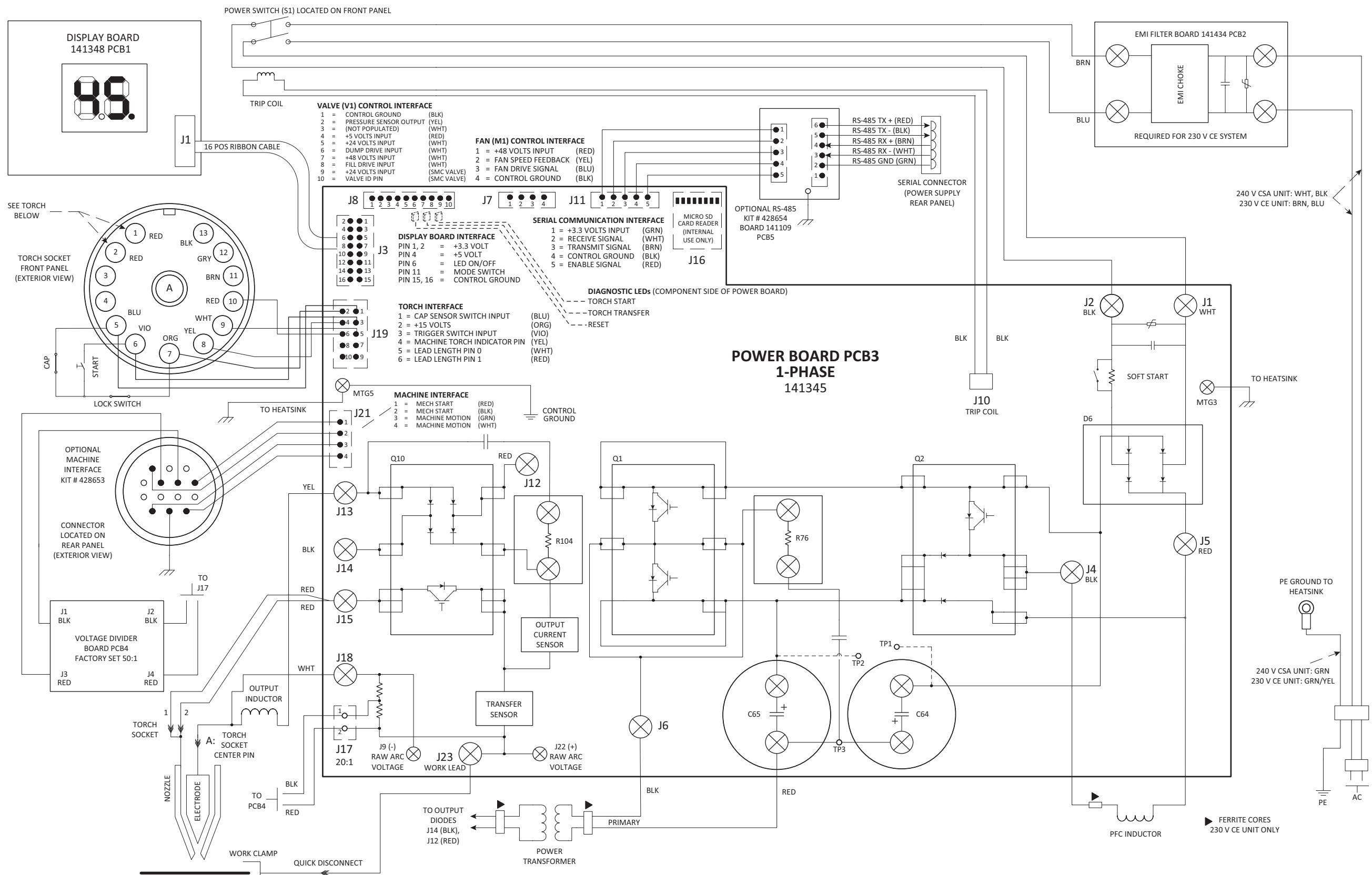
15

System Diagrams

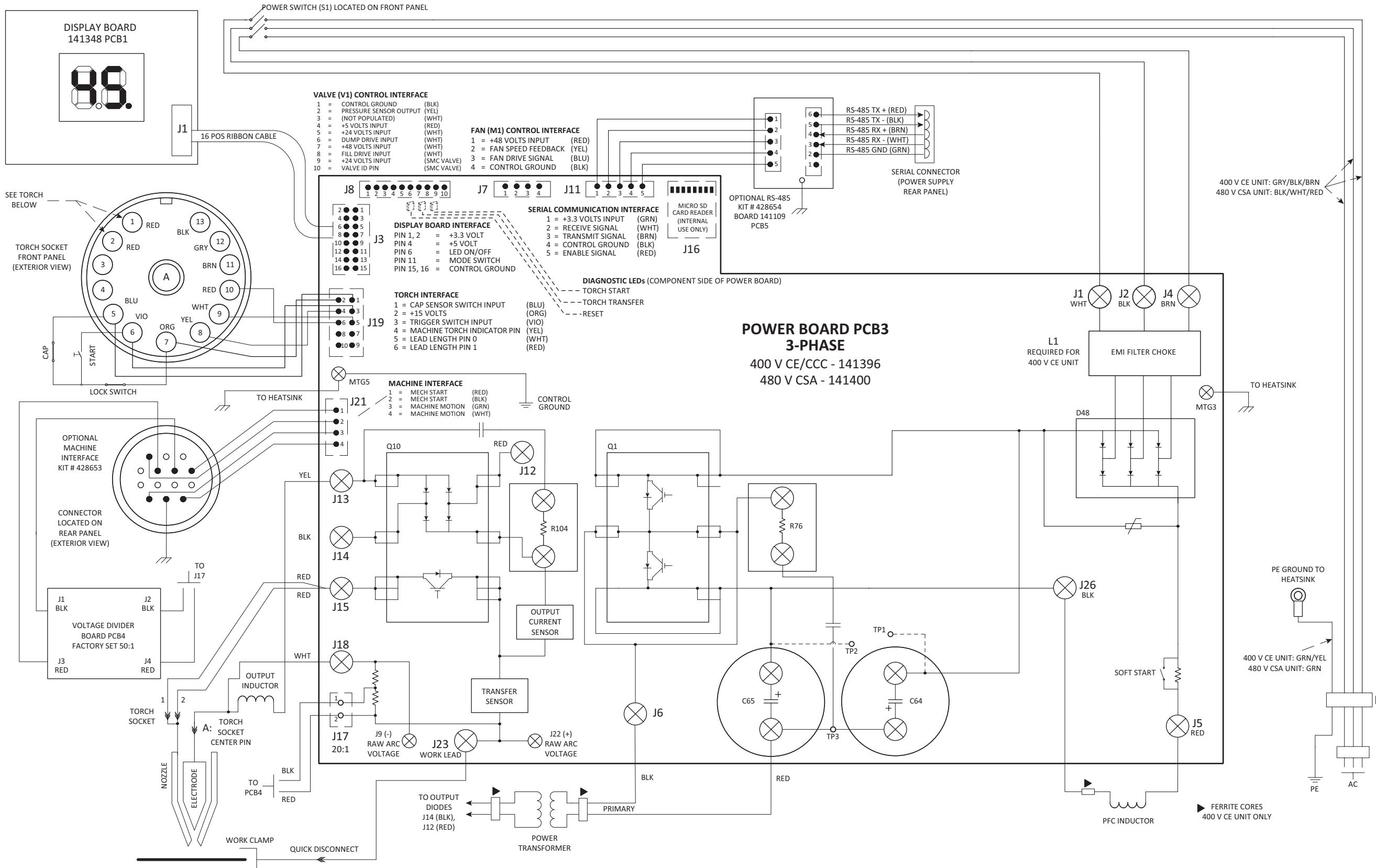
This section contains the following system diagrams:

- *Powermax45 XP schematic – 200 – 240 V 1-phase models* on page 345
- *Powermax45 XP schematic – 400 V CE/CCC and 480 V CSA 3-phase models* on page 346
- *Timing chart for torch start* on page 347

Powermax45 XP schematic - 200 - 240 V 1-phase models



Powermax45 XP schematic – 400 V CE/CCC and 480 V CSA 3-phase models



Timing chart for torch start

