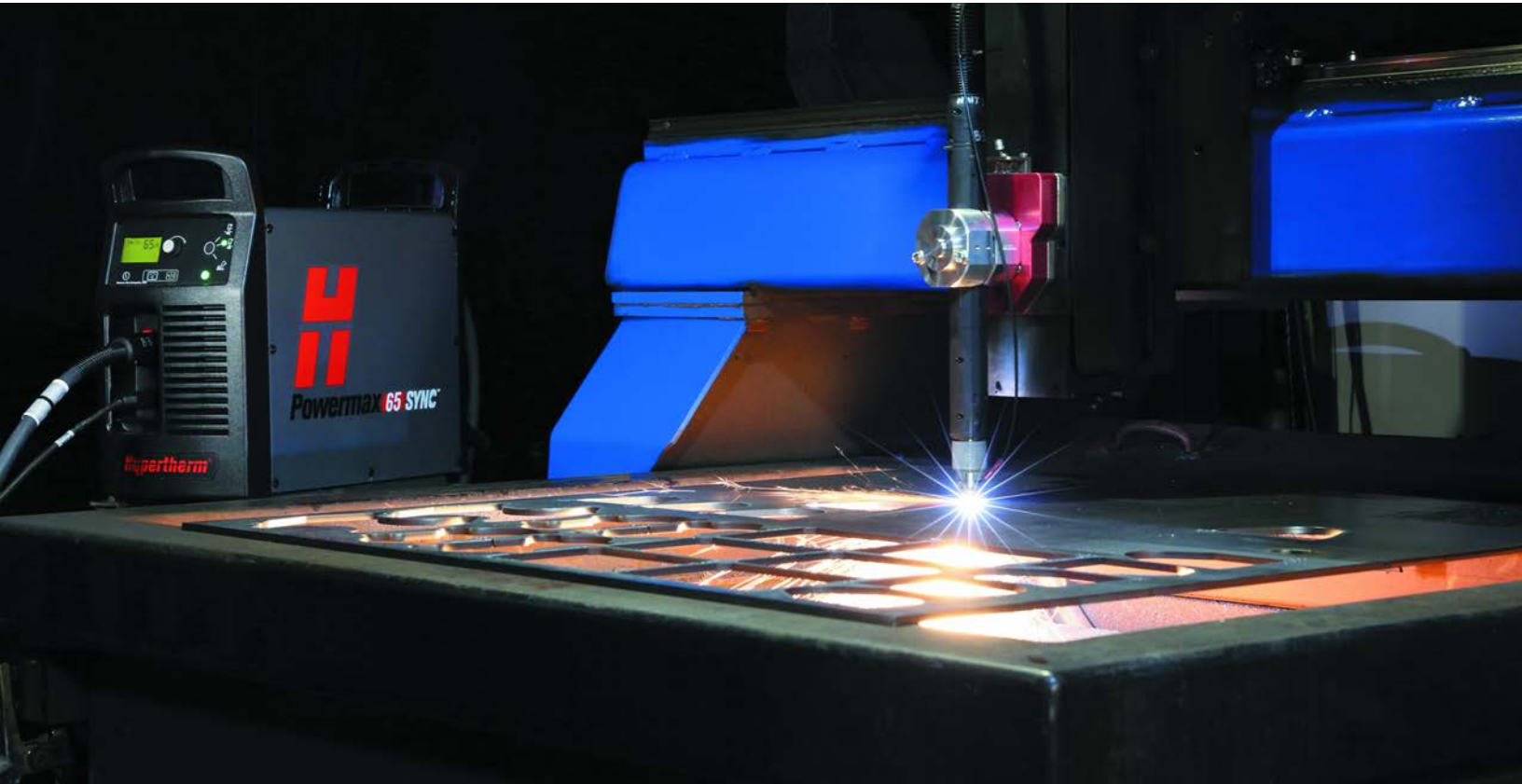




# Powermax45/65/85/105 SYNC<sup>®</sup>

## Mechanized Cutting Guide



810480 – REVISION 5

ENGLISH



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# ***Powermax45/65/85/105 SYNC***

## **Mechanized Cutting Guide**

810480  
REVISION 5

ENGLISH  
Original instructions

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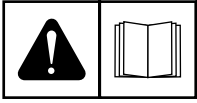
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For training and education resources, go to the Hypertherm Cutting Institute (HCI) online at [www.hypertherm.com/hci](http://www.hypertherm.com/hci).





## ENGLISH

**WARNING!** Before operating any Hypertherm equipment, read the safety instructions in your product's manual, the *Safety and Compliance Manual* (80669C), *Waterjet Safety and Compliance Manual* (80943C), and *Radio Frequency Warning Manual* (80945C). Failure to follow safety instructions can result in personal injury or in damage to equipment.

Copies of the manuals can come with the product in electronic and printed formats. Electronic copies are also on our website. Many manuals are available in multiple languages at [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## BG (БЪЛГАРСКИ/BULGARIAN)

**ПРЕДУПРЕЖДЕНИЕ!** Преди да работите с което и да е оборудване Hypertherm, прочетете инструкциите за безопасност в ръководството на вашия продукт, „Инструкция за безопасност и съответствие“ (80669C), „Инструкция за безопасност и съответствие на Waterjet“ (80943C) и „Инструкция за предупреждение за радиочестота“ (80945C).

Продуктът може да е съпроводен от копия на ръководствата в електронен и в печатен формат. Тези в електронен формат са достъпни също на уебсайта ни. Много ръководства са налице на няколко езика на адрес [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## CS (ČESKY/CZECH)

**VAROVÁNÍ!** Před uvedením jakéhokoli zařízení Hypertherm do provozu si přečtěte bezpečnostní pokyny v příručce k produktu a v *Manuálu pro bezpečnost a dodržování předpisů* (80669C), *Manuálu pro bezpečnost a dodržování předpisů při řezání vodním paprskem* (80943C) a *Manuálu varování ohledně rádiových frekvencí* (80945C).

Kopie příruček mohou být součástí dodávky produktu, a to v elektronické i tištěné formě. Elektronické kopie jsou k dispozici i na našich webových stránkách. Mnoho příruček je k dispozici v různých jazycích na stránce [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## DA (DANSK/DANISH)

**ADVARSEL!** Inden Hypertherm udstyr tages i brug skal sikkerhedsinstruktionerne i produktets manual og i *Manual om sikkerhed og overholdelse af krav* (80669C), *Manual om sikkerhed og overholdelse af krav for vandstråleskæring* (80943C), og *Manual om radiofrekvensadvarsel* (80945C), gennemlæses.

Kopier af manualerne kan leveres med produktet i elektronisk og trykt format. Elektroniske kopier findes også på vores hjemmeside. Mange manualer er tilgængelige på flere sprog på [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## DE (DEUTSCH/GERMAN)

**WARNUNG!** Bevor Sie ein Hypertherm-Gerät in Betrieb nehmen, lesen Sie bitte die Sicherheitsanweisungen in Ihrer Bedienungsanleitung, das *Handbuch für Sicherheit und Übereinstimmung* (80669C), das *Handbuch für Sicherheit und Compliance bei Wasserstrahl-Schneidanlagen* (80943C) und das *Handbuch für Hochfrequenz-Warnung* (80945C).

Bedienungsanleitungen und Handbücher können dem Gerät in elektronischer Form oder als Druckversion beiliegen. In elektronischer Form liegen sie auch auf unserer Website vor. Viele Handbücher stehen in verschiedenen Sprachen auf [www.hypertherm.com/docs](http://www.hypertherm.com/docs) zur Verfügung.

## ES (ESPAÑOL/SPANISH)

**¡ADVERTENCIA!** Antes de operar cualquier equipo Hypertherm, lea las instrucciones de seguridad del manual de su producto, del *Manual de seguridad y cumplimiento* (80669C), del *Manual de seguridad y cumplimiento en corte con chorro de agua* (80943C) y del *Manual de advertencias de radiofrecuencia* (80945C).

El producto puede incluir copias de los manuales en formato digital e impreso. Las copias digitales también están en nuestra página web. Hay diversos manuales disponibles en varios idiomas en [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## ET (EESTI/ESTONIAN)

**HOIATUS!** Enne Hyperthermi mis tahes seadme kasutamist lugege läbi toote kasutusjuhendis olevad ohutusjuhised ning *Ohutus- ja vastavusjuhend* (80669C), *Veejõa ohutuse ja vastavuse juhend* (80943C) ja *Raadiosageduse hoiatusjuhend* (80945C). Ohutusjuhiste eiramine võib põhjustada vigastusi ja kahjustada seadmeid.

Juhiste koopiad võivad tootega kaasas olla elektrooniliselt või trükituna. Elektroonilised koopiad on saadaval ka meie veebilehel. Paljud kasutusjuhendid on erinevates keeltes saadaval veebilehel [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## FI (SUOMI/FINNISH)

**VAROITUS!** Ennen minkään Hypertherm-laitteen käyttöä lue tuotteen käyttöoppaassa olevat turvallisuusohjeet, *turvallisuuden ja vaatimustenmukaisuuden käsikirja* (80669C), *vesileikkauksen turvallisuuden ja vaatimustenmukaisuuden käsikirja* (80943C) ja *radiotaajuusvaroitusten käsikirja* (80945C).

Käyttöoppaiden kopiot voivat olla tuotteen mukana sähköisessä ja tulostetussa muodossa. Sähköiset kopiot ovat myös verkkosivustollamme. Monet käyttöoppaat ovat myös saatavissa useilla kielillä [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## FR (FRANÇAIS/FRENCH)

**AVERTISSEMENT!** Avant d'utiliser tout équipement Hypertherm, lire les consignes de sécurité du manuel de votre produit, du *Manuel de sécurité et de conformité* (80669C), du *Manuel de sécurité et de conformité du jet d'eau* (80943C) et du *Manuel d'avertissement relatif aux radiofréquences* (80945C).

Les exemplaires des manuels qui accompagnent le produit peuvent être sous forme électronique ou papier. Les manuels sous forme électronique se trouvent également sur notre site Internet. Plusieurs manuels sont offerts en plusieurs langues à [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## GR (ΕΛΛΗΝΙΚΑ/GREEK)

**ΠΡΟΕΙΔΟΠΟΙΗΣΗ!** Πριν θέσετε σε λειτουργία οποιονδήποτε εξοπλισμό της Hypertherm, διαβάστε τις οδηγίες ασφαλείας στο εγχειρίδιο του προϊόντος και στο *εγχειρίδιο ασφαλείας και συμμόρφωσης* (80669C), στο *εγχειρίδιο ασφαλείας και συμμόρφωσης του waterjet* (80943C) και στο *εγχειρίδιο προειδοποιήσεων για τις ραδιοσυχνότητες* (80945C).

Το προϊόν μπορεί να συνοδεύεται από αντίγραφα των εγχειριδίων σε ηλεκτρονική και έντυπη μορφή. Τα ηλεκτρονικά αντίγραφα υπάρχουν επίσης στον ιστότοπό μας. Πολλά εγχειρίδια είναι διαθέσιμα σε διάφορες γλώσσες στο [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## HU (MAGYAR/HUNGARIAN)

**VIGYÁZAT!** Mielőtt bármilyen Hypertherm berendezést üzemeltetne, olvassa el a biztonsági információkat a termék kézikönyvében, a *Biztonsági és szabálykövetési kézikönyvben* (80669C), a *Vízugaras biztonsági és szabálykövetési kézikönyvben* (80943C) és a *Rádiófrekvenciás figyelmeztetéseket tartalmazó kézikönyvben* (80945C).

A termékhez a kézikönyv példányai elektronikus és nyomtatott formában is mellékelve lehetnek. Az elektronikus példányok webhelyünkön is megtalálhatók. Számos kézikönyv áll rendelkezésre több nyelven a [www.hypertherm.com/docs](http://www.hypertherm.com/docs) weboldalon.

## ID (BAHASA INDONESIA/INDONESIAN)

**PERINGATAN!** Sebelum mengoperasikan peralatan Hypertherm, bacalah petunjuk keselamatan dalam manual produk Anda, *Manual Keselamatan dan Kepatuhan* (80669C), *Manual Keselamatan dan Kepatuhan Jet Air* (80943C), dan *Manual Peringatan Frekuensi Radio* (80945C). Kegagalan mengikuti petunjuk keselamatan dapat menyebabkan cedera pribadi atau kerusakan pada peralatan.

Produk mungkin disertai salinan manual atau petunjuk dalam format elektronik maupun cetak. Salinan elektronik juga tersedia di situs web kami. Berbagai manual tersedia dalam beberapa bahasa di [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## IT (ITALIANO/ITALIAN)

**AVVERTENZA!** Prima di usare un'attrezzatura Hypertherm, leggere le istruzioni sulla sicurezza nel manuale del prodotto, nel *Manuale sulla sicurezza e la conformità* (80669C), nel *Manuale sulla sicurezza e la conformità Waterjet* (80943C) e nel *Manuale di avvertenze sulla radiofrequenza* (80945C).

Copie del manuale possono accompagnare il prodotto in formato cartaceo o elettronico. Le copie elettroniche sono disponibili anche sul nostro sito web. Molti manuali sono disponibili in diverse lingue all'indirizzo [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## JA (日本語/JAPANESE)

**警告!** Hypertherm 機器を操作する前に、この製品説明書にある安全情報、「安全とコンプライアンスマニュアル」(80669C)、「ウォータージェット的安全とコンプライアンス」(80943C)、「高周波警告」(80945C)をお読みください。

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。電子コピーは当社ウェブサイトにも掲載されています。説明書の多くは [www.hypertherm.com/docs](http://www.hypertherm.com/docs) にて複数の言語でご用意しています。

## KO (한국어/KOREAN)

**경고!** Hypertherm 장비를 사용하기 전에 제품 설명서와 안전 및 규정 준수 설명서(80669C), 워터젯 안전 및 규정 준수 설명서(80943C) 그리고 무선 주파수 경고 설명서(80945C)에 나와 있는 안전 지침을 읽으십시오.

전자 형식과 인쇄된 형식으로 설명서 사본이 제품과 함께 제공될 수 있습니다. 전자 사본도 Hypertherm 웹사이트에서 보실 수 있으며 설명서 사본은 [www.hypertherm.com/docs](http://www.hypertherm.com/docs) 에서 여러 언어로 제공됩니다.

## NE (NEDERLANDS/DUTCH)

**WAARSCHUWING!** Lees voordat u Hypertherm-apparaat gebruikt de veiligheidsinstructies in de producthandleiding, in de *Veiligheids- en nalevingshandleiding* (80669C) in de *Veiligheids- en nalevingshandleiding voor waterstralen* (80943C) en in de *Waarschuwingshandleiding radiofrequentie* (80945C).

De handleidingen kunnen in elektronische en gedrukte vorm met het product worden meegeleverd. Elektronische versies zijn ook beschikbaar op onze website. Veel handleidingen zijn in meerdere talen beschikbaar via [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## NO (NORSK/NORWEGIAN)

ADVARSEL! Før du bruker noe Hypertherm-utstyr, må du lese sikkerhetsinstruksjonene i produktets håndbok, *håndboken om sikkerhet og samsvar* (80669C), *håndboken om vannjet sikkerhet og samsvar* (80943C), og *håndboken om radiofrekvensadvarslar* (80945C).

Eksemplarer av håndbøkene kan følge med produktet i elektronisk og trykt form. Elektroniske eksemplarer finnes også på nettstedet vårt. Mange håndbøker er tilgjengelig i flere språk på [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## PL (POLSKI/POLISH)

OSTRZEŻENIE! Przed rozpoczęciem obsługi jakiegokolwiek systemu firmy Hypertherm należy się zapoznać z instrukcjami bezpieczeństwa zamieszczonymi w podręczniku produktu, w *podręczniku bezpieczeństwa i zgodności* (80669C), *podręczniku bezpieczeństwa i zgodności systemów strumienia wody* (80943C) oraz *podręczniku z ostrzeżeniem o częstotliwości radiowej* (80945C).

Do produktu mogą być dołączone podręczniki użytkownika w formie elektronicznej i drukowanej. Kopie elektroniczne znajdują się również w naszej witrynie internetowej. Wiele podręczników jest dostępnych w różnych językach pod adresem [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## PT (PORTUGUÊS/PORTUGUESE)

ADVERTÊNCIA! Antes de operar qualquer equipamento Hypertherm, leia as instruções de segurança no manual do seu produto, no *Manual de Segurança e de Conformidade* (80669C), no *Manual de Segurança e de Conformidade do Waterjet* (80943C) e no *Manual de Advertência de radiofrequência* (80945C).

Cópias dos manuais podem vir com o produto nos formatos eletrônico e impresso. Cópias eletrônicas também são encontradas em nosso website. Muitos manuais estão disponíveis em vários idiomas em [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## RO (ROMÂNĂ/ROMANIAN)

AVERTIZARE! Înainte de utilizarea oricărei echipament Hypertherm, citiți instrucțiunile de siguranță din manualul produsului, *manualul de siguranță și conformitate* (80669C), *manualul de siguranță și conformitate Waterjet* (80943C) și din *manualul de avertizare privind radiofrecvența* (80945C).

Produsul poate fi însoțit de copii ale manualelor în format tipărit și electronic. Exemplele electronice sunt disponibile și pe site-ul nostru web. Numeroase manuale sunt disponibile în mai mult limbi la adresa: [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## RU (РУССКИЙ/RUSSIAN)

БЕРЕГИТЬСЯ! Перед работой с любым оборудованием Hypertherm ознакомьтесь с инструкциями по безопасности, представленными в руководстве, которое поставляется вместе с продуктом, в *Руководстве по безопасности и соответствию* (80669C), в *Руководстве по безопасности и соответствию для водоструйной резки* (80943C) и *Руководстве по предупреждению о радиочастотном излучении* (80945C).

Копии руководств, которые поставляются вместе с продуктом, могут быть представлены в электронном и бумажном виде. Электронные копии также доступны на нашем веб-сайте. Целый ряд руководств доступны на нескольких языках по ссылке [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## SK (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), *Manuáli o bezpečnosti a súlade s normami pre systém rezania vodou* (80943C) a v *Manuáli s informáciami o rádiových frekvenciách* (80945C).

Návod na obsluhu sa dodáva spolu s produktom v elektronickej a tlačenej podobe. Jeho elektronickej formát je dostupný aj na našej webovej stránke. Mnohé z návodov na obsluhu sú dostupné vo viaczjazyčnej mutácii na stránke [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## SL (SLOVENŠČINA/SLOVENIAN)

OPOZORILO! Pred uporabo katerekoli Hyperthermove opreme preberite varnostna navodila v priročniku vašega izdelka, v *Priročniku za varnost in skladnost* (80669C), v *Priročniku za varnost in skladnost sistemov rezanja z vodnim curkom* (80943C) in v *Priročniku Opozorilo o radijskih frekvencah* (80945C).

Izvodi priročnikov so lahko izdelku priloženi v elektronski in tiskani obliki. Elektronski izvodi so na voljo tudi na našem spletnem mestu. Številni priročniki so na voljo v različnih jezikih na naslovu [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## SR (SRPSKI/SERBIAN)

UPOZORENJE! Pre rukovanja bilo kojom Hyperthermovom opremom pročitajte uputstva o bezbednosti u svom priručniku za proizvod, *Priručniku o bezbednosti i usaglašenosti* (80669C), *Priručniku o bezbednosti i usaglašenosti Waterjet tehnologije* (80943C) i *Priručniku sa upozorenjem o radio-frekvenciji* (80945C).

Uz proizvod se isporučuju kopije priručnika u elektronskom ili štampanom formatu. Elektronske kopije su takođe dostupne na našem web-sajtu. Mnogi priručnici su dostupni na više jezika na adresi [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## SV (SVENSKA/SWEDISH)

VARNING! Läs häftet säkerhetsinformationen i din produkts *säkerhets- och efterlevnadsmanual* (80669C), *säkerhets- och efterlevnadsmanualen för Waterjet* (80943C) och *varningsmanualen för radiofrekvenser* (80945C) för viktig säkerhetsinformation innan du använder eller underhåller Hypertherm-utrustning. Kopior av manualerna kan medfölja produkten i elektroniskt och tryckt format. Elektroniska kopior finns också på vår webbplats. Många manualer finns på flera språk på [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## TH (ภาษาไทย/THAI)

คำเตือน! ก่อนการใช้งานอุปกรณ์ของ Hypertherm ทั้งหมด โปรดอ่านคำแนะนำด้านความปลอดภัยในคู่มือการใช้งานสินค้า คู่มือด้านความปลอดภัยและการปฏิบัติตาม (80669C), คู่มือด้านความปลอดภัยและการปฏิบัติตามสำหรับการใช้หัวตัดระบบวอเตอร์เจ็ต (80943C) และ คู่มือคำเตือนเกี่ยวกับความถี่วิทยุ (80945C) การไม่ปฏิบัติตามคำแนะนำด้านความปลอดภัยอาจส่งผลให้เกิดการบาดเจ็บหรือเกิดความเสียหายต่ออุปกรณ์  
สำเนาคู่มือทั้งในรูปแบบอิเล็กทรอนิกส์และแบบสิ่งพิมพ์จะถูกแนบมาพร้อมกับผลิตภัณฑ์ สำหรับสำเนาคู่มือในรูปแบบอิเล็กทรอนิกส์ของผลิตภัณฑ์และสำเนาคู่มือต่าง ๆ ในหลากหลายภาษาอื่นยังมีให้บริการบนเว็บไซต์ [www.hypertherm.com/docs](http://www.hypertherm.com/docs) ของเรอีกด้วย

## TR (TÜRKÇE/TURKISH)

UYARI! Bir Hypertherm ekipmanını çalıştırmadan önce, ürününüzün kullanım kılavuzunda, *Güvenlik ve Uyumluluk Kılavuzu'nda* (80669C), *Su Jeti Güvenlik ve Uyumluluk Kılavuzu'nda* (80943C) ve *Radyo Frekansı Uyarısı Kılavuzu'nda* (80945C) yer alan güvenlik talimatlarını okuyun.

Kılavuzların kopyaları, elektronik ve basılı formatta ürüne birlikte verilebilir. Elektronik kopyalar web sitemizde de yer alır. Kılavuzların birçokğu [www.hypertherm.com/docs](http://www.hypertherm.com/docs) adresinde birçok dilde mevcuttur.

## VI (TIẾNG VIỆT/VIETNAMESE)

CẢNH BÁO! Trước khi vận hành bất kỳ thiết bị Hypertherm nào, hãy đọc các hướng dẫn an toàn trong hướng dẫn sử dụng sản phẩm của bạn, *Sổ tay An toàn và Tuân thủ* (80669C), *Sổ tay An toàn và Tuân thủ Tia nước* (80943C), và *Hướng dẫn Cảnh báo Tần số Vô tuyến* (80945C). Không tuân thủ các hướng dẫn an toàn có thể dẫn đến thương tích cá nhân hoặc hư hỏng thiết bị.

Bản sao của sổ tay có thể đi kèm với sản phẩm ở định dạng điện tử và in. Bản điện tử cũng có trên trang web của chúng tôi. Nhiều sổ tay có sẵn bằng nhiều ngôn ngữ tại [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

## ZH-CN (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、《安全和法规遵守手册》(80669C)、《水射流安全和法规遵守手册》(80943C) 以及《射频警告手册》(80945C) 中的安全操作说明。

随产品提供的手册可提供电子版和印刷版两种格式。电子版本同时也在我们的网站上提供。很多手册有多种语言版本, 详见 [www.hypertherm.com/docs](http://www.hypertherm.com/docs)。

## ZH-TW (繁體中文/CHINESE TRADITIONAL)

警告! 在操作任何 Hypertherm 設備前, 請先閱讀您產品手冊內的安全指示, 包括《安全和法規遵從手冊》(80669C)、《水刀安全和法規遵從手冊》(80943C), 以及《無線電頻率警示訊號手冊》(80945C)。

電子版和印刷版手冊複本可能隨產品附上。您也可以前往我們的網站下載電子版手冊。我們的網站上還以多種語言形式提供多種手冊, 請造訪 [www.hypertherm.com/docs](http://www.hypertherm.com/docs)。

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# 1

## ***Before You Begin***

This guide gives information to help you do the following:

- Set up a SmartSYNC® machine torch
- Configure a mechanized system
- Cut, gouge, and mark with a SmartSYNC machine torch
- Optimize cut quality
- Understand torch height control
- Troubleshoot common mechanized cutting issues
- Understand EMI grounding and shielding best practices

For related information, refer to the following documents:

- *Powermax65/85/105 SYNC Operator Manual* (810470)
- *Powermax45 SYNC Operator Manual* (811470)
- *Powermax45/65/85/105 SYNC Cut Charts Guide* (810500MU)
- *Powermax45/65/85/105 SYNC Parts Guide* (810490)
- *Safety and Compliance Manual* (80669C)

You can find these documents on the USB memory stick that came with your plasma power supply (Powermax65/85/105 SYNC) or by scanning the QR code on the side of your plasma power supply. Technical documentation is also available at [www.hypertherm.com/docs](http://www.hypertherm.com/docs).



Technical documentation is current as of the date of its release. Subsequent revisions are possible. Refer to [www.hypertherm.com/docs](http://www.hypertherm.com/docs) for the most recent revisions of released documents.





# 2

## ***Set Up the Machine Torch***

This section gives information on the following:

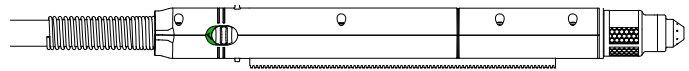
- SmartSYNC machine torch components and dimensions.
- Setup information for installing the SmartSYNC torch on X-Y tables, track burners, pipe bevelers, or other mechanized equipment.

Powermax45/65/85/105 SYNC plasma power supplies are shipped with one or more Hypertherm SmartSYNC cartridges. For a full list of the SmartSYNC cartridges available, refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).

### **About the machine torch**

---


SmartSYNC machine torch features include the following:



- Automatic setting of operating mode, amperage, and gas pressure based on the Hypertherm cartridge that you install, the torch type, and the torch lead length
- Communication of Hypertherm cartridge usage information to the plasma power supply, including cartridge end-of-life detection for Powermax65/85/105 SYNC power supplies
- A torch-lock switch that prevents the torch from firing accidentally, even when the plasma power supply is ON
- The quick-disconnect system to easily remove the torch for transport or to switch from one torch to another

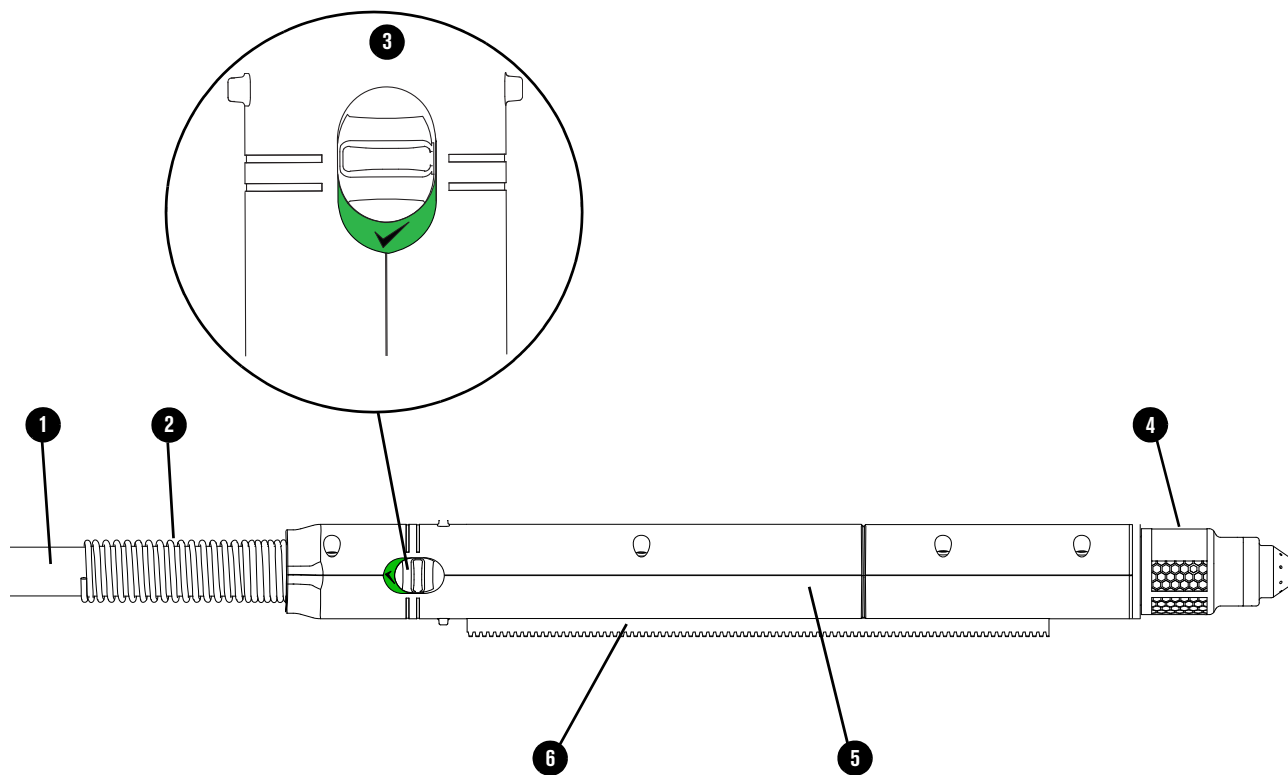
For information about the thicknesses that you can cut and pierce with a SmartSYNC machine torch, refer to the *Powermax65/85/105 SYNC Operator Manual* (810470) or the *Powermax45 SYNC Operator Manual* (811470).

## Machine torch components, dimensions, weights

 You cannot change a full-length machine torch into a mini machine torch, or change a mini machine torch into a full-length machine torch.

### Components

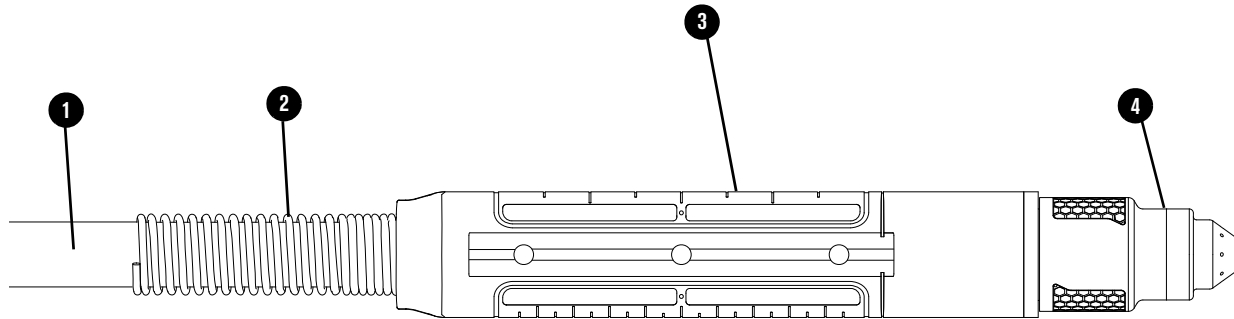
#### Full-length machine torch



- 1 Torch lead
- 2 Strain relief for torch lead
- 3 Torch-lock switch

- 4 Hypertherm cartridge
- 5 Shell
- 6 32-pitch removable gear rack

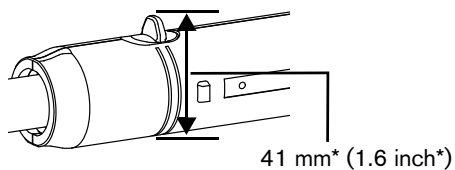
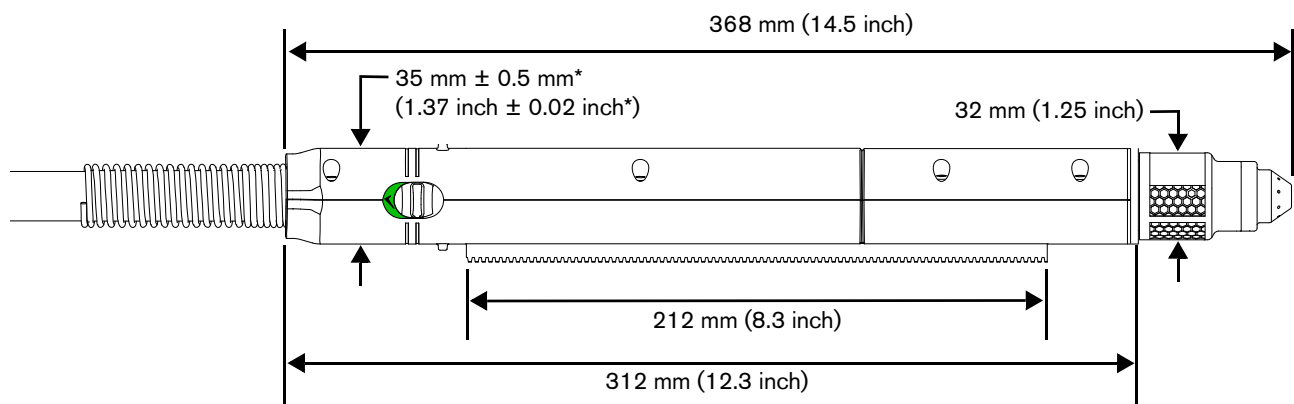
## Mini machine torch



- |                                |                        |
|--------------------------------|------------------------|
| 1 Torch lead                   | 3 Shell                |
| 2 Strain relief for torch lead | 4 Hypertherm cartridge |

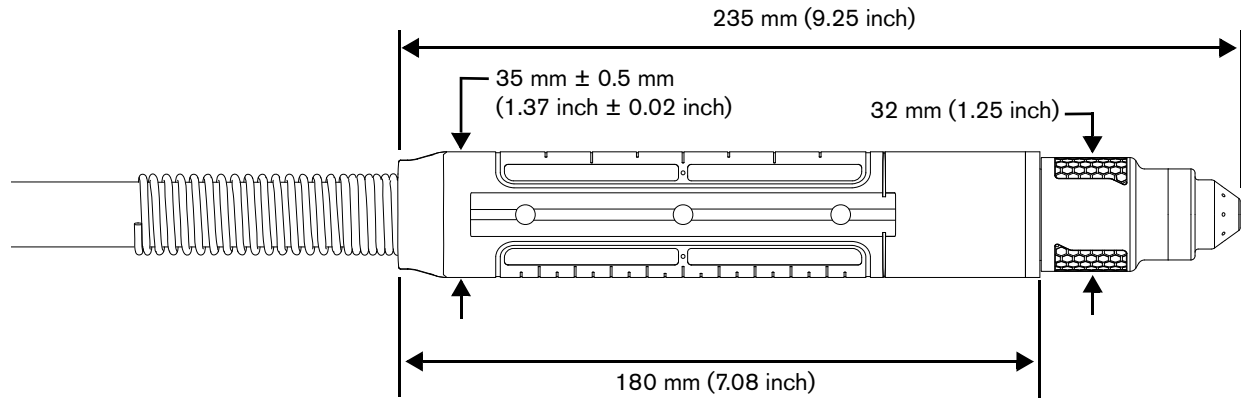
## Dimensions

### Full-length machine torch



\* Measuring to the top of the torch-lock switch adds 6 mm (0.23 inch) to the width of the torch shell.

**Mini machine torch**



**Weights**

**Full-length machine torch with torch lead**

Torch	Weight*
Machine torch with 4.6 m (15 foot) lead	2.2 kg (5 lb)
Machine torch with 7.6 m (25 foot) lead	3.2 kg (7 lb)
Machine torch with 10.7 m (35 foot) lead	4.2 kg (9 lb)
Machine torch with 15 m (50 foot) lead	5.8 kg (13 lb)
Machine torch with 23 m (75 foot) lead	8.3 kg (18 lb)

\* Without a Hypertherm cartridge installed.

**Mini machine torch with torch lead**

Torch	Weight*
Mini machine torch with 4.6 m (15 foot) lead	2.1 kg (5 lb)
Mini machine torch with 7.6 m (25 foot) lead	3.1 kg (7 lb)
Mini machine torch with 10.7 m (35 foot) lead	4.1 kg (9 lb)
Mini machine torch with 15 m (50 foot) lead	5.7 kg (13 lb)
Mini machine torch with 23 m (75 foot) lead	8.2 kg (18 lb)

\* Without a Hypertherm cartridge installed.

## Attach the torch to your equipment

You can put the machine torch on a wide variety of X-Y tables, track burners, pipe bevelers, and other equipment. Refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490) for a machine torch clamp assembly kit. To install the torch, refer to the instructions of the equipment manufacturer.

### NOTICE

**SENSITIVE ELECTRONICS AND OTHER COMPONENTS INSIDE THE TORCH. PERMANENT DAMAGE CAN OCCUR.**

**Do not disassemble the torch or the quick-disconnect shell** to put the torch in the mechanized cutting system track.

If your mechanized cutting system includes a track, do not disassemble the torch or the quick-disconnect shell. Do the following:

1. Put a clamp on the torch or on the lead near the torch to hold the torch in position.
2. Open the track fully.
3. Put the torch lead in the track.
4. Close the track.
5. Install the torch.

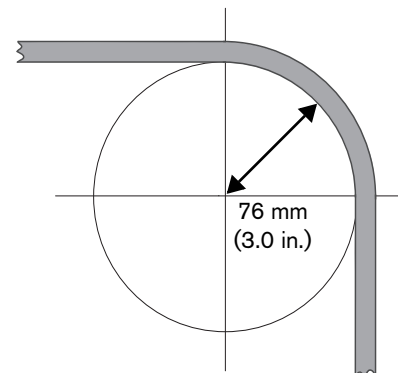
## Minimum bend radius for torch lead

### NOTICE

**MINIMUM BEND RADIUS. KINKING AND OTHER DAMAGE CAN OCCUR.**


Do not bend the torch lead too far.

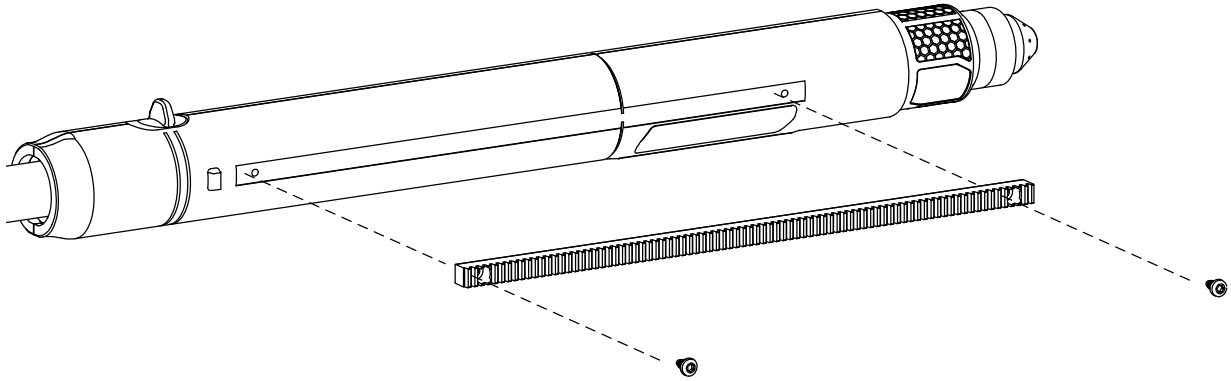
Do not bend the torch lead around a radius that is less than the minimum bend radius of 76 mm (3.0 inches).



## Remove the gear rack (optional)

The gear rack can be attached to either side of the full-length machine torch. If you must remove the gear rack, remove the 2 screws that attach the rack to the torch shell.

 When you install the gear rack, tighten the screws by hand. To avoid damage to the screws, do not tighten too much.

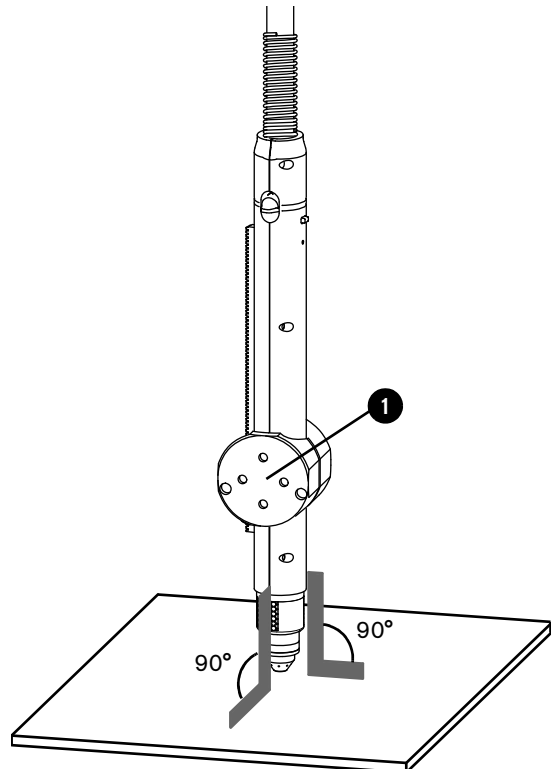


## Align the torch

Install the machine torch perpendicular to the workpiece to get a vertical cut. Use a square or digital level to align the torch at a 90° angle to the workpiece.

Position the mounting bracket **1** lower on the torch to keep vibration at the tip of the torch to a minimum.

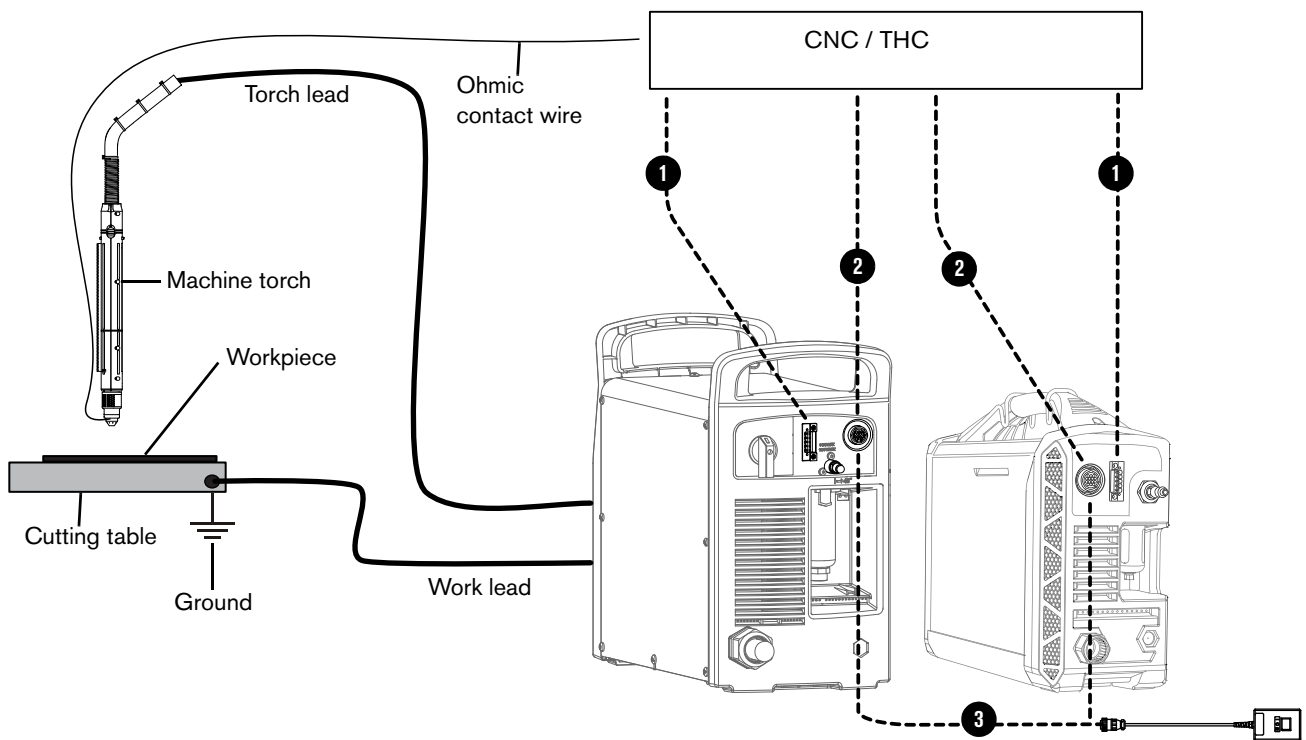
**Do not tighten the mounting bracket too much.** Too much force from the mounting bracket can cause damage to the printed circuit board (PCB) inside the torch. Too much force can also warp or cause other damage to the torch shell.



# 3

## ***Configure Controls for Mechanized Cutting***

This section explains how to set up the following optional external controls for a Powermax65/85/105 SYNC or a Powermax45 SYNC in a mechanized cutting system using serial communications.



- 1 **RS-485 serial interface cable** - Operating mode, output current (A), gas pressure signals, and more
- 2 **Machine interface (CPC) cable (optional)** - Divided arc voltage, plasma start/stop, arc transfer signals
- 3 **Remote-start pendant** - Plasma start/stop signals only

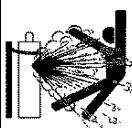
As shown, the setup that is necessary varies based on which of the plasma power supply operations that you want to control externally.

Operation	Setup necessary	For more information
<ul style="list-style-type: none"> <li>▪ Plasma start/stop <b>only</b></li> </ul>	<ul style="list-style-type: none"> <li>▪ Machine interface receptacle</li> <li>▪ Remote-start pendant</li> </ul>	Refer to <a href="#">Connect a remote-start pendant (optional)</a> on page 22
<ul style="list-style-type: none"> <li>▪ Plasma start/stop signals</li> <li>▪ Arc transfer signal</li> <li>▪ Divided arc voltage</li> </ul>	<ul style="list-style-type: none"> <li>▪ Machine interface receptacle</li> <li>▪ Voltage divider PCB</li> <li>▪ Machine interface cable</li> </ul>	Refer to <a href="#">Connect a machine interface cable (optional)</a> on page 23
<ul style="list-style-type: none"> <li>▪ Operating mode</li> <li>▪ Amperage</li> <li>▪ Gas pressure</li> <li>▪ Gas tests</li> <li>▪ Quick resets</li> </ul>	<ul style="list-style-type: none"> <li>▪ RS-485 serial interface connector</li> <li>▪ RS-485 serial interface PCB</li> <li>▪ RS-485 serial interface cable</li> </ul>	Refer to <a href="#">Connect an RS-485 serial interface cable (optional)</a> on page 37

**EDGE® Connect CNC hardware requirements:** Hypertherm’s EDGE Connect CNC communicates with Powermax45/65/85/105 SYNC systems using an EtherCAT™ interface. For more information, refer to the *Powermax EtherCAT Interface for EDGE Connect Installation and Setup Manual* (810330) and the *Cut with Powermax® on an EDGE® Connect CNC Manual Addendum* (810290). Technical documentation is available at [www.hypertherm.com/docs](http://www.hypertherm.com/docs).

**⚠ WARNING**

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**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 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**

When water touches aluminum during plasma cutting operations, hydrogen can be released and can explode. 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.

Refer to the *Safety and Compliance Manual* (80669C) for more information.

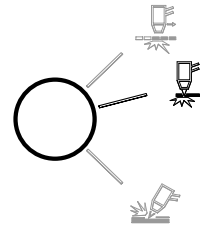


The following are the general steps to set up a mechanized cutting system. For more information about plasma power supply setup, refer to the *Powermax65/85/105 SYNC Operator Manual* (810470) or the *Powermax45 SYNC Operator Manual* (811470).

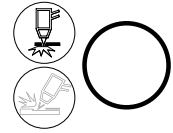
1. Attach the work lead from the plasma power supply to the cutting table or to the workpiece you are cutting. Refer to your table manufacturer's instructions.
  - Make sure that the work lead makes good metal-to-metal contact with the cutting table or workpiece. Remove rust, dirt, paint, coatings, and other debris so that the work lead makes sufficient contact with the cutting table or workpiece.
2. Connect the gas supply to the plasma power supply.
  - Use compressed air to cut mild steel, stainless steel, aluminum, and other conductive metals.
  - Use F5 to cut stainless steel.
3. Do one of the following:
  - **To control plasma start/stop only:** Connect a remote-start pendant to your plasma power supply using the machine interface receptacle.
    - To use a remote-start pendant, your plasma power supply must have a factory-installed (or user-installed) machine interface receptacle on the rear panel. Refer to [Connect a remote-start pendant \(optional\)](#) on page 22.
  - **To control plasma start/stop, arc transfer, and arc voltage:** Connect the plasma power supply to your CNC (or other control) using the machine interface receptacle.
    - To use the machine interface, your plasma power supply must have a factory-installed (or user-installed) machine interface receptacle with internal voltage divider PCB. Refer to [Connect a machine interface cable \(optional\)](#) on page 23.
4. **To control operating mode, amperage, gas pressure, gas tests, and quick resets:** Connect the plasma power supply to your CNC using the RS-485 serial interface connection.
  - To use the RS-485 serial interface, your plasma power supply must have the following:
    - A factory-installed (or user-installed) RS-485 serial interface connector and RS-485 serial interface PCB. Refer to [Connect an RS-485 serial interface cable \(optional\)](#) on page 37. Termination resistors are included in the plasma power supply.
    - A machine interface connection to the CNC with the machine interface receptacle. Refer to [Connect a machine interface cable \(optional\)](#) on page 23.
    - The correct parameters for serial communication on the plasma power supply. Refer to [Set the parameters on the CNC Interface Settings screen \(Powermax65/85/105 SYNC\)](#) on page 41 or [Set a node address \(Powermax45 SYNC\)](#) on page 43.
5. Attach the torch to the cutting table or other cutting equipment. Refer to [Set Up the Machine Torch](#) on page 13.
6. Install the correct cutting or gouging cartridge for your application:
  - **For cutting and piercing with a machine torch:** Refer to [Select the cartridge](#) on page 48
  - **For gouging:** Refer to [Gouging processes](#) on page 67

### 3 Configure Controls for Mechanized Cutting

7. Make sure that the plasma power supply is automatically set to Cut mode or Gouge mode to align with the Hypertherm cartridge that you installed.
  - To change from Cut mode to Expanded Metal mode, push the operating mode button (Powermax65/85/105 SYNC only).
  - Move the torch-lock switch to the green “ready to fire” (✓) position before you change the operating mode or the output current (A).
8. Adjust the torch speed and output current (A) as necessary. Refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide* (810500MU).




Powermax65/85/105 SYNC

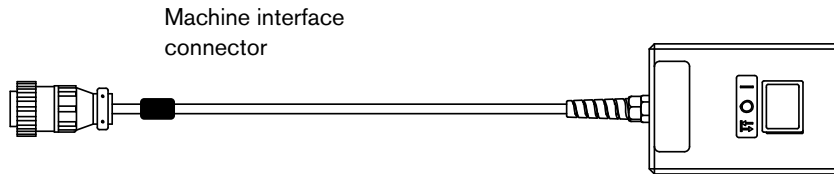


Powermax45 SYNC

## Connect a remote-start pendant (optional)

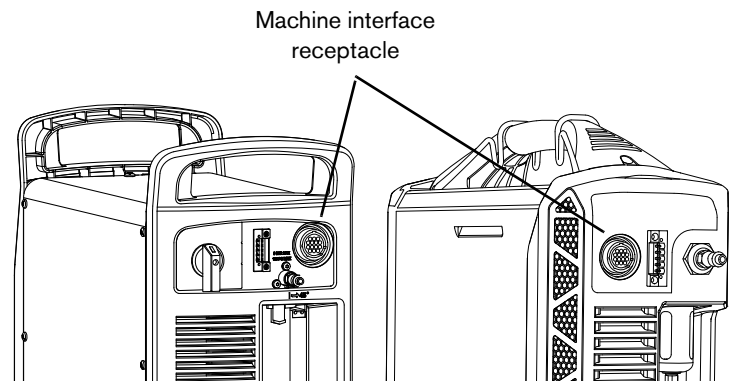
-  Before you begin, make sure that the plasma power supply has a factory-installed (or user-installed) machine interface receptacle on the rear panel. Refer to the *Machine Interface Receptacle with Voltage Divider PCB Field Service Bulletin* (806980 for Powermax65/85/105 SYNC or 809940 for Powermax45 SYNC). Also refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).


Plasma power supply configurations with a machine torch can include an optional remote-start pendant.



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

To use the remote-start pendant, connect it to the machine interface receptacle on the rear of the plasma power supply.



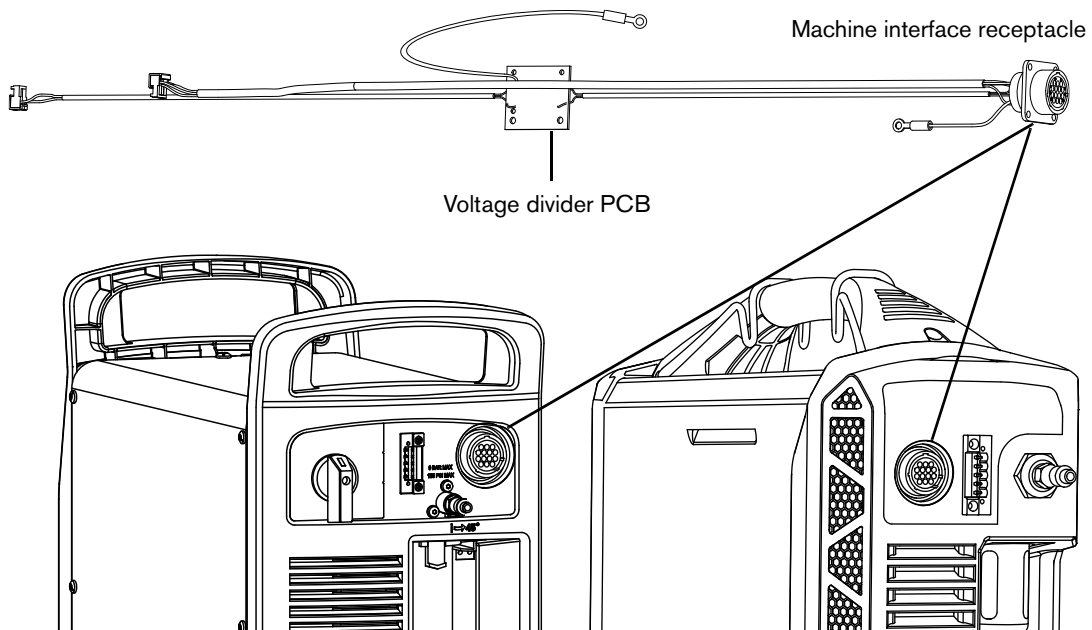
-  The remote-start pendant is only for a plasma power supply with a machine torch. It will not operate if a hand torch is installed.

Hypertherm offers remote-start pendants in multiple lengths. Refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).

## Connect a machine interface cable (optional)

- Before you begin, make sure that the plasma power supply has a factory-installed (or user-installed) machine interface receptacle on the rear panel. Refer to the *Machine Interface Receptacle with Voltage Divider PCB Field Service Bulletin* (806980). Also refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).

The machine interface receptacle on the rear of the plasma power supply includes a 5-position voltage divider PCB and wires that are installed inside the plasma power supply.



The voltage divider PCB gives a scaled down arc voltage of 20:1, 21.1:1, 30:1, 40:1, or 50:1.

- The factory default setting on the voltage divider PCB is 50:1. To change the voltage divider PCB to a different setting, refer to [Set the 5-position voltage divider PCB](#) on page 34.

### NOTICE

The voltage divider PCB is a simple resistive divider of raw arc voltage. To prevent ground loops and electrical interference, **you must isolate the divided arc signal.**

## **CAUTION**



The voltage divider PCB supplies a voltage that is in proportion to the arc voltage. The DIP switch settings on the voltage divider PCB control the output in open circuit conditions, to a maximum output of 15 V. This output is an impedance-protected, functional extra-low voltage (ELV) output. This type of output prevents shock, energy, and fire under normal conditions at the machine interface receptacle and in single-fault conditions with the machine interface wiring. The voltage divider PCB is not fault tolerant and ELV outputs do not comply with safety extra-low voltage (SELV) requirements for direct connection to electrical devices.

The machine interface receptacle gives access to the scaled down arc voltage and to the signals for arc transfer and plasma start.



Some mechanized cutting systems use an external voltage divider instead of the internal voltage divider PCB that comes with the machine interface receptacle. In these systems, the machine interface cable supplies signals for arc transfer and plasma start only.

Hypertherm offers machine interface cables for mechanized cutting systems that use the internal voltage divider PCB and mechanized cutting systems that use an external voltage divider. Hypertherm also offers machine interface cables that are designed specifically for use with PlasmaCAM® tables. Cables are available in multiple lengths. Refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).

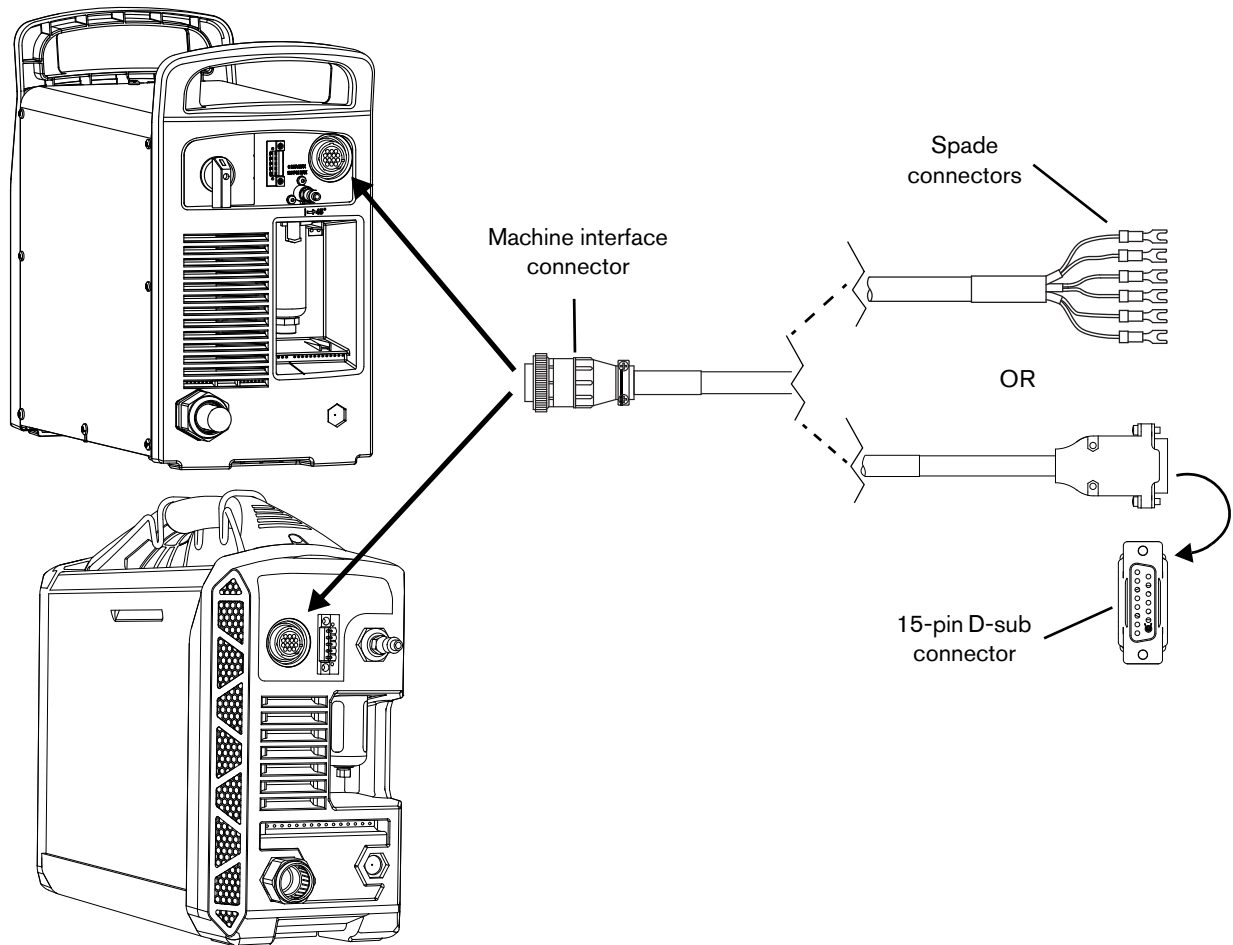
Also refer to the following sections:

- [Machine interface cables that use the internal voltage divider PCB](#) on page 25
- [Machine interface cables that use an external voltage divider](#) on page 26
- [Machine interface cables for tables with a 21.1:1 voltage ratio](#) on page 30

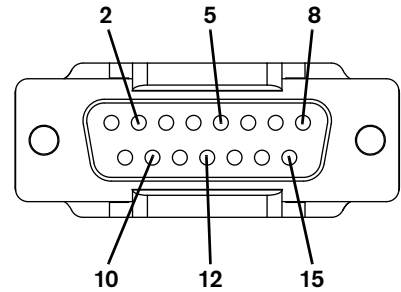
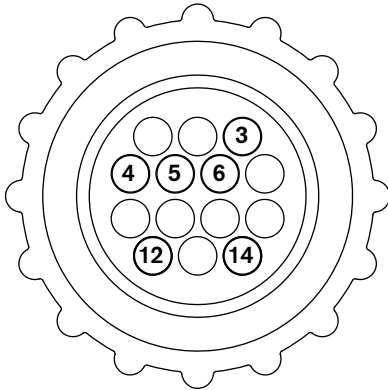
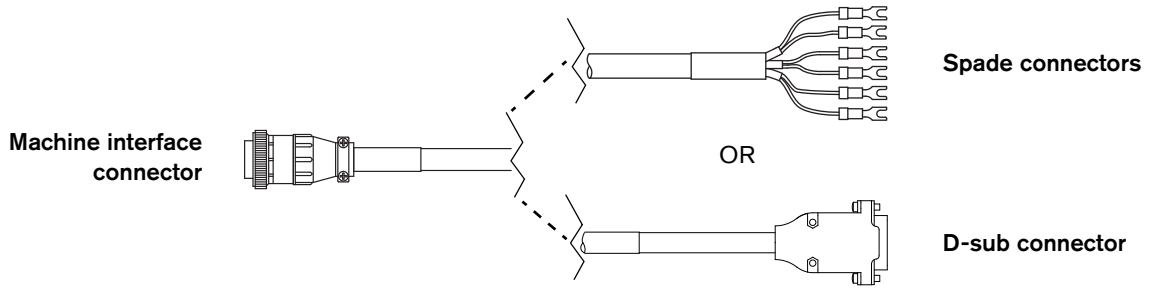
## Machine interface cables that use the internal voltage divider PCB

The following diagram shows a cable that uses the internal voltage divider PCB for scaled down arc voltage in addition to signals for arc transfer and plasma start.

Cables are available in multiple lengths. Refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).



**Cable signals**

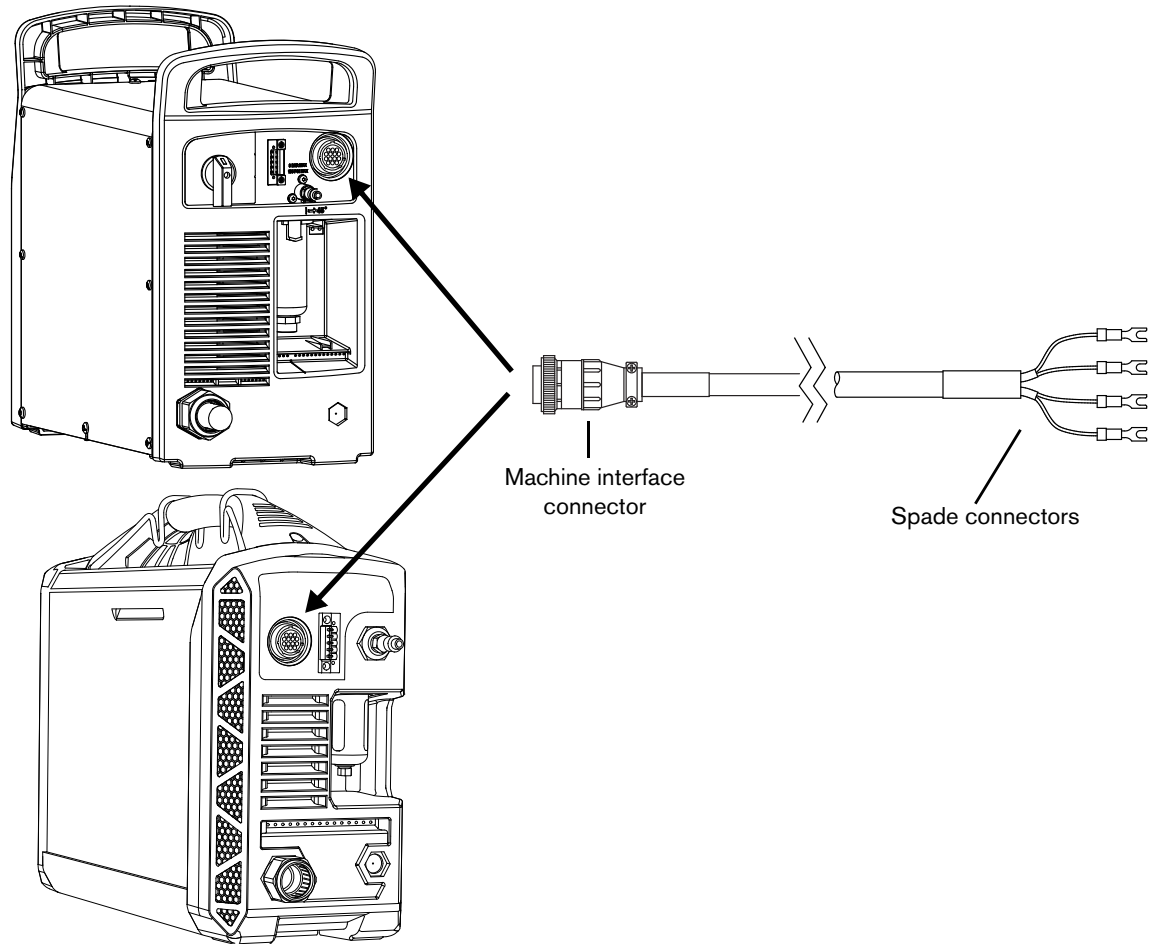


Signal	Connectors		
	Machine interface pin number	D-sub pin number	Spade wire color
Plasma start	3	10	Green
	4	2	Black
Arc transfer	12	12	Red
	14	5	Black
Voltage divider	5 (-) (Electrode)	15 (-)	Black (-)
	6 (+) (Work)	8 (+)	White (+)

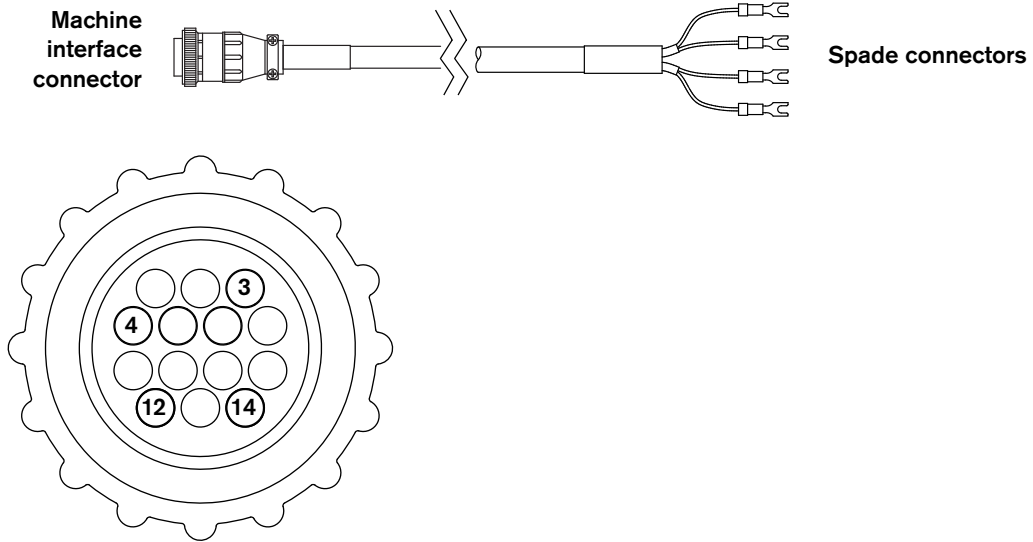
**Machine interface cables that use an external voltage divider**

These cables are for mechanized cutting systems that use an external voltage divider instead of the internal voltage divider PCB that comes with the machine interface receptacle. In these systems, the machine interface cable supplies signals for arc transfer and plasma start only. You must set up the external voltage divider to access the raw arc voltage of the plasma power supply directly. Refer to [Access raw arc voltage \(optional\)](#) on page 29.

The ends of these cables have wires that are terminated with spade connectors. Cables are available in multiple lengths. Refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).



**Cable signals**

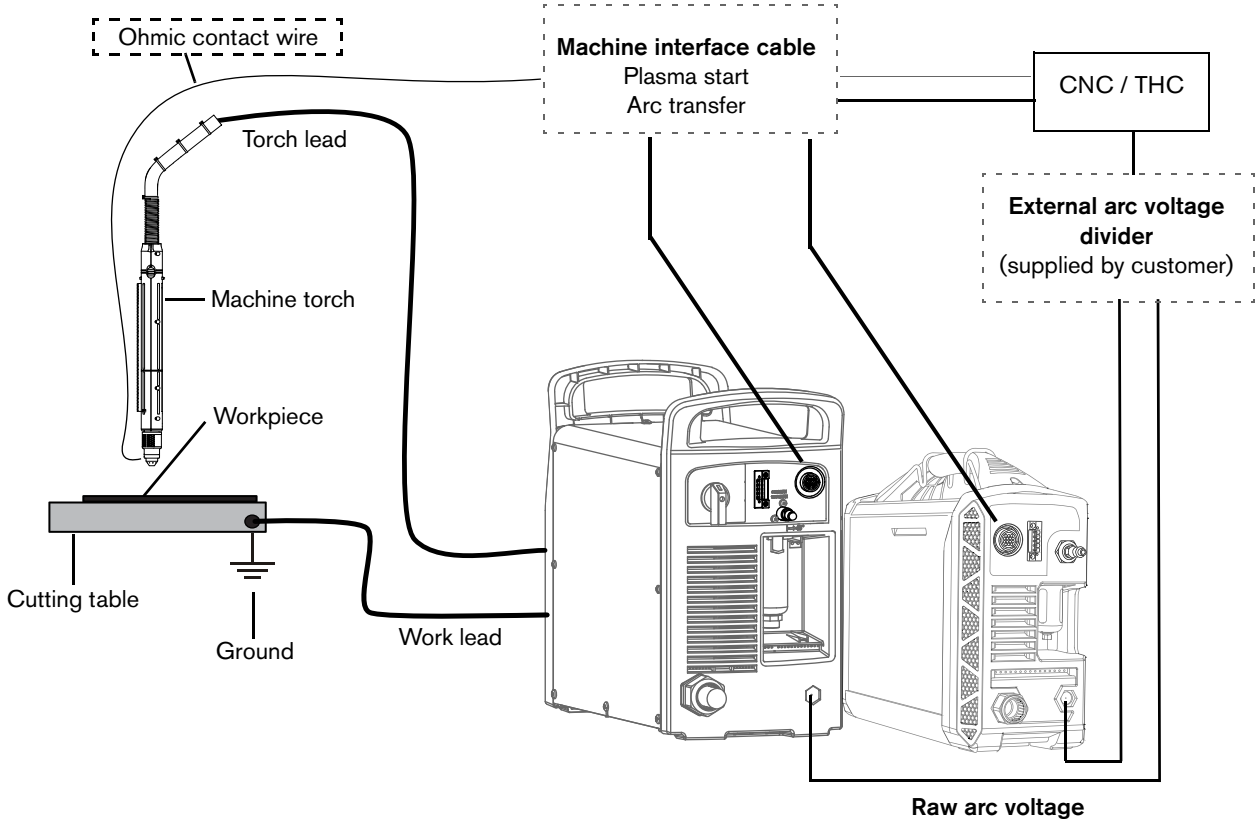


Signal	Connectors	
	Machine interface pin number	Spade wire color
Plasma start	3	Green
	4	Black
Arc transfer	12	Red
	14	Black



### Access raw arc voltage (optional)

If the mechanized cutting system does not use the voltage divider PCB in the plasma power supply, then you must set up an external voltage divider to access the raw arc voltage of the plasma power supply directly.



For instructions on how to access raw arc voltage, refer to the *Raw Arc Voltage Field Service Bulletin* (810320 for Powermax65/85/105 SYNC or 809520 for Powermax45 SYNC). **A setup that uses raw arc voltage must be performed only by qualified technicians.**

## **⚠ WARNING**




### **SHOCK HAZARD, ENERGY HAZARD, AND FIRE HAZARD**

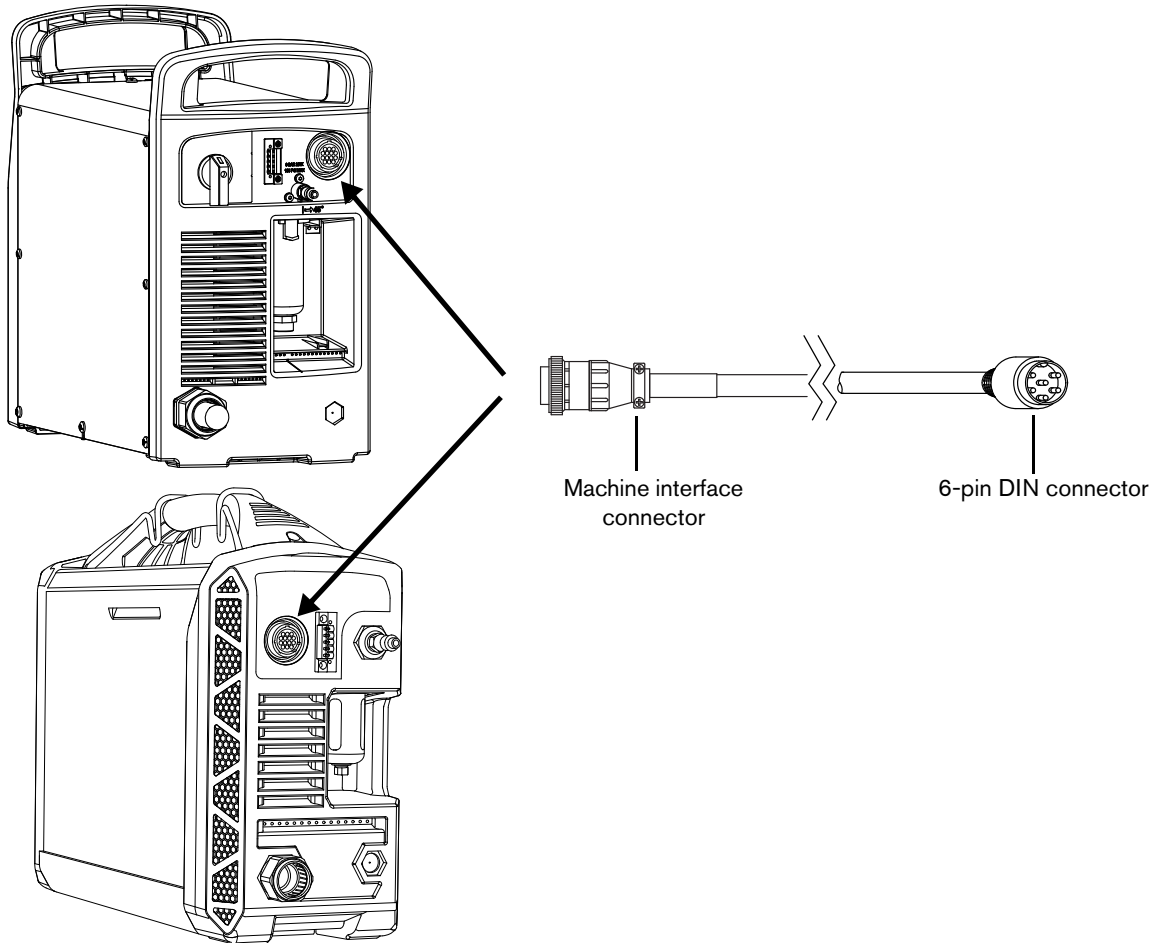
Connecting directly to the plasma circuit for access to raw arc voltage increases the risk of shock hazard, energy hazard, and fire hazard in the event of a single fault. The output voltage and the output current of the circuit are specified on the data plate.

Have a qualified technician make the connection.

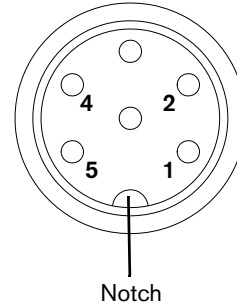
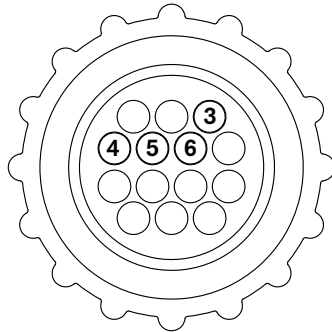
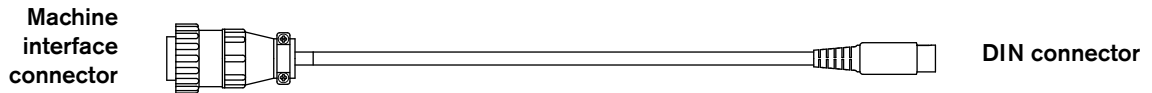
## Machine interface cables for tables with a 21.1:1 voltage ratio

Hypertherm offers machine interface cables that are designed specifically for PlasmaCAM cutting tables, for which a voltage ratio of 21.1:1 is necessary. These cables can be used with all mechanized cutting systems for which a voltage ratio of 21.1:1 is necessary. Cables are available in multiple lengths. Refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).

 The voltage divider PCB must be set to 21.1:1 for these cables. Refer to [Set the 5-position voltage divider PCB](#) on page 34.




## Cable signals



Signal	Connectors	
	Machine interface pin number	DIN pins*
Plasma start	3	5
	4	4
Voltage divider (21.1:1)	5 (-) (Electrode)	1 (-)
	6 (+) (Work)	2 (+)

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

## Install the machine interface cable

 Before you begin, make sure that the plasma power supply has a factory-installed (or user-installed) machine interface receptacle on the rear panel. Refer to the *Machine Interface Receptacle with Voltage Divider PCB Field Service Bulletin* (806980).

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

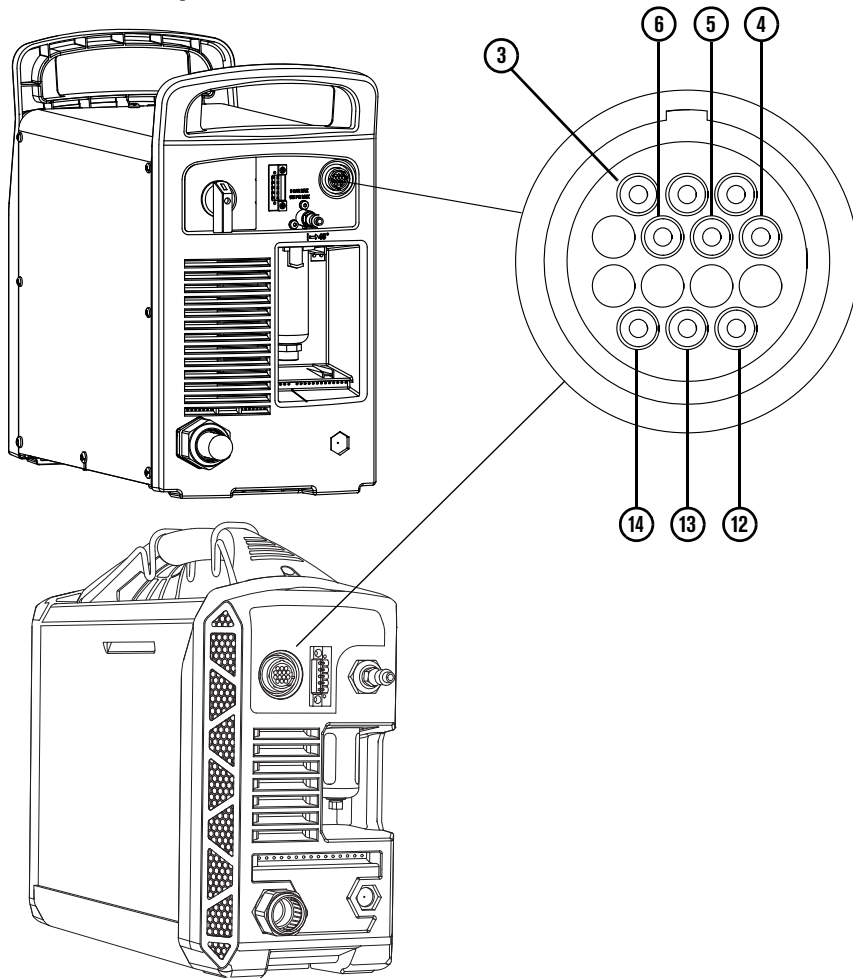
1. Set the power switch on the plasma power supply to OFF (O), and disconnect the power cord.
2. Remove the cover of the machine interface receptacle from the rear of the plasma power supply.
3. Connect the Hypertherm machine interface cable to the machine interface receptacle.


**4.** Do one of the following:

For a cable with a D-sub connector on the other end:	For a cable with wires and spade connectors on the other end:
<ol style="list-style-type: none"> <li><b>1.</b> Connect the D-sub connector to the receptacle on the torch height control (THC) or CNC.</li> <li><b>2.</b> Tighten the screws on the D-sub connector.</li> </ol>	<ol style="list-style-type: none"> <li><b>1.</b> Terminate the machine interface cable inside the electrical enclosure of the torch height control (THC) or CNC.                             <ul style="list-style-type: none"> <li>■ This prevents unauthorized access to the connections after installation.</li> </ul> </li> <li><b>2.</b> Make sure that the connections are correct and that all live parts are enclosed and protected before operating the equipment.*</li> </ol>

\* 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.

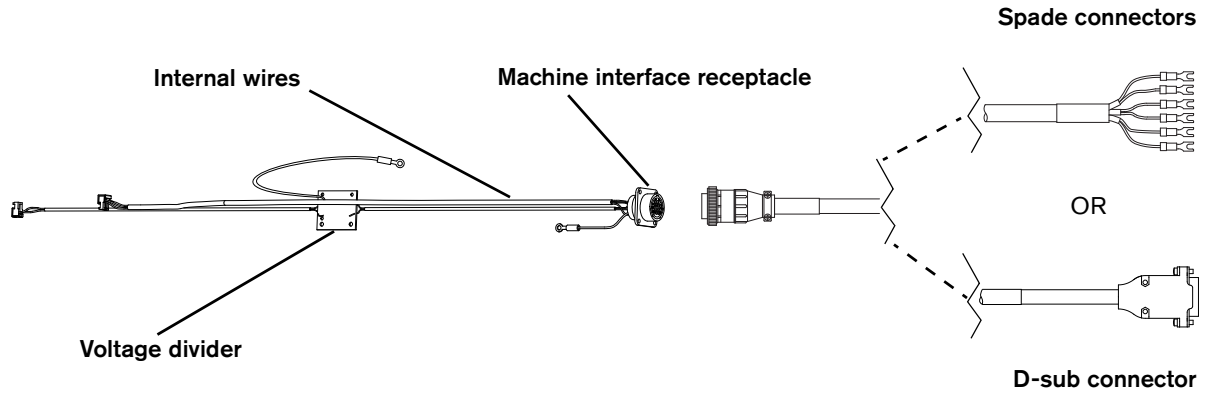
**Machine interface receptacle sockets**



 Sockets 1 and 2 are wired but not used.

## Machine interface signals

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



Powermax internal wires and machine interface receptacle				D-sub connector cables	Cables with spade connectors
Signal	Type	Wire color	Socket number	D-sub pin number	Unterminated wire color
Start <sup>†</sup> (plasma)	Input <sup>*</sup>	Black	3	10	Green
		Red	4	2	Black
Transfer <sup>†</sup> (start motion)	Output <sup>**</sup>	White	12	12	Red
		Green	14	5	Black
Voltage divider	Output <sup>***, †</sup>	Black (-)	5, 1 (-) (Electrode)	15 (-)	Black (-)
		Red (+)	6, 2 (+) (Work)	8 (+)	White (+)
Ground		Green / yellow	13		

\* Normally open. 18 VDC open circuit voltage at START terminals. Requires dry contact closure to activate.

\*\* Normally open. Dry contact closure when the arc transfers. 120 VAC / 1 A maximum at the machine interface relay.

\*\*\* Divided arc signal of 20:1, 21.1:1, 30:1, 40:1, 50:1. Supplies a maximum of 15 V under open circuit conditions.

† The divided arc signal is a resistive divider of raw arc voltage. **This signal is not isolated.** To prevent ground loops, you must supply galvanic isolation.

‡ **If you use the Start signal with a delay to begin to move a Duramax™ torch for cutting, instead of the Transfer signal, do the following:** Increase the delay when you use a SmartSYNC torch. For a 0.7 m (35 foot) or 15 m (50 foot) SmartSYNC torch, add 60 ms to the delay. For a 23 m (75 foot) SmartSYNC torch, add 120 ms to the delay. The additional delay prevents the torch from moving before postflow is done. An additional delay is not necessary for 4.6 m (15 foot) or 7.6 m (25 foot) SmartSYNC torches.

## Set the 5-position voltage divider PCB

The voltage divider is a printed circuit board (PCB) inside the plasma power supply. It measures the voltage of the plasma arc. This voltage can range from 0 VDC – 250 VDC. For safety reasons, the PCB decreases the arc voltage to a lower voltage signal (0 VDC – 15 VDC) to send to the CNC.

The voltage divider PCB has 5 settings. The factory default setting is 50:1. The specification of your torch height control (THC) system determines the correct setting to use. If you are unsure which setting to use, or if the Hypertherm 5-position voltage divider PCB does not supply the necessary voltage signal for your application, speak to your Hypertherm distributor or authorized repair facility, or speak to the nearest Hypertherm office shown in the front of this manual.

### Examples:

- The factory default setting of 50:1 divides each volt by 50, meaning that for each volt, 20 mV is sent to the CNC. For raw arc voltage of 140 V, a divided arc voltage reading of 2800 mV (2.8 V) is sent to the CNC.
- The 20:1 setting divides each volt by 20, meaning that for each volt, 50 mV is sent to the CNC. For raw arc voltage of 140 V, a divided arc voltage reading of 7000 mV (7.0 V) is sent to the CNC.

To change the factory default setting of the voltage divider PCB from 50:1 to a different setting, do the following.

### CAUTION



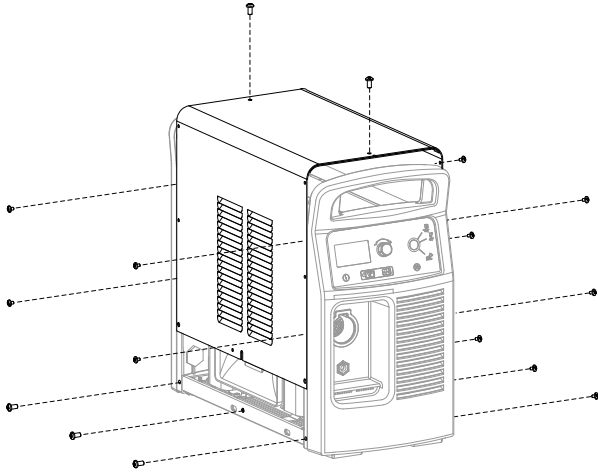
#### STATIC ELECTRICITY CAN DAMAGE PRINTED CIRCUIT BOARDS

Use precautions when handling printed circuit boards (PCBs) to protect them from static electricity. Correct PCB handling includes the following steps:

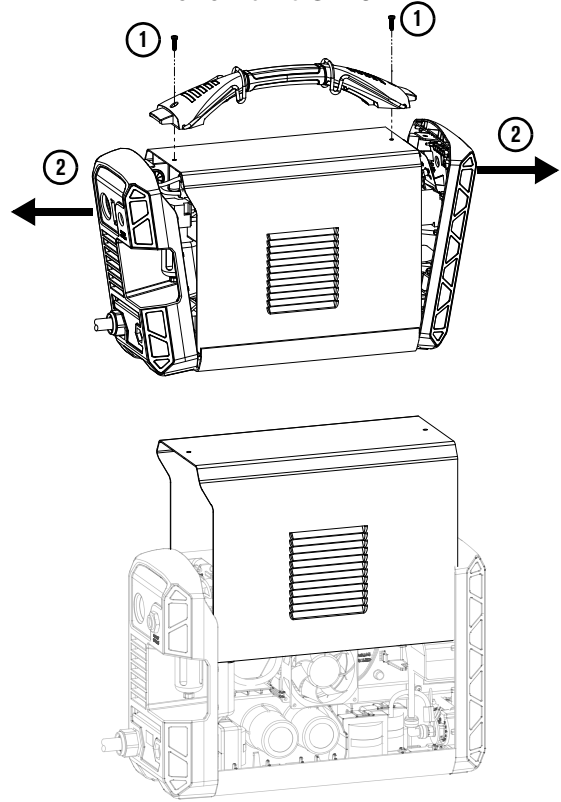
- Store PCBs in anti-static containers.
- Wear a grounded wrist strap when handling PCBs.

1. Set the power switch on the plasma power supply to OFF (O), and disconnect the power cord.
2. Remove the plasma power supply cover.

Powermax65/85/105 SYNC

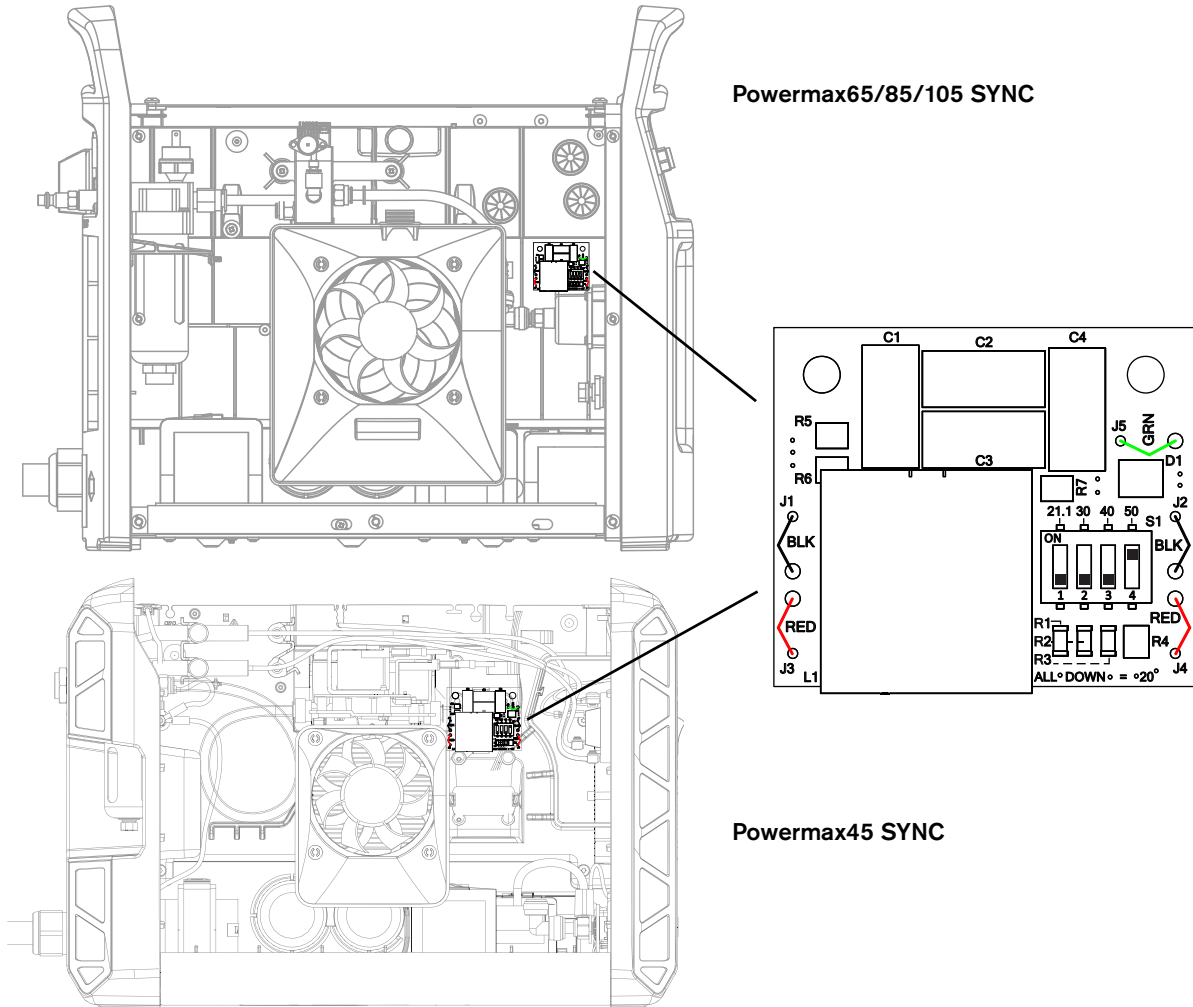


Powermax45 SYNC



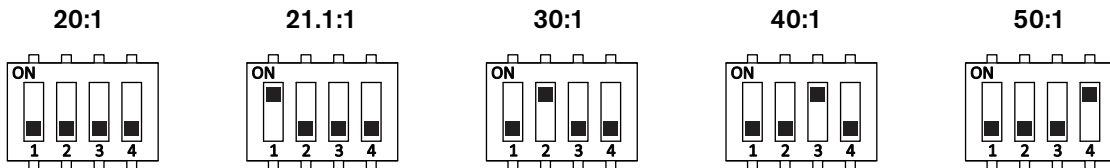
### 3 Configure Controls for Mechanized Cutting

3. Find the voltage divider PCB DIP switches on the fan side of the plasma power supply.



This figure shows the voltage divider PCB at the factory default setting (50:1) with switch 4 in the up position.

4. Set the DIP switches to one of the following settings:



The 21.1:1 setting is designed specifically for PlasmaCAM cutting tables, but can be used on all mechanized cutting systems for which a voltage ratio of 21.1:1 is necessary.

5. Install the plasma power supply cover.



## Connect an RS-485 serial interface cable (optional)

Before you begin, make sure that the plasma power supply has the following:

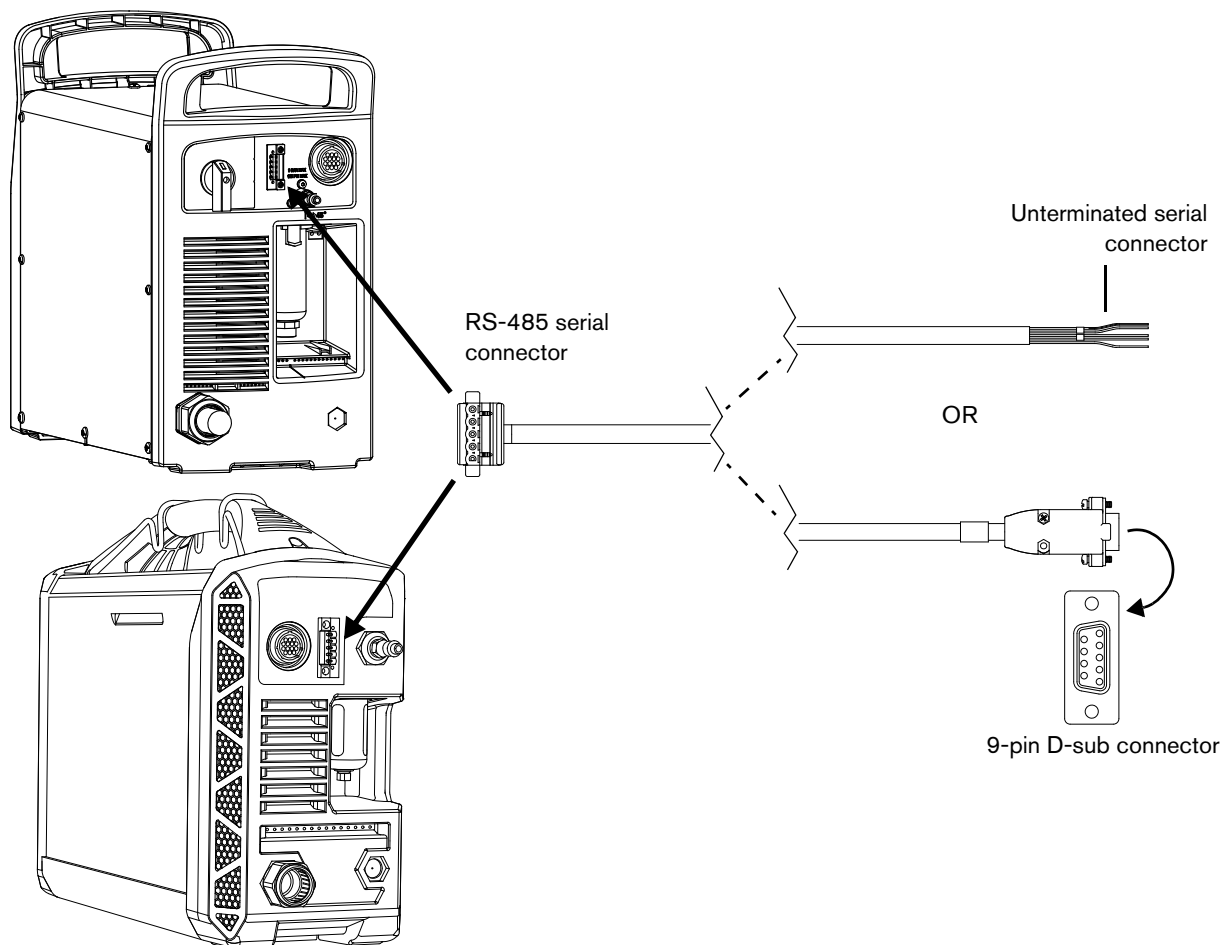
- A factory-installed (or user-installed) RS-485 serial interface connector and internal RS-485 serial interface PCB. Refer to the *RS-485 Serial Interface Connector Field Service Bulletin* (806710 for Powermax65/85/105 SYNC or 809930 for Powermax45 SYNC). Also refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490). The plasma power supply includes termination resistors.
- A machine interface connection to the CNC with the machine interface receptacle. Refer to [page 23](#).



The RS-485 serial interface cannot be used alone. The plasma power supply must also have a machine interface connection to the CNC.

The RS-485 serial interface connector and cable give the plasma power supply support for serial communications with a CNC.

Cables are available in multiple lengths. Refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).



## Install the RS-485 serial interface cable

Installation of the RS-485 serial interface cable must be performed by a qualified service technician.


1. Set the power switch on the plasma power supply to OFF (O), and disconnect the power cord.
2. Connect the RS-485 serial interface cable to the RS-485 serial connector.
3. Do one of the following:

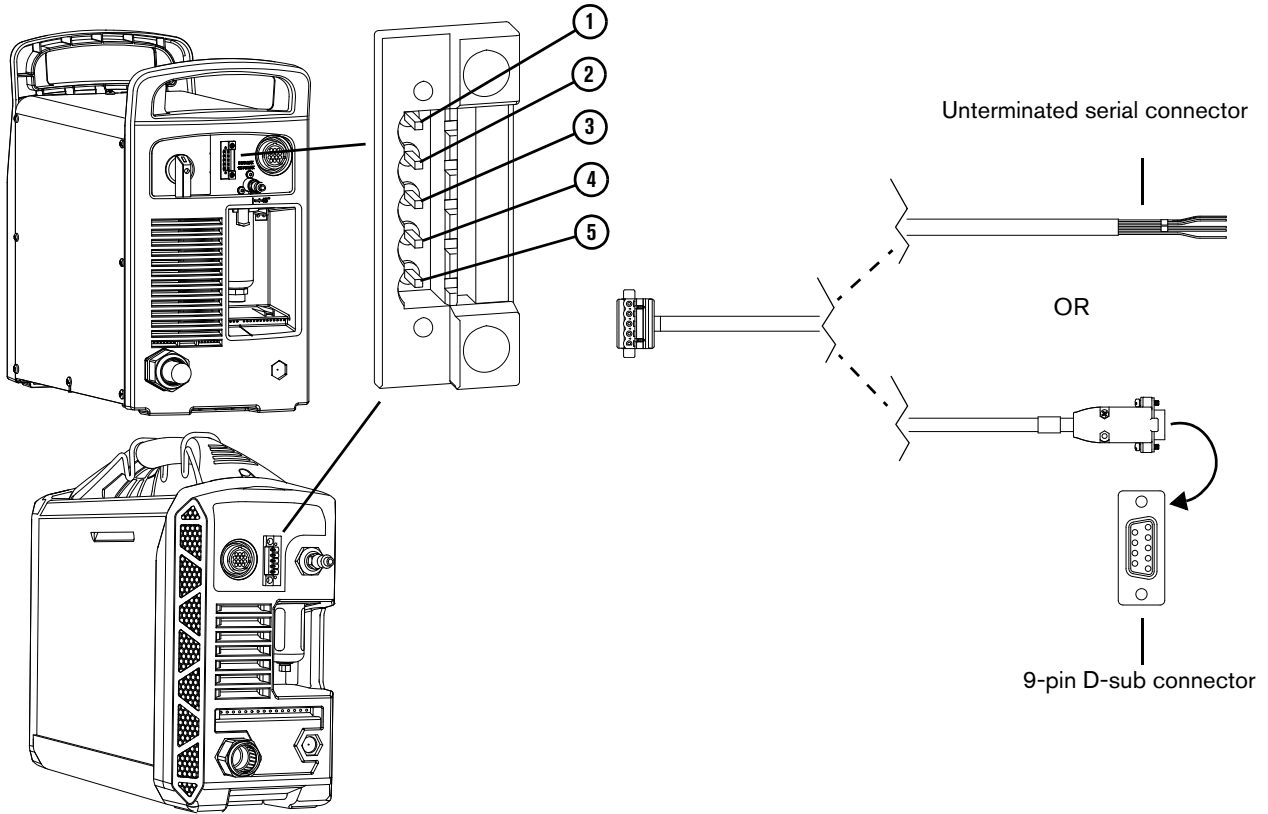
<b>For a cable with a D-sub connector on the other end:</b>	<b>For a cable with unterminated wires on the other end:</b>
<ol style="list-style-type: none"> <li>1. Connect the D-sub connector to the pin connector on the CNC.</li> <li>2. Tighten the screws on the D-sub connector.</li> </ol>	<ol style="list-style-type: none"> <li>1. Terminate the RS-485 serial interface cable inside the electrical enclosure of the CNC.                             <ul style="list-style-type: none"> <li>■ This prevents unauthorized access to the connections after installation.</li> </ul> </li> <li>2. Make sure that the connections are correct and that all live parts are enclosed and protected before operating the equipment.*</li> </ol>

\* 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.

### RS-485 serial interface signals for connecting to a CNC

Refer to the following table for the cable signal information when connecting the plasma power supply to a CNC with a serial interface cable.

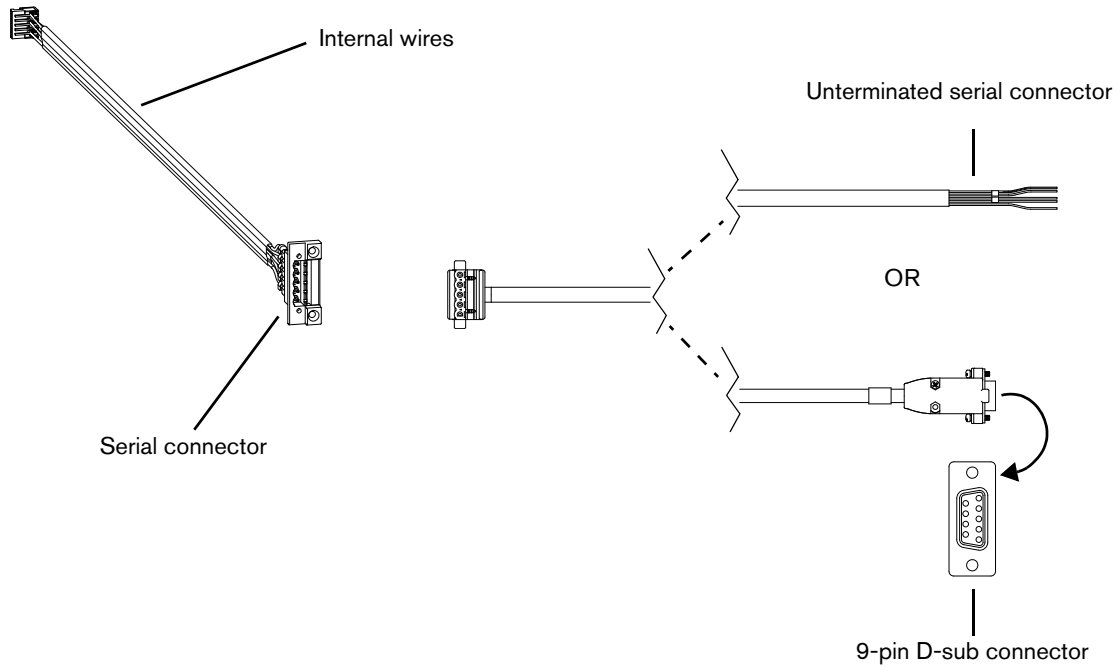
 The plasma power supply includes termination resistors.



Powermax serial connector	D-sub connector	Unterminated wires		
Pin number	Pin number	Signal	Wire color	Type
1	7	RxD (+)	Red	Input
2	3	RxD (-)	Black	Input
3	4	TxD (+)	White	Output
4	2	TxD (-)	Black	Output
5	5	Ground	Green	
	1	Not connected		
	6	Not connected		
	8	Not connected		
	9	Not connected		

### RS-485 serial interface signals for troubleshooting




Refer to the following table for the cable signal information when troubleshooting serial connection problems between the plasma power supply and the CNC.

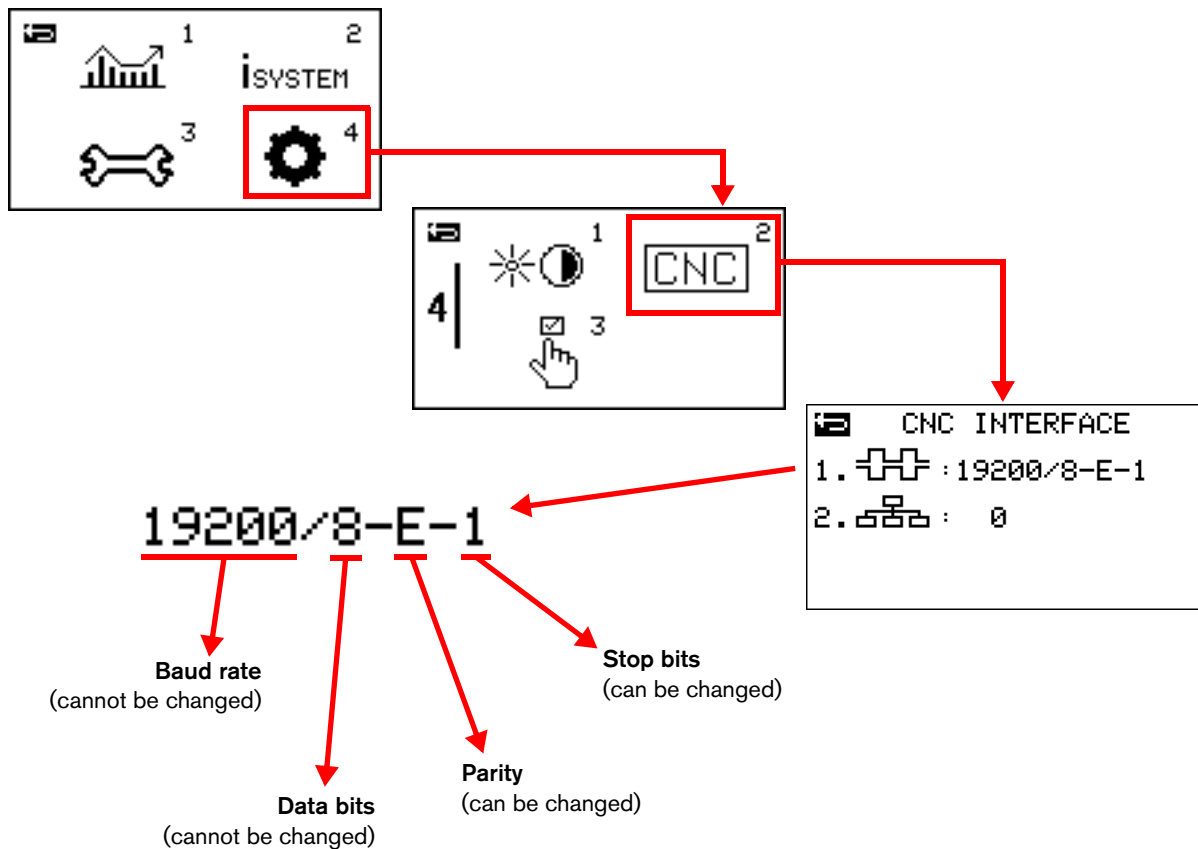



Powermax internal wires and serial connector				D-sub connector	Unterminated wires		
Wire color	Pin number	Signal	Type	Pin number	Signal	Wire color	Type
Red	1	Tx (+)	Output	7	RxD (+)	Red	Input
Black	2	Tx (-)	Output	3	RxD (-)	Black	Input
Brown	3	Rx (+)	Input	4	TxD (+)	White	Output
White	4	Rx (-)	Input	2	TxD (-)	Black	Output
Green	5	Ground		5	Ground	Green	
				1	Not connected		
				6	Not connected		
				8	Not connected		
				9	Not connected		

## Set the parameters on the CNC Interface Settings screen (Powermax65/85/105 SYNC)

Use the CNC Interface Settings screen (CNC INTERFACE) to set parameters for serial communication.

1. Select <sup>4</sup> on the main menu screen.
2. Select **CNC**<sup>2</sup> to go to the **CNC INTERFACE** screen.
3. Turn the adjustment knob to go to the field you want to change.
4. Push  to select the field.
5. Turn the adjustment knob to change the value in the field.
6. Push  to select the new value.



 – Set the parity-check configuration and stop-bit configuration for this Powermax65/85/105 SYNC power supply. Make sure that the values in this field are the same as the values at the CNC.

Select one of the following values for **parity checking**:

<b>E</b>	Even (default)
<b>O</b>	Odd
<b>N</b>	No parity checking

Select one of the following values for **stop bit**:

<b>1</b>	1 stop bit (default)
<b>2</b>	2 stop bits

 – This is the Modbus node address for this Powermax65/85/105 SYNC power supply. The default value is zero (0).

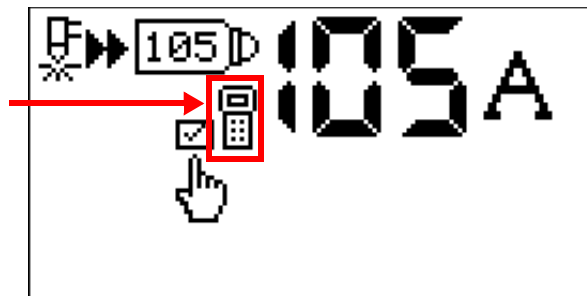
- ❑ **For cutting systems with 1 Powermax65/85/105 SYNC power supply:** Keep the default value of zero (0).

A value of zero (0) lets the CNC set the node address for the Powermax65/85/105 SYNC power supply automatically. The node address is set by the first valid Modbus request message that the Powermax65/85/105 SYNC power supply receives from the CNC after the Powermax65/85/105 SYNC power supply power switch is set to the ON (I) position. This field continues to show a value of zero (0) during Modbus communication to indicate that the node address is being controlled by the CNC.

- ❑ **For cutting systems with 2 or more Powermax 65/85/105 power supplies:** Select a unique number from 1 to 255 for each Powermax.
  - After you set the node address for this Powermax65/85/105 SYNC power supply, do a cold restart.
  - Make sure that the CNC uses this node address when it communicates with each Powermax.

## Remote mode indicator (Powermax65/85/105 SYNC)

The remote mode indicator shows that a CNC or other control is controlling the plasma power supply. The front panel controls are disabled during remote mode operation, but fault codes and fault icons still show as they would otherwise. You can go to the menu screens to see information about the plasma power supply, torch, and cartridge.



## Set a node address (Powermax45 SYNC)

Use the Powermax45 SYNC setup menu to set a node address for serial communications.

1. Push and hold the mode button ① until S.U. shows in the LED display ②.

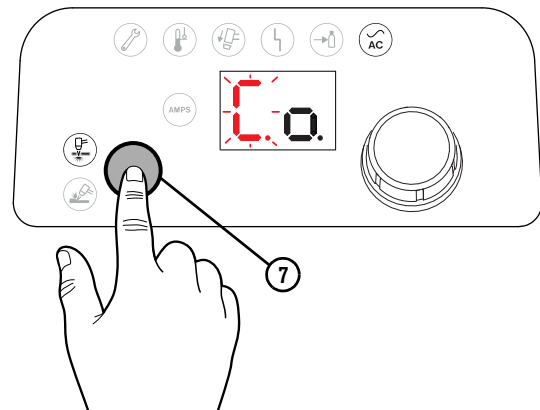
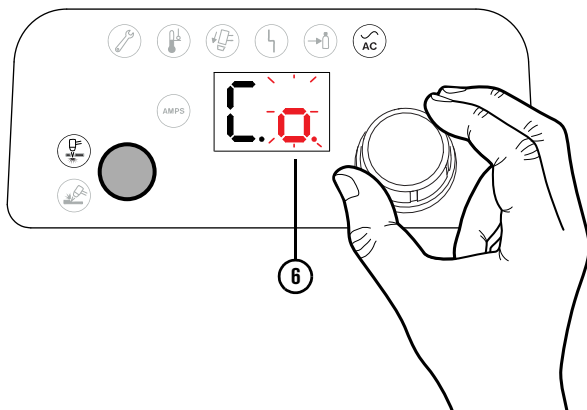
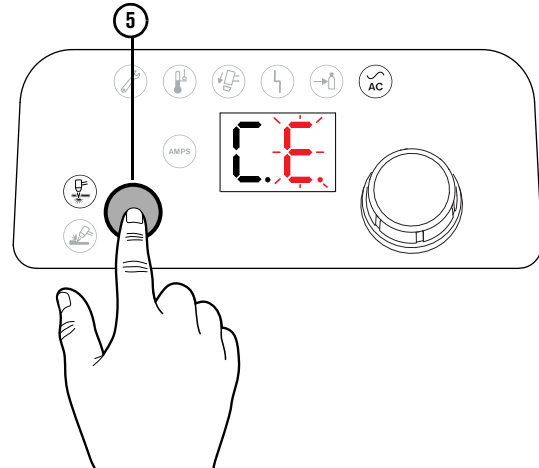
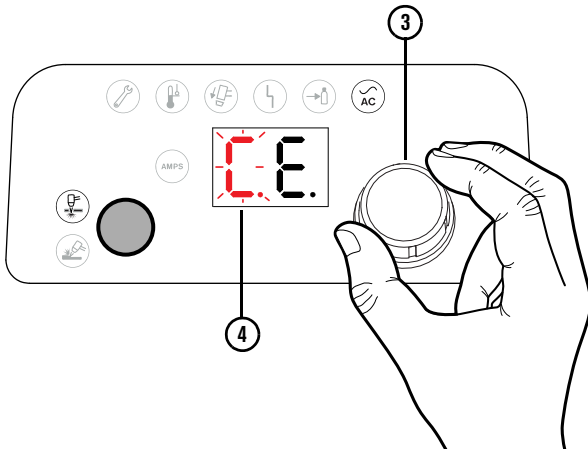
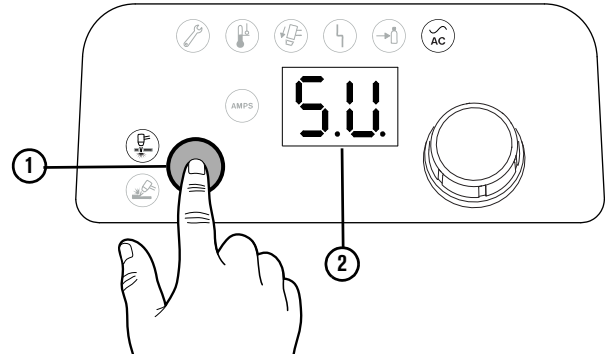
2. Release the mode button.

3. Turn the control knob ③ to show other setup options ④.









4. Push the mode button ⑤ to select a setup option.

5. Turn the control knob to change the value ⑥ for the setup option.

6. Push the mode button ⑦ to select the new value.



7. Repeat steps 3 through 6 to set the node address for the plasma power supply.

Menu Option	Description	Settings
	CNC parity bit	E = even parity (default) o = odd parity n = no parity check
	CNC stop bit	1 = send stop bit (default) 2 = no stop bit
  	CNC node address. Default = 000.	 CNC node address set to 245.  

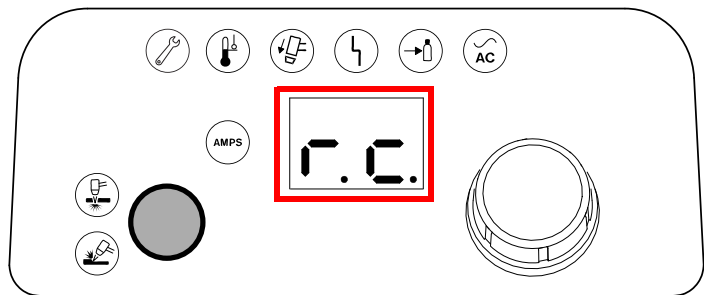
8. Select .

9. Press the mode button to save your changes and exit the setup menu.

10. Do a cold restart of the plasma power supply.

### Remote mode indicator (Powermax45 SYNC)

The remote mode indicator shows that a CNC or other control is controlling the plasma power supply. The front panel controls are disabled during remote mode operation, but fault codes and fault icons still show as they would otherwise.





## More information about serial communication setup

Powermax SYNC plasma power supplies provides more plasma power supply data through a serial connection than what is available for older Powermax plasma power supplies, as well as access to cartridge-usage data. A CNC can also request a gas test and a quick reset on a Powermax SYNC.

For more information, refer to the *Powermax45/65/85/105 SYNC Serial Communication Protocol and Implementation Guide* (810400). Technical documentation is available at [www.hypertherm.com/docs](http://www.hypertherm.com/docs).



# 4

## ***Cut with the Machine Torch***

This section gives information to help you do the following:




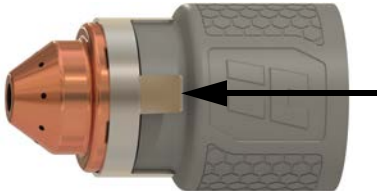
- Select the correct Hypertherm cutting cartridge
- Optimize cut quality
- Understand torch height control
- Pierce metal
- Cut stainless steel with F5 gas

For gouging information, refer to [Gouge with the Machine Torch](#) on page 67.

To troubleshoot cutting system problems or resolve issues with cut quality, refer to [Common Mechanized System Problems](#) on page 75.

## Select the cartridge

Hypertherm offers the following types of mechanized cutting cartridges:

Cartridge Type	Purpose
 <p>Mechanized cutting (gray)</p>	<p>Use these standard cartridges for the widest range of cutting applications.</p>
 <p>FineCut® mechanized cutting (gray)</p>	<p>Use these cartridges to get a narrower kerf on thin mild steel and stainless steel up to 3 mm (10 gauge). Also use these cartridges for marking on mild steel, stainless steel, and aluminum (Powermax45 SYNC only). Refer to <a href="#">page 71</a>.</p>
 <p>FlushCut™ (black)</p>	<p>Use these cartridges to cut as close to the base as possible without piercing or damaging the workpiece (Powermax65/85/105 SYNC only).</p>
 <p>Ohmic ring</p>	<p>Use this cartridge accessory with torch height controls (THCs) that support ohmic contact to find the surface of the workpiece before each cut. Refer to <a href="#">Ohmic contact for initial height sensing</a> on page 62.</p>


- These mechanized cutting cartridges are compatible with SmartSYNC hand torches. If you use these cartridges on a hand torch, keep a standoff while cutting.
- For a full list of the cutting and gouging cartridges available refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).
- For information on gouging processes and cartridges, refer to [Gouge with the Machine Torch](#) on page 67.
- For help installing the cartridge, refer to [Prepare to fire the torch](#) on page 55.


Select the cartridge with the amperage that is best for the thickness of the material you want to cut. Also think about the parameters that will give you the cut quality that you want for a particular job. For more information, refer to [Understand and optimize cut quality](#) on page 57.



Make sure that the cartridge that you select is an amperage supported by the plasma power supply. For example, if you have a Powermax85 SYNC, select an 85 A, 65 A, or 45 A cartridge, not a 105 A cartridge.

Select the best cartridge for the material you want to cut.

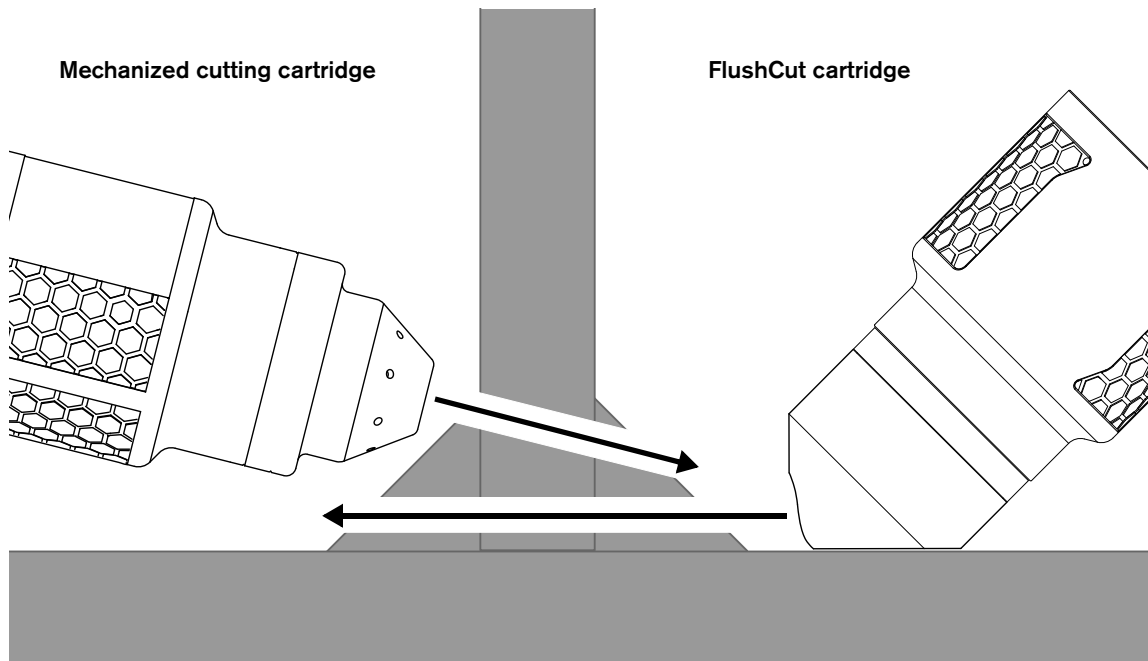
	Metric material thickness (mm)											
	0.5	1	2	3	5	8	10	12	15	20	25	30
FineCut	Optimal	Optimal	Optimal	Optimal	Near to optimal	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased
45 A	Near to optimal	Near to optimal	Near to optimal	Optimal	Optimal	Near to optimal	Near to optimal	Decreased	Decreased	Decreased	Decreased	Decreased
65 A	Decreased	Decreased	Near to optimal	Near to optimal	Optimal	Optimal	Near to optimal	Near to optimal	Near to optimal	Near to optimal	Decreased	Decreased
85 A	Decreased	Decreased	Decreased	Near to optimal	Near to optimal	Optimal	Optimal	Near to optimal	Near to optimal	Near to optimal	Near to optimal	Near to optimal
105 A	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Optimal	Optimal	Near to optimal	Near to optimal	Near to optimal	Near to optimal

	English material thickness (in.)										
	0.02	0.06	1/8	1/4	3/8	1/2	5/8	3/4	1	1-1/4	1-1/2
FineCut	Optimal	Optimal	Optimal	Near to optimal	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased
45 A	Near to optimal	Near to optimal	Near to optimal	Optimal	Optimal	Near to optimal	Near to optimal	Decreased	Decreased	Decreased	Decreased
65 A	Decreased	Decreased	Near to optimal	Near to optimal	Optimal	Optimal	Near to optimal	Near to optimal	Near to optimal	Near to optimal	Decreased
85 A	Decreased	Decreased	Decreased	Near to optimal	Near to optimal	Optimal	Optimal	Near to optimal	Near to optimal	Near to optimal	Near to optimal
105 A	Decreased	Decreased	Decreased	Decreased	Decreased	Decreased	Optimal	Optimal	Near to optimal	Near to optimal	Near to optimal

Optimal cut quality
Near to optimal cut quality
Decreased cut quality or speed

## Use a FlushCut specialty cartridge (Powermax65/85/105 SYNC)

FlushCut cartridges can remove lugs, bolts, pad eyes, and other attachments without piercing or damaging the workpiece below. You can also use FlushCut cartridges for metal washing. FlushCut cartridges supply an angled plasma arc that lets you cut very close to the base material without leaving a large amount of remaining material to grind off. For these long, straight cuts typically FlushCut cartridges are used with carriage or track mounted machine torches or portable track burners.



## Get the most out of your cartridges

---

How often you must change the Hypertherm cartridge on your machine torch depends on the following:

- **Gas supply quality**

- It is extremely important to keep the gas supply line clean and dry. Oil, water, vapor, and other contamination in the gas supply can degrade cut quality and cartridge life. Refer to the *Powermax65/85/105 SYNC Operator Manual (810470)* or the *Powermax45 SYNC Operator Manual (811470)*.

- **Cutting parameters**

- Make sure that the arc current, arc voltage, cut speed, cut height, and other cut settings are correct. Refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide (810500MU)*.
- Use the correct torch height and pierce delay time for piercing. Refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide (810500MU)*.

- **Firing the torch only when necessary**

- To get maximum cartridge life, do not fire the torch when you are not cutting. For example, do not start or stop cuts off of the surface of the workpiece.



Starting at the edge of the workpiece is permitted if the arc makes contact with the workpiece when started.

- **Letting the gas postflow complete after cutting**

- Gas continues to flow for approximately 20 seconds after you stop cutting. This postflow is necessary to decrease the temperature of the cartridge. Always let postflow complete before removing a cartridge.

- **Thickness of the workpiece**

- In general, the thicker the workpiece, the more quickly the cartridges become worn. For best results, 80% of the workpieces that you cut should be equal to or less than the thickness specified for this system and cartridge. Refer to the *Powermax65/85/105 SYNC Operator Manual (810470)* or the *Powermax45 SYNC Operator Manual (811470)*.
- For best results, do not cut workpieces that are more than the thickness specified for this system and cartridge.

- **Expanded metal cutting**

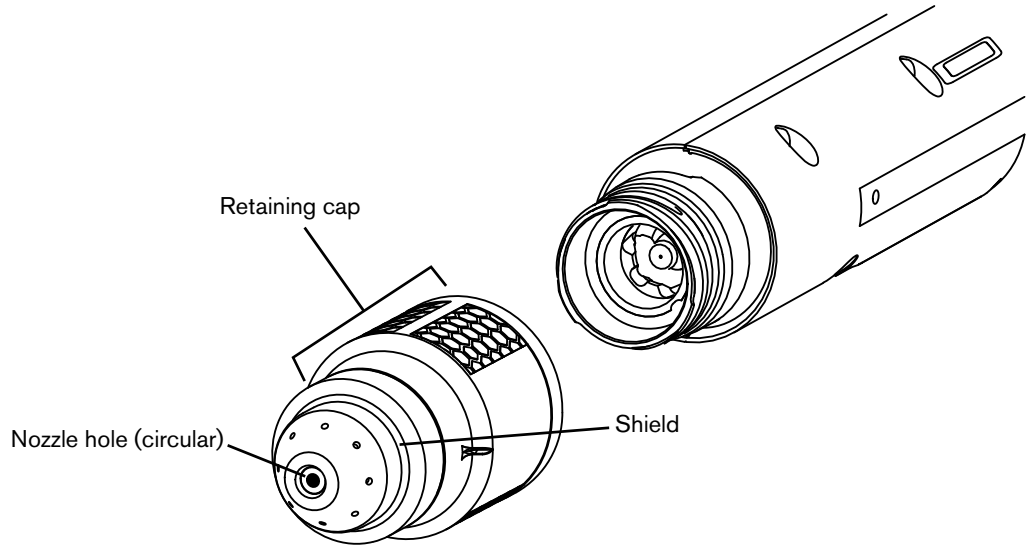
- Expanded metal has a slotted or mesh pattern. Cutting expanded metal wears out cartridges more quickly because a continuous pilot arc is necessary. A pilot arc occurs when the torch is fired but the plasma arc is not in contact with the workpiece.
- Make sure that the operating mode is **not** set to Expanded Metal mode if you are not cutting expanded metal (Powermax65/85/105 SYNC only).



During standard mechanized cutting with Powermax45/65/85/105 SYNC plasma power supplies under lab conditions, Hypertherm got 1 to 3 hours of actual "arc on" time.

## Signs that a cartridge is near end-of-life

Usually, the best indication of when to install a new cartridge is when the cut quality is no longer satisfactory. When it is necessary to replace a cartridge, replace the full cartridge with a new one. **Do not try to disassemble the cartridge.**



The following signs can be indications that a cartridge is near or at end-of-life:

- **Examine the nozzle hole.** A nozzle hole in good condition is circular. If the nozzle hole is not circular, replace the cartridge.
- **Look for a higher rate of 0-30-0 faults.** As a cartridge wears, unwanted material can collect inside the cartridge and cause 0-30-0 faults to occur. In some conditions, you can remove this material by carefully shaking the cartridge.

- **Examine the crown ❶.** The crown is the square copper piece inside of the cartridge. Push down the crown and then release the spring tension.

A crown in good condition goes back to its start position. If the crown stays in the down position, carefully shake the cartridge. If the crown continues to stay in the down position, replace the cartridge.



- If the system shows an 0-32-0 or 0-32-1 fault code, install a new cartridge.



If you do a lot of piercing, it is possible to see black marks on the retaining cap. Usually this is not a sign that the cartridge is at end-of-life. Continue to cut with the cartridge until the cut quality is no longer satisfactory.



For more information, refer to the following sections:

- [Understand and optimize cut quality](#) on page 57
- [Understand torch height control for plasma cutting](#) on page 61
- [Common Mechanized System Problems](#) on page 75

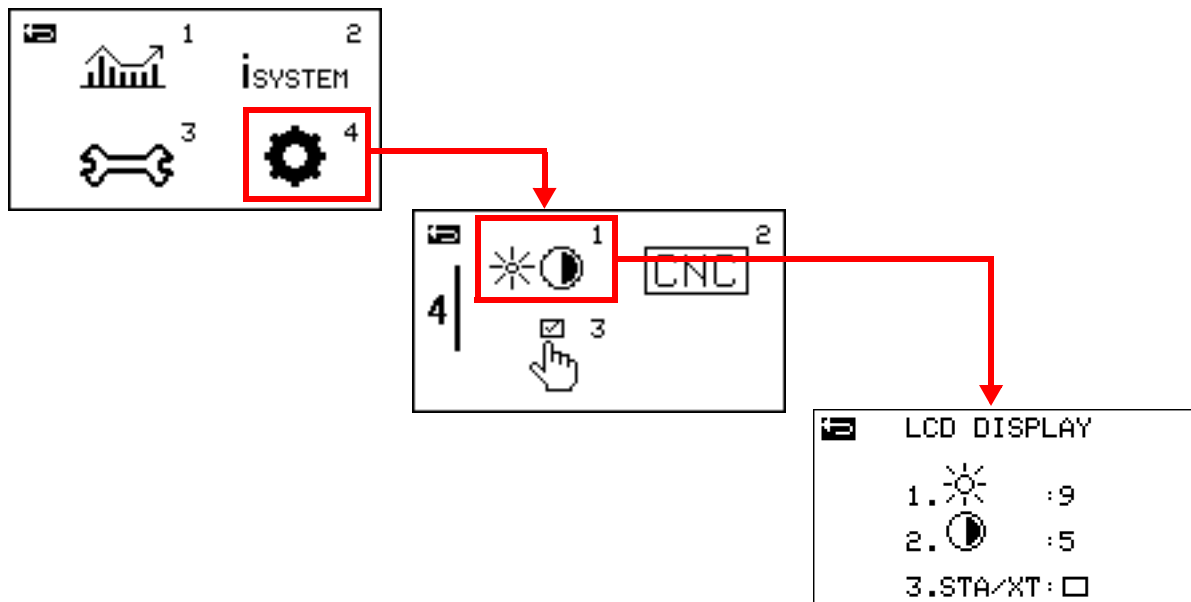
## Show cartridge data on the status screen (Powermax65/85/105 SYNC)



Use the Hypertherm cartridge reader (528083) and the Hypertherm cartridge reader app as an alternate way to read data from all Powermax45/65/85/105 SYNC cartridges.

You can show the cartridge data for pilot arc starts (**STA**) and arc transfer time (**XT**) on the status screen. When you set the **STA/XT** field to on, these values stay on the status screen until you set the **STA/XT** field to off.


1. Push and hold for 2 seconds to go to the main menu screen.
2. Turn the adjustment knob to go to <sup>4</sup>. Push to select it.
3. Turn the adjustment knob to go to <sup>1</sup>, and push to select it. The LCD Display screen (LCD DISPLAY) shows.




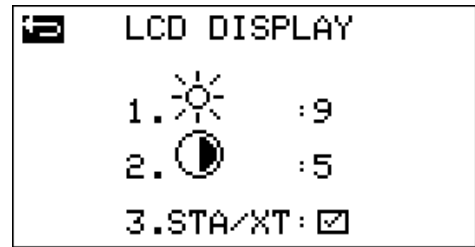
4. Turn the adjustment knob to go to the **STA/XT** field, and push to select it.

## 4 *Cut with the Machine Torch*

5. Turn the adjustment knob to set the **STA/XT** field to on: .

6. Push  to apply the setting.

7. Push  to go back to the status screen.  
The **STA** and **XT** fields now show on the screen.



## Prepare to fire the torch

### WARNING



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

The plasma arc ignites immediately when you send a START / STOP command from the CNC. Before changing the cartridge, one of the following actions must be taken. Whenever possible, complete the first action.

- Set the power switch on the plasma power supply to OFF (O).
- OR
- Move the torch-lock switch to the yellow lock (X) position. Send a START / STOP command from the CNC to make sure that the torch does not fire a plasma arc.

### WARNING



#### INSTANT-ON TORCHES – STAY CLEAR OF PLASMA ARC

The plasma arc will cut quickly through gloves and skin.

- Put on correct and approved 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 – USE INSULATED GLOVES

Always put on insulated gloves when changing the cartridges. The cartridges get very hot during cutting and can cause severe burns.



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

## 4 Cut with the Machine Torch

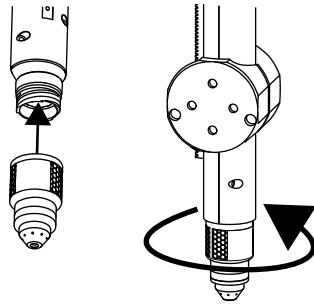
The following is an overview of preparing to fire the machine torch. Before firing the machine torch, make sure that you understand how to operate the plasma power supply and SmartSYNC torch correctly. Refer to the *Powermax65/85/105 SYNC Operator Manual* (810470) or the *Powermax45 SYNC Operator Manual* (811470).

These instructions begin with the power switch on the plasma power supply in the ON (I) position.

**1. Do one of the following:**

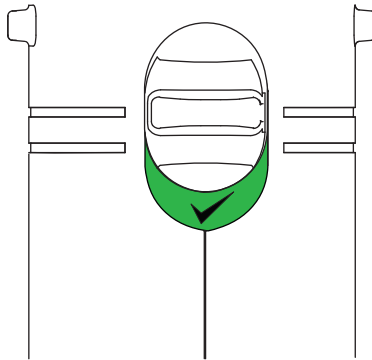
- Mini machine torch: set the power switch on the plasma power supply to OFF (O).
- Full-length machine torch: move the torch-lock switch to the yellow lock (X) position.

**2. Install the correct Hypertherm cartridge. Tighten 1/4 turn.**



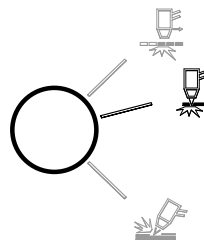
**3. Do one of the following:**

- Mini machine torch: set the power switch on the plasma power supply to ON (I).
- Full-length machine torch: move the torch-lock switch to the green “ready to fire” (✓) position.



**4. Make sure that the plasma power supply is automatically set to Cut mode or Gouge mode to align with the Hypertherm cartridge that you installed.**

- To change from Cut mode to Expanded Metal mode, push the operating mode button (Powermax65/85/105 SYNC only).



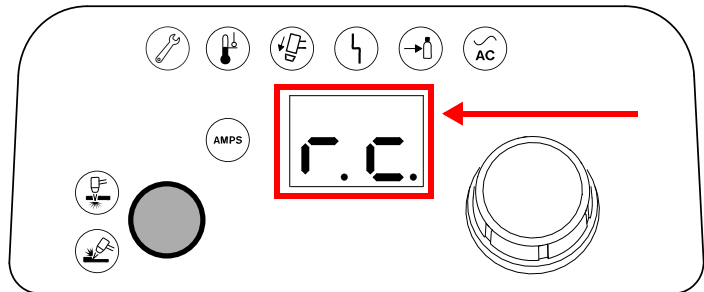
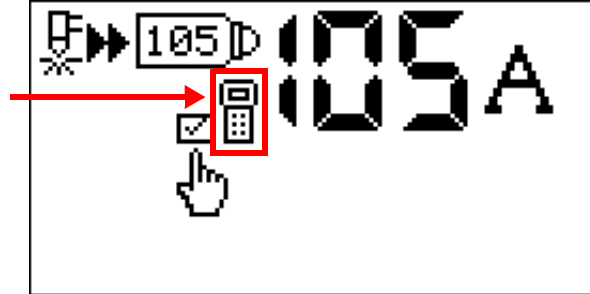


When a cut cartridge is installed, Gouge mode is not available.

5. Send a START / STOP command from the CNC to fire a plasma arc.

## Remote mode indicators

The remote mode indicator shows that a CNC or other control is controlling the plasma power supply. The front panel controls are disabled during remote mode operation, but fault codes and fault icons still show as they would otherwise. You can go to the menu screens (Powermax65/85/105 only) to see information about the plasma power supply, torch, and cartridge.



## Understand and optimize cut quality

### What is good cut quality?

When the following properties of a cut have been **minimized**, the cut is considered a good quality cut:

- Cut angle (bevel)
- Kerf (cut) width
- Size of the heat-affected zone
- Dross (melted metal that attaches to the cut)
- Roughness of the cut edge

There are many reasons you can want good cut quality. For example:

- To keep secondary operations such as grinding to a minimum
- When the cut edge will be visible in the final product
- To make it easier to weld or paint the part after cutting

## 4 ***Cut with the Machine Torch***

But there can also be times when cut quality is not as important. For example, speed can be more important for a particular job. Often, the best choice balances speed and quality.



Hypertherm does not recommend cutting material that is in contact with or covered in water. Doing so can result in poor cut quality. Refer to [Guidelines for cutting on water tables](#) on page 65.

## What is a cut chart?

To help you find the parameters that will give you the cut quality that you want for a particular job, Hypertherm gives you a starting point: a set of parameters for each mechanized cutting cartridge and type and thickness of metal. These sets of parameters are known as *cut charts*.

Hypertherm makes the cut charts under laboratory test conditions using new Hypertherm cartridges. The cut charts give beginning parameters for finding the best cut quality with your cutting system and material. From this starting point, you tune the cutting system for the material that you are cutting and for the results that you want for the cutting job.



Differences between cutting system installations and material composition can cause actual results to vary from those shown in the cut charts.

Examples of cut chart parameters include the following:

- Amperage
- Metal thickness
- Cut height
- Initial pierce height
- Pierce delay time
- Cut speed
- Arc voltage
- Kerf (cut) width

For more information, refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide* (810500MU).

## Cutting and piercing guidelines

### Cutting guidelines

- Always start with the recommended settings from the cut charts. Refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide* (810500MU).
- If you decide that it is necessary to adjust a default setting and you have a CNC or other control, use offset or override commands to make incremental changes to the original values, within limits.
- Do not allow the torch to touch the workpiece during cutting system operation. Contact with the workpiece can cause damage to the cartridge and to the surface of the workpiece.



If you have a torch height control (THC) and it uses ohmic contact sensing, contact during initial height sensing (IHS) is permitted. Refer to [Ohmic contact for initial height sensing](#) on page 62.

- Make sure that the torch is perpendicular (at a 90° angle) to the workpiece for perpendicular-position processes.
- Unsteady drive system and rail movement can make torch motion unsteady, which can cause irregular cut patterns. Make sure that you do routine service and maintenance to the drive system and rails.



Refer to the instruction manual that came with your mechanized cutting system for information on how to do this.

- Do all cutting system maintenance tasks as scheduled. Refer to the *Powermax65/85/105 SYNC Operator Manual (810470)* or the *Powermax45 SYNC Operator Manual (811470)*.
- Avoid firing the torch unnecessarily. It decreases cartridge life.



Starting at the edge of the workpiece is permitted if the arc makes contact with the workpiece when started.

- Avoid lead-outs that move away from the workpiece and stretch the plasma arc.
- If supported by your CNC, do the following to avoid the loss of a transferred plasma arc:
  - Complete every cut with the plasma arc still attached to the workpiece.
  - Decrease the cutting speed when the end of the cut is near.

### Piercing guidelines

Piercing goes through the full thickness of the workpiece. Piercing is also typically the first action involved in cutting a part.



Starting at the edge of the workpiece is permitted if the arc makes contact with the workpiece when started.

You can keep unwanted results to a minimum, increase the number of pierces, and get maximum cartridge life when you use the pierce and cut height settings that Hypertherm recommends in the cut charts. Refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide (810500MU)* and the following:

- **Pierce delay:** Pierce delay is the length of time that the torch stays at the specified pierce height before the torch starts to move for cutting. 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.  
  
Pierce delay times given in the cut charts are based on average delay times throughout the life of the cartridges. If necessary as the cartridge wears, increase the pierce delay time.
- **Pierce height:** Pierce height is the distance between the torch and the workpiece that is necessary to initially pierce the workpiece before beginning to cut. The pierce height is generally between 150% and 400% of the cut height. Refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide (810500MU)* for specific values.
- **Pierce maximum thickness:** When piercing materials close to the maximum thickness for a specific process, think about the following important factors:
  - Use a lead-in distance approximately equal to the thickness of the material being pierced. For example, a 20 mm (3/4 inch) lead-in is necessary for 20 mm (3/4 inch) material.
  - To avoid damage to the cartridge from the collection of molten material created by the pierce, do not let the torch descend to cut height until it is away from the puddle of molten material.
  - Different material chemistries can have an effect on the pierce operation of the plasma power supply. For example, high-strength steel with high manganese or silicon contents can decrease the maximum pierce capability. Hypertherm gets cut chart parameters by testing with commonly used metal types, but your results can vary.



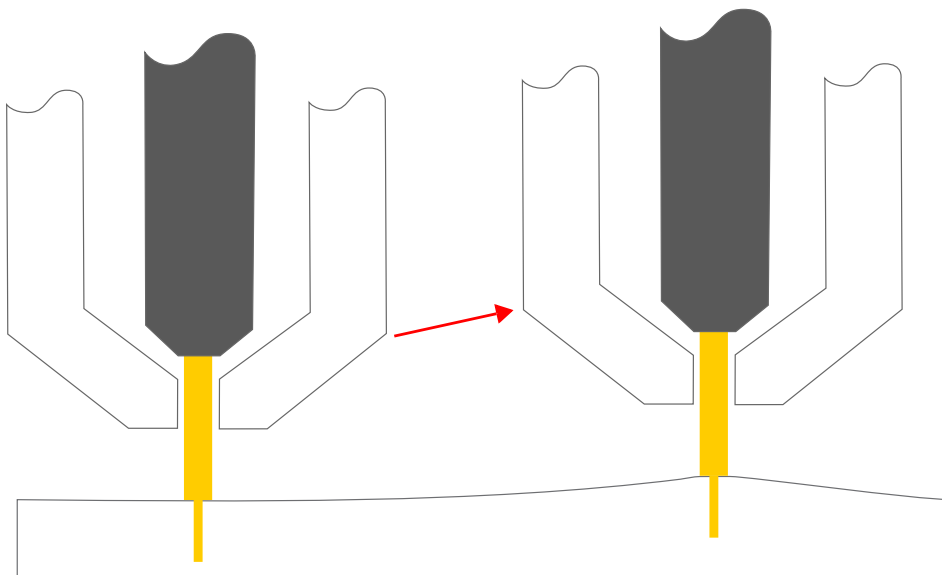
## Understand torch height control for plasma cutting

Torch height is the distance between the torch and the workpiece. Arc voltage is the corresponding voltage of the plasma arc between the torch and the workpiece. You use the Hypertherm cut charts to set the initial torch height and arc voltage that will give you the cut quality that you want. To keep the cut quality consistent and get the longest cartridge life, you must monitor and adjust the torch height and arc voltage during cutting.

A range of torch height control systems exist, from manual systems to fully automated systems.

- A manual system keeps the torch in the same position in its fixture during cutting. The operator uses a gauge or trial and error to put the torch at the initial best height for the cutting job. The operator then monitors the cut quality results, and uses more trial and error to adjust the torch height accordingly. With these systems, cut quality is inconsistent and cartridge life is shorter.
- A fully automated system integrates torch height control and CNC functions to continually raise and lower the torch during cutting in response to variations in the metal, such as from heat-induced warping. These systems can also adjust arc voltage as a cartridge wears, avoiding torch contact with the workpiece and extending the life of the cartridge. Automated torch height control systems give the best cut quality and longest cartridge life, without intervention from the operator during cutting.

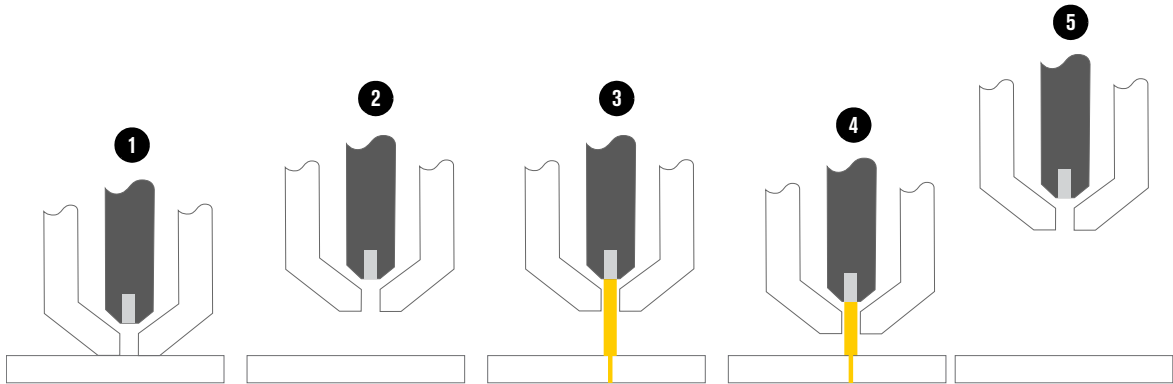
**Figure 1** – Raise and lower the torch in response to variations in the metal



## Torch height during the cut cycle

Automated torch height control systems must sense the surface of the workpiece before each cut cycle. This is known as *initial height sensing* (IHS). After IHS, the system lifts the torch to the pierce height. The torch fires, and pierces the workpiece. Then the torch lowers to the cut height to complete the cut. During cutting, the system raises and lowers the torch based on arc voltage feedback.

When the cut is done, the torch lifts to the traverse height, and moves into position for the next cut.



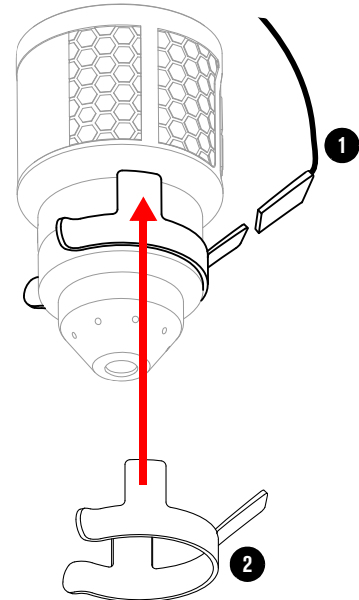
- 1 Senses the surface of the workpiece
- 2 Lifts to pierce height
- 3 Pierces the workpiece
- 4 Lowers to cut height
- 5 Lifts to traverse height

## Ohmic contact for initial height sensing

Ohmic contact sensing is one of the most accurate methods for doing IHS. Ohmic contact refers to the electrical connection made between the torch and the workpiece when the torch touches the workpiece during IHS. The torch height control has an electrical wire **1** that supplies the electrical connection necessary for IHS. The wire goes from the torch height control to a metal ring, known as an ohmic ring **2**, that attaches to the cartridge at the tip of the torch.



Ohmic contact sensing does not work underwater or with non-conductive surfaces such as heavy rust, primer, paint, and masking.



## Learn more

This section gives only a high-level overview of torch height control. For more information, refer to the following:

- *CNCs, THCs, and machine motion for light industrial tables*, a recorded webinar on the Hypertherm website at [www.hypertherm.com/webinars](http://www.hypertherm.com/webinars)
- *Height Control Theory*, an on-demand online course at the Hypertherm Cutting Institute (HCI) at [www.hypertherm.com/hci](http://www.hypertherm.com/hci)



These resources are in English only.

## Cut stainless steel with F5

### **⚠ WARNING**

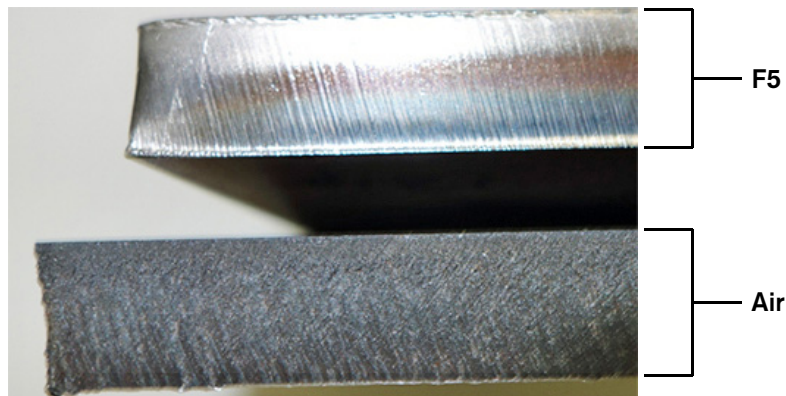


#### **TOXIC FUMES CAN CAUSE INJURY OR DEATH**

Some metals, including stainless steel, can release toxic fumes when cut. Make sure that your work site has sufficient ventilation to make sure 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 and gouge stainless steel with the Powermax45/65/85/105 SYNC. Hypertherm recommends using F5 gas **only** for cutting stainless steel.

Plasma cutting with F5 gives smooth, shiny cuts with silver edges that are close to the original color of the metal. F5 prevents the rough, dark finish that is a typical result of air plasma cutting.



F5: Advantages	F5: Disadvantages	F5: Similarities to air
<ul style="list-style-type: none"> <li>▪ Smooth, shiny cut edge</li> <li>▪ Silver cut edge, similar to the original color of the metal (does not leave the rough, dark surface that air can give)</li> <li>▪ No oxidation of the cut surface – the cut steel keeps its corrosion resistance</li> <li>▪ Ability to use the same Hypertherm cartridges as for standard cutting and gouging with air</li> </ul>	<ul style="list-style-type: none"> <li>▪ Can only use F5 gas with stainless steel</li> <li>▪ Slower cut speeds</li> <li>▪ F5 gas is more expensive than compressed air</li> <li>▪ Slightly degraded cut quality on bevel cuts</li> </ul>	<ul style="list-style-type: none"> <li>▪ Approximately the same amount of dross (with F5 and with air, stainless steel dross is dark in color and can be challenging to remove)</li> <li>▪ Approximately the same gas pressure requirements</li> </ul>

## Guidelines for cutting on water tables

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SmartSYNC torches are designed to be splash resistant. They are not designed to be submerged in water. When cutting over a water table, do the following:

- Lower the water level to 76 mm (3 inches) or more below the plate.



The water level must be at least 76 mm (3 inches) below the bottom of the plate to achieve the best cut quality.

- Reduce cut speeds to the **Best Quality** settings specified in the Hypertherm cut charts. Refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide* (810500MU).
- Keep splash-back to a minimum to protect the torch and to prevent dross on the bottom of the plate.
- Make sure that the water table is designed to safely manage the release of hydrogen gas that can occur when cutting aluminum.

### **WARNING**



#### **EXPLOSION HAZARD – CUTTING WITH ALUMINUM NEAR WATER**

When water touches aluminum during plasma cutting operations, hydrogen can be released and can explode. 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.

Refer to the *Safety and Compliance Manual* (80669C) for more information.

## **4** *Cut with the Machine Torch*

# 5



## ***Gouge with the Machine Torch***

This section helps you to select the correct gouging cartridge and to optimize the gouge contour.


### **Gouging processes**

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Hypertherm offers the following gouging cartridges:

Cartridge Type		Purpose
	Maximum Control gouging (green)	Use these cartridges for more precise metal removal, shallow gouge contours, and light metal washing (Powermax65/85/105 SYNC only).
	Maximum Removal gouging (green)	Use these cartridges for aggressive metal removal, deep gouge contours, and extreme metal washing.

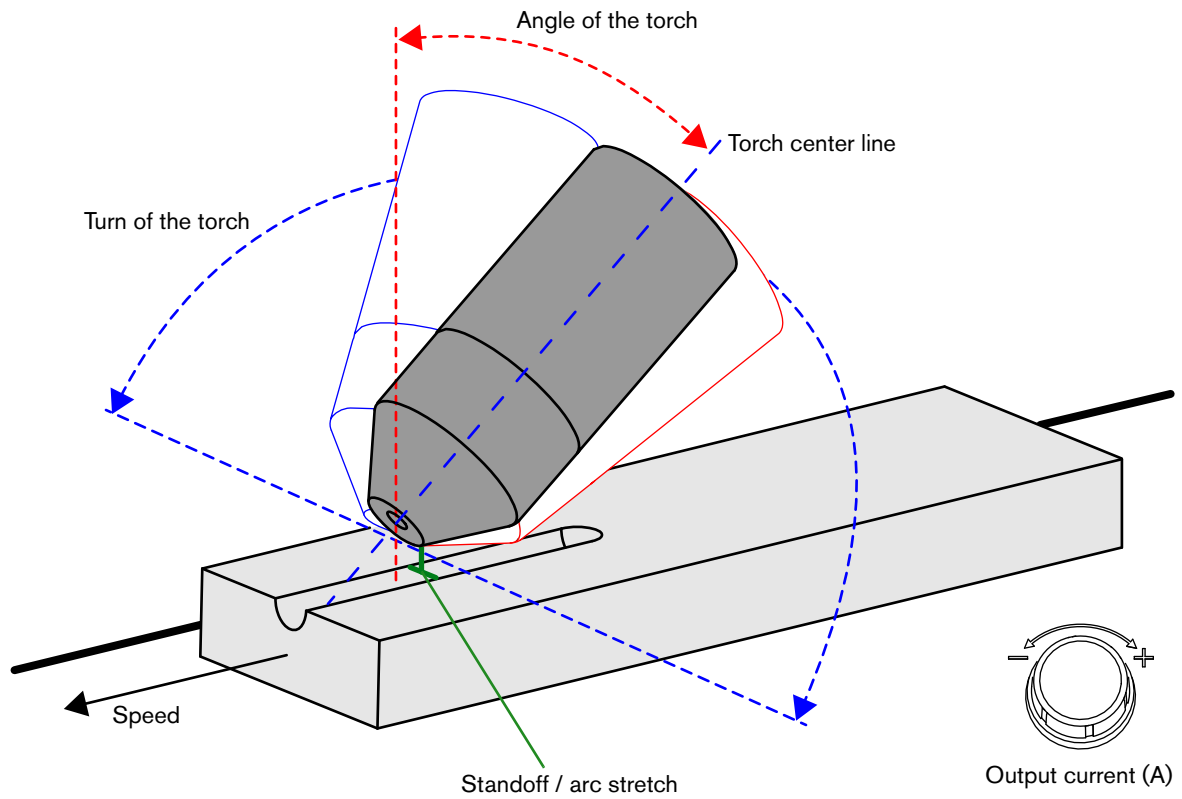
For a full list of the cutting and gouging cartridges available, refer to the *Powermax45/65/85/105 SYNC Parts Guide* (810490).

 Gouging cartridges can also be used on the hand torch. Refer to the *Powermax65/85/105 SYNC Operator Manual* (810470) or the *Powermax45 SYNC Operator Manual* (811470).

For help installing the cartridge, refer to [Prepare to fire the torch](#) on page 55.

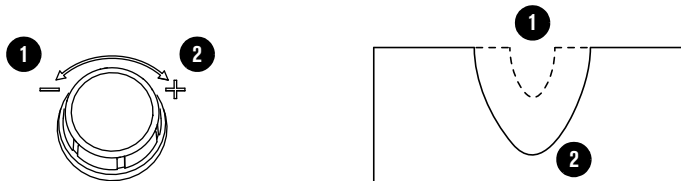
## Change the gouge contour

The width and the depth of the gouge contour are a result of the following factors. **Adjust these factors in combination to get the gouge that you want.**

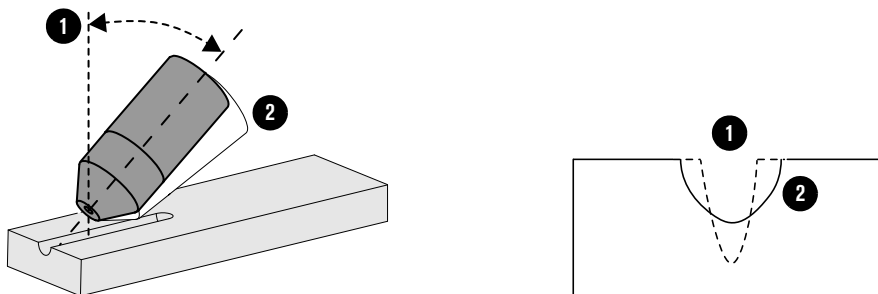




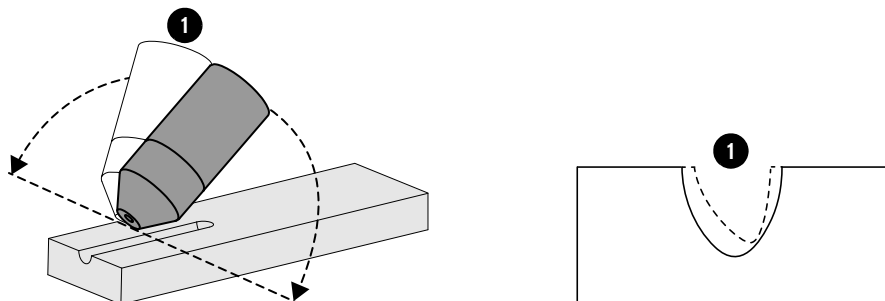
- **Output current (A) of the plasma power supply** – Decrease the amperage on the front panel to make the gouge narrower and shallower ①. Increase the amperage to make the gouge wider and deeper ②.



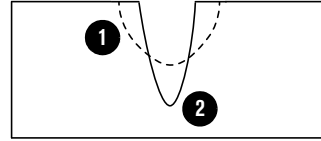
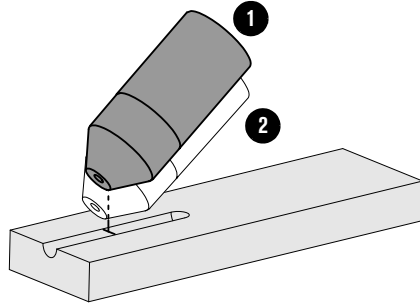
- Arc stretch is related to the output current (A) of the plasma power supply. The higher the amperage, the longer that you can stretch the arc. Hypertherm recommends that you keep amperage and arc stretch consistent.
- The lowest and highest possible amperage setting relates to the plasma power supply and the Hypertherm cartridge you are using. Refer to the *Powermax65/85/105 SYNC Operator Manual* (810470) or the *Powermax45 SYNC Operator Manual* (811470).
- **Angle of the torch to the workpiece** – Put the torch in a more upright position to make the gouge narrower and deeper ①. Tilt down the torch so that it is closer to the workpiece to make the gouge wider and more shallow ②.



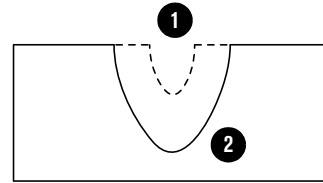
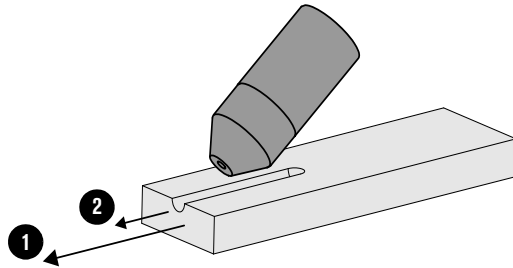
- **Turn of the torch** – Turn the torch relative to the torch center line to make the gouge flatter and steeper on one side ①.



- **Torch-to-work standoff / arc stretch** – Move the torch away from the workpiece to make the gouge wider, shallower, and smoother on the bottom ❶. Move the torch closer to the workpiece to make the gouge narrower and deeper ❷.



- Arc stretch is related to the output current (A) of the plasma power supply. The higher the amperage, the longer that you can stretch the arc. Hypertherm recommends that you keep amperage and arc stretch consistent.
- Keep at least a small distance between the torch tip and the molten metal to increase cartridge life and prevent damage to the torch.
- **Speed of the torch** – Increase the speed of the torch movement to make the gouge narrower and more shallow ❶. Decrease the speed of the torch movement to make the gouge wider and deeper ❷.



# 6

## ***Mark with the Machine torch (Powermax45 SYNC)***

This section helps you to:

- Select the correct cartridge for marking
- Select the plasma power settings for marking
- Optimize the quality of your marks

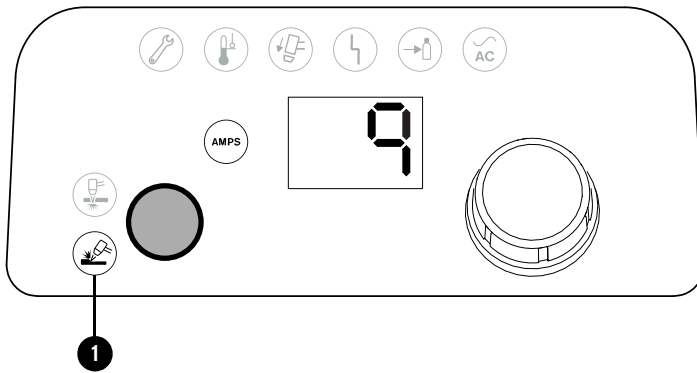
### **Before you begin marking**

---

- 1.** Install a FineCut mechanized cutting cartridge on the SmartSYNC torch.
- 2.** Set the output current from 9 A to 19 A to enter marking mode.



The gouge LED ❶ is on when the plasma power supply is in marking mode.



3. Adjust the torch speed and plasma power supply output current (A) for your marking job. Refer to the cut charts in the *Powermax45/65/85/105 SYNC Cut Charts Guide* (810500MU)
  - Marking mode is only available when the output current is set from 9 A to 19 A.
  - Do not exceed 19 A for marking applications.
  - The gas pressure is automatically set by the plasma power supply.

## Optimize mark quality

Use the general guidelines in the following table to change the characteristics of a mark.

	Amperage	Cut Height	Cut Speed
To make a darker mark	Increase	Decrease	Decrease
To make a lighter mark	Decrease	Increase	Increase

Factors that affect the quality of your marks include:

- Material surface finish
- Plasma power supply output current (A)
- Torch speed
- Torch height
- Characteristics of the cutting table and CNC, such as how it handles delays, accelerations, and decelerations

To troubleshoot marking problems or to resolve issues with mark quality, refer to [Marking problems \(Powermax45 SYNC\)](#) on page 82.

Use the settings in the following table as a starting point for the output current, torch height, and torch speed. Adjust each setting as necessary to change the characteristics of the mark. For example, moving the torch closer to the workpiece will result in a deeper mark.

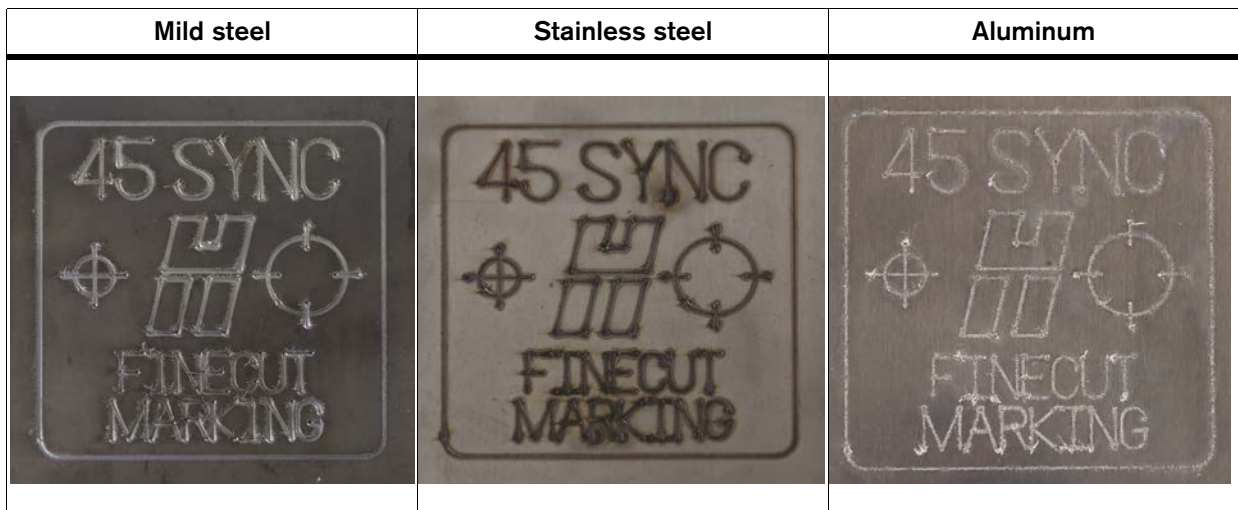
**Metric**

	Output Current	Torch-to-Work Distance	Initial Marking Height	Delay Time	Marking Speed	Arc Voltage
	A	mm	mm	seconds	mm/min	volts
Mild Steel	9	3.5	3.5	0	3800	128
Stainless Steel	9	3.5	3.5	0	3800	117
Aluminum	9	3.5	3.5	0	3800	120

**English**

	Output Current	Torch-to-Work Distance	Initial Marking Height	Delay Time	Marking Speed	Arc Voltage
	A	in	in	seconds	in/min	volts
Mild Steel	9	0.14	0.14	0	150	128
Stainless Steel	9	0.14	0.14	0	150	117
Aluminum	9	0.14	0.14	0	150	120

The following pictures show sample marks in mild steel, stainless steel, and aluminum using the settings from the previous table.



## Additional considerations

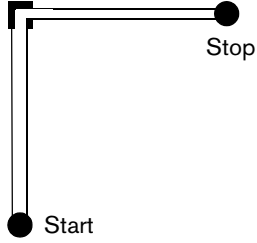
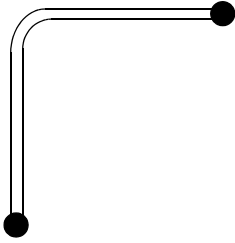
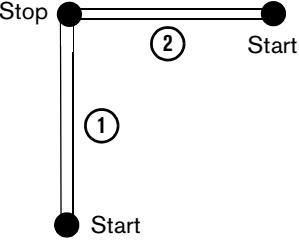
You may need to try different cornering methods to optimize 90° corners for your CNC and cutting table.

### Guidelines for cornering

- 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.

## 6 Mark with the Machine torch (Powermax45 SYNC)

- ❑ On many tables, it can be difficult to achieve a clean 90° corner. It requires the torch to temporarily come to a complete stop, which can result in a corner that is wider and deeper than you want.
- ❑ The rounded corner method shown below is recommended for most cutting 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 cutting tables/CNCs	Alternate 2-step operation
		



# Common Mechanized System Problems

This section explains the following common problems and how to solve them:

- Cutting system problems
- Cut quality problems, such as cut angle (bevel) and dross
- Gouging problems
- Marking problems
- Grounding or shielding problems




This section is a *supplement* to the troubleshooting information in the *Powermax65/85/105 SYNC Operator Manual (810470)* or the *Powermax45 SYNC Operator Manual (811470)*. When you troubleshoot a mechanized cutting problem, use both resources.

## Cutting system problems

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Problem	Solutions
The plasma arc sputters or hisses, or you lose the plasma arc.	<ul style="list-style-type: none"><li>▪ Make sure that the cartridge is installed correctly.</li><li>▪ Examine the cartridge. Replace it if it is worn or damaged. A higher rate of 0-30-0 faults is typical as a cartridge gets near end-of-life.</li><li>▪ Examine the gas filtration system for signs of moisture. Refer to the <i>Powermax65/85/105 SYNC Operator Manual (810470)</i> or the <i>Powermax45 SYNC Operator Manual (811470)</i>.</li></ul>

Problem	Solutions
<p>The plasma arc does not transfer to the workpiece.</p>	<ul style="list-style-type: none"> <li>▪ Clean the workpiece surface of rust, paint, or other material that can prevent a good metal-to-metal connection.</li> <li>▪ Make sure that the work lead is making good contact with the cutting table or workpiece, and is not damaged. Repair or replace it if necessary. Refer to the <i>Powermax45/65/85/105 SYNC Parts Guide</i> (810490).</li> <li>▪ Make sure that the cutting table is correctly grounded and is making good contact with the workpiece.</li> <li>▪ Decrease the cut height. Refer to the <i>Powermax45/65/85/105 SYNC Cut Charts Guide</i> (810500MU).</li> <li>▪ Examine the work lead for cuts or other signs of damage. Replace if necessary. Refer to the <i>Powermax45/65/85/105 SYNC Parts Guide</i> (810490).</li> </ul>
<p>The torch does not completely pierce the workpiece, and there is excessive sparking on the top of the workpiece.</p>	<ul style="list-style-type: none"> <li>▪ Examine the cartridge. Replace it if it is worn or damaged. A higher rate of 0-30-0 faults is typical as a cartridge gets near end-of-life. Refer to <a href="#">Signs that a cartridge is near end-of-life</a> on page 52.</li> <li>▪ Decrease your cut speed.</li> <li>▪ Restart the plasma power supply. Does it correctly recognize the type of cartridge installed? Does it correctly set the amperage and operating mode to align with the cartridge? If it does not, look at the LCD screen (Powermax65/85/105). Do you see the icon at right on the LCD screen? If yes, there is possibly a plasma power supply configuration setting that you must change. If no, there is possibly a problem with the cartridge, torch, or plasma power supply. Refer to the <i>Powermax65/85/105 SYNC Operator Manual</i> (810470) or the <i>Powermax45 SYNC Operator Manual</i> (811470). </li> <li>▪ Increase the output current (A) on the plasma power supply.</li> <li>▪ If the output current (A) cannot be increased, do a check to see if the thickness of the workpiece is more than the maximum capacity for this plasma power supply. Refer to the cutting specifications in the <i>Powermax65/85/105 SYNC Operator Manual</i> (810470) or the <i>Powermax45 SYNC Operator Manual</i> (811470).</li> <li>▪ Clean the workpiece surface of rust, paint, or other material that can prevent a good metal-to-metal connection.</li> <li>▪ Examine the torch lead. Make it straight if it is twisted or kinked. Replace it if it is damaged.</li> <li>▪ Examine the gas pressure and the gas supply hose.</li> <li>▪ Adjust the gas flow rate. Refer to the gas supply specifications in the <i>Powermax65/85/105 SYNC Operator Manual</i> (810470) or the <i>Powermax45 SYNC Operator Manual</i> (811470).</li> <li>▪ Make sure that the cut chart parameters or the program code values are correct. Refer to the <i>Powermax45/65/85/105 SYNC Cut Charts Guide</i> (810500MU).</li> </ul>



Problem	Solutions
Cartridge life is shorter than expected.	<ul style="list-style-type: none"> <li>▪ Do a check of the gas pressure and the gas supply hose.</li> <li>▪ Do not start or stop cuts off of the surface of the workpiece. Starting at the edge of the workpiece is permitted if the arc makes contact with the workpiece when started.</li> <li>▪ Examine the torch lead. Straighten it if it is twisted or kinked. Replace it if it is damaged.</li> <li>▪ Make sure that the output current, arc voltage, cut speed, and other cut settings are correct. Refer to the <i>Powermax45/65/85/105 SYNC Cut Charts Guide</i> (810500MU).</li> <li>▪ Use the correct torch height for piercing. Refer to the <i>Powermax45/65/85/105 SYNC Cut Charts Guide</i> (810500MU) for the initial pierce height.</li> <li>▪ Make sure that the pierce delay time is correct. Refer to the <i>Powermax45/65/85/105 SYNC Cut Charts Guide</i> (810500MU).</li> <li>▪ Examine the gas filtration system for signs of contaminants that can interfere with system performance.</li> <li>▪ Examine the cut data on the Cartridge Data screen and the Power Supply Data screen (Powermax65/85/105 SYNC). Refer to the <i>Powermax65/85/105 SYNC Operator Manual</i> (810470). Also refer to <a href="#">Get the most out of your cartridges</a> on page 51.</li> <li>▪ Use the Hypertherm cartridge reader (528083) and the Hypertherm cartridge reader app as an alternate way to read data from all Powermax45/65/85/105 SYNC cartridges.</li> <li>▪ A faulty pilot arc IGBT can shorten cartridge life. Speak to your Hypertherm distributor or authorized repair facility, or speak to the nearest Hypertherm office shown in the front of this manual.</li> </ul>

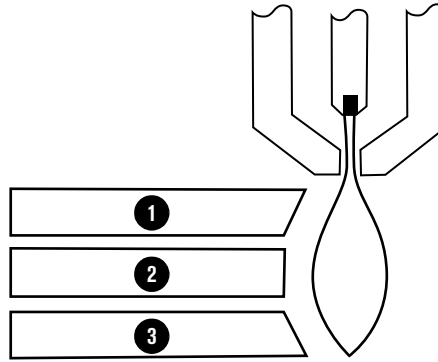
## Cut quality problems

The following are problems that you can have when the appearance of a cut is unsatisfactory:

- **Cut angle (bevel)** – The degree of angularity of the cut edge.
- **Dross** – The molten material that solidifies on the top or bottom of the workpiece.

Each is explained in the following sections.

## Cut angle (bevel)



	Cut angle (bevel)	Causes	Solution
❶	<b>Negative bevel</b> More material is removed from the bottom of the cut than from the top.	<ul style="list-style-type: none"> <li>The cutting speed is too slow.</li> <li>The torch is too low. Or, if you are using a torch height control, arc voltage is too low.</li> <li>The amperage is too high.</li> </ul>	<ul style="list-style-type: none"> <li>Increase the cutting speed in small increments (125 mm/min or 5 in/min or less).</li> <li>Raise the torch in small increments (2 mm or 1/16 in.). Or, if you are using a torch height control, increase the arc voltage in small increments (5 volts or less).</li> <li>Decrease the amperage in 10 A increments.</li> </ul>
❷	<b>No bevel (square cut)</b>	This is good cut quality.	
❸	<b>Positive bevel</b> More material is removed from the top of the cut than from the bottom.	<ul style="list-style-type: none"> <li>The cartridge is worn.</li> <li>The cutting speed is too fast.</li> <li>The torch is too high. Or, if you are using a torch height control, arc voltage is too high.</li> <li>The amperage is too low.</li> </ul>	<ul style="list-style-type: none"> <li>Install a new cartridge.</li> <li>Decrease the cutting speed in small increments (125 mm/min or 5 in/min or less).</li> <li>Lower the torch in small increments (2 mm or 1/16 in.). Or, if you are using a torch height control, decrease the arc voltage in small increments (5 volts or less).</li> <li>Increase the amperage in 10 A increments.</li> </ul>
	<b>Irregular bevel</b> Positive and negative bevel on the same workpiece.	<ul style="list-style-type: none"> <li>The cartridge is severely worn.</li> <li>The torch is not aligned perpendicular to the workpiece.</li> <li>Cut surface is concave on one side and convex on the other side.</li> </ul>	<ul style="list-style-type: none"> <li>Install a new cartridge.</li> <li>Use a square or digital level to align the torch at a 90° angle to the workpiece. Refer to <a href="#">Find the cause of a cut-angle problem.</a></li> </ul>



The squarest cut angle is always on the right side with respect to the forward motion of the torch. The left side always has some degree of bevel. A bevel angle of more than 5 degrees shows a possible problem.

## Find the cause of a cut-angle problem

### 1. Make a test cut.



Use a square for the test cuts. It makes it easier to find which side is affected by the cut-angle problem and if that side moved with the rotation of the torch.

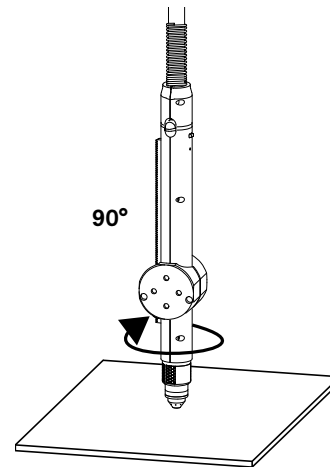
### 2. Measure the angle of each side of the test cut.

### 3. Turn the torch 90° in its holder.

### 4. Repeat steps 1 – 3.

### 5. If the angles are the same in both tests:



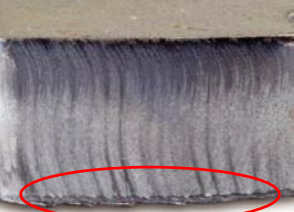
- Make sure that you have removed all mechanical causes. Refer to [Configure Controls for Mechanized Cutting](#) on page 19.
- Do a check of the cut height (especially if the cut angles are all positive or all negative). Refer to the *Powermax45/65/85/105 SYNC Cut Charts Guide* (810500MU).
- Examine the material being cut. If the workpiece is magnetized or hardened, then you are more likely to have cut angle problems.



If the cut angle problem persists, speak to the manufacturer of your mechanized cutting system to make sure that your torch height control is operating correctly.

## Dross

Dross (slag) is molten metal that is the result of the cut process and that hardens on the bottom of the part. There is always some amount of dross when cutting with plasma. To keep the amount and type of dross to a minimum, adjust your system correctly for your application.

Problem	Causes	Solution
<p>Too much dross (splatter) on the top of the plate.</p> 	<ul style="list-style-type: none"> <li>▪ The cartridge is worn.</li> <li>▪ The cutting speed is too fast.</li> <li>▪ The torch is too high. Or, if you are using a torch height control, arc voltage is too high.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Install a new cartridge.</li> <li>▪ Decrease the cutting speed in small increments (125 mm/min or 5 in/min or less).</li> <li>▪ Lower the torch in small increments (2 mm or 1/16 in.). Or, if you are using a torch height control, decrease the arc voltage in small increments (5 volts or less).</li> </ul>
<p>Low-speed dross that collects on the bottom of the cut and is heavy and bubbly.</p> 	<ul style="list-style-type: none"> <li>▪ The cutting speed is too slow.</li> <li>▪ The torch is too low. Or, if you are using a torch height control, arc voltage is too low.</li> <li>▪ The amperage is too high.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Increase the cutting speed in small increments (125 mm/min or 5 in/min or less).</li> <li>▪ Raise the torch in small increments (2 mm or 1/16 in.). Or, if you are using a torch height control, increase the arc voltage in small increments (5 volts or less).</li> <li>▪ Decrease the amperage in 10 A increments.</li> </ul>
<p>High-speed dross near the cut that is a thin, linear bead of solid metal. It is welded to the bottom of the cut and is difficult to remove.</p> 	<ul style="list-style-type: none"> <li>▪ The cartridge is worn.</li> <li>▪ The cutting speed is too fast.</li> <li>▪ The torch is too high. Or, if you are using a torch height control, arc voltage is too high.</li> <li>▪ The amperage is too low.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Install a new cartridge.</li> <li>▪ Decrease the cutting speed in small increments (125 mm/min or 5 in/min or less).</li> <li>▪ Lower the torch in small increments (2 mm or 1/16 in.). Or, if you are using a torch height control, decrease the arc voltage in small increments (5 volts or less).</li> <li>▪ Increase the amperage in 10 A increments.</li> </ul>

## Gouging problems

When gouging, always make sure of the following:

- A Hypertherm gouging cartridge is installed.
- The Hypertherm cartridge is not worn or damaged. Refer to [Signs that a cartridge is near end-of-life](#) on page 52.
- The operating mode is set to Gouge mode.
  - When you install a Hypertherm gouging cartridge, the plasma power supply automatically sets the operating mode to Gouge mode. There is a condition in which the operating mode does **not** automatically set to Gouge mode even if a Hypertherm gouging cartridge is used. Refer to “Smart mode versus basic mode” in the *Powermax65/85/105 SYNC Operator Manual (810470)*.

Problem	Solution
The arc goes out during gouging.	<ul style="list-style-type: none"> <li>▪ Decrease the arc stretch (standoff).</li> <li>▪ Put the torch in a more upright position.</li> </ul>
The torch tip hits the molten metal (slag).	<ul style="list-style-type: none"> <li>▪ Increase the arc stretch (standoff).</li> <li>▪ Keep the torch tip pointed in the direction of the gouge that you want to make.</li> </ul>
The gouge has too much depth.	<ul style="list-style-type: none"> <li>▪ Tilt the torch down so that it is closer to the workpiece.</li> <li>▪ Increase the arc stretch (standoff).</li> <li>▪ Increase the gouging speed.</li> <li>▪ Decrease the output current (A).</li> <li>▪ Refer to <a href="#">Change the gouge contour</a> on page 68.</li> </ul>
The gouge does not have enough depth.	<ul style="list-style-type: none"> <li>▪ Put the torch in a more upright position.</li> <li>▪ Decrease the arc stretch (standoff).</li> <li>▪ Decrease the gouging speed.</li> <li>▪ Increase the output current (A).</li> <li>▪ Refer to <a href="#">Change the gouge contour</a> on page 68.</li> </ul>
The gouge has too much width.	<ul style="list-style-type: none"> <li>▪ Put the torch in a more upright position.</li> <li>▪ Decrease the arc stretch (standoff).</li> <li>▪ Increase the gouging speed.</li> <li>▪ Decrease the output current (A).</li> <li>▪ Refer to <a href="#">Change the gouge contour</a> on page 68.</li> </ul>
The gouge does not have enough width.	<ul style="list-style-type: none"> <li>▪ Tilt the torch down so that it is closer to the workpiece.</li> <li>▪ Increase the arc stretch (standoff).</li> <li>▪ Decrease the gouging speed.</li> <li>▪ Increase output current (A).</li> <li>▪ Refer to <a href="#">Change the gouge contour</a> on page 68.</li> </ul>

## Marking problems (Powermax45 SYNC)

Many common marking issues can be resolved by installing a new cartridge on the torch. Do not use worn or damaged cartridges.

Problem	Solution
The arc goes out during marking.	<ul style="list-style-type: none"> <li>▪ Make sure that the torch-to-work distance (standoff) is not too high.</li> <li>▪ Change worn or damaged cartridges.</li> </ul>
The mark is too narrow or too shallow.	<ul style="list-style-type: none"> <li>▪ Increase the output current.</li> <li>▪ Decrease the marking speed.</li> <li>▪ Decrease the torch height.</li> <li>▪ Change worn or damaged cartridges.</li> </ul>
The beginning of the mark is too large.	<ul style="list-style-type: none"> <li>▪ 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).</li> <li>▪ Check the cutting table parameters, especially the acceleration parameter. It may need to be increased.</li> <li>▪ 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.</li> <li>▪ Check the torch-to-work distance (standoff) to make sure there is a good, fast transfer of the plasma arc to the workpiece.</li> </ul>
The end of the mark is too large.	<ul style="list-style-type: none"> <li>▪ Check the cutting table parameters. If possible, increase the deceleration parameter.</li> </ul>
The mark becomes too deep and too wide during cornering.	<ul style="list-style-type: none"> <li>▪ You may need to try a different method for cornering. Refer to <a href="#">Guidelines for cornering</a> on page 73.</li> </ul>
Marks such as letters, numbers, and other symbols are not legible.	<ul style="list-style-type: none"> <li>▪ Make the marks larger. The minimum recommended height is 8 mm (0.31 in.) for marks such as letters and numbers.</li> </ul>

## EMI grounding and shielding best practices

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### Types of grounding and shielding

The following types of grounding and shielding for a mechanized plasma cutting system must be installed correctly. Refer to the diagram on [page 86](#) for an example.

- **Service ground** (also known as *safety ground*) is the grounding system that applies to the incoming line voltage. It prevents a shock hazard to personnel from the equipment or the cutting table. It includes the service ground coming into the plasma power supply and other systems, such as a CNC, as well as the supplemental ground rod connected to the cutting table.
- **Protective earth (PE) ground** is the grounding system inside the electrical equipment. The PE ground, which connects to the service ground, provides electrical continuity between the equipment and the AC service.
- **DC power ground** (also known as *output current ground*) is the grounding system that completes the path of the output current from the torch back to the plasma power supply. In this system, the positive lead from the plasma power supply must be tightly connected to the cutting table ground bus with a correctly sized cable. Also, the slats on which the workpiece rests must make good contact with the cutting table and the workpiece.
- **Electromagnetic interference (EMI) grounding and shielding** is the grounding system that limits the amount of EMI (or *noise*) that comes from the plasma power supply and other equipment near the cutting system. It also limits the amount of EMI that is received by a control (e.g., a CNC) and measurement circuits.

### Grounding and shielding best practices

This section describes EMI grounding and shielding best practices specifically.



The grounding practices in this section have been used on many installations with excellent results. Hypertherm recommends that these practices be a routine part of the installation process. The actual methods used to implement these practices can vary from system to system, but must stay as consistent as possible. Due to the variation in equipment and installations, these grounding practices cannot succeed in every case to eliminate EMI problems. Hypertherm recommends that you refer to your local and national electrical codes to make sure that the grounding and shielding practices that you use satisfy the requirements for your location.

- The cutting table is used for the *common*, or *star*, EMI ground point and must have threaded studs welded to the table with a copper bus bar attached to them. A separate bus bar must be attached to the gantry as close to each motor (if applicable) as possible. If there are motors at each end of the gantry, install a separate EMI ground cable from the far motor to the gantry bus bar. The gantry bus bar must have a separate, heavy EMI ground cable to the table bus bar. Make the routing of each of the EMI ground cables for the torch lifter, if applicable, separate to the table ground bus.
- Insufficient grounding exposes operators to dangerous voltages. Insufficient grounding also increases the risk of equipment failure and unnecessary downtime. Ideally a ground should be zero ohms resistance, but Hypertherm's field experience shows that less than 1 ohm

resistance is satisfactory for most applications. Hypertherm recommends that you refer to your local and national electrical codes to make sure that the grounding and shielding practices that you use satisfy the requirements for your location.

- A ground rod (a PE ground) that meets all applicable local and national electric codes must be installed within 6 m (20 ft) of the cutting table. The PE ground must connect to the cutting table ground bus bar. Speak to an electrician in your location to make sure that your grounding meets all local and national electric codes.
- All hardware used in the ground system must be brass or copper. While you can use steel studs welded to the cutting table for attaching the ground bus, no other aluminum or steel hardware can be used in the ground system.
- AC power, PE, and service grounds must connect to all equipment according to local and national codes.
- Each Hypertherm component, as well as the CNC or other components or enclosures, must have a separate ground cable to the common (star) ground on the table.
- The torch holder and the torch breakaway mechanism – the part attached to the lifter, not the part attached to the torch – must connect to the stationary part of the lifter with copper braid. A separate cable must go from the lifter to the gantry ground bus bar.
- If the gantry operates on rails that are not welded to the table, then each rail must connect with a ground cable from the end of the rail to the table. The rail ground cables connect directly to the table. It is not necessary to connect the rail ground cables to the table ground bus bar.
- The torch lead and work lead can go parallel to other wires or cables **only** if they are separated by at least 150 mm (6 inches). If possible, put power and signal cables in separate cable tracks. If it is not possible to keep at least a 150 mm (6 inch) separation between cables, then add shielding to decrease the noise interaction. If cables must cross paths, make sure that the groups intersect at right angles.
- You can attach the work lead from the plasma power supply to the cutting table or to the workpiece you are cutting. Make sure that the work lead makes good metal-to-metal contact with the cutting table or workpiece. Remove rust, dirt, paint, coatings, and other debris so that the work lead makes sufficient contact with the cutting table or workpiece.
- The metal braided shield on the torch lead must connect tightly to the torch. Hypertherm recommends that it be electrically insulated from metal and from contact with the floor or building. Put the torch lead in a plastic cable tray or track, or cover the torch lead with a plastic or leather sheath.
- If you are installing an external voltage divider PCB, attach it as closely as possible to where the arc voltage is sampled. If a Hypertherm voltage divider PCB is used, you must supply galvanic isolation to prevent ground loops. The processed signal must go through a twisted shielded cable. Use a cable with a braided shield, not a foil shield. A shield with a braid over foil is best. Connect the shield to the chassis of the plasma power supply and leave it unconnected at the other end.

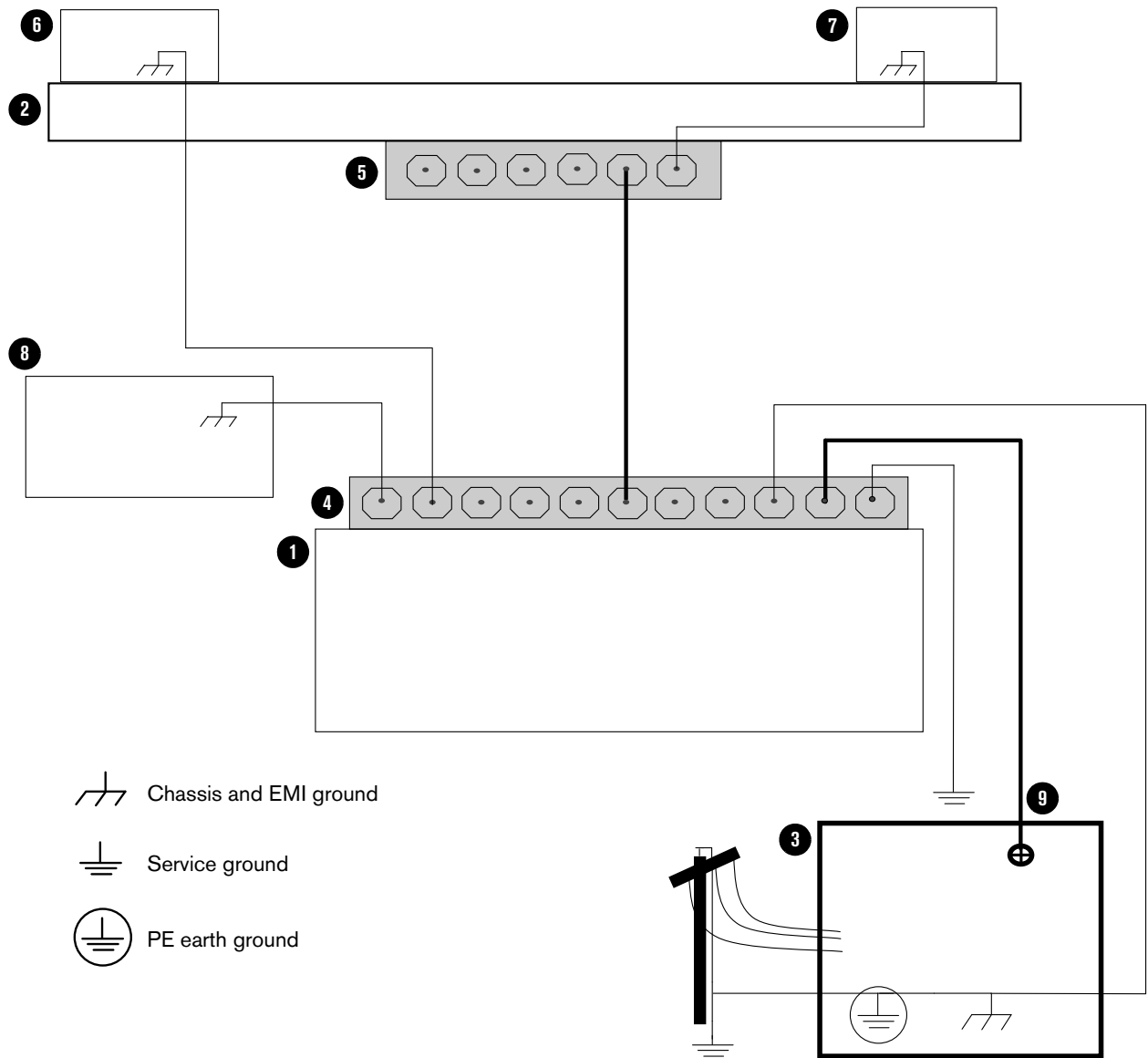


Insulation on an electrical cable does not prevent electromagnetic interference (EMI). Shielding for electrical wires, including insulated cables, is necessary to prevent noise-related problems.



- All other signals (analog, digital, serial, and encoder) must go through twisted pairs inside a shielded cable. Connectors on these cables must have a metal housing. The shield, not the drain, must connect to the metal housing of the connector at each end of the cable. Never put the shield or the drain through the connector on the pins.
- Use correct shield grounding techniques. Connect a braided shield over its entire circumference by using grounding clamps or EMC cable glands. A 360-degree shield connection is much better than other connection methods. The quality of the shield bond increases with the clamped surface area. Install ferrite sleeves on long-length data cables. Ferrite sleeves decrease common mode noise currents without affecting the differential signal currents. If necessary, put multiple turns through the ferrite.

## Example grounding diagram



- |                         |                               |
|-------------------------|-------------------------------|
| 1 Cutting table         | 6 Torch height control lifter |
| 2 Gantry                | 7 CNC controller              |
| 3 Plasma system         | 8 Torch height control module |
| 4 Table ground bus bar  | 9 DC power ground (work)      |
| 5 Gantry ground bus bar |                               |



This example is based on practices in North America. Other regions can have different local or national electrical codes. Hypertherm recommends that you consult your local and national electrical codes to make sure that the grounding and shielding practices that you use satisfy the requirements for your location.