828 Series
Carbon/Hydrogen/Nitrogen Analyzer
with Cornerstone® Brand Software
Instruction Manual
CHN828/CN828/FP828P/FP828

Version 2.9.x
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Patents Pending in U.S. and other countries.

Minor revisions may not be reflected in this manual.

LECO Corporation
3000 Lakeview Avenue · St. Joseph, MI 49085
Phone: 269-983-5531 · Fax: 269-983-3850
info@leco.com · www.leco.com
ISO-9001:2015 Q-994

LECO Europe B.V.
Vouersweg 118
6161 AG Geleen
(P.O. Box 1174 - 6160 BD Geleen)
The Netherlands
Phone: 31-46-4747473 · Fax: 31-46-4747333
info_nl@leco.com www.nl.leco-europe.com

Original Instructions

Quality at LECO Corporation means understanding our customer’s requirements and establishing specifications that clearly define those requirements. The essence of our quality philosophy is the commitment to quality objectives, aimed at never-ending improvement and complete customer satisfaction.

Safety Symbols

These symbols may be found on LECO equipment or their components. Some of the symbols shown may not appear in this manual. These symbols indicate the use of specific safety guidelines. Important safety information is highlighted in this manual by one of the following symbols, as well as by WARNING and CAUTION statements. Operator and service personnel must follow these instructions for personal safety and to prevent damage to the instrument.


CAUTION


HAZARDOUS VOLTAGE WARNING


HIGH TEMPERATURE WARNING


EXPLOSION HAZARD


ELECTROSTATIC SENSITIVE DEVICES


PINCH HAZARD


PINCH HAZARD


PINCH HAZARD


PINCH HAZARD


FIRE HAZARD

ROTATING FAN BLADES

EXPLOSIVE

FLAMMABLE

OXIDIZING

COMPRESSED GAS

CORROSIVE

TOXIC

HARMFUL

HEALTH HAZARD

ENVIRONMENTAL HAZARD

PROTECTIVE GLOVES

PROTECTIVE EYEWEAR

EAR PROTECTION

NOT ALLOWED

Cautions, Warnings, and Residual Risks

CAUTIONS

- This instrument should be operated only by technically qualified and trained individuals who have fully read and understood these instructions.
- It is highly recommended that users attend training courses provided by LECO Corp. prior to operating this equipment.
- This instrument should be operated only in accordance with these instructions.
- The operator should follow all of the warnings and cautions set forth in this manual and employ all applicable standard laboratory safety procedures.
- If this equipment is used in a manner not specified by the manufacturer, the protection measures provided by the equipment may be impaired.
- Maintenance is to be completed by a Responsible Body: a person who has the proper training and knowledge to perform the task safely.
- Consumables and replacement parts other than those specified and provided by the manufacturer may cause damage to the instrument as well as impair the protection measures provided by the equipment.
- Instruments can be very heavy. Proper equipment must be used to safely transport, position, and lift equipment (if necessary).
- Front panels and other cosmetic parts of this instrument are not designed to be weight bearing. DO NOT use such parts as lifting points, or damage may result. ALWAYS lift near the feet at the sides or the rear of the instrument base.

RISK OF ELECTRICAL SHOCK

- Disconnect the equipment from facility power before servicing or removing any guard or tool-accessible panel.
- The plug on the power cord that connects the instrument to facility power must remain accessible at all times. A “lock-out” device can be installed over the plug when servicing the equipment if so required by local electric code.
- Qualified personnel must ensure that the receptacle providing the facility power has a reliable connection to Protective Earth (Safety Ground). A failure in the Protective Earth terminal may impair the protection provided by the equipment.
- Detachable/interchangeable power cords are available in several wire gauges, voltages, and current ratings and can easily be used with the wrong equipment. Make sure properly rated power cords are used for each piece of equipment. The use of inadequately rated power cords can cause a Fire and/or Electrical Shock Hazard.
- During the installation and operation of this instrument, do not position equipment or materials so that it is difficult to operate or access the On/Off switch (AC Mains Disconnect Device). This switch must remain easily accessible to the user at all times.
- If the instrument power cord is wired directly into an electrical box, the box must supply a lockable disconnect, be located close to the instrument, and remain accessible at all times.
- Facility power connections must meet all local, state, and national electric codes. In some locations, this may require changing the power cord, plug/receptacle, or the cordage used. If unsure, always consult with a local electrical authority.

SOUND PRESSURE LEVELS

Most LECO instruments produce sound pressure levels far below 70 dB(A) and generally do not require ear protection to be worn by the operator in most laboratory environments.

The sound pressure levels on some LECO instruments, such as saws, polisher/grinders, or instruments using vacuum cleaners, may exceed 70 dB(A) for short periods of time, depending on how the instrument is used and the types of materials that are being processed.

Because sound pressure levels can be accumulative and dependent on many factors, including other equipment operating in the vicinity of a workstation, it is recommended by some authorities that a Time Weighted Sound Pressure Level be measured or calculated at the operator's position after installation to assess the possibility of the need for Personal Protective Equipment (PPE) such as ear protection.

INSTRUMENTS WITH ACCESSIBLE HIGH TEMPERATURES

RISK OF SEVERE BURNS

- Do not touch hot surfaces near ovens, heaters, furnaces, crucibles, reagent tubes, catalyst tubes, combustion tubes, etc.
- Wait for surfaces to cool to a safe temperature before performing any maintenance or service operations in these areas.

INSTRUMENTS WITH HOT CRUCIBLES AND MATERIALS

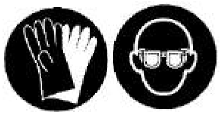
RISK OF SEVERE BURNS

- Spent crucibles are very HOT after leaving the furnace and can remain hot for a long period of time. Do not touch spent crucibles with bare hands.
- Use proper Personal Protection Equipment (PPE) and provided tools when handling hot materials.
- Wait for surfaces to cool to a safe temperature before performing any maintenance or service operations in these areas.

RISK OF FIRE

- Empty spent crucible bucket into a nonflammable, heat-resistant container only.
- Dispose of hot materials into a fireproof container only.
- Do not attempt to permanently dispose of spent crucibles or any hot materials until they have cooled to a safe temperature.

INSTRUMENTS WITH GLASS TUBES



RISK OF INJURY

- Wear protective gloves and eye protection whenever handling glass tubes to prevent injury. Other Personal Protection Equipment (PPE) may also be required.

RISK OF SEVERE BURNS

- Glass tubes used with reduction and catalyst heaters may be hot. The materials inside these tubes may also be hot. Do not attempt to remove tubes until they have cooled to a safe temperature.

RISK OF INJURY

- Visually inspect all glass tubing before installation or repacking. Do not use, and properly dispose of, any glass tubing that has cracks, chips, or scarring. Damaged tubes could possibly rupture under pressure.
- Depressurization of the Incoming Carrier Gas may be necessary before removal of glass tubes to prevent injury or damage to the tubes during the removal process. Turn Off the gas in the software and wait approximately 1 minute before attempting to remove any tubes.

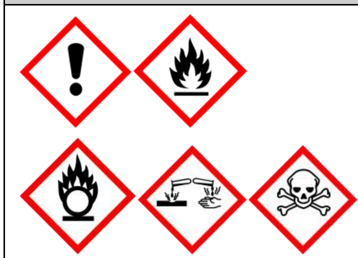
INSTRUMENTS WITH PNEUMATICS, COMPRESSED GASES, AND FLUIDS

CAUTION – RISK OF INJURY OR DAMAGE TO INSTRUMENT

- An external shutoff device must be provided to isolate and depressurize the supply from the instrument. This device must be easily accessible to the user. A means must be provided to indicate that the system has been depressurized, such as a clearly visible pressure gauge. The local codes in some areas may require the shutoff devices (supply isolators) to be lockable.
- Use of external pressure-limiting devices are required to ensure that maximum-rated pressures cannot be exceeded.
- Depressurize the entire system and all supply lines prior to performing any service or maintenance tasks on this instrument.
- External flexible supply lines/piping/hoses/tubes must be securely supported and restrained every 1 meter or shielded by suitable means to reduce sudden hazardous movement (whiplash) resulting from leakage or a failure in the connections.
- Pipes and hoses must be properly marked to clearly identify their purpose and connection point.

- All external elements (pipes, hoses, pop-offs, regulators, gas bottles [tanks], receivers, valves, etc.) must be properly rated for the pressures available in both a normal and a fault condition.
- All external elements must be properly rated for the type of gas, fluid, and/or materials the system is supplying or venting.
- All external elements must be protected from damage from external effects.
- All external elements (especially gas bottles) must be adequately secured to avoid injury or damage.
- It is the responsibility of the facility owner or utility supplier to perform a risk assessment to ensure that a fault in external components of the fluid power system does not cause injury or damage to equipment and to install risk-lowering protection measures if necessary.
- Hazardous gases must be safely vented into a non-hazardous area with a connection to atmosphere.
- Regularly scheduled maintenance must be performed by the facility's management to check for leaks and make sure drains are clear, vents are working properly, filters are replaced, etc.
- Where the quantity of available gas and the volume of the room can cause an asphyxiation hazard, the facility's management is responsible for installing proper safety measures.
- Where flammable gases are used, the facility's management is responsible for ensuring that an unsafe condition cannot occur external to the instrument and for installing proper safety measures.

INSTRUMENTS THAT USE HAZARDOUS CHEMICALS



RISK OF CHEMICAL BURNS, INHALATION, CHEMICAL REACTIONS, AND FIRE

The gaseous and solid productions of this analytical instrument may be toxic relative to the sample material analyzed. Normal laboratory procedures and regulations for handling such materials should be followed. Please refer to the Safety Data Sheet (SDS) of the sample material for further information regarding these potential hazards, and follow the environmental protection measures and regulations applicable to your region.

- Be aware of all hazardous chemicals, solvents, accelerants, oxidizers, cleaners, reagent materials, etc., used by this instrument and its methods. Not all instruments use hazardous chemicals or materials.
- Obtain Safety Data Sheets (SDS) for all hazardous chemicals and materials used, and store them near where they are used. Users must familiarize themselves with all warnings, precautions, and required Safety Procedures for the handling, use, and disposal of such materials.
- Safety information and warnings may also appear on the chemical bottles or containers.
- Wear proper Personal Protective Equipment (PPE) if required.
- Avoid vapors and direct contact with chemicals.

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- True Plasma Power®
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1 Introduction

The Introduction chapter contains general information about the 828 Series Carbon/Hydrogen/Nitrogen Analyzers, including safety guidelines and warranty terms. Reference this chapter for replacement parts, operating supplies, and optional accessories. To place an order by phone, call our customer service department toll-free in the United States at 1-800-292-6141 or 269-985-5496. Orders may also be sent by fax to 269-982-8977.

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Warranty

Equipment manufactured by LECO Corporation, St. Joseph, Michigan is warranted free from defect in material and workmanship for a period of 1) thirteen months from date of shipment or 2) twelve months from date of installation, whichever occurs first. Equipment not manufactured by LECO is covered to the extent of warranty provided by the original manufacturer and this warranty does not cover any equipment, new or used, purchased from anyone other than LECO Corporation. All replacement parts shall be covered under warranty for a period of thirty days from date of purchase. **LECO makes no other representation or warranty of any other kind, expressed or implied, with respect to the goods sold hereunder, whether as to merchantability, fitness for purpose, or otherwise**.

Expendable items such as crucibles, combustion tubes, chemicals, and items of like nature are not covered by this warranty.

LECO's sole obligation under this warranty shall be to repair or replace any part or parts which, to our satisfaction, prove to be defective upon return prepaid to LECO Corporation, St. Joseph, Michigan. This obligation does not include labor to install replacement parts, nor does it cover any failure due to accident, abuse, neglect, or use in disregard of instructions furnished by LECO. In no event shall damages for defective goods exceed the purchase price of the goods, and **LECO shall not be liable for incidental or consequential damages whatsoever.**

All claims in regard to the parts or equipment must be made within ten (10) days after Purchaser learns of the facts upon which the claim is based. Authorization must be obtained from LECO prior to returning any other parts. This warranty is voided by failure to comply with these notice requirements.

Notice

The warranty on LECO equipment remains valid only when genuine LECO replacement parts are employed. Since LECO has no control over the quality or purity of consumable products not manufactured by LECO, the specifications for accuracy of results using LECO instruments are not guaranteed unless genuine LECO consumables are employed in conjunction with LECO instruments. If purchaser defaults in making payment for any parts or equipment, this warranty shall be void and shall not apply to such parts and equipment. No late payment or cure of default in payment shall extend the warranty period provided herein.

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WEEE

Disposal of WEEE and the Wheeled Bin Symbol

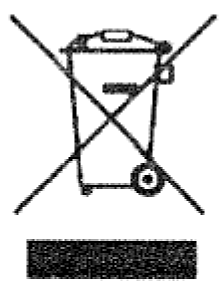
In 2002, the European Union introduced the Directive on Waste Electrical and Electronic Equipment (WEEE). The main aim of the Directive is to ensure that WEEE is collected and treated separately. WEEE may contain hazardous substances that should not end up in the (human) environment because it can have adverse effects on it.

Furthermore, WEEE is a vast source of raw materials. With the ever rising worldwide demand for new equipment and the ever decreasing volume of raw materials in nature, letting this potential source of such materials go to waste is unacceptable.

If equipment is collected separately, the equipment can be recycled and up to 85% to 90% of the equipment can be reused as new material, saving the use of virgin raw materials and energy of producing these. Separate collection and treatment of WEEE will thus decrease CO_2 emissions as well.

For the above reasons, LECO expects end users to dispose of the material in an environmentally friendly way, being separate collection and treatment.

Electrical and Electronic Equipment is labeled with the following “crossed-out wheeled bin” symbol, indicating that the equipment should be disposed of by the end user separate from other types of waste.



End users should contact their dealer/distributor or our company about disposal, collection, recycling options, and Safety Data Sheets (SDS information) in their country.

English

Correct Disposal of This Product

(Waste Electrical & Electronic Equipment)

(Applicable in the European Union and other European countries with separate collection systems)

This marking shown on the product or its literature, indicates that it should not be disposed with other household wastes at the end of its working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate this from other types of wastes and recycle it responsibly to promote the sustainable reuse of material resources.

Household users should contact either the retailer where they purchased this product, or their local government office, for details of where and how they can take this item for environmentally safe recycling.

Business users should contact their supplier and check the terms and conditions of the purchase contract. This product should not be mixed with other commercial wastes for disposal.

Deutsch

Korrekte Entsorgung dieses Produkts

(Elektromüll)

(Anzuwenden in den Ländern der Europäischen Union und anderen europäischen Ländern mit einem separaten Sammelsystem)

Die Kennzeichnung auf dem Produkt bzw. auf der dazugehörigen Literatur gibt an, dass es nach seiner Lebensdauer nicht zusammen mit dem normalen Haushaltsmüll entsorgt werden darf. Entsorgen Sie dieses Gerät bitte getrennt von anderen Abfällen, um der Umwelt bzw. der menschlichen Gesundheit nicht durch unkontrollierte Müllbeseitigung zu schaden. Recyceln Sie das Gerät, um die nachhaltige Wiederverwertung von stofflichen Ressourcen zu fördern.

Private Nutzer sollten den Händler, bei dem das Produkt gekauft wurde, oder die zuständigen Behörden kontaktieren, um in Erfahrung zu bringen, wie sie das Gerät auf umweltfreundliche Weise recyceln können.

Gewerbliche Nutzer sollten sich an Ihren Lieferanten wenden und die Bedingungen des Verkaufsvertrags konsultieren. Dieses Produkt darf nicht zusammen mit anderem Gewerbemüll entsorgt werden.

Français

Comment éliminer ce produit

(déchets d'équipements électriques et électroniques)

(Applicable dans les pays de l'Union Européen et aux autres pays européens disposant de systémes de collecte sélective)

Ce symbole sur le produit ou sa documentation indique qu'il ne doit pas être éliminé en fin de vie avec les autres déchets ménagers. L'élimination incontrôlée des déchets pouvant porter préjudice à l'environnement ou à la santé humaine, veuillez le séparer des autres types de déchets et le recycler de façon responsable. Vous favoriserez ainsi la réutilisation durable des ressources matérielles.

Les particuliers sont invités à contacter le distributeur leur ayant vendu le produit ou à se renseigner auprès de leur mairie pour savoir où et comment ils peuvent se débarrasser de ce produit afin qu'il soit recyclé en respectant l'environnement.

Les entreprises sont invitées à contacter leurs fournisseurs et à consulter les conditions de leur contrat de vente. Ce produit ne doit pas être éliminé avec les autres déchets commerciaux.

Italiano

Corretto smaltimento del prodotto

(rifiuti elettrici ed elettronici)

(Applicabile in i paesi dell'Unione Europea e in quelli con sistema di raccolta differenziata)

Il marchio riportato sul prodotto o sulla sua documentazione indica che il prodotto non deve essere smaltito con altri rifiuti domestici al termine del ciclo di vita. Per evitare eventuali danni all'ambiente o alla salute causati dall'inopportuno smaltimento dei rifiuti, si invita l'utente a separare questo prodotto da altri tipi di rifiuti e di riciclarlo in maniera responsabile per favorire il riutilizzo sostenibile delle risorse materiali.

Gli utenti domestici sono invitati a contattare il rivenditore presso il quale è stato acquistato il prodotto o l'ufficio locale preposto per tutte le informazioni relative alla raccolta differenziata e al riciclaggio per questo tipo di prodotto.

Gli utenti aziendali sono invitati a contattare il proprio fornitore e verificare i termini e le condizioni del contratto di acquisto. Questo prodotto non deve essere smaltito unitamente ad altri rifiuti commerciali.

Español

Eliminación correcta de este producto

(material eléctrico y electrónico de descarte)

(Aplicable en la Unión Europea y en países europeos con sistenmas de recogida selectiva de residuos)

La presencia de esta marca en el producto o en el material informativo que lo acompaña, indica que al finalizar su vida útil no deberá eliminarse junto con otros residuos domésticos. Para evitar los posibles daños al medio ambiente o a la salud humana que representa la eliminación incontrolada de residuos, separe este producto de otros tipos de residuos y recíclelo correctamente para promover la reutilización sostenible de recursos materiales.

Los usuarios particulares pueden contactar con el establecimiento donde adquirieron el producto, o con las autoridades locales pertinentes, para informarse sobre cómo y dónde pueden llevarlo para que sea sometido a un reciclaje ecológico y seguro.

Los usuarios comerciales pueden contactar con su proveedor y consultar las condiciones del contrato de compra. Este producto no debe eliminarse mezclado con otros residuos comerciales.

Netherlands

Correcte verwijdering van dit product

(elektrische & elektronische afvalapparatuur)

Dit merkteken op het product of het bijbehorende informatiemateriaal duidt erop dat het niet met ander huishoudelijk afval verwijderd moet worden aan het einde van zijn gebruiksduur. Om mogelijke schade aan het milieu of de menselijke gezondheid door ongecontroleerde afvalverwijdering te voorkomen, moet u dit product van andere soorten afval scheiden en op een verantwoorde manier recyclen, zodat het duurzame hergebruik van materiaalbronnen wordt bevorderd.

Huishoudelijke gebruikers moeten contact opnemen met de winkel waar ze dit product hebben gekocht of met de gemeente waar ze wonen om te vernemen waar en hoe ze dit product milieuvriendelijk kunnen laten recyclen.

Zakelijke gebruikers moeten contact opnemen met hun leverancier en de algemene voorwaarden van de koopovereenkomsten nalezen. Dit product moet niet worden gemengd met ander bedrijfsafval voor verwijdering.

Czech Republic

Správná likvidace tohoto produktu

(Zničení elektrického a elektronického zařízení)

Tato značka zobrazená na produktu nebo v dokumentaci znamená, že by neměl být používán s jinými domácími zařízeními po skončení svého funkčního období. Aby se zabránilo možnému znečištění životního prostředí nebo zranění člověka díky nekontrolovanému zničení, oddělte je prosíme od dalších typů odpadů a recyklujte je zodpovědně k podpoře opětovného využití hmotných zdrojů.

Členové domácnosti by měli kontaktovat jak prodejce, u něhož produkt zakoupili, tak místní vládní kancelář, ohledně podrobností, kde a jak můžete tento výrobek bezpečně vzhledem k životnímu prostředí recyklovat.

Obchodníci by měli kontaktovat své dodavatele a zkontrolovat všechny podmínky koupě. Tento výrobek by se neměl míchat s jinými komerčními produkty, určenými k likvidaci.

Estonia

Õige viis toote kasutusest kõrvaldamiseks

(elektriliste ja elektrooniliste seadmete jäätmed)

Selline tähistus tootel või selle dokumentidel näitab, et toodet ei tohi kasutusaja lõppemisel kõrvaldada koos muude olmejäätmetega. Selleks, et vältida jäätmete kontrollimatu kõrvaldamisega seotud võimaliku kahju tekitamist keskkonnale või inimeste tervisele ning edendada materiaalsete vahendite säästvat taaskasutust, eraldage toode muudest jäätmetest ja suunake taasringlusse.

Kodukasutajad saavad teavet keskkonnaohutu ringlussevõtu kohta kas toote müüjalt või keskkonnaametist.

Firmad peaksid võtma ühendust tarnijaga ning kontrollima ostulepingu tingimusi ja sätteid. Toodet ei tohi panna muude hävitamiseks mõeldud kaubandusjäätmete hulka.

Finland

Tämän tuotteen turvallinen hävittäminen

(elektroniikka ja sähkölaitteet)

Oheinen merkintä tuotteessa tai tuotteen oheismateriaalissa merkitsee, että tätä tuotetta ei tule hävittää kotitalousjätteen mukana sen elinkaaren päätyttyä. Hallitsemattomasta jätteenkäsittelystä ympäristölle ja kanssaihmisten terveydelle aiheutuvien vahinkojen välttämiseksi tuote tulee käsitellä muista jätteistä erillään. Jäte on hyvä kierrättää raaka-aineiksi kestävän ympäristökehityksen takia.

Kotitalouskäyttäjien tulisi ottaa yhteyttä tuotteen myyneeseen jälleenmyyjään tai paikalliseen ympäristöviranomaiseen, jotka antavat lisätietoja tuotteen turvallisista kierrätysmahdollisuuksista.

Yrityskäyttäjien tulisi ottaa yhteyttä tavarantoimittajaan ja selvittää hankintasopimuksen ehdot. Tätä tuotetta ei tule hävittää muun kaupallisen jätteen seassa.

Slovenia

Ustrezno odstranjevanje tega izdelka

(odpadna električna in elektronska oprema)

Oznaka na izdelku ali spremljevalni dokumentaciji pomeni, da ga na koncu uporabne dobe ne smemo odstranjevati skupaj z drugimi gospodinjskimi odpadki. Da bi preprečili morebitno tveganje za okolje ali zdravje človeka zaradi nenadzorovanega odstranjevanja odpadkov, izdelek ločite od drugih vrst odpadkov in ga odgovorno reciklirajte ter tako spodbudite trajnostno ponovno uporabo materialnih virov.

Uporabniki v gospodinjstvih naj za podrobnosti o tem, kam in kako lahko odnesejo ta izdelek na okolju varno recikliranje, pokličejo trgovino, kjer so izdelek kupili, ali lokalni vladni urad.

Podjetja naj pokličejo dobavitelja in preverijo pogoje nabavne pogodbe. Tega izdelka pri odstranjevanju ne smete mešati z drugimi gospodarskimi odpadki.

Sweden

Korrekt avfallshantering av produkten

(elektriska och elektroniska produkter)

Denna markering på produkten och i manualen anger att den inte bör sorteras tillsammans med annat hushållsavfall när dess livstid är över. Till förebyggande av skada på miljö och hälsa bör produkten hanteras separat för ändamålsenlig återvinning av dess beståndsdelar.

Hushållsanvändare bör kontakta den återförsäljare som sålt produkten eller sin kommun för vidare information om var och hur produkten kan återvinnas på ett miljösäkert sätt.

Företagsanvändare bör kontakta leverantören samt verifiera angivna villkor i köpekontraktet. Produkten bör inte hanteras tillsammans med annat kommersiellt avfall.

Latvia

Izstrādājuma pareiza likvidēšana

(nolietotas elektriskās un elektroniskās ierīces)

Uz izstrādājuma vai tam pievienotajās instrukcijās dotais marķējums norāda, ka to nedrīkst likvidēt kopā ar citiem sadzīves atkritumiem pēc tā ekspluatācijas laika. Lai novērstu videi un cilvēku veselībai iespējamo kaitējumu, kas ir saistīts ar nekontrolējamu atkritumu likvidēšanu, tas jānošķir no citiem atkritumiem un jāpārstrādā, lai sekmētu materiālo resursu atbildīgu atkārtotu lietošanu.

Mājsaimniecības lietotājiem jāsazinās vai nu ar veikalu, kurā šis izstrādājums ir pirkts, vai ar pašvaldību, lai iegūtu informāciju par to, kā un kur var nodot šo izstrādājumu, lai garantētu ekoloģiski drošu reciklēšanu.

Rūpnieciskajiem lietotājiem jāsazinās ar piegādātāju un jāpārbauda pirkuma līguma nosacījumi. Šo izstrādājumu nedrīkst sajaukt ar citiem likvidējamiem rūpnieciskajiem atkritumiem.

Greece

Σωστή Διάθεση αυτού του Προϊόντος

(Απορρίμματα Ηλεκτρικού & Ηλεκτρονικού Εξοπλισμού)

Τα σήματα που εμφανίζονται επάνω στο προϊόν ή στα εγχειρίδια που το συνοδεύουν, υποδεικνύουν ότι δεν θα πρέπει να ρίπτεται μαζί με τα υπόλοιπα οικιακά απορρίμματα μετά το τέλος του κύκλου ζωής του. Προκειμένου να αποφευχθούν ενδεχόμενες βλαβερές συνέπειες στο περιβάλλον ή την υγεία εξαιτίας της ανεξέλεγκτης διάθεσης απορριμμάτων, σας παρακαλούμε να το διαχωρίσετε από άλλους τύπους απορριμμάτων και να το ανακυκλώσετε, ώστε να βοηθήσετε στην βιώσιμη επαναχρησιμοποίηση των υλικών πόρων.

Οι οικιακοί χρήστες θα πρέπει να έλθουν σε επικοινωνία είτε με τον πωλητή απ' όπου αγόρασαν αυτό το προϊόν, είτε τις κατά τόπους υπηρεσίες, προκειμένου να πληροφορηθούν τις λεπτομέρειες σχετικά με τον τόπο και τον τρόπο με τον οποίο μπορούν να δώσουν αυτό το προϊόν για ασφαλή προς το περιβάλλον ανακύκλωση.

Οι επιχειρήσεις-χρήστες θα πρέπει να έλθουν σε επαφή με τον προμηθευτή τους και να ελέγξουν τους όρους και τις προϋποθέσεις του συμβολαίου πώλησης. Το προϊόν αυτό δεν θα πρέπει να αναμιγνύεται με άλλα συνηθισμένα απορρίμματα προς διάθεση.

Poland

Prawidłowe usuwanie produktu

(zużyty sprzęt elektryczny i elektroniczny)

Oznaczenie umieszczone na produkcie lub w odnoszących się do niego tekstach wskazuje, że produktu po upływie okresu użytkowania nie należy usuwać z innymi odpadami pochodzącymi z gospodarstw domowych. Aby uniknąć szkodliwego wpływu na środowisko naturalne i zdrowie ludzi wskutek niekontrolowanego usuwania odpadów, prosimy o oddzielenie produktu od innego typu odpadów oraz odpowiedzialny recykling w celu promowania ponownego użycia zasobów materialnych jako stałej praktyki.

W celu uzyskania informacji na temat miejsca i sposobu bezpiecznego dla środowiska recyklingu tego produktu użytkownicy w gospodarstwach domowych powinni skontaktować się z punktem sprzedaży detalicznej, w którym dokonali zakupu produktu, lub z organem władz lokalnych.

Użytkownicy w firmach powinni skontaktować się ze swoim dostawcą i sprawdzić warunki umowy zakupu. Produktu nie należy usuwać razem z innymi odpadami komercyjnymi.

Macedonia

Правилно отстранување на овој производ

(Истрошена електрична и електронска опрема)

Оваа ознака прикажана на производот или во неговата документација покажува дека тој не треба да се фрла со преостанатиот отпад од домаќинствата, кога веќе нема да биде употреблив. За да се избегне можното нарушување на животната средина или на човековото здравје, како резултат на неконтролираното отстранување на отпадот, ве молиме да го одделите од другите видови отпад и совесно да го рециклирате, за да промовирате одржлива повторна употреба на материјалните ресурси.

Корисниците во домаќинствата треба да се обратат до дистрибутерите кај кои го купиле производот или до локалните власти, за да ги дознаат деталите за тоа каде и како можат да го однесат производот заради рециклирање коешто е безбедно за животната средина.

Деловните корисници треба да се обратат до нивните набавувачи и да ги проверат условите од договорот за купопродажба. При отстранувањето, овој производ не треба да се меша со другиот комерцијален отпад.

Norway

Korrekt avhending av dette produkt

(Avfall elektrisk og elektronisk utstyr)

Denne merkingen som vises på produktet eller dens dokumentasjon, indikerer at den ikke skal kastes sammen med annet husholdningsavfall ved slutten av sin levetid. For å hindre mulig skade på miljøet eller menneskelig helse fra ukontrollert avfallsavhending, vennligst atskill dette fra andre typer avfall og resirkuler det ansvarlig for å fremme bærekraftig gjenbruk av materielle ressurser.

Husholdningsbrukere bør kontakte enten forhandleren de kjøpte produktet av, eller lokale myndigheter, for detaljer om hvor og hvordan de kan frakte denne artikkelen for miljømessig trygg resirkulering.

Forretningsbrukere bør kontakte sin leverandør og undersøke vilkårene i kjøpekontrakten. Dette produktet skal ikke blandes med annet kommersielt avfall som skal kastes.

Romania & Moldova

Evacuarea corectă a acestui produs

(reziduuri provenind din aparatură electrică şi electronică)

Marcajele de pe acest produs sau menţionate în instrucţiunile sale de folosire indică faptul că produsul nu trebuie aruncat împreună cu alte rezuduuri din gospodărie atunci când nu mai este în stare de funcţionare. Pentru a preveni posibile efecte dăunătoare asupra mediului înconjurător sau a sănătăţii oamenilor datorate evacuării necontrolate a reziduurilor, vă rugăm să separaţi acest produs de alte tipuri de rezuduuri şi să-l reciclaţi în mod responsabil pentru a promova refolosirea resurselor materiale.

Utilizatorii casnici sunt rugaţi să ia legătura fie cu distribuitorul de la care au achiziţionat acest produs, fie cu autorităţile locale, pentru a primi informaţii cu privire la locul şi modul în care pot depozita acest produs în vederea reciclării sale ecologice.

Companiile sunt rugate să ia legătura cu furnizorul şi să verifice condiţiile stipulate în contractul de vânzare. Acest produs nu trebuie amestecat cu alte reziduuri de natură comercială.

Bulgaria

Изхвърляйте правилно този продукт

(отпадъчно електрическо и електронно оборудване)

Това обозначение на продукта или съпътстващите го материали означава, че той не бива да бъде изхвърлян заедно с другите битови отпадъци след края на полезния му живот. За да се предотврати възможно увреждане на околната среда или човешки живот от безконтролното изхвърляне на отпадъци, моля, отделяйте такива продукти от другите видове отпадъци и го рециклирайте, демонстрирайки отговорно отношение към насърчаването на устойчива многократна употреба на материални ресурси.

При употреба за битови нужди трябва да се свържете с продавача на дребно, от когото сте закупили продукта или с местните власти за подробности относно това къде и как можете да предадете продукта за безопасно рециклиране.

При употреба за стопански нужди трябва да се свържете с доставчика си и да проверите реда и условията в договора за закупуване. Този продукт не трябва да се смесва с други отпадъци на работното място.

Denmark

Korrekt affaldsbortskaffelse af dette produkt

(elektrisk & elektronisk udstyr)

Mærket på dette produkt eller i den medfølgende dokumentation betyder, at produktet ikke må bortskaffes sammen med almindeligt husholdningsaffald efter endt levetid. For at undgå skadelige miljø- eller sundhedspåvirkninger på grund af ukontrolleret affaldsbortskaffelse skal dette produkt bortskaffes særskilt fra andet affald og indleveres behørigt til fremme for bæredygtig materialegenvinding.

Hjemmebrugere bedes kontakte forhandleren, hvor de har købt produktet, eller den lokale myndighed for oplysning om, hvor og hvordan de kan indlevere produktet med henblik på miljøforsvarlig genvinding.

Erhvervsbrugere bedes kontakte leverandøren og læse betingelserne og vilkårene i købekontrakten. Dette produkt bør ikke bortskaffes sammen med andet erhvervsaffald.

Republic of Ireland (Gaelic)

Diúscairt Cheart an Táirge Seo

(Trealamh Leictreach agus Leictreonach Dramhaíola)

Léiríonn an mharcáil seo atá ar an táirge nó sa litríocht a thagann leis, nár chóir é a dhiúscairt le dramhaíl tí eile ag deireadh a shaoil oibre. Chun cosaint i gcoinne dochar don chomhshaol nó do shláinte an duine, a d'fhéadfadh bheith mar thoradh ar an ndiúscairt dramhaíola neamhtheoranta, scar an dramhaíl seo ó chineálacha eile dramhaíola le do thoil agus déan athchursáil fhreagrach air chun athúsáid inmharthana na hacmhainní ábhartha a chur chun cinn.

Ba chóir dóibh siud a úsáideann an trealamh sa bhaile dul i dteagmháil leis an díoltóir ónar cheannaigh siad an táirge seo, nó lena n-oifig áitiúil Rialtais, ar mhaithe le sonraí a fháil faoi cá háit agus cathain is féidir athchúrsáil atá slán ó thaobh an chomhshaoil de a dhéanamh ar an táirge seo.

Ba chóir dóibh siúd a úsáideann an trealamh seo ina ngnó dul i dteagmháil leis an soláthróir agus téarmaí agus coinníollacha an chonartha ceannaigh a sheiceáil. Níor chóir an táirge seo a chur le dramhaíl eile tráchtála agus diúscairt á déanamh.

Slovakia

Správna likvidácia tohoto výrobku

(Elektrotechnický a elektronický odpad)

Toto označenie na výrobku alebo v sprievodnej brožúre hovorí, že po skončení jeho životnosti by nemal byť likvidovaný s ostatným odpadom. Prípadnému poškodeniu životného prostredia alebo ľudského zdravia môžete predísť tým, že budete takéto typy výrobkov oddeľovať od ostatného odpadu a vrátite ich na recykláciu.

Používatelia v domácnostiach by pre podrobné informácie, ako ekologicky bezpečne naložiť s týmto výrobkom, mali kontaktovať buď predajcu, ktorý im výrobok predal, alebo príslušný úrad v okolí ich bydliska.

Priemyselní používatelia by mali kontaktovať svojho dodávateľa a preveriť si podmienky kúpnej zmluvy. Tento výrobok by nemal byť likvidovaný spolu s ostatným priemyselným odpadom.

Portugal

Eliminação Correcta Deste Produto

(Resíduo de Equipamentos Eléctricos e Electrónicos)

Esta marca, apresentada no produto ou na sua literatura indica que ele não deverá ser eliminado juntamente com os resíduos domésticos indiferenciados no final do seu período de vida útil. Para impedir danos ao ambiente e à saúde humana causados pela eliminação incontrolada de resíduos deverá separar este equipamento de outros tipos de resíduos e reciclá-lo de forma responsável, para promover uma reutilização sustentável dos recursos materiais.

Os utilizadores domésticos deverão contactar ou o estabelecimento onde adquiriram este produto ou as entidades oficiais locais para obterem informações sobre onde e de que forma podem levar este produto para permitir efectuar uma reciclagem segura em termos ambientais.

Os utilizadores profissionais deverão contactar o seu fornecedor e consultar os termos e condições do contrato de compra. Este produto não deverá ser misturado com outros resíduos comerciais para eliminação.

Hungary

A termék megfelelő leadása

(Elektromos és elektronikus készülékek hulladékkezelése)

A terméken vagy a hozzá tartozó dokumentáción szereplő jelzés arra utal, hogy hasznos élettartama végén a terméket nem szabad háztartási hulladékkal együtt kidobni. Annak érdekében, hogy megelőzhető legyen a szabálytalan hulladékleadás által okozott környezet- és egészségkárosodás, különítse ezt el a többi hulladéktól, és felelősségteljesen gondoskodjon a hulladék leadásáról, a hulladékanyagok fenntartható szintű újrafelhasználása céljából.

A háztartási felhasználók a termék forgalmazójától vagy a helyi önkormányzati szervektől kérjenek tanácsot arra vonatkozóan, hová és hogyan vihetik el ez elhasznált terméket a környezetvédelmi szempontból biztonságos hulladékleadás céljából.

Az üzleti felhasználók lépjenek kapcsolatba a forgalmazóval, és vizsgálják meg az adásvételi szerződés feltételeit. A terméket nem szabad leadni kereskedelmi forgalomból származó egyéb hulladékkal együtt.

Lithuania

Tinkamas produkto atliekų tvarkymas

(atitarnavusi elektros ir elektronikos įranga)

Šis ženklas, pateikiamas ant produkto ar jo dokumentacijoje, nurodo, kad pasibaigus produkto tarnavimo laikui, jo negalima išmesti kartu su kitomis buitinėmis atliekomis. Kad būtų išvengta galimos nekontroliuojamo atliekų išmetimo žalos aplinkai arba žmonių sveikatai, ir siekiant skatinti aplinką tausojantį antrinių žaliavų panaudojimą, pašom atskirti jį nuo kitų rūšių atliekų ir atiduoti perdirbti.

Informacijos, kur ir kaip pristatyti šį produktą saugiai perdirbti, privatūs vartotojai turėtų kreiptis arba į parduotuvę, kurioje šį produktą pirko, arba į vietines valdžios institucijas.

Verslo vartotojai turėtų kreiptis į savo tiekėją ir peržiūrėti pirkimo sutarties sąlygas. Šis produktas tvarkant atliekas negali būti sumaišytas su kitomis atliekomis.

LECO-Supplied Hewlett-Packard® Computers

Hewlett-Packard Support

All LECO-supplied *Hewlett-Packard* computers include HP® customer technical support and warranty claim information.

The inclusion of *HP* customer technical support and product warranty with LECO-supplied *HP* Computers ensures that any computer-related service issues are handled directly by the experts at *HP*. This eliminates the unnecessary step of working through the LECO service professionals for a resolution from *HP*.

For more information, call 1-866-625-1175, or access the *HP* website by following the link below and selecting the appropriate country and support language:

http://www8.hp.com/us/en/contact-hp/ww-contact-us.html

To expedite service, please have your *HP* computer serial number and model number available when contacting *HP*. These can be found on the back or side of the computer tower.

LECO-Supplied Balances

Sartorius® Support

All LECO-supplied *Sartorius* balances are supported and covered by warranty through *Sartorius*.

The direct support and warranty coverage by *Sartorius* with LECO-supplied *Sartorius* balances ensures that any balance-related service issues are handled directly by the experts at *Sartorius*. This eliminates the unnecessary step of working through the LECO service professionals for a resolution from *Sartorius*.

For more information, access the *Sartorius* website by following the link below and selecting the appropriate country:

http://www.sartorius.com/en/contact/local-contact/

To expedite service, please have your *Sartorius* balance serial number and model number available when contacting *Sartorius*.

Declaration of Conformity Statement

European Union Directives - CE Marking

This equipment, which bears the CE Marking, complies with all the applicable requirements set out in the EU Directives.

NOTE The EU Declaration of Conformity (EU-DoC) for this instrument is available upon request.

The following information sets out the content of the EU-DoC, including a list of EU Directives, harmonized standards, supporting standards and other applicable documents.

Machinery Directive (Product Safety)

EN ISO 12100 Risk Assessment - Safety of Machinery

EN/IEC 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

EMC Directive (Electromagnetic Compatibility)

EN55011 RF Emissions Class A

EN 61000-3-2 & EN 61000-3-12 Harmonic Emissions

EN 61000-3-3 & EN 61000-3-11 Flicker Emissions

EN 61326-1 EMC requirements for electrical equipment for measurement, control, and laboratory use.

- CISPR11 RF Emissions Class A
- IEC 61000-4-2 Electrostatic Discharge
- IEC 61000-4-3 Radiated RF Immunity
- IEC 61000-4-4 Fast Transient Burst
- IEC 61000-4-5 Surge Immunity
- IEC 61000-4-6 Conducted RF Immunity
- IEC 61000-4-8 Magnetic Immunity
- IEC 61000-4-11 Voltage Dips, Interrupts

RoHS Directive (Restriction of Hazardous Substances)

EN 50581 RoHS in Electrical and Electronic Equipment

Product Safety

The equipment is also designed and manufactured to meet the following product safety requirements.

International

IEC 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

USA

UL 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

Canada

CAN/CSA-C22.2 No. 61010 Safety requirements for electrical equipment for measurement, control, and laboratory use.

Australia & New Zealand

AS/NZS 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use.

Instruments with Hydraulic and/or Pneumatic Fluid Systems

The hydraulic and pneumatic systems and their components are in accordance with the applicable sections of the following:

ISO 4413, Hydraulic fluid power-General rules and safety requirements for systems and their components.

ISO 4414, Pneumatic fluid power-General rules and safety requirements for systems and their components.

Electromagnetic Compatibility Notices

USA

Federal Communications Commission (FCC) statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 (Part 18 where applicable) of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. LECO Corporation is not responsible for any radio or television interference caused by using other than recommended cables and connectors or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 (Part 18 where applicable) of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Canada

Industry Canada Class A Emission Compliance Statement

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

European Union

European Union EMC Directive conformance statement

LECO Corporation cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-authorized modification of the product.

Attention: This is an EN 55011 Class A Group 1 product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

Australia & New Zealand

Attention: This is a CISPR 11 Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take adequate measures.

Radio-Frequency Disturbance

This product complies with IEC/EN 55011/CISPR11 Radio-frequency disturbance characteristics of industrial, scientific and medical equipment (ISM), which requires the following information to be provided within the User Documentation:

NOTE → The use of **Interconnecting Cables** other than those provided and/or specified may cause undesired electromagnetic compatibility performance.

Definitions

NOTE → This is a Class A Group 1 Product.

Class A equipment is equipment suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes.

Class B equipment is equipment suitable for use in domestic establishments and in establishments directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes.

Group 1 equipment contains all equipment in the scope of this standard that is not classified as group 2 equipment.

Group 2 equipment contains all ISM RF equipment (Industrial, Scientific, Medical) in which radio-frequency energy in the frequency range 9 kHz to 400 GHz is intentionally generated and used, or only used, in the form of electromagnetic radiation, inductive and/or capacitive coupling, for the treatment of material or inspection/analysis purposes.

Flicker and Harmonic Emissions

To reduce the chance of voltage fluctuations, flicker emissions, or harmonic emissions, it is recommended that this equipment be connected to a private low-voltage distribution system. If connected to a public low-voltage distribution system, a minimum facility service current capacity of 100 amps is required. Consultation with the distribution system authority may be required.

About this Manual

The organization of this instruction manual is explained as follows. For each chapter, there is a hyperlinked table of contents and list of illustrations, if applicable.

NOTE The screenshots used throughout the manual are examples only and may or may not be applicable to specific procedures.

Chapter 1, **Introduction**, page 1–9, describes general information including safety guidelines and warranty terms. This chapter also provides information about parts and accessories.

Chapter 2, **Installation**, page 2–1, describes hardware setup and connection.

Chapter 3, **Analysis**, page 3–1, describes how to analyze samples.

Chapter 4, **Settings**, page 4–1, describes how to configure parameters in the software.

Chapter 5, **Instrument**, page 5–1, describes how to configure the instrument.

Chapter 6, **Maintenance**, page 6–1, describes procedures to perform on a regular basis to improve the instrument's performance and life span.

Chapter 7, **Theory of Operation**, page 7–1, provides a theoretical overview of instrument operation.

Chapter 8, **Diagnostics**, page 8–1, describes how to monitor the instrument to ensure proper operation.

Chapter 9, **Service**, page 9–1, describes service procedures. Contact the LECO Service Department for more information.

Chapter 10, **Illustrations**, page 10–1, provides illustrations and photographs that can assist with procedures and location of parts.

Chapter 11, **Schematics**, page 11–1, provides diagrams of circuit boards and wiring.

Chapter 12, **Glossary**, page 12–1, provides definitions of terms.

Chapter 13, **Index**, page 13–1, provides page numbers for topics throughout the manual. In the electronic manual available through the software, the page numbers in the index provide a hyperlink to the corresponding topic.

Equipment Packages

Items listed as follows are repeated throughout this manual and are subject to revision. Please consult the packing slip received with the instrument.

Refer to Test Pack Consumables, page 1–44, for more information on what is included in the Test Pack Consumable packages.

FP828-C PKG FP828 230V PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-100-600**	ASSY FP828 230V
1	686-712	ASSY PC TOWER 828 SERIES HP W10
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-555	PACK ACCESSORY FP828 W/LOOP

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-551 FP828 Test Pack Consumable

FP828-CR PKG FP828 230V NO PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-100-600**	ASSY FP828 230V
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-555	PACK ACCESSORY FP828 W/LOOP

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-551 FP828 Test Pack Consumable

FP828-MC PKG FP828 TSCREEN/PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-100-700**	ASSY FP828 W/TSCRN
1	686-712	ASSY PC TOWER 828 SERIES HP W10
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-555	PACK ACCESSORY FP828 W/LOOP

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-551 FP828 Test Pack Consumable

FP828-MCR PKG FP828 TSCREEN/NO PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-100-700**	ASSY FP828 W/TSCRN
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-555	PACK ACCESSORY FP828 W/LOOP

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-551 FP828 Test Pack Consumable

FP828P-C PKG FP828 PERFORMANCE PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-100-800**	ASSY FP828 PERFORMANCE
1	622-002-427	PACK ACCESSORY FP828P
1	686-712	ASSY PC TOWER 828 SERIES HP W10
1	619-591-921	ASSY KEY REGISTRATION

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-552 FP828P Test Pack Consumable

FP828P-CR PKG FP828 PERFORMANCE/NO PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-100-800**	ASSY FP828 PERFORMANCE
1	622-002-427	PACK ACCESSORY FP828P
1	619-591-921	ASSY KEY REGISTRATION

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-552 FP828P Test Pack Consumable

FP828P-MC PKG FP828 PERFORMANCE/TSCREEN/PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-100-900**	ASSY FP828 PERFORM/TSCRN
1	622-002-427	PACK ACCESSORY FP828P
1	686-712	ASSY PC TOWER 828 SERIES HP W10
1	619-591-921	ASSY KEY REGISTRATION

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-552 FP828P Test Pack Consumable

FP828P-MCR PKG FP828 PERFORMANCE/TSCREEN/NO PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-100-900**	ASSY FP828 PERFORM/TSCRN
1	622-002-427	PACK ACCESSORY FP828P
1	619-591-921	ASSY KEY REGISTRATION

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-552 FP828P Test Pack Consumable

CN828-C PKG CN828 230V PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-200-000**	ASSY CN828 230V
1	686-712	ASSY PC TOWER 828 SERIES HP W10
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-503	PACK ACCESSORY CN828

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-553 CN828 Test Pack Consumable

CN828-CR PKG CN828 230V NO PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-200-000**	ASSY CN828 230V
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-503	PACK ACCESSORY CN828

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**Includes 622-002-553 CN828 Test Pack Consumable

CN828-MC PKG CN828 TSCREEN/PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-200-100**	ASSY CN828 W/TSCRN
1	686-712	ASSY PC TOWER 828 SERIES HP W10
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-503	PACK ACCESSORY CN828

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**Includes 622-002-553 CN828 Test Pack Consumable

CN828-MCR PKG CN828 TSCREEN/NO PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	622-200-100**	ASSY CN828 W/TSCRN
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-503	PACK ACCESSORY CN828

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-553 CN828 Test Pack Consumable

CHN828-C PKG CHN828 230V PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-738	PACK ACCESSORY CHN828
1	622-200-200**	ASSY CHN828 230V
1	686-712	ASSY PC TOWER 828 SERIES HP W10
1	503-510-HAZ*	REAGENT FURNACE SECONDARY 100G

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-737 CHN828 Test Pack Consumable

CHN828-CR PKG CHN828 230V NO PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-738	PACK ACCESSORY CHN828
1	622-200-200**	ASSY CHN828 230V
1	503-510-HAZ*	REAGENT FURNACE SECONDARY 100G

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-737 CHN828 Test Pack Consumable

CHN828-MC PKG CNH828 230V TSCREEN/PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-738	PACK ACCESSORY CHN828
1	622-200-300**	ASSY CHN828 W/TSCRN
1	686-712	ASSY PC TOWER 828 SERIES HP W10
1	503-510-HAZ*	REAGENT FURNACE SECONDARY 100G

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-737 CHN828 Test Pack Consumable

CHN828-MCR PKG CHN828 230V TSCREEN/NO PC

1	259-097	SOFTWARE KIT 828 SERIES
1	501-171-HAZ*	ANHYDRONE 10-16 MESH 1/LB
1	502-174-HAZ*	LECOSORB 20-30 MESH 500G
1	619-591-921	ASSY KEY REGISTRATION
1	622-002-738	PACK ACCESSORY CHN828
1	622-200-300**	ASSY CHN828 W/TSCRN
1	503-510-HAZ*	REAGENT FURNACE SECONDARY 100G

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

**Includes 622-002-737 CHN828 Test Pack Consumable

Test Pack Consumables

622-002-551 FP828 Test Pack Consumable

1	502-688	NICTOTINIC ACID LCRM TM C/H/N 25G
1	502-896	EDTA LCRM C/H/N 50G

622-002-552 FP828P Test Pack Consumable

1	502-688	NICTOTINIC ACID LCRM TM C/H/N 25G
1	502-896	EDTA LCRM C/H/N 50G

622-002-553 CN828 Test Pack Consumable

1	502-688	NICTOTINIC ACID LCRM TM C/H/N 25G
1	502-896	EDTA LCRM C/H/N 50G

622-002-737 CHN828 Test Pack Consumable

1	502-896	EDTA LCRM C/H/N 50G
1	502-642	PHENYLALANINE LCRM C/H/N 50G

Options

622-100-6OP CN/CHN/FP828 Options

1	622-002-536	ASSY TOOL CLIBRATION THERMOCOUPLE PRIMARY
1	622-002-537	ASSY TOOL CALIBRATION THERMOCOUPLE SECONDARY
1	502-951-HAZ*	PACK CONSUMABLE 828 SML TIN FOIL CUP 1K
1	502-952-HAZ*	PACK CONSUMABLE 828 LRG TIN FOIL CUP 1K
1	502-953-HAZ*	PACK CONSUMABLE 828 SML GEL CAP 1K
1	502-954-HAZ*	PACK CONSUMABLE 828 MED GEL CAP 1K
1	502-955-HAZ*	PACK CONSUMABLE 828 SML TIN CAP 1K
1	502-956-HAZ*	PACK CONSUMABLE 828 SML TIN FOIL CUP 5K
1	502-957-HAZ*	PACK CONSUMABLE 828 LRG TIN FOIL CUP 5K
1	502-958-HAZ*	PACK CONSUMABLE 828 MED GEL CAP 5K
1	502-959-HAZ*	PACK CONSUMABLE 828 SML GEL CAP 5K
1	502-960-HAZ*	PACK CONSUMABLE 828 SML TIN CAP 5K
1	104-195-HAZ*	KIT PMA PARTS CN/FP828
1	104-196	KIT MAINT PARTS CN/FP828
1	501-426	COM-AID SOLIDS AND POWDER 1/LB
1	501-427	COM-AID LIQUIDS 1 LB
1	502-082	TOBACCO LRM TM C/N/S 20G
1	502-273	ALFALFA LRM TM C/N/S 50G
1	502-642	PHENYLALANINE LCRM C/H/N 50G
1	502-688	NICTOTINIC ACID LCRM TM C/H/N 25G
1	502-692	FLOUR WHEAT LCRM C/H/N/S 50G
1	502-694	SOIL LCRM C/N/S 65G
1	502-696	SYNTHETIC CARBON LCRM C 50G
1	502-697	SOIL LCRM C/N/S 65G
1	502-896	EDTA LCRM C/H/N 50G
1	502-897	BBOT LCRM C/H/N/S 25G
1	502-902	CALCIUM CARBONATE LCRM C 50G
1	502-905	SYNTHETIC CARBON LCRM C 50G
1	502-906	FLOUR BARLEY LCRM N 50G
1	502-907	FLOUR RICE LCRM N 50G
1	502-931	ORCHARD LEAVES LCRM C/H/N/S 20G
1	502-932	CORN GLUTEN LCRM C/H/N/S 50G
1	502-934	CARBON SYNTHETIC LCRM C 50G
1	619-592-148	POWER SUPPLY/CABLE 12V MONITOR TOUCHSCRN
1	619-592-882-B/O	SUBSCRIPTION MOBILE 1 YEAR
1	619-592-899-B/O	SUBSCRIPTION MOBILE 3 YEAR
1	619-593-556	PROTECTOR SCREEN TOUCH 22 IN
1	619-593-570	SCANNER BAR CODE LASER BLUETOOTH
1	619-593-628	KIT MONITOR T/SCREEN DESKTOP D/P 15FT

622-100-6OP CN/CHN/FP828 Options

1	619-593-630	KIT MONITOR T/SCREEN DESKTOP D/P W/CARD 15FT
1	619-995	SCANNER BAR CODE LASER USB
1	621-453-110	KIT PRINTER OFFICEJET PRO HP6230
1	621-454	CARTRIDGE BLACK PRNTR OFFICEJET PRO HP6230
1	621-455	CARTRIDGE CYAN PRNTR OFFICEJET PRO HP6230
1	621-456	CARTRIDGE MAGENTA PRNTR OFFICEJET PRO HP6230
1	621-457	CARTRIDGE YELLOW PRNTR OFFICEJET PRO HP6230
1	625-603-403	ASSY BLOCK TC LEAK CHECK
1	686-550	MONITOR PC 19 IN NEC
1	710-198-B/O	LABOR SMARTLINE SETUP INTERNET
1	751-350-110	KIT BALANCE 4-PLC SECURA124-1S
1	751-700-120	KIT BALANCE 5PL PC CTRL
1	625-603-414	SWAB FOAM FLEXIBLE LARGE 100PKG
1	633-103-359	KIT REGULATOR PRESS UHP LINE 0-50 W/BRKT QTV
1	633-103-354	KIT REGULATOR PRESS 2 STAGE SCI AIR CGA346 QTV
1	633-103-356	KIT REGULATOR PRESS 2 STAGE OXYGEN CGA540 QTV
1	633-103-358	KIT REGULATOR PRESS 2 STAGE INERT GAS CGA580 QTV
1	502-397-400	CUP SAMPLE TIN LARGE 400/PK
1	502-186-100	CUP SAMPLE TIN FOIL 1000BT
1	502-040-100	CAPSULE TIN .250X.625 1000BT
1	502-167	CAPSULE TIN .343X .750 100/BT
1	502-825	CAPSULE TIN LARGE 9.05 X 21MM 50/BX
1	619-180-110	KIT CAROUSEL STACKBL 30P
1	619-591-726	MONITOR COLOR LCD 23 IN EA SERIES
1	625-603-398	ASSY CAP BALLAST LEAK CHECK
1	502-962	SOIL LCRM C/N/S 65G
1	660-054	KIT INSTALLATION QUALIFICATION 828
1	660-055	KIT OPERATION QUALIFICATION CN/FP828
1	502-713	FLOUR CORN LCRM TM N 50G
1	051-115	SPEC SHEET 828 SERIES
1	625-603-297	VALVE S070B 24V NC
1	622-002-652	KIT CONVERSION FP828 TO FP828P
1	622-002-654	KIT CONVERSION FP828 TO CN828
1	622-002-656	KIT CONVERSION FP828P TO CN828
1	502-973	STICK COPPER DEOXIDIZED 200G
1	619-593-680-B/O	SOFTWARE UPGR C/STONE REMOTE CNTRL/COMM
1	259-097-CPK	SOFTWARE KIT 828 W/KEY
1	259-097UPGR	SOFTWARE KIT 828 UPGRADE WO/KEY

622-100-6OP CN/CHN/FP828 Options

1	502-983	ALFALFA LCRM C/N/S 50G
1	502-984	TOBACCO LCRM C/N/S 20G
1	622-002-713	KIT FURNACE TRANSFER LINE REPL 828
1	625-603-536	KIT REPL COVER/INSUL BLOCK CELL TC
1	751-060-110	KIT BALANCE 4 PLC ENTRIS II 124 120G

*Packed and shipped separately in the U.S.A. Not included with international shipments due to shipping regulations. These items are essential for operation. Contact your LECO distributor for quotation and delivery.

Components and Accessories

622-002-555 Accessory Pack FP828 w/Loop

1	203-828	LIT ORGANIC SUPPLIES CAT
1	501-241	LUB GREASE VACUUM 5.3OZ
1	501-614	SPATULA SAMPLE
1	502-023	FUNNEL QUICK DISC TUBE
1	502-049	REAGENT N CATALYST 50G
1	502-186-200	CUP SAMPLE TIN FOIL 100BT
1	502-237	WIPES FOAM 25/PK
1	502-310	WOOL STEEL #2 1LB
1	502-382	CAPSULE QUIKCAP MEDIUM 400/PK
1	502-896	EDTA LCRM C/H/N 50G
1	604-378	TWEEZER CURVED SST 3.9
1	604-398	SLEEVE CAPSULE
2	608-379	STRIP QUARTZ WOOL 15 IN 10/PK
1	614-961-110	CRUCIBLE POROUS FP-528 10/PK
1	616-152	ASSY TOOL CRUCIBLE EXTRACTOR
1	616-513	TOOL INSTALLATION O-RING DOSER
1	622-002-476	PACK TUBES SPARE
1	625-603-404	ASSY TOOL PACKING TUBE
1	762-515	TOOL O-RING REMOVAL
1	763-265	WOOL GLASS .50/LB
1	778-405	ASSY BLOCK CAPSULE STORAGE
1	789-260	ASSY TOOL WOOL EXTRACTOR
1	625-601-867	WRENCH OPEN END 7-16
1	502-177	WOOL QUARTZ FINE 50G
1	778-233-110	KIT REPL LOOP SAMPLE 10CC SST
1	778-321	ASSY TOOL LANCE EXTRACTOR
1	502-973	STICK COPPER DEOXIDIZED 200G
1	209-270-006	USB 828 SERIES INSTALL/MAINT SVC VIDEO ASSY
1	502-995	COPPER TURNINGS DEGASSED 60G

622-002-427 Accessory Pack FP828P

1	203-828	LIT ORGANIC SUPPLIES CAT
1	501-241	LUB GREASE VACUUM 5.3OZ
1	501-614	SPATULA SAMPLE
1	502-023	FUNNEL QUICK DISC TUBE
1	502-049	REAGENT N CATALYST 50G
1	502-186-200	CUP SAMPLE TIN FOIL 100BT
1	502-310	WOOL STEEL #2 1LB
1	502-382	CAPSULE QUIKCAP MEDIUM 400/PK

622-002-427 Accessory Pack FP828P

1	604-378	TWEEZER CURVED SST 3.9
1	604-398	SLEEVE CAPSULE
2	608-379	STRIP QUARTZ WOOL 15 IN 10/PK
1	614-961-110	CRUCIBLE POROUS FP-528 10/PK
1	616-152	ASSY TOOL CRUCIBLE EXTRACTOR
1	616-513	TOOL INSTALLATION O-RING DOSER
1	762-515	TOOL O-RING REMOVAL
1	763-265	WOOL GLASS .50/LB
1	778-405	ASSY BLOCK CAPSULE STORAGE
1	789-260	ASSY TOOL WOOL EXTRACTOR
1	622-002-476	PACK TUBES SPARE
1	502-237	WIPES FOAM 25/PK
1	625-603-404	ASSY TOOL PACKING TUBE
1	625-711-260	TOOL REMOVAL SCREEN/STEM DOSER
1	625-601-867	WRENCH OPEN END 7-16
1	502-177	WOOL QUARTZ FINE 50G
1	778-321	ASSY TOOL LANCE EXTRACTOR
1	502-973	STICK COPPER DEOXIDIZED 200G
1	209-270-006	USB 828 SERIES INSTALL/MAINT SVC VIDEO ASSY
1	502-995	COPPER TURNINGS DEGASSED 60G

622-002-503 Accessory Pack CN828

1	203-828	LIT ORGANIC SUPPLIES CAT
1	501-241	LUB GREASE VACUUM 5.3OZ
1	501-614	SPATULA SAMPLE
1	502-023	FUNNEL QUICK DISC TUBE
1	502-049	REAGENT N CATALYST 50G
2	502-186-200	CUP SAMPLE TIN FOIL 100BT
1	502-310	WOOL STEEL #2 1LB
1	604-378	TWEEZER CURVED SST 3.9
1	604-398	SLEEVE CAPSULE
2	608-379	STRIP QUARTZ WOOL 15 IN 10/PK
1	614-961-110	CRUCIBLE POROUS FP-528 10/PK
1	616-152	ASSY TOOL CRUCIBLE EXTRACTOR
1	616-513	TOOL INSTALLATION O-RING DOSER
1	762-515	TOOL O-RING REMOVAL
1	763-265	WOOL GLASS .50/LB
1	778-405	ASSY BLOCK CAPSULE STORAGE
1	789-260	ASSY TOOL WOOL EXTRACTOR
1	622-002-476	PACK TUBES SPARE
1	502-237	WIPES FOAM 25/PK
1	625-603-404	ASSY TOOL PACKING TUBE

622-002-503 Accessory Pack CN828

1	625-711-260	TOOL REMOVAL SCREEN/STEM DOSER
1	625-601-867	WRENCH OPEN END 7-16
1	502-177	WOOL QUARTZ FINE 50G
1	778-321	ASSY TOOL LANCE EXTRACTOR
1	502-973	STICK COPPER DEOXIDIZED 200G
1	209-270-006	USB 828 SERIES INSTALL/MAINT SVC VIDEO ASSY
1	502-995	COPPER TURNINGS DEGASSED 60G

622-002-738 Accessory Pack CHN828

1	203-828	LIT ORGANIC SUPPLIES CAT
1	501-241	LUB GREASE VACUUM 5.3OZ
1	501-614	SPATULA SAMPLE
1	502-023	FUNNEL QUICK DISC TUBE
1	502-049	REAGENT N CATALYST 50G
2	502-186-200	CUP SAMPLE TIN FOIL 100BT
1	604-378	TWEEZER CURVED SST 3.9
1	604-398	SLEEVE CAPSULE
4	608-379	STRIP QUARTZ WOOL 15 IN 10/PK
1	614-961-110	CRUCIBLE POROUS FP-528 10/PK
1	616-152	ASSY TOOL CRUCIBLE EXTRACTOR
1	616-513	TOOL INSTALLATION O-RING DOSER
1	762-515	TOOL O-RING REMOVAL
1	763-265	WOOL GLASS .50/LB
1	778-405	ASSY BLOCK CAPSULE STORAGE
1	789-260	ASSY TOOL WOOL EXTRACTOR
1	622-002-747	PACK TUBES SPARE
1	502-237	WIPES FOAM 25/PK
1	625-603-404	ASSY TOOL PACKING TUBE
1	625-711-260	TOOL REMOVAL SCREEN/STEM DOSER
1	625-601-867	WRENCH OPEN END 7-16
1	502-177	WOOL QUARTZ FINE 50G
1	778-321	ASSY TOOL LANCE EXTRACTOR
1	502-973	STICK COPPER DEOXIDIZED 200G
1	209-270-006	USB 828 SERIES INSTALL/MAINT SVC VIDEO ASSY
1	502-995	COPPER TURNINGS DEGASSED 60G

622-160-070 Component Pack CN/FP828/P

1	200-793	MANUAL INSTR CN/CHN/FP828
1	619-180	ASSY CAROUSEL STACKABLE 30 POS
1	619-304	ASSY COVER DUST CAROUSEL
2	619-592-395	ASSY CONNECTION CU .125 GAS CARRIER 6FT
1	620-682	ASSY CABLE CAT 5 15FT CRSSOVER

622-160-070 Component Pack CN/FP828/P

1	625-603-197	ASSY FLASK EXHAUST
12	625-710-695	TUBING FLX POLYU ORG .166ID X .042W
1	709-806-720	CORD POWER ASSY 8FT 15A/250V
1	709-806-808	RECEPTACLE SNGL 15A 250V BLK
1	709-806-809	COVER RECEPTACLE SNGL SST
1	622-002-516	ASSY PLATE BYPASS
1	622-002-531	ASSY MIRROR VIEWING FURNACE

622-170-070 Component Pack CN/FP828/P w/Touchscreen

1	200-793	MANUAL INSTR CN/CHN/FP828
1	619-180	ASSY CAROUSEL STACKABLE 30 POS
1	619-304	ASSY COVER DUST CAROUSEL
1	619-592-148	POWER SUPPLY/CABLE 12V MONITOR TOUCHSCRN
2	619-592-395	ASSY CONNECTION CU .125 GAS CARRIER 6FT
1	619-593-602	ASSY MONITOR T/SCREEN 22 MNTD DISP PORT
1	620-682	ASSY CABLE CAT 5 15FT CRSSOVER
1	625-603-197	ASSY FLASK EXHAUST
12	625-710-695	TUBING FLX POLYU ORG .166ID X .042W
1	709-806-720	CORD POWER ASSY 8FT 15A/250V
1	709-806-808	RECEPTACLE SNGL 15A 250V BLK
1	709-806-809	COVER RECEPTACLE SNGL SST
1	622-002-516	ASSY PLATE BYPASS
1	622-002-531	ASSY MIRROR VIEWING FURNACE

622-220-070 Component Pack CHN828

1	200-793	MANUAL INSTR CN/CHN/FP828
1	619-180	ASSY CAROUSEL STACKABLE 30 POS
1	619-304	ASSY COVER DUST CAROUSEL
2	619-592-395	ASSY CONNECTION CU .125 GAS CARRIER 6FT
1	620-682	ASSY CABLE CAT 5 15FT CRSSOVER
12	625-710-695	TUBING FLX POLYU ORG .166ID X .042W
1	709-806-720	CORD POWER ASSY 8FT 15A/250V
1	709-806-808	RECEPTACLE SNGL 15A 250V BLK
1	709-806-809	COVER RECEPTACLE SNGL SST
1	622-002-516	ASSY PLATE BYPASS
1	622-002-531	ASSY MIRROR VIEWING FURNACE
1	619-777	TUBE MIDDLE DIRECTING
1	622-002-748	TUBE REAGENT SEC LOAD STOP

622-230-070 Component Pack CHN828 w/Touchscreen

1	200-793	MANUAL INSTR CN/CHN/FP828
1	619-180	ASSY CAROUSEL STACKABLE 30 POS
1	619-304	ASSY COVER DUST CAROUSEL
1	619-592-148	POWER SUPPLY/CABLE 12V MONITOR TOUCHSCRN
2	619-592-395	ASSY CONNECTION CU .125 GAS CARRIER 6FT
1	619-593-602	ASSY MONITOR T/SCREEN 22 MNTD DISP PORT
1	620-682	ASSY CABLE CAT 5 15FT CRSSOVER
12	625-710-695	TUBING FLX POLYU ORG .166ID X .042W
1	709-806-720	CORD POWER ASSY 8FT 15A/250V
1	709-806-808	RECEPTACLE SNGL 15A 250V BLK
1	709-806-809	COVER RECEPTACLE SNGL SST
1	622-002-516	ASSY PLATE BYPASS
1	622-002-531	ASSY MIRROR VIEWING FURNACE
1	619-777	TUBE MIDDLE DIRECTING
1	622-002-748	TUBE REAGENT SEC LOAD STOP

686-712 ASSY PC TOWER 828 HP W10

1	686-712-101	NAMEPLATE ID 828 SERIES PC
1	WARR-365	WARRANTY 12 MONTH STANDARD
1	686-733	COMPUTER HP Z2 3.6GHZ I3-8100 W10
1	609-787	PACK COMPONENT TWR RECEP/MOUSE

Specifications

Instrument Range*

Nitrogen, FP828**

(10 cm^3), Helium Carrier Gas ....0.04 mg to 300 mg
(3 cm^3), Helium Carrier Gas ....0.08 mg to 300 mg
(10 cm^3), Argon Carrier Gas ....0.12 mg to 300 mg
(3 cm^3), Argon Carrier Gas................0.24 mg to 300 mg

Nitrogen, FP828P and CN/CHN828

(10 cm^3), Helium Carrier Gas ....0.02 mg to 300 mg
(3 cm^3), Helium Carrier Gas ....0.04 mg to 300 mg
(10 cm^3), Argon Carrier Gas ....0.06 mg to 300 mg
(3 cm^3), Argon Carrier Gas................0.12 mg to 300 mg

Carbon, CN/CHN828

(10 cm^3), Helium Carrier Gas ....0.02 mg to 175 mg
(3 cm^3), Helium Carrier Gas ....0.04 mg to 175 mg
(10 cm^3), Argon Carrier Gas ....0.02 mg to 175 mg
(3 cm^3), Argon Carrier Gas................0.04 mg to 175 mg

Hydrogen, CHN828

(10 cm^3), Helium Carrier Gas ....0.02 mg to 17 mg
(3 cm^3), Helium Carrier Gas ....0.02 mg to 17 mg
(10 cm^3), Argon Carrier Gas ....0.02 mg to 17 mg
(3 cm^3), Argon Carrier Gas................0.02 mg to 17 mg

Precision Range† (mg vs RSD, whichever is greater)

Nitrogen, FP828**

(10 cm^3), Helium Carrier Gas ....0.02 mg or 0.6% RSD
(3 cm^3), Helium Carrier Gas ....0.04 mg or 1.2% RSD
(10 cm^3), Argon Carrier Gas ....0.06 mg or 1.2% RSD
(3 cm^3), Argon Carrier Gas................0.12 mg or 2.4% RSD

Nitrogen, FP828P and CN/CHN828

(10 cm^3), Helium Carrier Gas ....0.01 mg or 0.3% RSD
(3 cm^3), Helium Carrier Gas ....0.02 mg or 0.6% RSD
(10 cm^3), Argon Carrier Gas ....0.03 mg or 0.6% RSD
(3 cm^3), Argon Carrier Gas................0.06 mg or 1.2% RSD

Carbon, CN/CHN828

(10 cm^3), Helium Carrier Gas ....0.01 mg or 0.4% RSD
(3 cm^3), Helium Carrier Gas ....0.02 mg or 0.8% RSD
(10 cm^3), Argon Carrier Gas ....0.01 mg or 0.4% RSD
(3 cm^3), Argon Carrier Gas................0.02 mg or 0.8% RSD

Hydrogen (CHN828)

(10 cm^3), Helium Carrier Gas ....0.01 mg or 0.5% RSD
(3 cm^3), Helium Carrier Gas ....0.01 mg or 0.5% RSD
(10 cm^3), Argon Carrier Gas ....0.01 mg or 0.5% RSD
(3 cm^3), Argon Carrier Gas................0.01 mg or 0.5% RSD

Sample Mass

FP828 and FP828P	up to 1.0 g, 0.5 g nominal
CN828	up to 0.5 g, 0.25 g nominal
CHN828	up to 0.3 g, 0.1 g nominal

Cycle Time/Throughput†† (Analyzing EDTA at Nominal Mass)

FP828, FP828P, and CN828	
Helium Carrier Gas	2.8 mins/21 samples/hr
Argon Carrier Gas	3.0 mins/20 samples/hr
CHN828	
Helium Carrier Gas	4 mins/15 samples/hr
Argon Carrier Gas	4.5 mins/13 samples/hr

Detection Method

Nitrogen	Thermal Conductivity (TC Cell) Detector
Carbon, Hydrogen	Non-Dispersive Infrared (NDIR) Absorption

Gases Required

Carrier Gas	Helium or Argon (99.99% pure) @ 25 psi (1.7 bar) ±10%
Combustion Gas	Oxygen (99.99% pure) @ 25 psi (1.7 bar) ±10%
Pneumatic Gas	Compressed Air (oil and water free) @ 40 psi (2.8 bar) ±10%

Resistance Furnace .... 1050 °C max. (Primary and Secondary Furnace)

Autoloader .... 30-sample position (up to 120-sample position optional)

Operating Conditions

Temperature	15 to 35 °C (59 to 95 °F)
Rel. Humidity	20% to 80%, non-condensing

Sound Pressure Level .... 58 dBa (max reading at operator's level per IEC/EN 61010-1)

Electrical Power .... 230 V~(+10%/-15%; at max load), 50/60 Hz, single phase, 12 A (max), 2,400 Btu/hr§

Dimensions‡

Instrument with touch-screen	31.5 in H x 25.3 in W x 31.0 in D (80 cm H x 59 cm W x 79 cm D) Distance from instrument back panel to front foot is 22 in (56 cm)

Weight (approx.) .... 250 lb (113 kg)

*Lower range is calculated as 2 σ instrument blank deviation. Method range may differ due to factors such as sample type and method parameters.

**3 cm^3 aliquot loop installed in FP828 model, 10 cm^3 aliquot loop parts included with the instrument as an option for installation in place of the standard 3 cm^3 aliquot loop.

†Calculated as 1 σ instrument blank deviation. Method precision may differ due to sample inhomogeneity or other external factors.

††Cycle Time and Throughput represent the time between two sequential samples' results being reported with portions of the Analysis time for the samples being interleaved.

‡Allow for a 6-inch (15 cm) minimum access area around all sides of the instrument.

§Average output based on nominal operating parameters.

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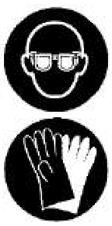
2 Installation

This chapter lists step-by-step instructions to install the 828 Series instruments.

HAZARDOUS VOLTAGE WARNING
During installation and operation of this instrument, the ON/OFF switch must be easily accessible. The ON/OFF switch is located on the right side of the instrument.



PROTECTIVE EYEWEAR/PROTECTIVE GLOVES
Protective eyewear and gloves should be worn when handling chemicals.

Refer to the Safety Data Sheet (SDS) for the specific chemical for additional information.

Illustrations

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Lifting and Moving the Instrument

CAUTION
Refer to Specifications, page 1–53, for the approximate shipping and instrument weight. To lift or move the instrument, use equipment capable of safely lifting this weight.

1. Properly distribute weight prior to lifting.

CAUTION
Front panels and other cosmetic parts of this instrument are not designed to be weight bearing. DO NOT use such parts as lifting points, or damage may result. ALWAYS lift near the feet at the sides or the rear of the instrument base.

2. Position instrument in a location convenient to power and gas supplies, providing a minimum access space of 6 inches around the instrument. The location for the instrument must also be adequately rated to support the weight of the instrument and all accessories.
3. Visually inspect the instrument for damage.

Instrument Front Panel Overview

Refer to the appropriate front panel overview figures, depending on the instrument configuration.

CHN828

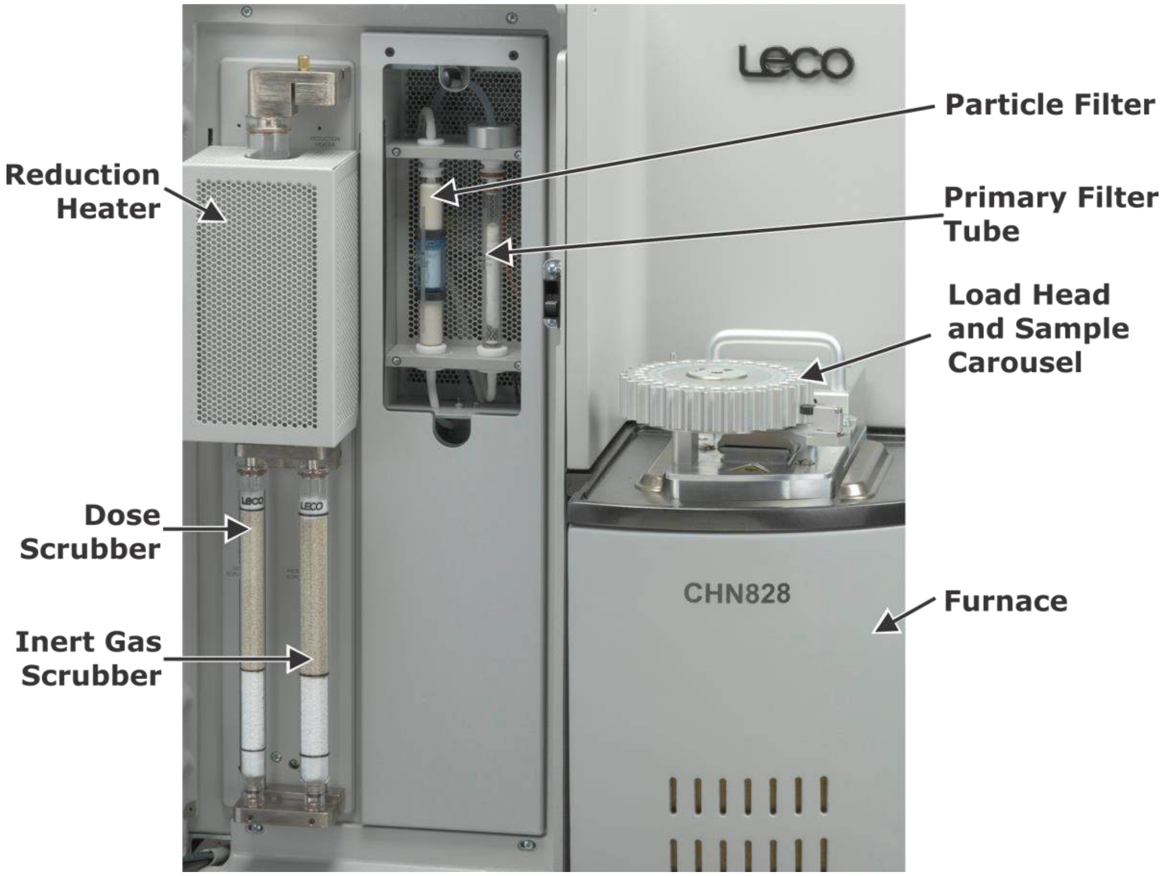


Figure 2-1
CHN Front Panel

CN828, FP828P, and FP828

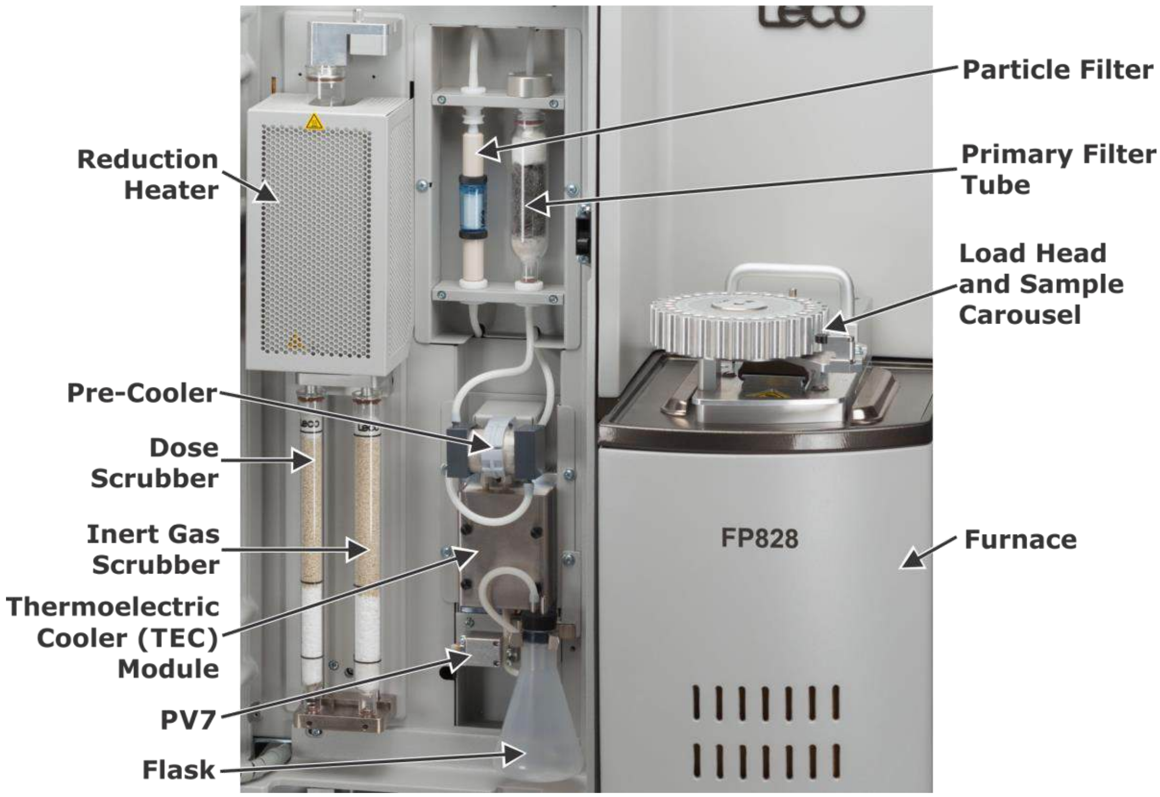


Figure 2-2
CN/FP Front Panel

Inside Front Door (All Models)

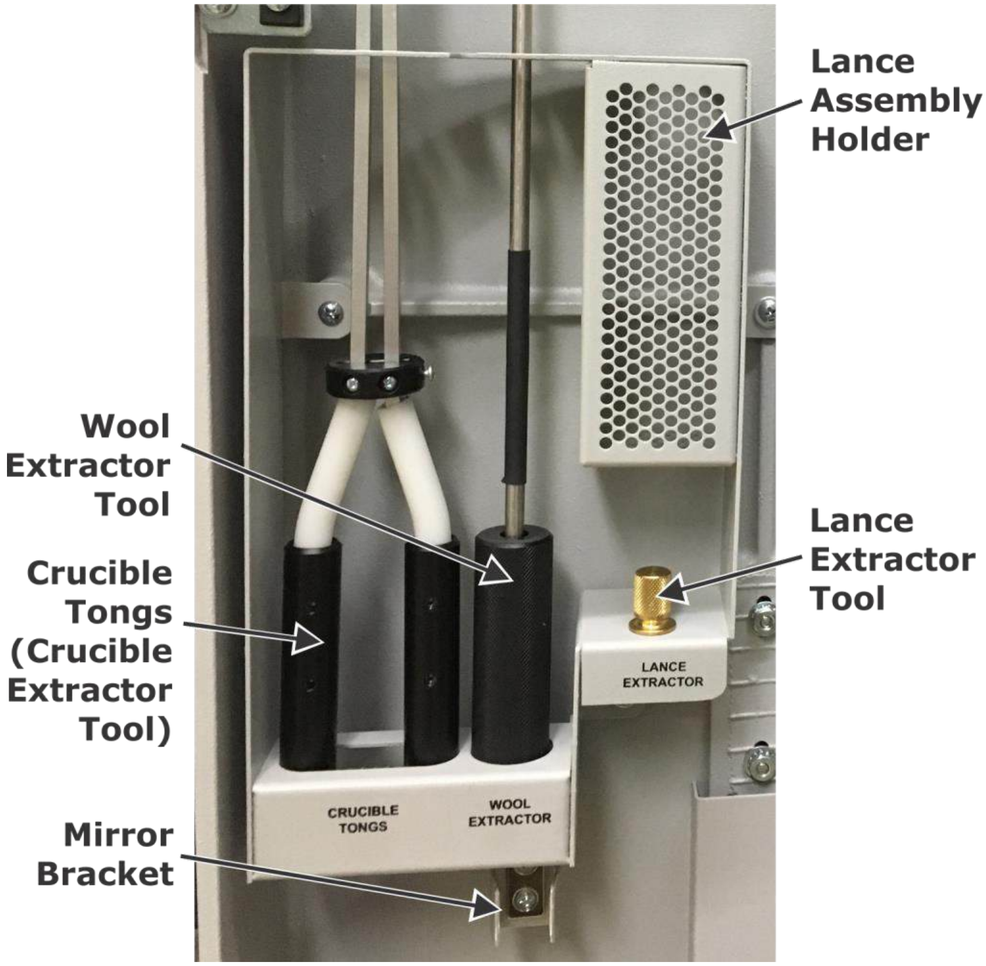


Figure 2-3
Tool Rack – Inside Front Door

Instrument Rear Panel Overview

NOTE Depending on your configuration, the instrument rear panel may not appear exactly as shown.

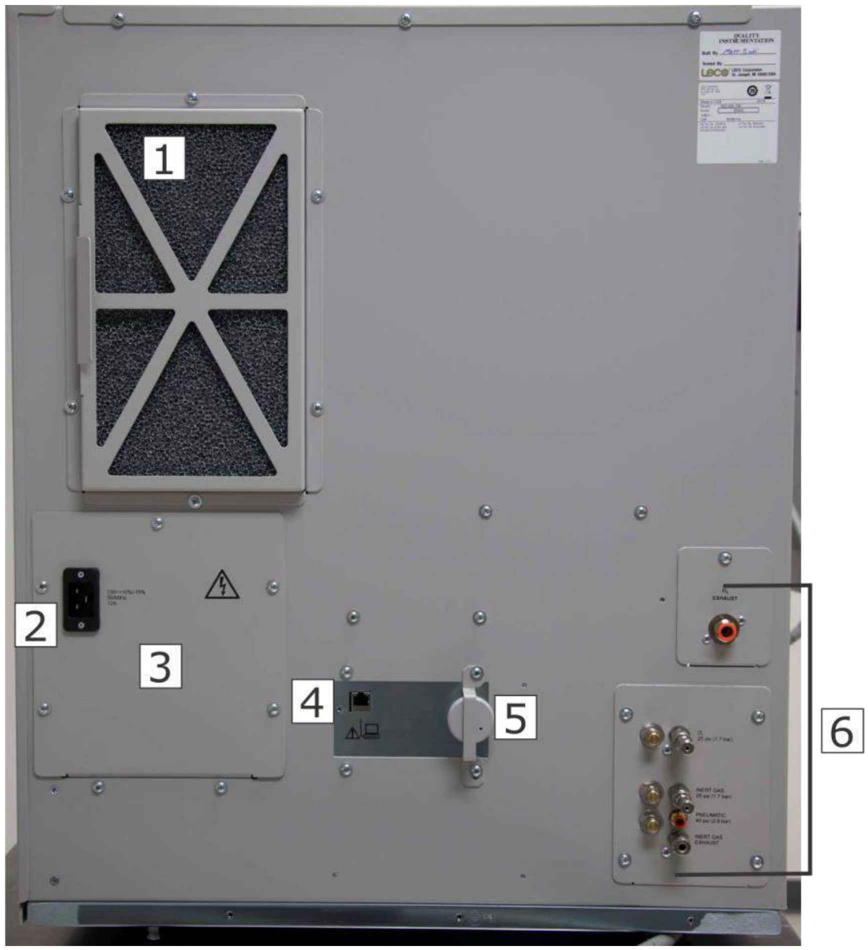


Figure 2-4
Rear Panel

Table of Rear Panel Connections

1	Air Filters	**4**	Network/Ethernet
2	Power Cable Connector	**5**	Ambient Monitor
3	Distribution Panel	**6**	Gas Connections*

NOTE *Refer to Figure 2-5, following, for the specific gas connections.

Figure 2-5
Rear Panel Gas Connections

Table of Rear Panel Gas Connections

1	O_2 Pressure Relief	**5**	O_2
2	Inert Gas Pressure Relief	**6**	Inert Gas
3	Pneumatic Pressure Relief	**7**	Pneumatic
4	O_2 Exhaust	**8**	Inert Gas Exhaust

Installing the Analyzer

CAUTION

Many substances that do not normally burn in air, as well as other substances that are combustible in oxygen, may burn violently when a higher percentage of oxygen is present.

OXIDIZING/PROTECTIVE EYEWEAR/PROTECTIVE GLOVES

Oxygen is an oxidizer and is pressurized. It can become volatile when subjected to heat or high temperatures. Protective eyewear and gloves should be worn when handling oxygen.

Refer to the Safety Data Sheet (SDS) for additional information.

NOTES

- Follow all local regulations for storage and handling of oxygen. Keep combustibles away from oxygen and eliminate ignition sources.
- Do not allow oil, grease, or other readily combustible materials to come in contact with a cylinder or equipment used for oxidant services. Use only equipment that is intended for oxygen service. Use only a regulator that is designated and labeled "cleaned for oxygen service."
- Do not use plastic tubing to supply oxygen to the analyzer. Copper/copper-base or nickel/nickel-base alloys are preferred for oxygen supply lines because the ignition temperature and burn resistance is higher than plastic.
- Oxygen, as a liquid or cold gas, may cause severe frostbite to the skin or eyes. Do not touch frosted pipes or valves.
- For more detailed information, consult the Safety Data Sheet (SDS) provided by your oxygen supplier and review local regulations and guidelines for oxygen piping.

The following procedure should be used for first-time installation of the instrument. This procedure assumes the instrument has been unpacked and positioned in its permanent location. Refer to Lifting and Moving the Instrument, page 2–5.

The balance and printer must be purchased separately; they are not supplied with the instrument. Refer to Installing the Balance, page 5–5, and Printer, page 5–37.

For power and gas supply requirements, refer to the Specifications, page 1–53.

CAUTION

For proper operation, the analyzer must be installed on a relatively level surface.

HAZARDOUS VOLTAGE WARNING

During installation and operation of this instrument, the On/Off switch must be easily accessible. The ON/OFF switch is located on the right side of the instrument.

IMPORTANT If a dual-instrument configuration is being used, ensure enough space is provided for both instruments and the monitor when finding a suitable location.

1. Provide a level work surface with convenient electrical power and gas supplies. Refer to Specifications, page 1–53. Set the analyzer on the work surface.

IMPORTANT Do not connect the instrument to facility power until instructed to do so in step 21, page 2–14.

2. Connect the oxygen tubing assembly from the oxygen tank to the O_2 inlet on the rear of the instrument. Refer to Figure 2-5, page 2–10, and Compression Fittings, page 9–17.

NOTE The oxygen inlet fitting is an adapter that accommodates the $^1/_8$-inch copper tubing supplied in the component pack. If $^1/_4$-inch tubing is preferred, remove the adapter and connect the $^1/_4$-inch tubing (not supplied in the component pack).

3. Turn On the oxygen gas at the tank and set the regulator to 25 psi (1.7 bar).
4. Connect the inert gas tubing assembly from the inert gas tank to the incoming inert gas fitting on the rear of the instrument. Refer to Figure 2-5, page 2–10 , and Compression Fittings, page 9–17.

NOTE The inert gas inlet fitting is an adapter that accommodates the $^1/_8$-inch copper tubing supplied in the component pack. If $^1/_4$-inch tubing is preferred, remove the adapter and connect the $^1/_4$-inch tubing (not supplied in the component pack).

5. Turn On the inert gas at the tank, and then set it to 25 psi (1.7 bar).
6. Connect the pneumatic tubing assembly from the pneumatic tank to the pneumatic fitting on the rear of the instrument. Refer to Figure 2-5, page 2–10, and Installing Tubing into One-Touch Fittings, page 9–19.
   A. Push the tubing into the pneumatic fitting until it is seated. Pull back on the tubing to ensure it is secure. If it is necessary to remove the tubing from the instrument, push in on the outer edges of the fitting, and then pull the tubing out.
   B. Turn On the pneumatic gas at the tank and set it to 40 psi (2.76 bar).

7. **OPTIONAL:** Connect the O_2 exhaust from the rear of the instrument to the facility exhaust by pushing the tubing into the exhaust fitting until it is sealed. Pull back on the tubing to ensure it is secure. If it is necessary to remove the tubing from the instrument, push in on the outer edges of the fitting, and then pull the tubing out.

NOTE Do not couple inert and oxygen exhaust together. Attach them to separate exhaust systems.

8. **OPTIONAL:** Connect the inert exhaust from the rear of the instrument to the facility exhaust using the $^1/_4$" tube connection. Refer to Figure 2-5, page 2–10.
9. Remove, pack, and then reinstall the primary filter. Refer to Replacing the Primary Filter Tube, page 6–10.
10. If the particle filter is not already installed, install the particle filter. Refer to Installing the Particle Filter, page 6–14.
11. Remove, pack, and then reinstall the reduction heater tube. Refer to Replacing the Reduction Tube, page 6–18.
12. Remove, pack, and then reinstall the dose scrubber tube. Refer Replacing the Scrubber Tubes, page 6–15.
13. Remove, pack, and then reinstall the inert gas scrubber tube. Refer to Replacing the Scrubber Tubes, page 6–15.
14. **For CN828, FP828P, and FP828 models only:** Install the flask by completing the following steps. Refer to Figure 2-6, following, and Figure 2-2, page 2–7.
    - A. Make sure the instrument front door is open.
    - B. Attach the flexible tubing to the long open metal tube in the flask stopper.

NOTE Make sure there is enough water in the flask so that the end of the long tube is submerged in water.

    - C. Insert the flask into the clamp on the front panel of the instrument.

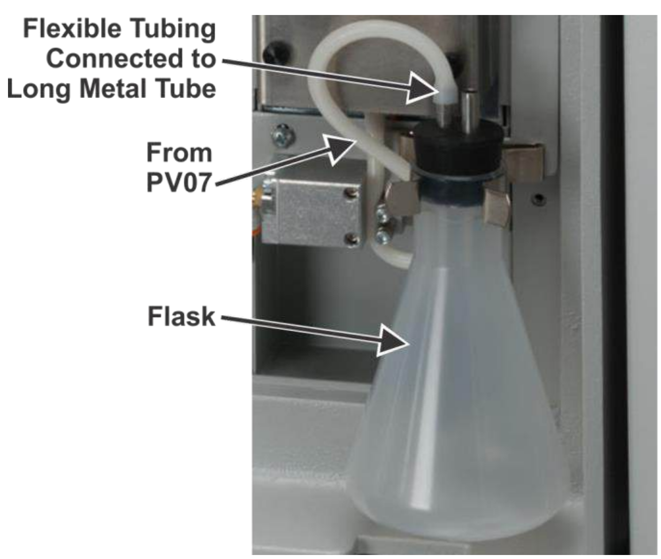


Figure 2-6
Exhaust Flask Installation

15. If the crucible is not already installed, install the crucible. Refer to Installing the Crucible, page 6–32.
16. **For CHN828 model only:** Pack the afterburner. Refer to step 15 of Packing the Combustion Tube, page 6–46.
17. Open the instrument front door. Place the lance extractor tool, crucible extractor tool, and wool extractor tool (from the Accessory pack) and the furnace viewing mirror (from the Component pack) in the tool rack inside the front door. Refer to Figure 2-3, page 2–8.
18. Install the computer near the instrument. Refer to Installing the Computer, page 2–18. Do not turn On the computer until instructed to do so in step 21.D, following.
19. Install the balance near the computer and instrument. A balance must be purchased separately and is optional equipment. Refer to Installing the Balance, page 5–5.
20. **For installing a dual-instrument configuration only:** Complete the installation for the second instrument.
21. Power On the instrument by completing the following steps.
    A. Connect the instrument to facility power. Refer to Installing the Electrical, page 2–16.
    B. Turn On the power switch located on the right side of the instrument. Allow 1 to 2 minutes for the instrument to start.
    C. Turn On the monitor.
    D. Turn On the computer. If using a non-LECO PC, refer to Setting Up PC for Use, page 2–26.
    E. When prompted, log in using the Customer account.
    F. Use the control panel to confirm that the display settings are configured to match the native resolution of the monitor and that the display is rotated to the portrait (flipped) orientation.
    G. Instrument software is installed during the manufacturing process, except when field installations are required or when a non-LECO PC is used. Install the software if necessary. Refer to LECO *Cornerstone* Brand Software, page 2–27.
    H. Double-click the instrument software desktop icon to launch the Cornerstone® brand software.

NOTE If a dual-instrument configuration is being used, launch the *Cornerstone* brand software twice to launch two instances of the software and allow for control of each instrument. Select the desired instance of Cornerstone by selecting it from the Microsoft® Windows® taskbar.

22. With the software open, insert the Installation and Service Video USB (located in the Accessory Pack) into a USB port. The videos copy to the software automatically.
    - A message appears at the top of the screen indicating that the video copy is in process.
    - Another message appears when the update is complete.
    - Both messages also appear in Message History. Refer to Viewing Message History, page 5–16, for more information on viewing messages, if desired.
    - For information on using the video guides, refer to Using the Guide, page 3–25.
23. From the Analysis screen, turn On the gas.
24. Set the furnace temperature by completing the following steps.
    A. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance.
    B. Check that the Furnace and Afterburner heaters are turned On and that their temperature set points are as desired.
25. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance, and confirm that the heaters are turned On. Refer to General Maintenance, page 5–25. Allow all heaters to reach the setpoint temperatures, and check all other readings for any warnings on the Diagnostics screen under the Ambients tab.
26. Perform a System Check by completing the following steps.
    A. In the software, select Diagnostics, and then select the System Check tab.
    B. Select Start, and then wait for the System Check sequence to finish.
    C. Address any items that do not pass.
27. Perform a Leak Check. Refer to Leak Check Procedures, page 8–14; in step 2, select Segmented System Leak Check.
28. Install the sample carousel, making sure the alignment pin correctly references the loading head and the arrow is pointed to the combustion tube opening.
29. **OPTIONAL:** Install the furnace viewing mirror. Refer to Installing the Furnace Viewing Mirror, page 6–80.
30. Turn Off the gas.
31. The instrument installation is now complete.

Installing the Electrical

Power Requirements - Electrical Wiring Diagrams

The instrument's configuration as shipped is detailed in this section. Utilization of other components may be required based on the location. Instruments that operate on 3-phase power are not supplied with a plug.

For all installations, ensure that the electrical receptacles at the installation site meet all of the requirements listed in this section. Follow all national and local electrical codes. Utilize professional electricians as required. Receptacles in North America must be Branch Circuit Protected. GFCI (Ground Fault Circuit Interrupter) receptacles may be required in some areas.

Analyzer

Power Input	230 VAC +10/-15% at max load, 50/60 Hz, single phase, 12 A maximum
Line Cord	(LECO P/N 709-806-720) detachable with NEMA 6-15 plug and IEC-60320-C19 connector, 15A/250V, 14 AWG, 3 conductor, 8 ft 2 in (2.5 m), included in instrument component pack
Receptacle Outlet	(LECO P/N 709-806-808) NEMA 6-15R, included in instrument component pack
Receptacle Cover	(LECO P/N 709-806-809) 1-gang, included in instrument component pack

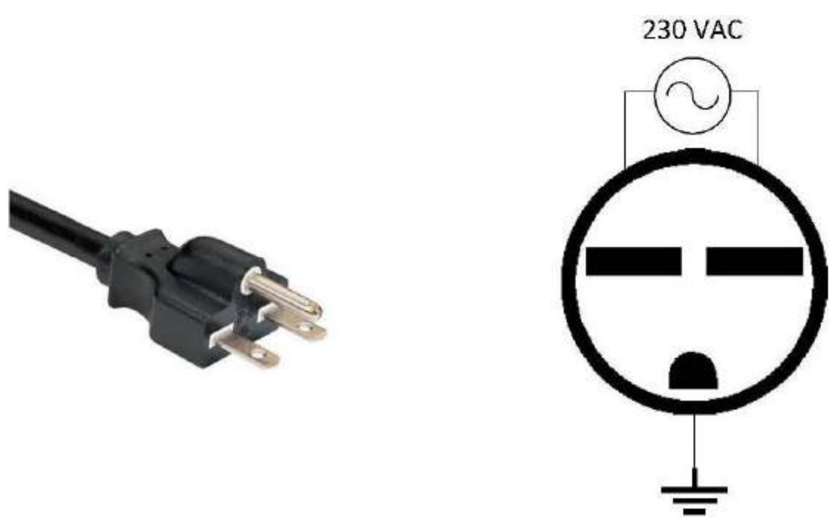


Figure 2-7
End View of Plug: NEMA 6-15P (15 A)

Computer (optional)

Power Input	115 VAC/230 VAC, 50/60 Hz, 6 A/3 A
Line Cord	detachable with NEMA 5-15 plug and C13 connector, included with computer

Monitor (optional LCD)

Power Input	100 VAC to 240 VAC, 50/60 Hz, 1.3 A, C14 inlet connector
Line Cord	detachable with NEMA 5-15 plug and C13 connector, included with monitor

Monitor (optional touchscreen)

Power Input	100 VAC to 240 VAC, 50/60 Hz, 1.5 A, C14 inlet connector
Line Cord	detachable with NEMA 5-15 plug and C13 connector, included with monitor

Balance (optional)

Power Input	100 VAC to 240 VAC, 50/60 Hz, 0.2 A, C8 inlet connector
Line Cord	detachable with NEMA 1-15 (or CEE 7/16) plug and C7 connector, both included with balance

Printer (optional)

Power Input	100 VAC to 240 VAC, 50/60 Hz, 900 mA, C8 inlet connector
Line Cord	detachable with NEMA 1-15 plug and C7 connector, included with printer

Installing the Computer

The™ computer system that consists of the computer, monitor, and printer (optional) can be purchased from LECO or supplied by the user. If the computer system is supplied by LECO, refer to Computer System Supplied by LECO, following. If the user supplies the computer system, refer to Computer System Supplied by the User, page 2–19.

Computer System Supplied by LECO

1. Unpack the computer.
2. Set the computer near the instrument.
3. Locate the keyboard, supplied with the computer, and set it in front of where the monitor will be installed. Connect the keyboard cable to a USB port on the rear of the computer.
4. Locate the mouse, supplied with the computer, and set it next to the keyboard. Connect the mouse cable to a USB port on the rear of the computer.

CAUTION: NETWORK CONNECTION
Connect the Ethernet port on the instrument to the appropriate port on the computer as instructed in this manual. Connecting the instrument directly to a corporate network (LAN) may result in communication problems.

5. Locate the Ethernet cable and connect one end to the network interface card on the rear of the computer. Connect the other end to the Ethernet Port  on the rear of the instrument. Refer to Figure 2-4, page 2–9.
6. **For dual-instrument configurations only:** Complete the following steps for dual-instrument configurations.
   A. Install a dual Ethernet card (purchased separately) if the computer is not already equipped with one.
   B. Connect a second Ethernet cable to the network interface card on the rear of the computer, and connect the other end to the Ethernet port on the second instrument.
7. Locate the Registration Key. Connect the key to a USB port on the rear of the computer.
8. Install the monitor by completing the following steps.
   - For systems with touch screen monitors, refer to Analyzer-Mounted Touch Screen Monitors, page 2–19, or Desktop-Mounted Touch Screen Monitors, page 2–20.
   - For systems with non-touch screen desktop-mounted monitors, complete the following steps:
     a) Connect the monitor to a suitable AC power source. Refer to the manual supplied with the monitor.
     b) Connect the video cable, supplied with the monitor, to the monitor and the computer. Refer to the manual supplied with the desktop monitor.

9. If the instrument and (optional) balance installation is complete, connect the computer's electrical supply connector to a suitable AC power source and turn On power to the computer. If the installation is not complete, do not turn On power to the computer until instructed to do so in Installing the Analyzer, page 2–11.
10. **OPTIONAL:** Install the printer according to the manual provided by the manufacturer.

Computer System Supplied by the User

If the Computer System is not supplied by LECO, the computer must meet minimum requirements. Contact LECO for more information.

Installing the Touch Screen Monitor

Analyzer-Mounted Touch Screen Monitors

1. Unpack the monitor.
2. Remove the three screws that secure the cable access panel on the back of the monitor. Refer to Figure 2-15, page 2–25.

NOTE Make sure that the spring-loaded stop pin is positioned toward the top of the analyzer. Refer to Figure 2-14, page 2–24.

3. Install the monitor on the front of the analyzer by completing the following steps. Refer to Figure 2-14, page 2–24.
   A. Using a 9/64-inch Allen® wrench (hex wrench), remove the bottom stop screw.
   B. Pull the stop pin in the mounting arm carriage to unlock. Continue holding onto the stop pin until the monitor is in position.
   C. Slide the monitor carriage block onto the monitor rail on the back of the monitor.
   D. Release the stop pin into the desired hole alongside the monitor rail to lock the monitor temporarily into position.
   E. Reinstall the bottom stop screw to prevent the monitor from falling out of the mount.
4. Route the cable assembly in through the cable opening in the monitor and out through the cable access panel opening as shown in Figure 2-14, page 2–24. Pull just enough wire through the opening to make the connections in step 5, following.
5. Connect each of the cables into the monitor.
6. Using the three screws removed in step 2, previous, reinstall the cable access panel on the monitor. Refer to Figure 2-15, page 2–25.
7. Adjust the monitor to a comfortable viewing height and angle by pulling out the stop pin in the mounting arm carriage. With the stop pin pulled out, raise or lower the monitor to the appropriate height. Release the stop pin into the desired hole alongside the monitor rail to lock the monitor into position. Refer to Figure 2-14, page 2–24.
8. Connect the USB cable, supplied with the monitor, to a USB port on the rear of the computer.

Desktop-Mounted Touch Screen Monitors

1. Unpack the monitor.
2. Place the post for the desktop monitor stand into the base with the groove toward the back of the base (in line with the screw hole). Refer to Figure 2-8, following.

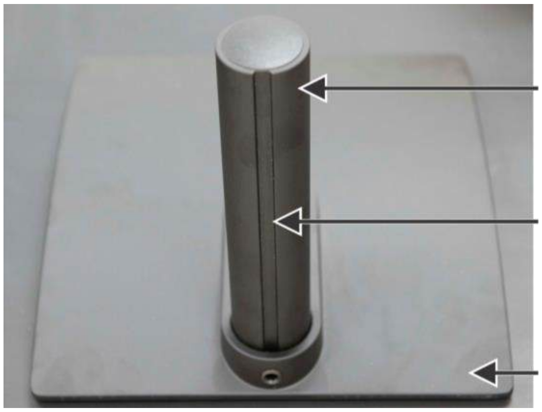


Figure 2-8
Monitor Post and Base

3. Using the $^7/_{32}$-inch *Allen* wrench (hex wrench), tighten the setscrew in the base to secure the post.
4. Install the post collar onto the tilt mechanism. Secure the two pieces together using the black washer (with prongs) and the black Phillips screw. Refer to Figure 2-9, following.

   Make sure the prongs on the washer are not visible when the washer is installed.

NOTE To increase or decrease the force required to tilt the monitor, adjust the setscrew in the tilt mechanism. Refer to Figure 2-9, following.

Figure 2-9
Post Collar/Tilt Mechanism Assembly

5. Attach the mounting plate to the tilt mechanism with the four 10-32 $^{3}/_{8}$-inch Phillips head screws supplied with the kit. Refer to Figure 2-10, following.

Figure 2-10
Attach Mounting Plate

6. Install the tilt mechanism mounting plate to the monitor carriage block by completing the following steps.
   - To install the monitor with a vertical orientation:
     a) Position the tilt mechanism mounting plate onto the monitor carriage block as shown in Figure 2-11, following.

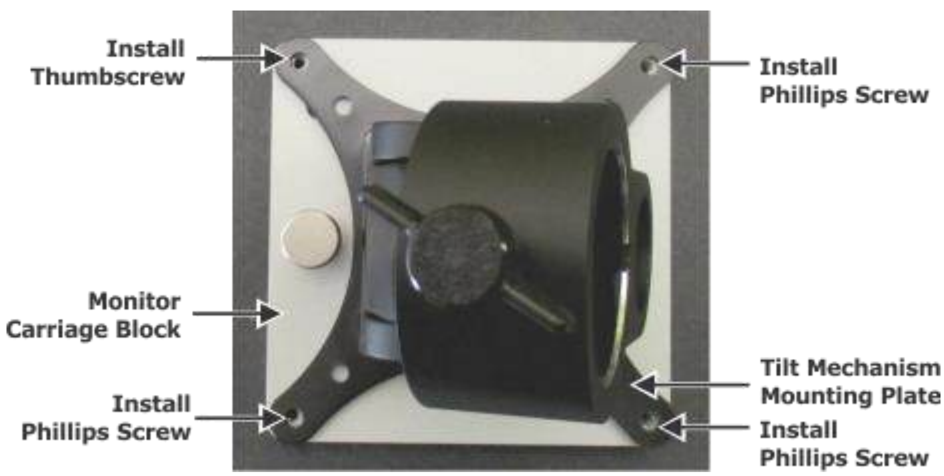


Figure 2-11
Vertical Monitor Installation

     b) Secure the carriage block to the tilt mechanism mounting plate with three Phillips screws, leaving the upper left screw hole empty. Refer to Figure 2-11, previous, for screw placement.

c) Install the thumbscrew in the fourth screw hole as a carriage lock. Refer to Figure 2-11, previous.

- To install the monitor with a horizontal orientation:

a) Position the tilt mechanism mounting plate onto the monitor carriage block as shown in Figure 2-12, following.

Figure 2-12
Horizontal Monitor Installation

b) Secure the carriage block to the tilt mechanism mounting plate with three Phillips screws, leaving the upper left screw hole empty. Refer to Figure 2-12, previous, for screw placement.

c) Install the thumbscrew in the fourth screw hole as a carriage lock. Refer to Figure 2-12, previous.

7. Place the monitor face down on a flat work surface or countertop.
8. Using a $^{9}/_{64}$-inch *Allen* (hex) wrench, remove the bottom stop screw from the back of the monitor. Refer to Figure 2-14, page 2–24.
9. Slide the monitor carriage block onto the monitor rail on the back of the monitor. Refer to Figure 2-14, page 2–24.
10. Reinstall the bottom stop screw.
11. Remove the three screws that secure the cable access panel on the back of the monitor. Refer to Figure 2-15, page 2–25.
12. Route the cable assembly in through the cable opening in the monitor and out through the cable access panel opening as shown in Figure 2-14, page 2–24. Pull just enough wire through the opening to make the connections in step 13, following.
13. Connect each of the cables into the monitor.
14. Using the three screws removed in step 11, previous, reinstall the cable access panel on the monitor. Refer to Figure 2-15, page 2–25.

15. Carefully pick up the monitor assembly, then slide it onto the base assembly post. Tighten the wingnut to secure the monitor into position. Refer to Figure 2-13, following.

Figure 2-13
Monitor Assembly

16. Connect the power supply to the cable assembly.
17. Tighten the thumbscrew installed in step 6, page 2–21, to prevent the monitor from wobbling.

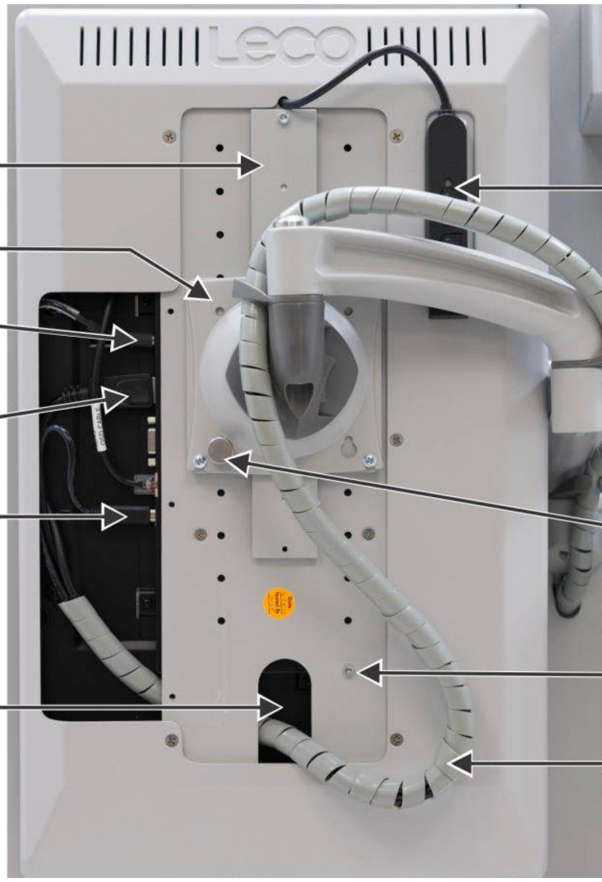


Figure 2-14
Touch Monitor Installation

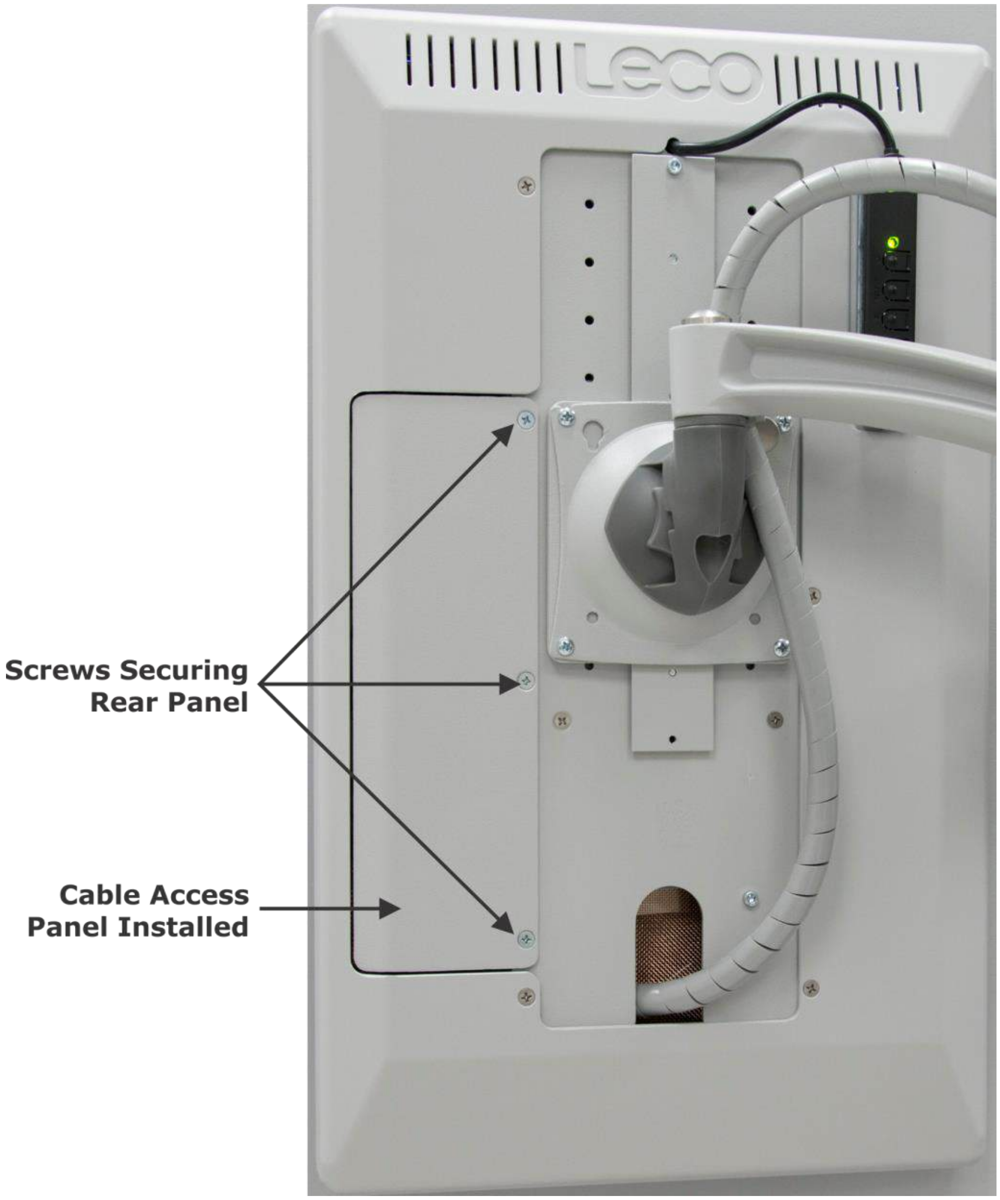


Figure 2-15
Touch Monitor Rear Panel Installation

Setting Up PC for Use

NOTES

- The following section applies only when using a non-LECO PC.
- Due to setup and hardware variations between computer manufacturers, LECO cannot accommodate all possible variables required for optimal operation of the *Cornerstone* brand software and the LECO analyzer. For non-LECO computers, contact the computer manufacturer's service department for support.

1. Install any required cards.
2. Connect keyboard, mouse, monitor, and power cords.
3. Turn On the computer tower.
4. Install and/or set up Microsoft® Windows® 7 64-bit operating system or later.
5. **For single-instrument configurations:** If the computer connects to the instrument via an Ethernet adapter, make sure that the adapter is named "LECO Hardware."

   Or

   For dual-instrument configurations: Refer to the dual-instrument information in Instrument Ethernet Adapter, page 2–28.

NOTE

Windows Firewall may ask to allow communications to the *Cornerstone* brand software. If prompted, these communications are trustworthy and should be allowed.

LECO *Cornerstone* Brand Software

IMPORTANT: LECO recommends performing the following procedures BEFORE installing any new version of the *Cornerstone* brand software. This will help identify any underlying hardware issues to be addressed before software installation.

System Check, page 8–16.

Leak Check, page 8–12.

Validating the Database, page 5–14.

The following section includes the following procedures:

Required Settings for LECO Software, following.

Instrument Ethernet Adapter, page 2–28.

Installing the Software, page 2–29.

Configuring Firewall Settings, page 2–30.

Troubleshooting Registration Key, page 2–30.

Uninstalling LECO Software, page 2–32.

Required Settings for LECO Software

Windows 7 (64-bit) or later is required for LECO *Cornerstone* brand software. *Windows* 10 (64-bit) is recommended. Make sure that all the latest *Windows* updates have been installed.

Operating System (OS) User Permission Requirements

The following table shows the minimum permissions that a user must have in the *Microsoft Windows* OS in order to perform certain tasks in the software. Refer to User Accounts.

Task	Minimum Permission
Using Software	Standard User
Installing Software	Administrator
Upgrading Software	Administrator
Setting up Users	Administrator
LECO Service	Administrator

Data File Permissions

To use LECO software, read-write access is required for all the data files. The proper permissions are automatically set up during the software installation; however, if these permissions are ever changed, file access errors can occur. The following data folders require read-write permissions: use the appropriate drive letter, typically C:\ProgramData\LECO (hidden OS folder).

Antivirus Software

LECO recommends that antivirus checking be turned off for the following files to avoid interference with data collection or storage: use the appropriate drive letter, typically C:\ProgramData\LECO (hidden OS folder).

Windows Settings

To use LECO software, certain *Windows* settings are required to ensure performance of the instrument. These settings are set up automatically during software installation; however, problems may be encountered if they are ever changed. The required *Windows* settings are listed in the following table.

Power Options		**Required Value**
Display	Turn Off display after	Never
Sleep	Sleep after	Never
Hard Disk	Turn Off hard disk after	0 minutes

Instrument Ethernet Adapter

The Ethernet adapter that connects to the instrument requires specific settings to allow communication. For a dual-instrument configuration, the two connections for the instruments must be named “LECO Hardware 1” and “LECO Hardware 2.” For a single instrument, the adapter must be named “LECO Hardware.” The following settings are automatically applied to the adapter during software installation. If these settings are changed, communication errors may occur.

Setting	**Value**
IP Address	10.10.10.2
Subnet Mask	255.255.255.0

Installing the Software

1. Turn On the computer tower.

CAUTION: NETWORK CONNECTION

Connect the Ethernet port on the instrument to the appropriate port on the computer as instructed in this manual. Connecting the instrument directly to a corporate network (LAN) may result in communication problems.

2. If the Ethernet cable was not previously connected, locate the Ethernet cable and connect one end to the network interface card on the rear of the computer. Connect the other end to the Ethernet Port on the rear of the instrument. Refer to Figure 2-4, page 2–9.
3. Make sure that the Ethernet adapter connected to the instrument has been named "LECO Hardware."
4. Complete one of the following steps to acquire administration-level permission, which is required for installation.
   - Log in to the operating system using an administrator-level account.

     Or
   - Log in as normal and have someone provide administrator credentials for the install.
5. Insert the software installation media.

   Or

   Navigate to https://www.lecosoftware.com/cornerstone, and select Web Installer or Offline Installer.
6. Run the installer by completing the appropriate set of steps, depending on what was done in step 5, previous:

   Software Installation Media:

   A. Press Windows key + E on the keyboard to open the File Explorer.

   B. Select the desired installation media from the left-hand navigation pane of the File Explorer.

   C. Double-click "Setup" to begin the software installation.

   LECO Software Website:

   Run the installer downloaded in step 5, previous.
7. Follow the onscreen prompts to allow the installer to make changes to the computer as part of the installation.

NOTE The software installation procedure may require the computer to be restarted at the end of installation. If prompted, allow the restart.

8. At the Welcome screen, select Begin to start the installation process.
9. At the Preparing to Install *Cornerstone* screen, insert the LECO-supplied Registration Key into a USB slot on the PC if not completed previously.
10. At the Install *Cornerstone* screen, select Install to install the *Cornerstone* brand software.
11. At the Installation Complete screen, select Finish. The icon for the instrument software will appear on the desktop.
12. Complete the steps in Setting Up *Microsoft Windows* for Touch Screen Operation, page 2–33.
13. Double-click the instrument software desktop icon 

to start the software.

NOTE If a dual-instrument configuration is being used, launch the *Cornerstone* brand software twice to launch two instances of the software and allow for control of each instrument. Select the desired instance of Cornerstone by selecting it from the *Windows* taskbar.

Configuring Firewall Settings

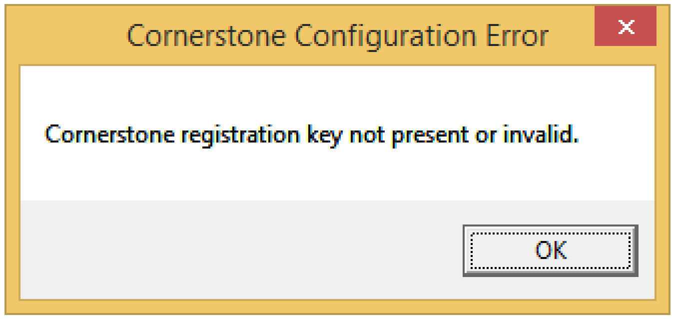
When the LECO software is installed, it automatically configures the *Microsoft Windows* firewall settings for the instrument software. (If the *Microsoft Windows* firewall settings are ever changed, the easiest fix is to reinstall the LECO software.)

If a firewall program other than *Microsoft Windows* is used, exclude "C:\Program Files\LECO Cornerstone\LECO Cornerstone.exe" from all firewall restrictions.

Troubleshooting Registration Key

- A Registration Key is required to use the software.
- Do not insert the Registration Key into the USB port until prompted by the LECO software installer.
- The Registration Key should remain installed in one of the USB ports while using the software.

Registration Key Error Messages



The *Cornerstone* Registration Key Not Present or Invalid dialog box will appear if the registration key is not installed.

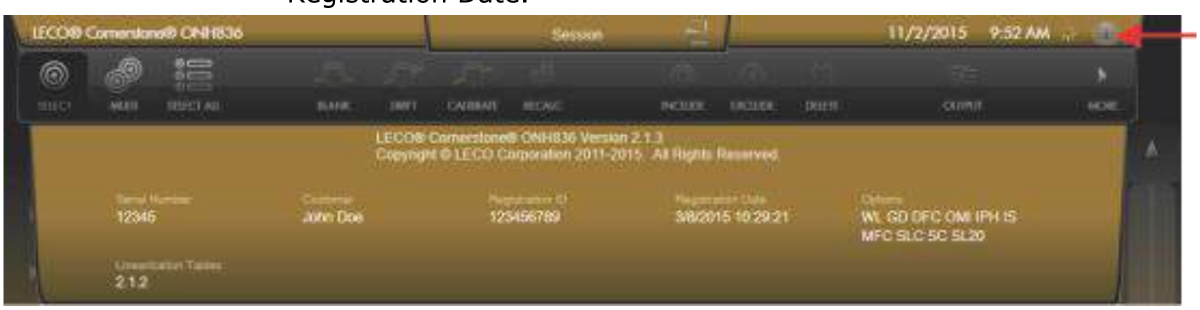
1. Verify the registration key is installed.
2. Verify the registration key driver is installed.
3. Select OK and restart the software.

Adding Options to the Registration Key

NOTE The steps in this section should be completed only when additional features are purchased.

The file "Cornerstone.CopyProtectionKey.v2c" can be used only once and it cannot be used to update an instrument other than the unit specified in step 1, following.

1. Select the information button in the upper right corner of the *Cornerstone* brand software. Record the Registration ID and Registration Date.



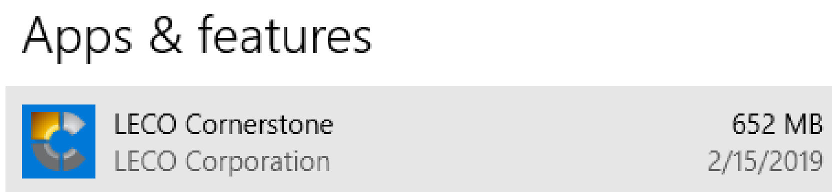
2. Provide your local LECO service representative with the product name, serial number, Registration ID, Registered On date, and the type of option to be added to the instrument.
3. A file named "Cornerstone.CopyProtectionKey.v2c" will be returned to the customer. Place this file in the instrument PC's Documents folder (C:\Users\Customer\Documents).
4. Start *Cornerstone* brand software. The software will automatically read the file, update the options on the registration key, and delete the file when done.
5. Any software features associated with that option will be enabled in *Cornerstone* brand software.

Uninstalling LECO Software

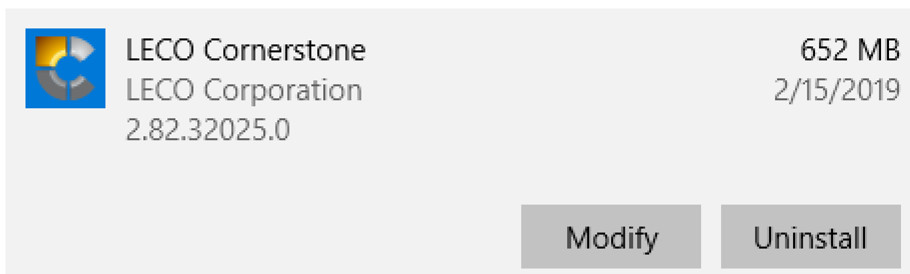
NOTE The following screenshot illustrations are examples only and may be different depending on what version of *Windows* you are using.

The following section explains how to uninstall LECO software.

1. Select the Start button in the lower left corner.
2. Enter the following text in the Search field: add or remove programs. When Add or Remove Programs appears in the matches, select it.
3. Scroll until LECO Cornerstone appears, and then select it.



4. Select Uninstall.



5. When prompted, verify that the name of the software being uninstalled is correct, and then confirm the uninstallation.

Setting Up *Microsoft Windows* for Touch Screen Operation

Auto Hiding Taskbar

The following instructions explain how to auto-hide the taskbar in order to view the bottom of the *Cornerstone* brand software.

1. Right-click on the taskbar.
2. Select Properties/Settings.
3. Select the Auto-Hide the Taskbar checkbox.
4. Select OK.

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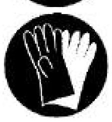
3 Analysis

The Analysis chapter describes common procedures related to analyzing samples and generating results.

HAZARDOUS VOLTAGE WARNING
During installation and operation of this instrument, the On/Off switch must be easily accessible. The ON/OFF switch is located on the right side of the instrument.



PROTECTIVE EYEWEAR/PROTECTIVE GLOVES
Protective eyewear and gloves should be worn when handling chemicals.

Refer to the Safety Data Sheet (SDS) for the specific chemical for additional information.

Illustrations

Software Overview

After the Cornerstone® brand software has been started, the main window will appear. The following section explains the items on the main window.

Depending on your configuration, the following software overview screen may not appear exactly as the screen on your instrument. Some items called out in the following software overview screen are available only on some configurations.

NOTE The software automatically detects whether the monitor is in portrait or landscape mode and runs the software to fit. Figure 3-1, following, shows a monitor in portrait mode. For a screenshot example of a monitor in landscape mode, refer to Figure 3-2, page 3–7.

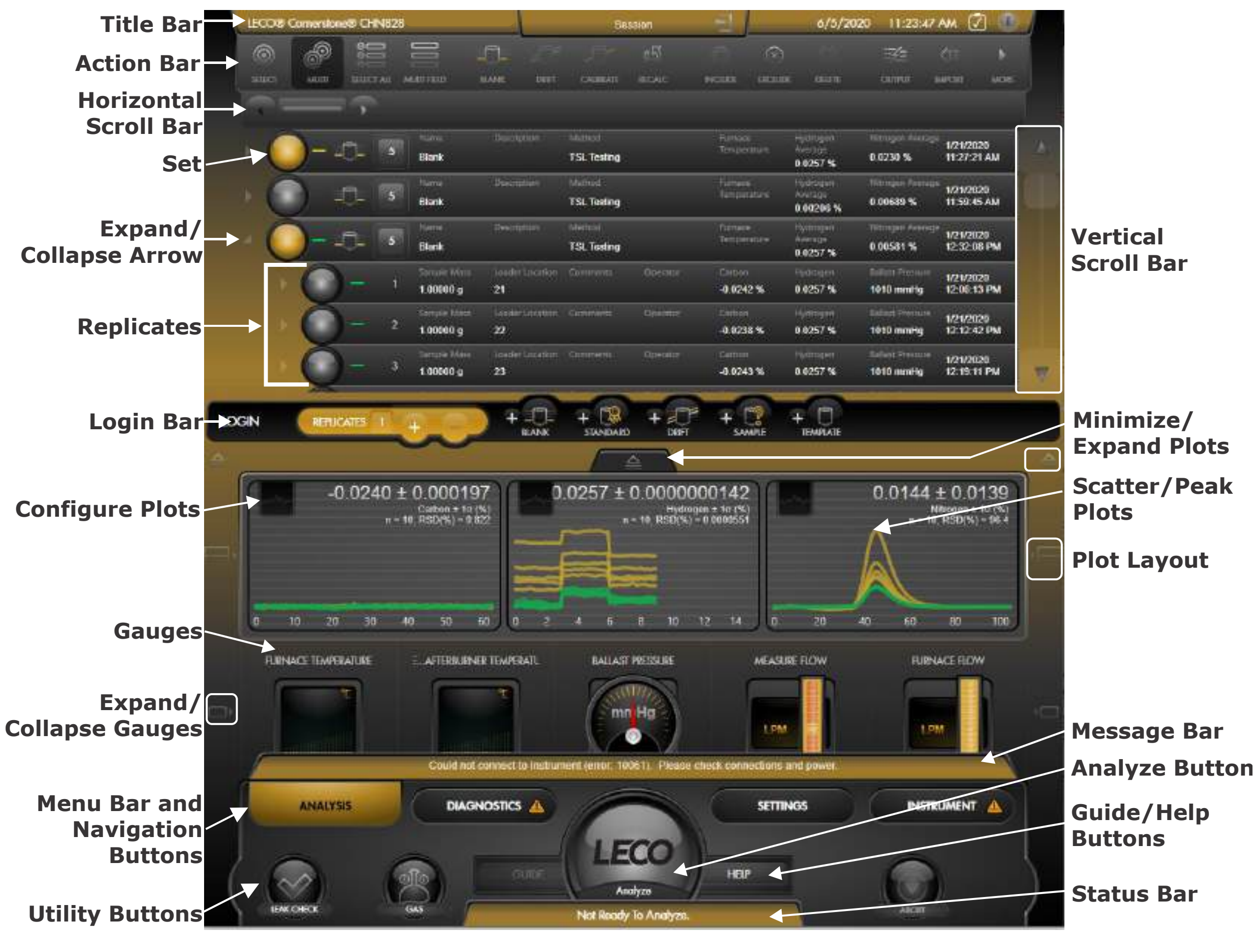


Figure 3-1
Software Overview Portrait Mode

Title Bar—Identifies the software. For dual-instrument configurations, the unit number for the connected instrument will also be displayed.

Action Bar—Provides the means to quickly find and perform specific tasks.

Horizontal Scroll Bar—Provides the means to scroll right and left through columns when the number of columns defined in the display is greater than can be shown on the screen.

Expand/Collapse Arrow—Provides the means to expand or collapse additional information associated with sets and reps.

Sets/Reps—Sets include the sample type, sample name, number of replicates, description, and method. Reps include the mass, comments, and sample results. In the software, check standards that are out of range are indicated by orange text; saturated cell results are indicated by blue text. Refer to Configuring the Display, page 4–5.

Vertical Scroll Bar—Provides the means to move up and down through the list of sample sets/reps.

Message Bar—Displays messages to the user. Select to dismiss the message.

Login Bar—Provides the means to log in blanks, standards, drifts, samples, templates, and QC wake up. Refer to Logging in Replicates for Analysis, page 3–32.

Configure Plots—Provides the means to select the desired options and configure the plot.

Minimize/Expand Plot—This tab, and the arrows on either side of the screen, can be selected and dragged to minimize or expand the plot.

Plot Layout Button—Changes whether the plots are stacked vertically or horizontally. Available only when the instrument configuration has two or more analytes.

Gauges—Displays system status. Refer to Ambient Gauges, page 3–13.

Expand/Collapse Gauges—These icons can be selected to minimize, hide, or expand the gauges. Refer to 3-State Gauge View, page 3–13.

Menu Bar and Navigation Buttons—Provides access to the main areas of the software.

Utility Buttons—Provides the means to perform common tasks such as leak check, turning On the gas, and aborting the process.

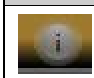
Status Bar—Displays instrument messages.

Guide/Help Buttons—Select Guide for a software demonstration; select Help to access the most recent instruction manual.

Analyze Button—Initiates or continues analyses.

Figure 3-2
Software Overview Landscape Mode

Title Bar Items

Button	Name	Description
	Information	Provides instrument information including version, registration, and installed options.
	Session	Accesses the Session menu. Refer to Session Menu Items, page 3–14.

Task Center

The Task Center can be used to check the status of tasks that take time to complete. The Task Center icon changes depending on whether any tasks are currently in progress.

—No tasks in progress

—Tasks in progress

When a task begins, a popup window describing the task appears briefly on the screen. Select Cancel to cancel the task, or do nothing to allow the task to complete.

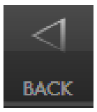
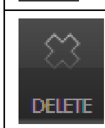
Complete the following steps to open Task Center to view or cancel tasks.

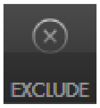
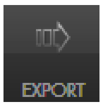
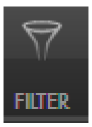
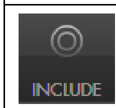
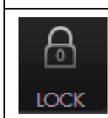
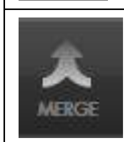
1. Open Task Center by selecting either icon from the right corner of the title bar. The Task Center progress screen opens.

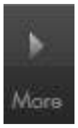
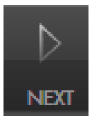
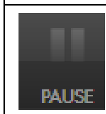
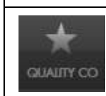
2. Complete the following actions as desired.
   - Select Cancel to cancel the task.
   - Select Clear Completed to remove completed tasks from the Task Center.
   - Select Close to close the Task Center progress screen.

Action Bar Items

NOTE Buttons are visible only on relevant screens.

Button	Name	Description
	Add	Select to add a new item.
	Assign Notify	Alerts the user when a rep is complete. Refer to Using Assign Notify, page 4–65.
	Back	Select to return to the previous screen.
	Backup	Performs a manual database backup. Refer to Backing Up the Database, page 5–14.
	Blank	Refer to Performing Blanks, page 3–39.
	Calibrate	Refer to Performing Calibrations, page 3–40.
	Check	Set check standards for quality control. Refer to Check Standards, page 4–23. This feature is available only with the QC option.
	Check Signals	Validate the functionality of the detector. Refer to Detectors, page 5–19.
	Clone	Refer to Cloning, page 3–24.
	Collapse All	Collapses all expanded items.
	Copy	Copy the contents of the screen to a clipboard to paste into another program.
	Delete	Select to delete an item. An item must be excluded before it can be deleted.

Button	Name	Description
	Drift	Refer to Performing Drifts, page 3–46.
	Edit	Select to edit an item.
	Exclude	Select to exclude an item. Refer to Including and Excluding, page 3–24.
	Export	Refer to Importing and Exporting, page 3–22.
	Filter	Refer to Working with Sample Filters, page 3–53.
	History	Select History to view the history of changes to all items on the screen. Refer to History, page 5–17. This feature is available only with the AT option.
	Ignore	Ignore an expired maintenance counter.
	Import	Refer to Importing and Exporting, page 3–22.
	Include	Select to include an item. Refer to Including and Excluding, page 3–24.
	Inspect	Resets only the Inspect portion of a maintenance counter, allowing the user to indicate that the component was checked but maintenance was unnecessary and was not performed at that time. This is most useful for components where a visual inspection is adequate for determining its status, such as reagents, crucible/boat buckets, and o-rings.
	Lock	Select Lock to plot digital outputs or make fields read-only.
	Merge	Merges multiple sets into one. Refer to Merging, page 3–35.

Button	Name	Description
	More	Display more Action Bar buttons.
	Multi	Select Multi-select mode to choose more than one item at a time.
	Multi Field	Select Multi Field to edit the same field on multiple sets or replicates at the same time.
	Next	Select Next to change the order in which reps are analyzed from the designated sequence. Refer to Using Next, page 3–50.
	Output	Select Output to print, transport, copy, or export from the Analysis screen. Refer to Printing Reports, page 4–38.
	Pause	Select Pause to halt the analysis sequence after the previous sample has completed analysis. Pause cannot be used to stop an analysis in process.
	Perform	Select Perform to reset both the inspect and stop aspects of a maintenance counter by acknowledging the task has been performed.
	Preview	Select to evaluate the setup of a report and determine if the width of the fields are appropriate.
	Print	Select to print the contents currently on the screen.
	Quality Control	Select to log in the necessary Quality Control steps. Refer to Configuring Quality Control, page 4–19. This feature is available only with the QC option.
	Recalculate	Refer to Recalculating, page 3–49.
	Reset	Select to restore default value.
	Restore	Select to restore a database. Refer to Restoring the Database, page 5–15.

Button	Name	Description
	Select	Switches from multi-select mode to single item mode.
	Select All	Selects all the fields on the current screen. On the Analysis screen, all sample sets are selected.
	Split	Select to make a replicate into a new set. Refer to Splitting, page 3–35.
	Style	Refer to Editing Styles, page 4–11.
	Unlock	Allows the user to actuate digital outputs; makes read-only fields editable.

Utility Bar Items

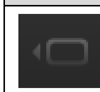
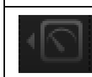
Button	Name	Description
	Leak Check	Perform a system leak check. Refer to Leak Check, page 8–12.
	Gas	Provides the means to turn the gas On and Off or set it to Gas Conservation mode. The system is depressurized during the gas Off sequence.
	Abort	Provides the means to stop a process.

Ambient Gauges

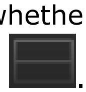
The ambient gauges provide a quick status check on some of the most critical system parameters.

Gauge	Description	Target
Furnace Temperature	Refer to Ambient Parameter Definitions, page 8–6.	Refer to Ambient Monitor Ranges, page 8–7.
Afterburner Temperature		
Ballast Pressure		
Measure Flow		
Furnace Flow		

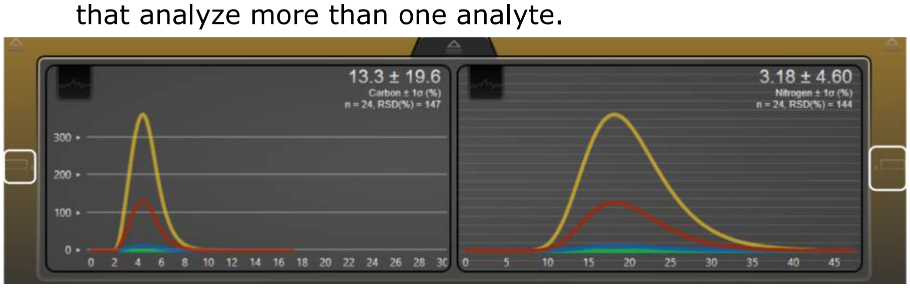
3-State Gauge View

Button	Description
	Select to change to the small gauge view.
	Select to hide gauges.
	Select to change to the full gauge view.

Plot Stack View

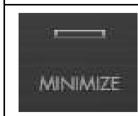
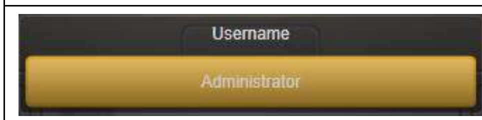
When more than one plot is displayed, select the **Plot Layout** button to change whether the plots are stacked vertically  or horizontally . 

NOTE The Plot Layout button is available only on instrument configurations that analyze more than one analyte.

Plot Layout


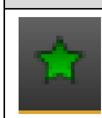
Plot Layout

Session Menu Items

Button	Name	Description
	Back	Select to return to the previous screen.
	Exit Gas Off	Exit the software and turn Off the gas.
	Exit Conserve Gas	Exit the software and set the gas to a low flow conserve mode.
	Language	Select the language for the software.
	Log Out	Log out the current user. This option is available only if user permissions are enabled.
	Login	Log in with the currently selected user. This option is available only if user permissions are enabled.
	Minimize	Select to minimize the *Cornerstone* brand software screen.
	Username	Select the name of user for login. This option is available only if user permissions are enabled. Refer to Working with User Permissions, page 4–51.

General Software Items

The following items are only visible when using the QC option.

Icon	Name	Description
	QC Green Star	Displayed as green on the main Analysis screen when QC is enabled and in control.
	QC Orange Caution	Displayed on the main Analysis screen when QC is enabled and not in control.

Keyboard Shortcuts

Function key labels can be enabled or disabled from the Display Settings screen of the software. Function keys are functional even when the labels are not displayed in the software. Refer to Setting Display Settings, page 4–5.

Key	Name	Description
F1	Leak Check	Begins a leak check.
F2	Gas	Toggles to the next gas state.
F4	Guide	Opens the Guide screen.
F5	Analyze	Begins analysis.
F6	Help	Opens the instruction manual.
F9	Abort	Stops the current process.

Performing Common Software Tasks

Starting the Software

1. Double-click the instrument software desktop icon 

to start the software.

NOTE If a dual-instrument configuration is being used, launch the *Cornerstone* brand software twice to launch two instances of the software and allow for control of each instrument. Select the desired instance of Cornerstone by selecting it from the Microsoft® Windows® taskbar.

2. At the onscreen prompt, select the desired startup.
   - To start the software using the default database, select Default Startup. Then, continue with step 4, page 3–17.
   - To choose a different database, select Startup Options, and then continue with step 3, following.

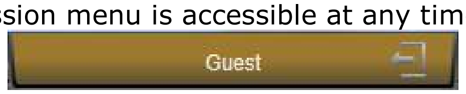
NOTE If nothing is selected within 10 seconds, the default database automatically loads.

3. Select the desired startup location by completing one of the following options.
   - To use the default startup location:
     A. Select No next to Use Custom Location.
     B. Select the box next to Startup Database and choose the desired database.
     C. Select OK.
   - To choose a different startup location:
     A. Select Yes next to Use Custom Location.
     B. Select the box next to Location and choose the desired file location.
     C. Select Accept, and then select OK.

NOTE The selected database will now be considered the Default Startup database the next time the software is started.

4. The software opens. If User Security is enabled, the Session menu appears.

NOTES

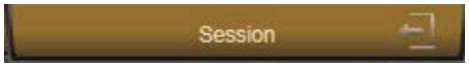
- The Session menu is accessible at any time by selecting the Session 

button on the Title bar.
- The following screenshot example shows options that may not be applicable to all instrument configurations.

Selecting a Language

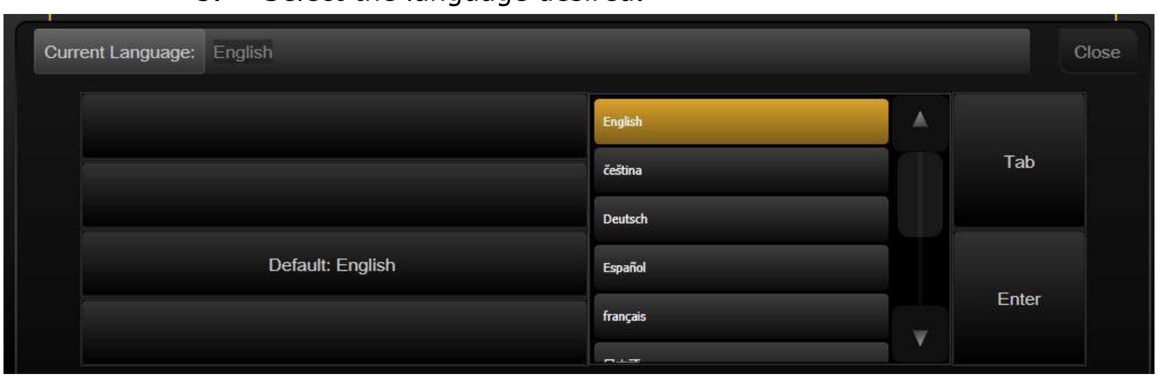
The Select Language feature allows the operator to localize the *Cornerstone* brand software for a specific language. The available language choices appear on the screen. Although the software is localized for a specific language, the built-in manual and help files will remain in English.

1. Select the Session bar.



2. Select the Language field.

3. Select the language desired.



4. Select Enter. The software will convert to the selected language.

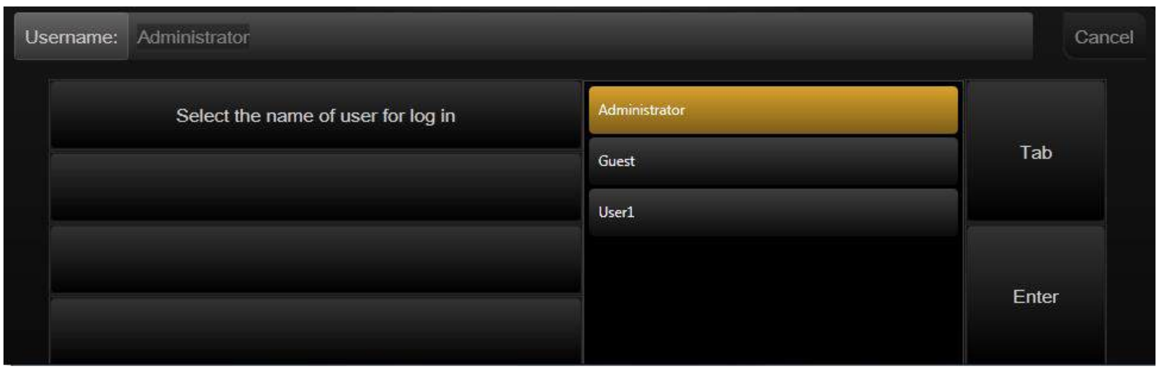
Logging In

NOTE

This section applies only if User Permissions are enabled. For more information on setting up user accounts, refer to Working with User Permissions, page 4–51.

1. If the desired user is already selected, select Login 

, and enter a password if necessary. Once the login is successful, the following steps do not apply.
2. To log in with a different user, select the Username field.
3. Select the desired user, and then select enter.



4. Enter a password, if necessary.

Exiting the Software

To exit the *Cornerstone* brand software, select the Session button on the Title bar. Select the desired option:

- If no software sequences are running, then select Exit-Gas Off 

 or Exit Gas Conserve 

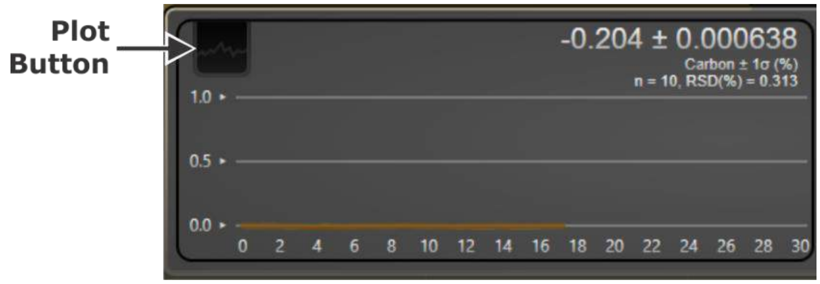
 to determine the gas state when the software is closed.
- If a software sequence is running, Abort appears. Wait for the running process to end, or select Abort 

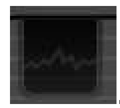
 to end the current process. Then, select the desired Exit as described previously.

CAUTION
Aborting some sequences can leave the instrument in an unsafe state.

- Select Back to return to the Analysis screen.

Configuring the Plot



To configure a plot, select the Plot button . An option box to configure the plot appears. Clear the option box by touching the screen anywhere outside the box.

Single-Touch Display **Multi-Touch Display**

NOTE The option box to configure the plot will vary depending on the type of display and the instrument configuration.

- Select **Curve** to change the plot to a signal curve.
- Select **Advanced** to plot the signal curve with extra information, such as y-axis values or furnace behavior. To view x- and y-axis coordinates, select and hold on a trace. Refer to Configuring the Display, page 4–5.
- Select **Scatter** and the results will appear as a scatter plot. Scatter mode requires a minimum of two replicates to be displayed.
- To **Zoom** and magnify the plot, use one of the following methods.
  - **On single-touch displays:** Select Zoom. Select and hold a corner of the area of interest, and then slowly drag diagonally toward the opposite corner of the area.
  - **On multi-touch displays:**
    - Select Zoom. With a single finger, touch and hold a corner of the area of interest, and then slowly drag diagonally toward the opposite corner of the area.

        - Select Multi-Touch. Touch the plot with two fingers and drag apart to zoom in, or pinch together to zoom out. Either axis can be zoomed, but not simultaneously. The axis that the user’s fingers more closely align with determines which axis zooms. The same axis is affected until the fingers are removed from the screen.
    - **On all displays:** Select Zoom or Multi-Touch, if available. Rotate the mouse wheel forward to zoom in or backward to zoom out. Both axes scale. To scale only one axis, hold the Alt key to scale the x-axis, or hold Shift to scale the y-axis.

- Once the plot is zoomed as described in Zoom, previous, use one of the following methods to **Pan** the plot left to right or up to down.
    - **On single-touch displays:** Select Pan to move the plot left to right or up to down using the mouse cursor.
    - **On multi-touch displays:** Touch the plot with one finger and drag or flick to move the plot as desired.
- Select **Restore** to restore the plot to its default view.
- Select the  button to minimize the plot. To restore the plot, select the analyte button.
- Select the  button to minimize all analyte plots except the current one. Select the button again to show all plots.
- Select **Advanced** and then select the  button to show or hide the different areas of signal such as baseline, integration, and endline. The button appears only when a single replicate is selected.

Configuring the Calculations Plots

The calculations (calibration, drift, and blank) plots have additional settings that can be configured by the user.

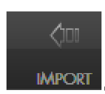
- Select **All** to see the entire plot.
- Select **Included** to focus on the data points included in the current calculation.
- Select the desired plot type from the dropdown menu. Plot Type is available only within calibrations. The Plot Type Options are Adjusted Area, Absolute Error, and Relative Area. When changing the plot type, the displayed replicate data changes to match the plot.

Importing and Exporting

NOTE All data imports use the method described in this section, except for sample files. For information on importing sample files, refer to Creating and Importing a Sample File, page 3–36.

Importing

Import allows the user to restore exported data to the *Cornerstone* brand software.

1. Select Import 

. The file browser opens.
2. Navigate to the location of the file to import using the file browser, and then select Accept.
3. Select the file(s) to import, and then select Import.
4. The software displays a message under the Import action button with the name(s) of the file(s) being imported and the path name(s).
5. Select Save to complete the import process.

Exporting

Export allows the user to save information from the *Cornerstone* brand software to an outside location.

1. Select the information to be exported.
2. Select Export 

. The file browser opens.
3. Navigate to the location to export the file using the file browser. Use the Add, Rename, and Delete buttons to modify folders on the computer.
4. Select Accept to confirm the location.
5. The software displays a message under the Export action button with the name(s) of the file(s) being exported and the path name(s).

Copy Output

1. From the Analysis screen, select the set(s) to copy.
2. Select Output 

on the Action bar.
3. Select the Copy tab.

4. Select Copy to copy the set(s) information to the system clipboard.

   Or

   Select Close to close the Copy tab.

Export Output

1. From the Analysis screen, select the set(s) to export.
2. Select Output 

on the Action bar.
3. Select the Export tab, and then select the data type to be exported. The following example uses Plot Data.

4. Select one of the following options as desired.
   - **Export**—Used to export the selected data. Continue with step 4, following.
   - **Close**—Closes the Export tab.
5. If Export was chosen in step 4, previous, a file browser opens. Navigate to the location to export the information using the file browser. Use the Add, Rename, and Delete buttons to modify folders on the computer. Select Accept to continue, or select Close to cancel the export.
6. If Accept was chosen in step 5, previous, complete the appropriate steps as follows.

   Plot Data:
   - A file named “Plots.csv” is created in the selected location. The export is complete.

   Sample Data:
   - A zipped folder containing the sample data is created in the selected location. The export is complete.

   Sample Data with Instrument Report:

   A. A zipped folder containing the sample data is created in the selected location.

   B. An additional file browser opens. Navigate to the location to save the Instrument Report PDF.

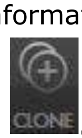
   C. Enter a file name for the PDF in the File Name field, and then select Save.

Including and Excluding

When an item is included, it can then be used for other tasks in the software – such as in the login, blank, calibration, and drifting processes – and it is used to determine results on the analysis page. When an item is excluded, it remains in the database but is not available for use in other tasks. When a counter is excluded, it is no longer part of the instrument maintenance process.

Excluded items are marked with an "X." On the Analysis screen, sets that contain some excluded replicates are marked with a "/," and sets that contain all excluded replicates are marked with an "X.”

Cloning

1. Select the information to be cloned.
2. Select Clone 

. The cloned item appears in the list as “Name of Item Copy.”

Customizing Analyze Button with Logo

The following procedure explains how to personalize the software's analyze button with a company logo.

1. Shut down the *Cornerstone* brand software.
2. Name or rename the image file "CustomLogo.png" or "CustomLogo.jpg." The file must be a .png or .jpg image to work properly.
3. Place the custom logo .png or .jpg file here:
   C:\ProgramData\LECO\CustomLogo.png
   Or
   C:\ProgramData\LECO\CustomLogo.jpg
   The file name must match exactly.
4. Restart the *Cornerstone* brand software.

Using the Guide

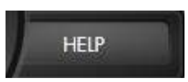
The guide contains videos detailing the performance of some necessary maintenance procedures.

NOTE The videos from the Installation and Service Video USB (located in the Accessory Pack), are copied to the software during the analyzer installation process. If new guide videos need to be copied, complete step 22 of Installing the Analyzer, page 2–15.

1. Select Guide 

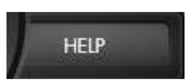
 from the Utility bar.
2. Choose a video, and then select Play.
   - Use the slide bar to move to a desired portion of the video.
   - Select Pause at any time to stop the video.

Using Help

Select Help 

 from the Utility bar to open the instruction manual. The onboard manual is updated with every software upgrade and may differ from the hard copy received with the instrument.

If more than one instruction manual is associated with an instrument, complete the following steps to select the desired manual.

1. Select Help 

 from the Utility bar.
2. Select Document.

3. A keyboard appears, displaying the list of available manuals. Select the desired manual, and then select Enter.

Navigating within the Manual

- Use the outline to select a specific section of the manual. Select the arrows to expand or collapse sections with subheadings.

- Select Increase Zoom and Decrease Zoom to change the magnification level.
- Use the Previous Page, Previous Chapter, Next Page, and Next Chapter buttons to move between pages and chapters without scrolling.
- Select Back or Forward to navigate to previously selected sections of the manual.

Searching the Manual

1. Select the search field next to the Find button.

2. Enter the desired search term.
3. Select Find to locate additional instances of the term within the manual.

Printing Pages from the Manual

1. Enter the range of pages to be printed in the From 

and To 

fields.

NOTE Select a desired section of the manual from the outline, and the From and To fields automatically populate with the correct page range for that section.

2. Select Print.

Using Select All

Select All 

is a feature available on the Action bar that will select all the fields available on the current screen. Using Select All in conjunction with filters is convenient for selecting sets for reports and transports.

After Select All is used, the Select button deselects everything except one highlighted item.

Using Multi Field

Multi Field 

is a feature available on the Action bar that will edit fields from multiple sets or replicates at once if the same edit is desired. For example, the same description can be added to multiple sets.

1. Select Multi Field 

.
2. Edit the desired fields by completing one of the following methods.
   - Select one of the fields to be edited. A keyboard appears. Select the same field in each of the other sets or replicates to be edited. Enter the desired information, and then select Enter.
   - Select one of the fields to be edited. A keyboard appears. Enter the desired information, and then select the same field in each of the other sets or replicates to be edited. When all of the desired sets or replicates have been edited, select Enter.

Daily Startup Procedure

The following section explains tasks that should be completed on a daily basis.

OXIDIZING/PROTECTIVE EYEWEAR/PROTECTIVE GLOVES

Oxygen is an oxidizer and is pressurized. It can become volatile when subjected to heat or high temperatures. Protective eyewear and gloves should be worn when handling oxygen.

Refer to the Safety Data Sheet (SDS) for additional information.

1. Check the incoming oxygen supply to confirm a sufficient volume exists for the analysis set.
2. Check that the instrument oxygen gauge reads between 24 and 26 psi.
3. Check that the carrier gas instrument pressure reads 24 and 26 psi.
4. Check that the pneumatic pressure reads 40 psi.
5. Check the primary filter tube, and replace it when the steel wool has visibly oxidized. Clean and grease the upper and lower o-rings. Refer to Replacing the Primary Filter Tube, page 6–10, and Cleaning and Greasing the O-Rings, page 6–9.
6. Check the furnace transfer tubing for discoloration. Refer to Replacing the Furnace Transfer Tubing, page 6–50.
7. Remove the particle filter. Clean and grease the upper and lower o-rings. Inspect the particle filter, and replace when the filter has darkened significantly. Install the particle filter. Refer to Replacing the Particle Filter, page 6–13, and Cleaning and Greasing the O-Rings, page 6–9.
8. Check that the pinch valve tubing is properly seated in the valves. Replace the tubing if it is worn or yellowed. Refer to Replacing the Pinch Valve Tubing, page 6–62.
9. Check Counters to ensure that no other maintenance items expire during the planned set of analyses. Refer to Counters, page 5–24.
10. Select Diagnostics and then select Ambient. Verify that the values are within specifications. Refer to Ambient, page 8–4.
11. Perform and pass a System Check. Refer to System Check, page 8–16.
12. Perform and pass a Leak Check. Refer to Leak Check, page 8–12.
13. Turn On the gas and verify that "Ready to Analyze" appears in the Status Bar.

Using Sample Carousels

The sample carousel is loaded with the samples to be analyzed. The samples are analyzed in sequential order. For reference, a Loader Location field can be added to the Sample Display. (Refer to Configuring the Display, page 4–5.) The Loader Location field is only for reference, and it does not specify the order in which samples will be analyzed. The Loader Location field auto increments when new replicates are added. A position should be left open for any blanks that are logged in, unless they are specified to Blank No Load Samples. (Refer to Logging in a Blank, page 3–32.)

1. Prepare and weigh 29 samples for the first or bottom carousel.
2. Looking down into the carousel, turn the bottom plate until hole number 30 is open. Refer to Figure 3-3, page 3–29.

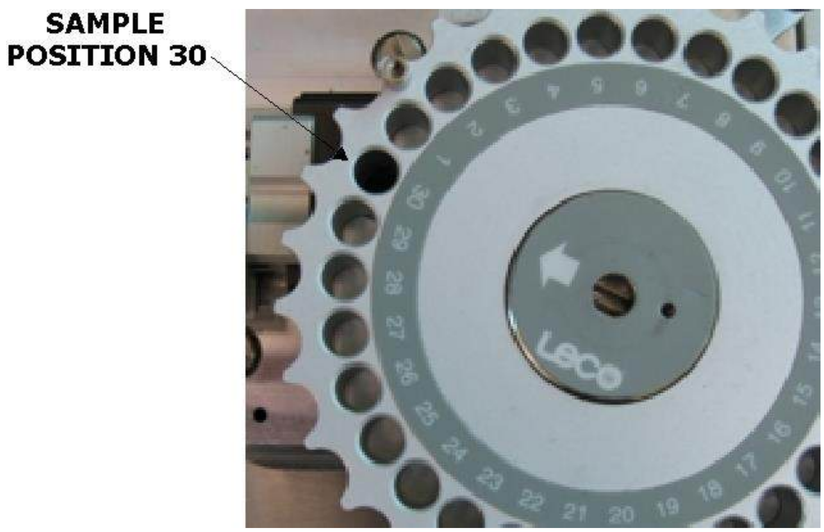


Figure 3-3
Carousel Open Position

3. Insert samples into holes 1 through 29 of the carousel. Do not move the bottom plate. Use this carousel only as the first or bottom carousel.

4. Without moving the bottom plate, install the carousel onto the loading head. The large and small pins on the bottom plate must align with the holes in the loading head. Do not move the bottom plate to align the holes; instead, move the entire carousel. Refer to Figure 3-4 and Figure 3-5, following.

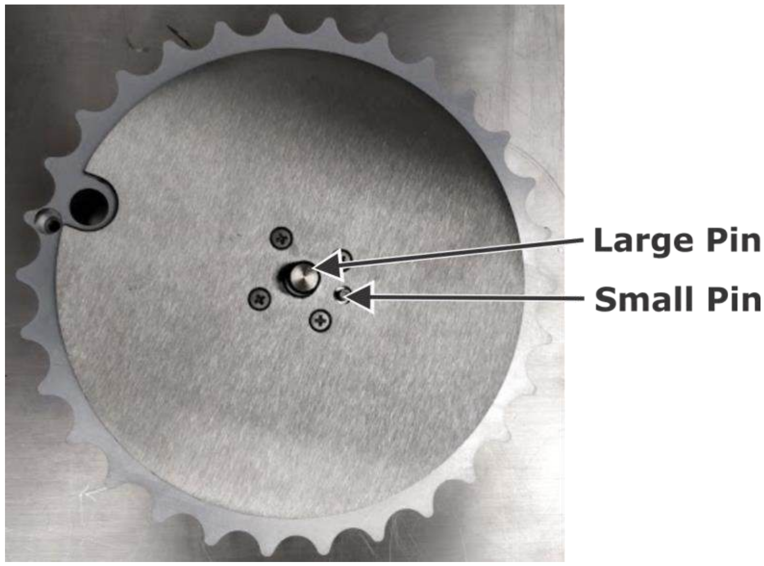


Figure 3-4
Carousel Bottom Plate

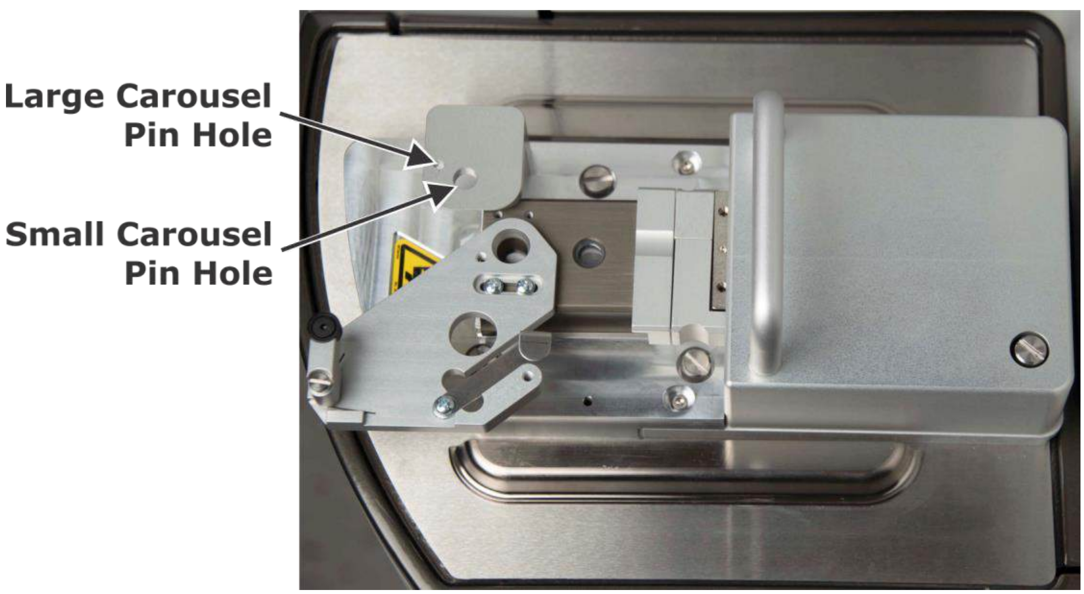


Figure 3-5
Carousel Mounting Position

Stacking Carousels

Stacking carousels increases the number of samples that can be analyzed without operator intervention. Each carousel can hold 29 samples, and up to four carousels can be stacked on the loading head.

As samples are analyzed, samples from the upper carousel drop and fill the lower carousel. Only samples from the lower carousel drop into the loading head.

1. Prepare and weigh up to 29 more samples for the second carousel.
2. Looking down into the carousel, turn the bottom plate until hole number 29 is open.
3. Insert samples into holes 30 through 28 of the carousel. Do not move the bottom plate.
4. Without moving the bottom plate, align the standoffs and install the second carousel on top of the first carousel. The standoff on the first carousel should be inserted into the hole in the second carousel, directly under the standoff in the second carousel. Refer to Figure 3-6, following.

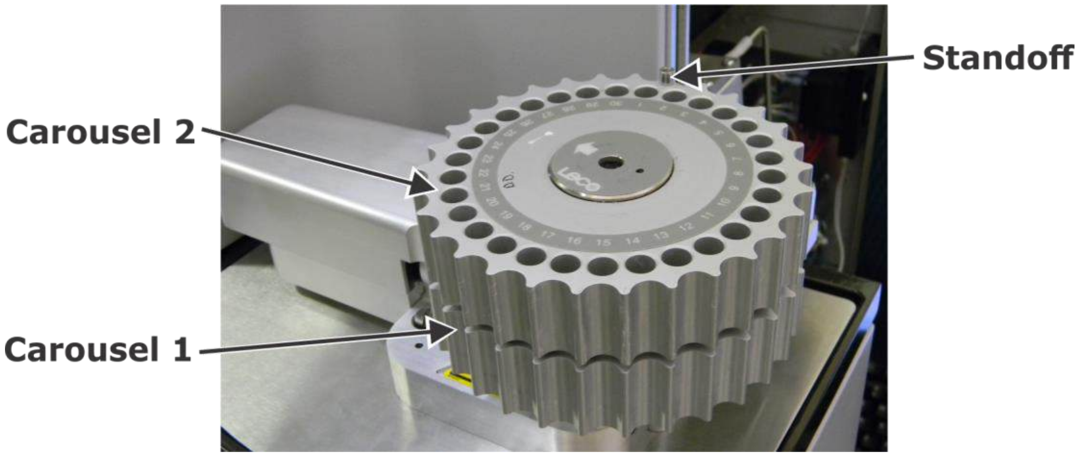


Figure 3-6
Stacked Carousels

5. To stack more carousels, repeat steps 2 through 4. For the third carousel, hole 28 should be open, and for the fourth carousel, hole 27 should be open. As the samples drop into the first carousel, they will be in the correct numerical order.
6. Log in the sample information into the Analysis screen. Refer to Logging in Replicates for Analysis, page 3–32.

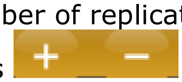
Logging in Replicates for Analysis

To analyze a replicate, sample information is logged in using the software. The following section explains how to log in Blanks, Standards, Drifts, Samples, Templates, and QC Wake Up for analysis.

Before a replicate is analyzed, the sample type and information associated with it must be entered. A sample set is entered with "n" user defined replicates. A sample set consists of the sample name, sample number of replicates, description, method, and average results. Sample replicates consist of the mass, comments, and sample results.

Sample masses can be logged in from the keyboard or balance.

Logging in a Blank

1. Enter the number of replicates for the blank set by adjusting the + or – buttons  on the Login bar.
2. Select Blank 

on the Login bar.

NOTE All blanks automatically have a mass determined by the Nominal Mass field set in the Method. This value can be edited only from the Method Edit screen. Refer to Creating and Editing Methods, page 4–13.

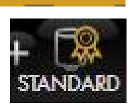
3. Select the desired type of blank, and then select Enter.

   Blank—A normal analysis sequence that expects a boat in a specified loader location.

   Quick No Dose Blank—A sequence that does not fill and dump the dose loop. No analyte should reach the detectors.

   Blank No Load—A Gas Blank sequence that does not actuate the load head mechanism between analyses.
4. Select Method, and then select a method name from the list.

Logging in a Standard

1. Enter the number of replicates for the sample adjusting by the + or – buttons  on the Login bar.
2. Select Standard 

on the Login bar.
3. Select a standard from the list, and then select Enter. The standard list displays only included standards from the Settings/Standards screen. Refer to Creating and Editing Standards, page 4–39.

4. For each rep, enter the mass of the standard, select Default: [X], select Read Mass from Balance, or press the Print button on the balance, and then select Enter.
5. Select Method, and then select the desired method name from the list.

Logging in a Drift

NOTE A replicate with a Sample Mass outside 10% or 1 mg, whichever is greater, of the average sample mass used at calibration cannot be used to drift a method.

1. Enter the number of replicates for the sample by adjusting the + or – buttons  on the Login bar.
2. Select Drift  on the Login bar.
3. If the current method has a drift standard selected in the calibration, then select a drift standard from the list, and then select Enter. The drift standard list displays only included drift standards.

   If the current method does not have a drift standard, one must be added. Refer to Adding Standards for Drift, page 3–47.
4. For each rep, enter the mass of the standard, select Default: [X], select Read Mass from Balance, or press the Print button on the balance, and then select Enter.

Logging in a Sample

1. Enter the number of replicates for the sample by adjusting the + or – buttons  on the Login bar.
2. Select Sample .
3. Enter a name for the sample.
4. For each rep, enter the mass of the standard, select Default: [X], select Read Mass from Balance, or press the Print button on the balance, and then select Enter.
5. Select Method, and then select a method name from the list.

Logging in a Template

Sample templates are a quick way of logging in multiple sample sets of various sample types that comprise a routine analysis pattern (for example: running five blanks, two check standards, and three normal unknown samples each day). For more information on templates, refer to Creating and Editing Templates, page 4–41, and Using Sample Templates, page 4–42.

Logging in QC Wake Up

NOTE QC Wake Up is applicable only to instruments with the QC option.

QC Wake Up is intended to log in all of the blanks, check standards, and conditioning samples required in order to satisfy the QC requirements specified in the selected method.

1. Select QC Wake Up 

.
2. Select the box next to Method. A list of methods that have QC enabled appears.
3. Select the method containing the QC criteria that the QC Wake Up will attempt to satisfy, and then select Enter. The calendar appears.
4. Select the desired date and time for analysis of the QC Wake Up items to begin by using one of the following methods.
   - Use the keyboard to enter the desired date and time in the text box.
   - Use the calendar to select the desired date and time.

IMPORTANT The following must be taken into consideration when choosing the date and time for QC Wake Up to begin, or the QC Wake Up will not occur. A warning appears in the software if the gas will not be On for the QC Wake Up to begin.

- The Gas Wake Up must be scheduled to complete turning On the gas before the QC Wake Up begins. Refer to Scheduling Gas Wake Up, page 5–34.
- If a Leak Check is set to run during the Gas Wake Up, it must have time to complete before the QC Wake Up begins. Refer to Scheduling Gas Wake Up, page 5–34.
- If a Gas Standby Time is set, the Gas Standby Time must be longer than the length of time between the scheduled Gas Wake Up and the scheduled QC Wake Up or the instrument will switch to gas standby mode. Refer to Gas Standby Time, page 5–33.

5. Select Enter.
6. Select the location to insert the desired combination of QC Wake Up blanks, standards, and conditioning samples, and then select Enter. This determines whether the QC Wake Up is inserted before the first unanalyzed sample or at the end of the sample list.
7. Select Accept.
8. For the QC Wake Up to be successful, the sample weights and loader locations (on some instruments) need to be entered.

Splitting

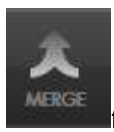
A replicate can be split off from a set and made into a new set of its own. The Name, Method, Comments, and Description fields will be copied into the new set. The comments associated with each sample replicate will be retained.

1. Select the replicate(s) to be split.
2. Select Split 

from the Action bar on the Analysis screen.

Merging

To merge two or more sets into one, the Name and Method must match. The Description and Comment fields do not have to match. When sets are merged, sample replicate comments are retained. The merged sample sets will have the same description as is associated with the first sample set.

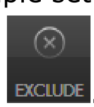
1. Select the sets to be merged.
2. Select Merge 

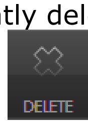
from the Action bar on the Analysis screen.

Excluding or Deleting a Sample

A sample can be excluded from the set result or permanently deleted from the software.

NOTE A standard sample that is referenced by a calibration cannot be deleted.

1. Select the sample set or sample rep to exclude or delete.
2. Select Exclude 

. Once a rep has been excluded, its results will not be used in the set results or when setting a blank, drift, or calibration.
3. To permanently delete a sample, select the sample again and select Delete 

.

NOTE Any unanalyzed sample with a mass, except for blanks, must be excluded before it can be deleted.

Creating and Importing a Sample File

Sample Import allows the user to import sample files (in .csv format) into the *Cornerstone* brand software to analyze. To transmit the results back to the .csv file, refer to Data Transmit, page 5–29.

Creating a Sample File to Import

A .csv (comma separated value) file containing all of the sample information can be created in any text editor. Refer to Table 3-1, following, for the description and valid values for each column in the file.

Column	Description	Valid Values
A	Set ID	Any text value. Rows with matching Set ID values will be grouped as replicates in a single set.
B	Sample Type	"Blank," "Standard," "Drift," "Sample," or "GasDose". Refer to Valid Values for Blank Type, page 3–37, for an additional list of values for blank types.
C	Name	For Standard, Drift, or GasDose sample types, this value must be the name of the *Cornerstone*-defined standard. For all other samples types, any text value. If multiple Standard names are listed under the same Set ID value, only the first value will be applied to the set.
D	Method Name	Name of *Cornerstone*-defined method. If multiple Method names are listed for the same Set ID value, only the first value will be applied to the set.
E	Description	Any text value. Optional. If multiple Description values are listed for the same Set ID value, only the first value will be applied to the set.
F	Replicate ID	Any text value. Optional.
G	Mass	Valid double value specified with invariant culture ("." as the decimal separator). This value will not be used for Blank or Gas Dose sample types.
H	Comments	Any text value. Optional. This is applied at the Replicate level.
I	Operator	Any text value. Optional.
J	Auto Loader Location	Any valid loader location (for example: for a CS instrument with a 60-place shuttle loader: A1-A10, B1-B10,…F1-F10

Table 3-1
Column Definitions Table

1. To create a .csv file in a text editor or in Microsoft® Excel®, enter each sample as a separate line with the following fields (as described in Table 3-1, previous): Set ID,Sample Type,Name,Method Name,Description,Replicate ID,Mass,Comments,Operator,Auto Loader Location.

NOTE To import multiple reps into the same set, give the reps the same Set ID value (column 1).

2. The fields must be delimited by commas in a text editor or by tabs in *Excel*. Refer to Figure 3-7 and Figure 3-8, following, for examples of the same sample information entered into *Excel* and Notepad.

NOTE The following screenshot illustrations are examples only and may not be the same on all instrument configurations.

	A	B	C	D	E	F	G	H	I	J
1	ABC123-2	Standard	502-348 LN 1031	New Method	MyDescription1	REP1	0.1221	My Comments1	My Operator	C7
2	ABC123-2	Standard	502-348 LN 1031	New Method	MyDescription2	REP2	0.3456	My Comments2	My Operator	C8
3	ABC123-3	Standard	502-348 LN 1031	New Method	MyDescription3	REP3	0.7788	My Comments3	My Operator	D2
4	ABC123-3	Standard	502-348 LN 1031	New Method	MyDescription4	REP4	0.6969	My Comments4	My Operator	B9

Figure 3-7
.csv File Created in *Excel*

File Edit Format View Help

```
ABC123-2,Standard,502-348 LN 1031,New Method,MyDescription1,REP1,0.1221,My Comments1,My Operator,C7
ABC123-2,Standard,502-348 LN 1031,New Method,MyDescription2,REP2,0.3456,My Comments2,My Operator,C8
ABC123-3,Standard,502-348 LN 1031,New Method,MyDescription3,REP3,0.7788,My Comments3,My Operator,D2
ABC123-3,Standard,502-348 LN 1031,New Method,MyDescription4,REP4,0.6969,My Comments4,My Operator,B9
```

Figure 3-8
.csv File Created in Notepad

3. To skip over fields (for example, optional fields such as Description, Replicate ID, Comments, or Operator), you will need to put in delimiters (commas in a text editor or tabs in *Excel*) as placeholders to indicate which fields should be filled in.
4. Save the file with a .csv file extension.

Valid Values for Blank Type

Refer to Table 3-2, following, for the valid value for each blank type.

IMPORTANT Values are case-sensitive. Enter them as listed in the table.

Name of Blank Type in Software	Valid Value
Blank	“Blank” or “BLANK”
Quick No Dose Blank	“NODOSEBLANK”
Blank No Load	“QUICKGASBLANK”

Table 3-2
Blank Type Names

Importing a Sample File

1. From the Analysis screen, select Import 

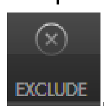
. The file browser opens.
2. Navigate to the location of the file to import using the file browser.
3. Select the file to import, and then select Accept. The samples log in beneath the existing samples.

Performing Blanks

Blanks are used to calculate the system blank or baseline, sometimes called a blank area. The system blank determines the system response without a sample present. A blank correction compensates for the system blank when calculating the analysis result. The system blank should be determined every day by performing a blank correction before analyzing unknown samples.

1. Log in and perform at least three blank analyses. Refer to Logging in a Blank, page 3–32.
2. Select the set of the blank replicates in the software.
3. Select Blank 

on the Action bar.
4. To review individual blank values, select the tab for the analyte range, and then select Edit 

.
5. To exclude results, select the tab for the analyte range, and then select the set of reps or a single rep.
6. Select Exclude 

.
7. Select Save to save changes.

Performing Calibrations

Calibration is the process that adjusts the instrument response to produce an analysis result that is equal to that of a known calibration standard.

Because a generic calibration for typical samples was performed during manufacturing, it may be necessary to create a calibration that corresponds to the samples that will be analyzed and the methods that will be used. When it is necessary to create a calibration, the following section explains how to calibrate in two ways: using standards with similar weights but multiple compositions; and using standards with the same composition but multiple weights.

Calibrations are stored per method: one method's calibration is not valid on samples run under other methods.

Multiple Compositions with Similar Mass

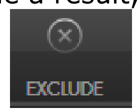
1. Develop a method for calibration that is suitable for the calibration sample. Refer to Creating and Editing Methods, page 4–5.
2. Perform two analyses on the highest composition standard samples as a conditioner. Refer to Running an Analysis, page 3–50.
3. Run conditioners and blanks, and set the blank.
4. Log in three to five Standards of varying compositions to use for calibration. Refer to Creating and Editing Standards, page 4–39.
5. Perform analysis using all the standards selected. The analysis should be performed for each analyte if there is more than one analyte. Analyze at least three samples per composition. Start with the lowest composition and end with the highest composition. Refer to Running an Analysis, page 3–50.
6. With the calibration results displayed, select the set results for calibration. All the results analyzed for calibration should be selected. To set a calibration, select Calibrate 

.
7. At this point, the user has the choice of selecting Save to set all calibrations without further review.
8. To review individual calibrations, select the analyte range and then select Edit 

.

NOTE: To expand the plot, select the tab  and drag it down.

9. To view relative and absolute error plots or display only included replicates, change the plot type. Refer to Configuring the Calculations Plot, page 3–22.

10. In the Existing Calibration box, select Show to display the current calibration, or select Hide and the plot will not appear.
11. In the New Calibration box, for Regression Type, select Full Regression. If there is not enough data for a full regression, the calibration will default to a force through origin calibration.
12. The samples analyzed for calibration and then selected will be listed. Look at the calculated values of each set, the relative error, and the points plotted on the graph.
13. Use the RMS Error as a guide when deciding which replicate results to include or exclude from the calibration. The Root Mean Square (RMS) Error decreases when the plotted points are closer to the calibration line. To exclude or include a result, select the signal on the plot, and then select Exclude 

or Include 

.

NOTE Refer to Calibration Definitions, page 3–44, for descriptions of the information displayed.

14. Repeat the procedure for each range tab.
15. Select Save to save the calibration.

Multiple Masses with Same Composition

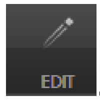
This approach assumes that the response of the instrument is zero when the analyte composition is less than detectable; therefore, calibrations created with this approach are not as robust as calibrations with multiple compositions with similar mass.

1. Develop a method for calibration that is suitable for the calibration sample. Refer to Creating and Editing Methods, page 4–5.
2. Perform two analyses as a conditioner. Refer to Running an Analysis, page 3–50.
3. Run blanks, and then set the blank.
4. Perform three to five analyses.

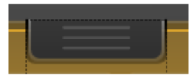
NOTE If the same standard is run at different masses, each mass group should be logged in as a different set.

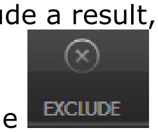
5. With the calibration results displayed, select the results for calibration. All the results analyzed for calibration should be selected except for the first two conditioning results. To set a calibration, select Calibrate 

.
6. At this point, the user has the choice of selecting Save to set all calibrations without further review.

7. To review individual calibrations, select the analyte, and then select Edit 

.

NOTE → To expand the plot, select the tab  and drag it down.

8. To view relative and absolute error plots or display only included replicates, change the plot type. Refer to Configuring the Calculations Plot, page 3–22.
9. In the Existing Calibration box, select Show to display the current calibration or select Hide and the plot will not appear.
10. In the New Calibration box, for Regression Type, select Forced through Origin.
11. The samples analyzed for calibration and then selected will be listed. Review the calculated values of each set, the relative error, and the points plotted on the graph.
12. Use the RMS Error as a guide when deciding which replicate results to include or exclude from the calibration. The Root Mean Square (RMS) Error decreases when the plotted points are closer to the calibration line. To exclude or include a result, select the signal on the plot, and then select Exclude 

or Include 

.

NOTE → Refer to Calibration Definitions, page 3–44, for descriptions of the information displayed.

13. Repeat the procedure for each range tab.
14. Select Save to save the calibration.

Adding or Replacing Standards in a Method Calibration

Complete the following steps to add or replace standards in an existing method calibration.

Refer to Calibration Definitions, page 3–44, for descriptions of the information displayed.

NOTE The default option when entering a calibration is "Don't Use" for Existing Standards and "Use" for New Standards. Therefore, when a standard is added to a single analyte, the other analytes will need to be set to "Use" for Existing Standards and "Don't Use" for New Standards. When saving a calibration, the existing and new standards will be recalculated using the current method blank.

1. From the Analysis screen, select the set(s) needed to add to or modify the existing calibration.
2. Select Calibrate 

.
3. Select the tab for the desired analyte.
4. Choose one of the following options as desired.
   - **To replace the existing calibration with a new calibration:** Select Don't Use next to Existing Standards and Use next to New Standards.
   - **To keep the existing calibration without adding any new sets:** Select Use next to Existing Standards and Don't Use next to New Standards.
   - **To add new sets to the existing calibration**: Select Use next to both Existing Standards and New Standards.
5. Sets and replicates can be included or excluded as desired. Select the set or replicate, and then select Include or Exclude on the Action bar. Refer to Including and Excluding, page 3–24.
6. To change the regression type and regression order complete the following steps.
   A. Select Edit. The Editing screen appears.
   B. Under New Calibration, select the Regression Type drop-down arrow, and then select the desired regression type.
   C. Select Close to close the Editing screen.
7. Select Save to save changes.

Calibration Definitions

The following section explains the parameters displayed on the Calibration screen. The information displayed is helpful when reviewing the calibration results.

Drift—Select Yes to use the standard to drift this calibration. The default is No. Drift standards can also be set by completing the steps in Managing Drift Standards, page 3–48.

Certified Composition—The certified composition of the standard for each set. The value and the units displayed are the same as those entered for that standard on the Standards screen.

Calculated Composition—The composition of the standard as determined by the calibration equation. The units displayed here are the same as those entered on the Standards screen. At the set level, the Calculated Composition shown is the average result for the underlying included replicate measurements. Excluded replicates are not included when determining the average value. (Refer to Calculation of Analysis Results, page 7–7, for more information.)

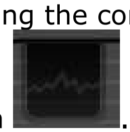
Error—The difference between the average Calculated Composition and the Certified Composition for each set. The units displayed are the same as those entered on the Standards screen.

Analysis Date—The date and time when a replicate analysis began. At the set level, the value shown is the date and time when the last replicate began.

Sample Mass (g)—The sample mass entered by the user when the sample was weighed for analysis.

Certified Mass (g)—The absolute amount of analyte expected in the sample as determined by the Sample Mass and the Certified Composition.

Calculated Mass (g)—The absolute amount of analyte present in the sample as determined by the calibration equation. (Refer to Calculation of Analysis Results, page 7–7, for more information.)

Adjusted Area—The peak area after the Sensitivity Factor and Blank Correction have been applied. The value displayed here can be changed to Adjusted Area, Absolute Error (g), or Relative Error (%) by selecting the corresponding value for Plot Type via the Plot button . (Refer to Calculation of Analysis Results, page 7–7, for more information.)

Peak Height—The maximum height of the measured peak. For dual-range instruments, the Peak Height is used to determine which range is used to report the result for that analyte. The final result is a function of the low and high threshold values as configured in the Method settings. (Refer to Calculation of Analysis Results, page 7–7, for more information.)

Weighting—Allows the user to enter a custom factor used to adjust the relative importance of individual replicates when the calibration coefficients are determined. The greater the value, the more significant the replicate when determining the calibration coefficients. By default, the value is 1.0. (Refer to Calculation of Analysis Results, page 7–7, for more information.)

Performing Drifts

Drifts should be performed when the check standards are outside established limits. Drift correction adjusts the original calibration response to match the current instrument response and ensures accurate calibration and analysis results.

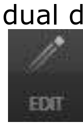
Drift standards are included in the original calibration by selecting Yes in the Drift column of the Calibration table for the specific standard that will be used to drift.

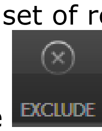
To add a standard as a drift standard after the original calibration has been established, refer to Adding Standards for Drift, following.

NOTE For each Sample Set, the Sample Mass of each included replicate must be within 10% or 1 mg, whichever is greater, of the average sample mass for that set in order to be used as a drift standard.

1. **OPTIONAL:** If necessary, run conditioners.
2. Run blanks, and then set the blank.
3. Log in and perform at least three analyses with the drift standards that have been selected in the Calibration table. Refer to Running an Analysis, page 3–50.
4. Select the set of drift reps and then select Drift 
.
5. Select Save to make no further changes.

   Or

   A. To review individual drift factors, select the drift range, and then select Edit 
.

   B. To exclude individual results, select the set of replicates or a single replicate, and then select Exclude 
.

C. Repeat as necessary, depending on the application.

D. Select Save to set all drift factors.

NOTE The drift factor must be between 0.5 and 1.5 in order for the software to save the drift changes.

Adding Standards for Drift

A standard can be added as a drift standard after determining the original calibration.

NOTES

- For each Sample Set, the Sample Mass of each included replicate must be within 10% or 1 mg, whichever is greater, of the average sample mass for that set in order to be used as a drift standard.
- For best accuracy, blank and drift the method using current drift standards prior to adding new standards for drift.
- When adding standards for drift, the calculated values for each range will not change. The standards are only added to the drift standards list and a baseline value is determined. Once added, the standards can then be analyzed as drift standards and used to calculate new drift values.

1. **OPTIONAL:** If necessary, run conditioners.
2. Run blanks, and then set the blank.
3. Run a current drift standard, and then perform a drift. Refer to steps 3 through 5 of Performing Drifts, page 3–46.
4. Run an analysis with a standard that is to be added for drifting the calibration. Refer to Running an Analysis, page 3–50, and Performing Drifts, page 3–46.
5. Select the standard to be added for drift, and then select Drift 

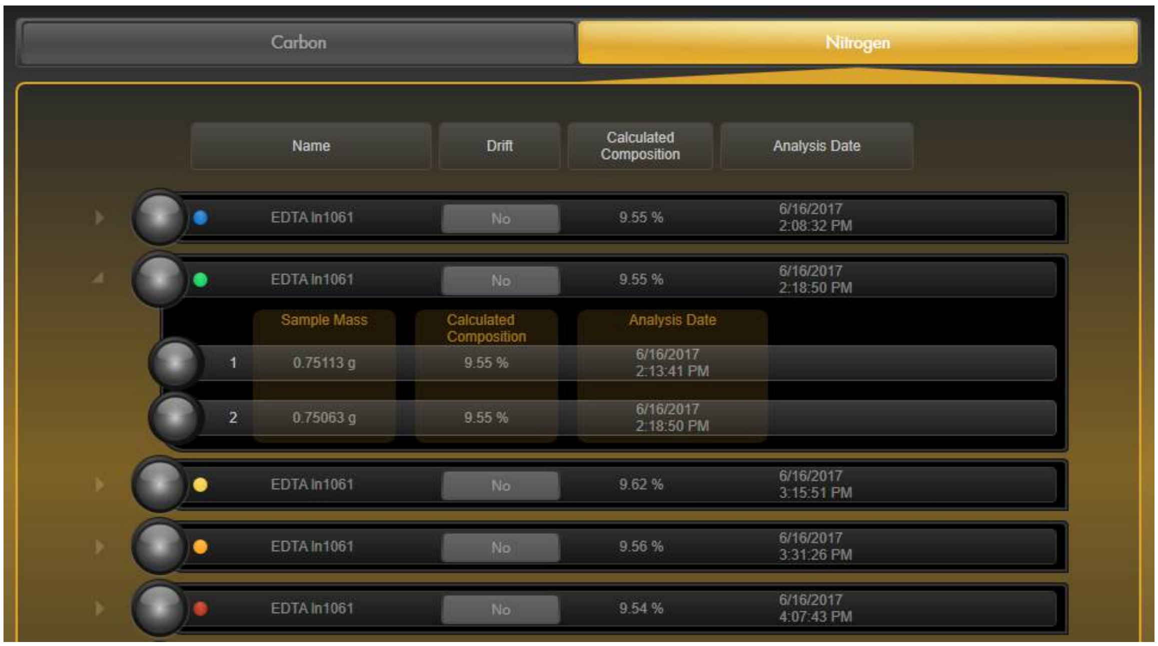
.
6. The newly added drift standard appears in the Standards Added For Drift table.

7. Select Add, and then select Save. The newly added drift standard will now be listed in the Manage Drift Standards table with the Drift Standards included in the original calibration. Refer to Managing Drift Standards, following.

Managing Drift Standards

Managing Drift Standards allows drift standards to be configured for each range in a given method.

1. When editing a method, select Manage Drift Standards located under Calculations. Refer to Method Parameters, page 4–15.
2. Select the desired analyte range by selecting its tab.
3. Drift standards are included in the calibration by selecting Yes in the Drift column of the Manage Drift Standards table for the specific standard that will be used to drift.
4. Select Save to save changes.



Recalculating

After a sample is analyzed, the result can be recalculated if sample data has changed. Recalculation may be necessary if the mass, blank, drift, or calibration has changed.

1. In the software on the Analysis screen, select the sample.
2. Select Recalc 

on the Action bar. The selected samples will be recalculated using the new sample mass, method parameters, blank, calibration, and drift factor.

Running an Analysis

After a sample is logged in, it can be analyzed. Analysis will start with the first unanalyzed sample. Refer to Logging in Replicates for Analysis, page 3–32. Saturated cell results will be indicated by blue text in the software.

HIGH TEMPERATURE WARNING
The removed crucibles/boats (if applicable) may still be hot. Do not touch the crucibles/boats with bare hands. Use only crucible tongs to transfer the crucibles/boats.

1. Select the Gas button to turn On the gas supply.
2. If unanalyzed replicates are available, the top one will be the next to analyze. If no unanalyzed replicates are available, log in a new sample set. On some configurations, the next replicate to be analyzed can be changed. Refer to Using Next, following.
3. Select the Analyze button to start the analysis.
4. During many analysis types, the Analyze button must be pressed to continue the analysis after loading a sample or crucible/boat. Follow the instructions on the screen.

Using Next

NOTE The Next button is not available on all instrument configurations.

In a queue of more than one unanalyzed set with replicates, an unanalyzed set with replicates can be promoted out of chronological order to be the next analyzed. The status indicator in the replicate orb will change from yellow to green to indicate that it is the next replicate to be analyzed. The system will then continue analyzing the set with replicates in chronological order.

1. From the Analysis screen, select the replicate to be analyzed next.
2. Select Next  on the Action bar.

Aborting an Analysis

During sample analysis, the analysis can be stopped or aborted. To stop an analysis, select Abort.

Pausing and Restarting an Analysis

Use Pause to prevent an analysis from automatically being initiated. A paused sample can be resumed either manually or at a predetermined time.

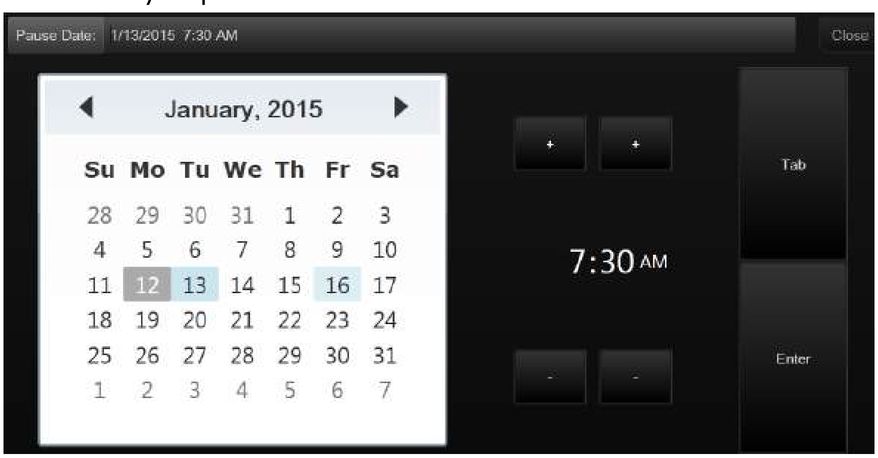
NOTES

- Once an analysis has started, Pause may not be able to be applied.
- Delayed Pause is available only for gas doses or instruments with auto loaders installed.

1. Select the desired sample, and then select the Pause button on the Action bar.
2. If the replicate is to be restarted manually, select the Manual button to stop the analysis and manually restart it later. A black Pause symbol will be displayed in the replicate orb to indicate that it is manually paused. Select the Analyze button to initiate a manually paused sample.

   Or

   If the replicate is to be automatically analyzed at a later time, continue with step 3, following.
3. To delay the start of the analysis until a predefined time, select the time/date button and enter the desired time. A green and black Pause symbol will be displayed in the replicate orb to indicate that it is a delayed paused.



4. Select Clear to remove the pause if desired.

Deleting a Sample

Refer to Excluding or Deleting a Sample, page 3–35, for more information.

Viewing Sample History

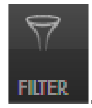
NOTE Viewing Sample History is not available on all instrument configurations.

History of specific samples can be viewed from the Analysis screen.

1. Select the set orb next to the desired set. If more than one set is desired, select Multi  on the Action bar, and then select the set orbs next to the desired sets.
2. Select History  . Then, refer to History, page 5–17.

Working with Sample Filters

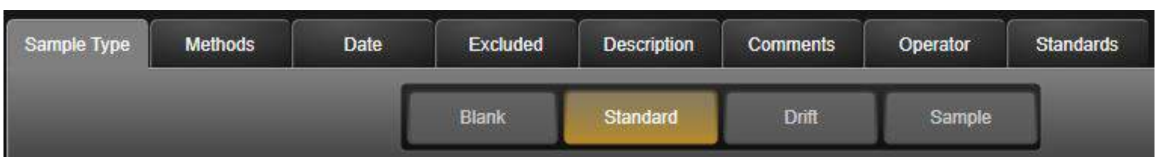
Filters determine which sample results are displayed. For example, sample results can be grouped by a method name, a date range, or a sample name. A filter can be created that selects all samples analyzed before a certain date for deletion, or a filter can be created that selects all of the current day's results to export or print.

1. On the Action bar, select Filter 

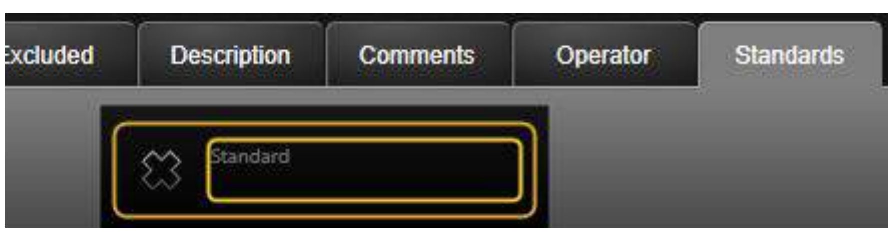
.
2. A tab bar to filter by Sample Type, Methods, Date, Excluded, Description, Comments, or Operator appears.

Filtering by Sample Type

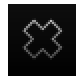
1. Select the Sample Type tab.
2. Select the sample type(s): Blank, Standard, Drift, or Sample. Selected sample types will be highlighted, and additional tabs appear if Standard, Drift, or Sample is selected.



3. If Standard, Drift, or Sample is selected, complete the following steps as desired. Otherwise, continue with step 4, following.
   A. Select the tab for the desired sample type: Standards or Sample Name. The following example uses the Standards tab.
   B. Select inside the box for the selected sample type.



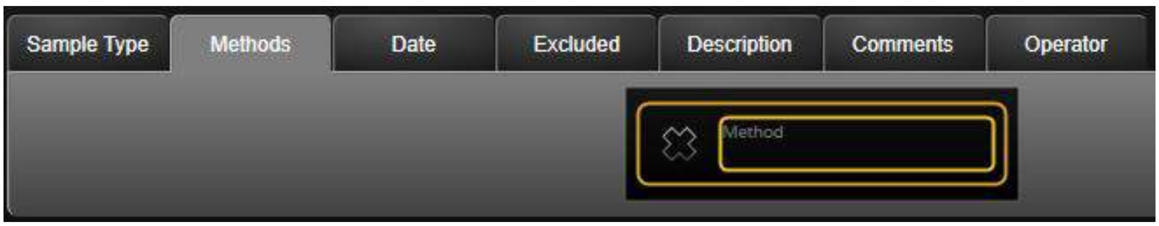
- In the Standards tab, select specific standards as desired.
- In the Sample Name tab, enter samples names as desired. This field is case-sensitive, but a partial name can be entered.

- Additional items of the same type can be added to the filter with the  button. Extra items of a type can be removed with the  button.

4. Select Apply to activate the filter; select Clear to remove all selected items and any filter currently applied to the sets; select Collapse to close the Filter area. To clear the filter parameters on the current tab, select Clear Sample Type.

Filtering by Methods

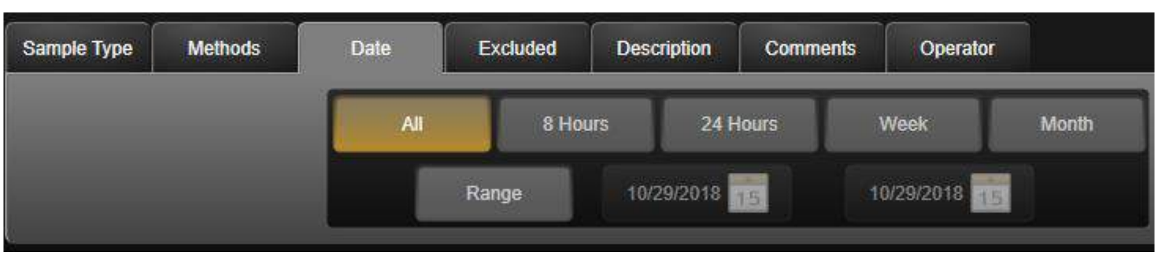
1. Select the Method tab.
2. Select inside the Method box. A list of methods appears.



3. Select the desired method from the list, and then select Enter.
4. Additional methods can be added to the filter with the  button. Extra methods can be removed with the  button.
5. Select Apply to activate the filter; select Clear to remove all selected items and any filter currently applied to the sets; select Collapse to close the Filter area. To clear the filter parameters on the current tab, select Clear Methods.

Filtering by Date

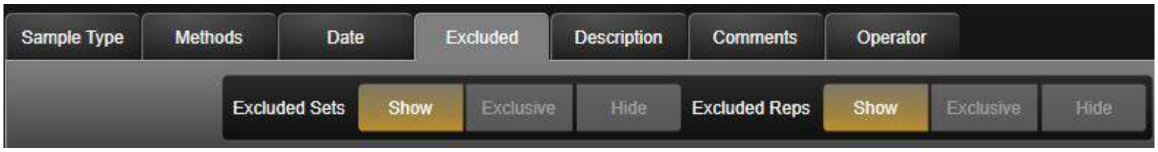
1. Select the Date tab. The date selections appear.



2. Select the desired time sequence.
3. Select Apply to activate the filter; select Clear to remove all selected items and any filter currently applied to the sets; select Collapse to close the Filter area. To clear the filter parameters on the current tab, select Clear Date.

Filtering by Excluded

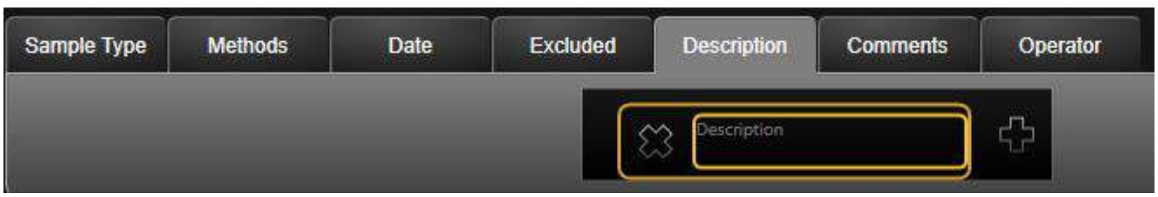
1. Select the Excluded tab.

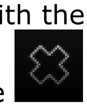


2. Select to show or hide excluded sets. Select Exclusive to show only the excluded sets or reps.
3. Select to show or hide excluded reps. Select Exclusive to show only the excluded sets or reps.
4. Select Apply to activate the filter; select Clear to remove all selected items and any filter currently applied to the sets; select Collapse to close the Filter area. To clear the filter parameters on the current tab, select Clear Excluded.

Filtering by Description

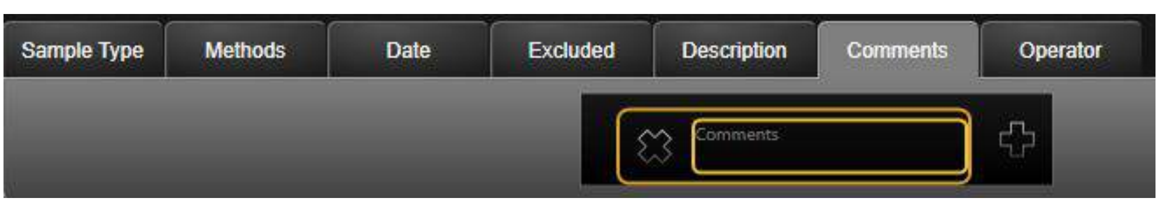
1. Select the Description tab.
2. Select inside the Description box. The keyboard appears.



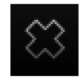
3. Enter the description as desired. A partial description can be entered.
4. Additional descriptions can be added to the filter with the  button. Extra descriptions can be removed with the  button.
5. Select Apply to activate the filter; select Clear to remove all selected items and any filter currently applied to the sets; select Collapse to close the Filter area. To clear the filter parameters on the current tab, select Clear Descriptions.

Filtering by Comments

1. Select the Comments tab.
2. Select inside the Comments box. The keyboard appears.

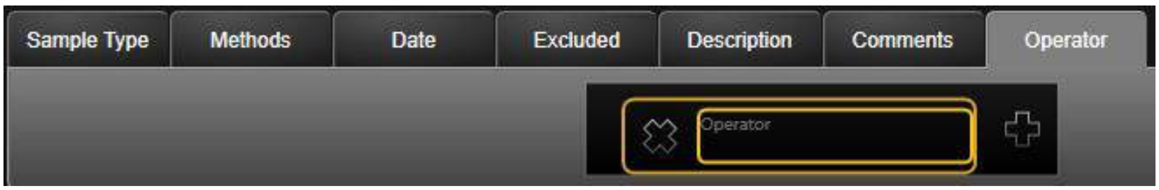


3. Enter the comment as desired. A partial comment can be entered.

4. Additional comments can be added to the filter with the  button. Extra comments can be removed with the  button.
5. Select Apply to activate the filter; select Clear to remove all selected items and any filter currently applied to the sets; select Collapse to close the Filter area. To clear the filter parameters on the current tab, select Clear Comments.

Filtering by Operator

1. Select the Operator tab.
2. Select inside the Operator box. The keyboard appears.



3. Enter the operator name as desired. A partial name can be entered.
4. Additional operators can be added to the filter with the  button. Extra operators can be removed with the  button.
5. Select Apply to activate the filter; select Clear to remove all selected items and any filter currently applied to the sets; select Collapse to close the Filter area. To clear the filter parameters on the current tab, select Clear Operators.

Saving and Deleting a Filter

- To save filter settings, after applying the desired filter parameters, select Save Current Filter.
- To delete filter settings, after applying the desired filter parameters, select Delete Current Filter.
- To clear the filter parameters on the current tab, select Clear “X,” where “X” is the name of the current tab. Or, clear specific parameters by selecting the “X” in the parameter name.

Applying a Saved Filter

Select the desired filter from the Apply Saved Filter Parameters drop-down menu.

NOTE The Save Current Filter tab is not available until the filter has been applied by selecting Apply.

4 Settings

The Settings chapter describes procedures and options for customizing the Cornerstone® brand software.

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Configuring the Display

NOTE Depending on the instrument configuration, the following screens may not exactly match the screen shown to the user.

Setting Display Settings

1. Select Settings, and then select Display.
2. Select the default Scale Factor by entering a number in the field or using the sliding scale. The scale factor affects button size throughout the software and row height for the current sample display.
3. Select whether or not to display the function key labels. Refer to Keyboard Shortcuts, page 3–15.
4. Select the monitor to be used when displaying the software. Users with a dual-instrument configuration and who have purchased a second monitor can select a different monitor for each instrument.
5. Select the monitor to be used when displaying the software.
6. **OPTIONAL:** Select the desired sample display for remote clients. Refer to Remote Access, page 5–27.
7. Select the desired sample display for the Analysis screen.

Creating a Sample Display

1. Select Settings, and then select Display.
2. Select Add  to create a new Sample Display.

NOTE Sample displays can also be imported or exported. Refer to Importing and Exporting, page 3–22, for more information.

3. Enter a name for the new display settings, and enter a description if desired.

4. Next to Basis Corrections, select the moisture basis for display of results.

NOTE Composition results will appear in orange type on the main analysis screen until all fields that are necessary for basis calculations are filled in. White type indicates that all parameters required are given.

- None performs no corrections on analysis data and reports the results as-is.
- Dry(d) corrects results to report on a dry basis. The moisture content of the sample set is represented by the Moisture(ad) field in the display layout and is given in units of %. Moisture(ad) is removed from the analysis results of all replicates in the given set.
- As Received(ar) corrects results to report on a chosen moisture basis. The Moisture(ar) field represents this moisture basis and is given in units of %. Moisture(ar) is added to the analysis results of all replicates in the given set.

5. Change the available settings as needed. Refer to the following sections for instructions on editing these settings.

Analyte Units Tab

Use the following steps to determine how the analyte units display in the software. If all uses of an analyte should use the same unit and formatting, it is easiest to set this using the Analyte Units tab.

1. Select the desired sample display, and then select Edit. Analyte Units will be automatically highlighted.
2. For units, select the Mass Ratio field. A keyboard appears.
3. Select the desired unit.
4. Select Enter.
5. Select the desired Rounding Method, which controls the method used to determine the number of significant digits to display or report. Refer to Cornerstone Brand Software Rounding, page 7–19, for more information.

   Fixed Decimals—Shows results rounded to a specified number of digits after the decimal point.

   Significant Digits—Shows results rounded to a specified number of significant digits.

6. Select Enter.

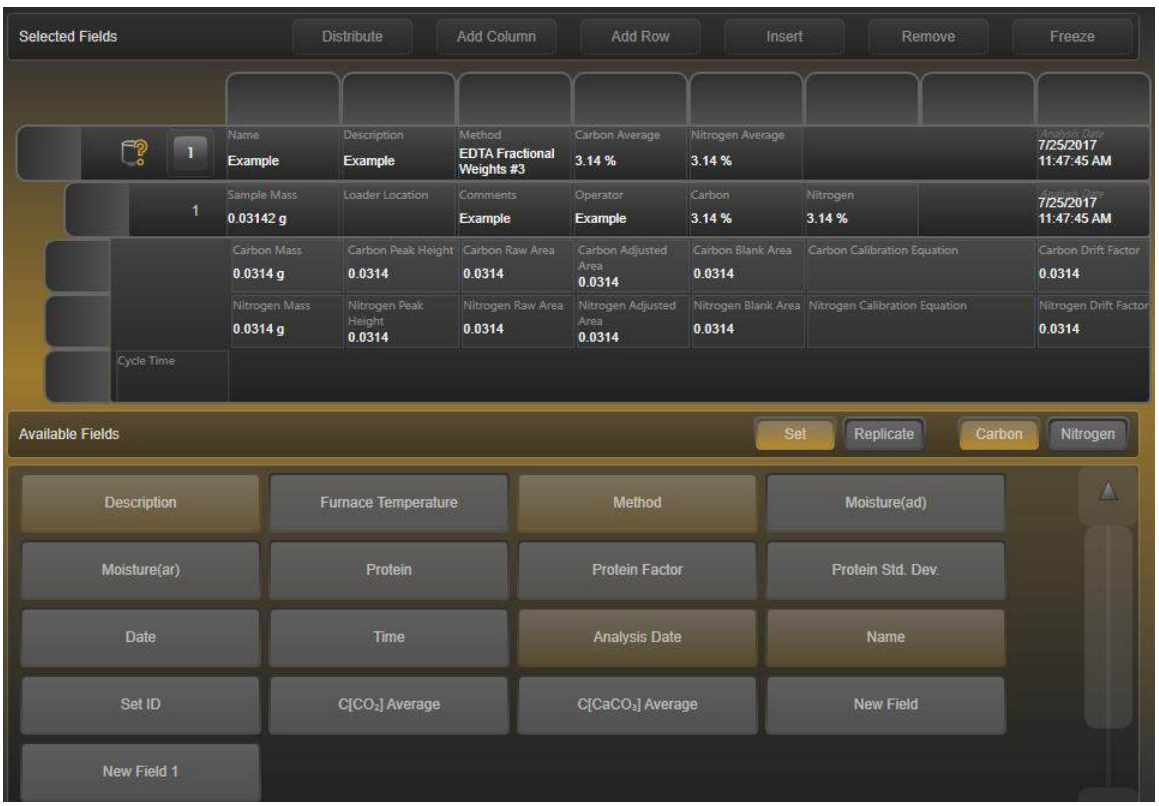
NOTES

- Numeric settings will be displayed only if all numeric entries selected are of the same type. Mass and Mass Ratio fields cannot be mixed.
- Numeric settings set in the Analyte Units tab apply to all fields unless they are overridden by a Style setting. To change the Style, refer to Editing Styles, page 4–11.

7. Select the number of Significant Digits or Decimal Places to be displayed.
8. Select Enter.

Samples Tab

The data displayed in the designer is the currently selected sample, or the last run sample if no sample is currently selected.



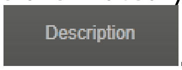
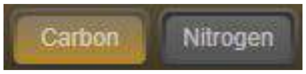
Selected Fields show what will be displayed.

Available Fields is located under Selected Fields and shows the available fields (buttons) that can be added to the report. General fields will be shown first, followed by element-specific fields.

Selecting Fields to Display

NOTES

- Select a field and select Style from the Action bar to edit the style. Refer to Editing Styles, page 4–11.
- Some fields are defaults and cannot be removed.
- If a field is dragged to a location that is not allowed, it will return to its original location.

1. Select Samples from the display editor screen.
2. Select the tab next to a row to show the available fields for that area. This navigation may also be done by selecting the Set  or Replicate  button next to Available Fields. Fields that are in use are muted yellow  , and fields not in use are gray  .
3. Select an element button to show the available fields for that element.
   

4. Select a cell in the Selected Fields grid. Available fields that are in use by other cells in the same grid are muted yellow in color.
5. Add fields from the Available Fields area to the Selected fields area by one of the following methods:
   - Select a cell in the Selected Fields area, and then select a field from the Available Fields area to add it to the selected cell.
   - Drag a field from the Available Fields area to add it to a desired cell in the Selected Fields area.
6. Drag a field outside the Selected Fields area to remove it from the selected fields.
7. In the Selected Fields area, drag a field to desired place in the display.

Distributing Rows and Columns

Distribute  adjusts selected rows or columns to all have the same height or width.

1. With Multi enabled, select two or more rows or columns in the Selected Fields area.
2. Select Distribute.

Adding Rows or Columns

1. Select any row or column.
2. Select Add Row or Add Column. A row or column will be added to the end of the grid.

Inserting

1. Select any row, column, or field.
2. Select Insert. A new row will be added above the selected row. A new column will be added to the left of the selected column. A new empty field will be added and the existing fields will be shifted to the right.

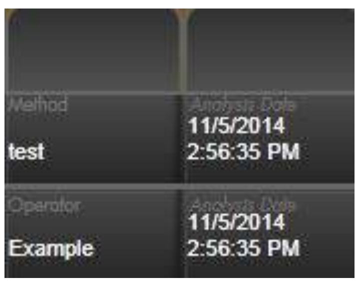
Removing

1. Select any row, column, or field.
2. Select Remove.

Moving the Freeze Bar

When more columns have been defined than will fit on the screen, the columns can be scrolled. The frozen column is the last one that does not scroll. Every column to the right of the frozen column will scroll when the scroll left and scroll right buttons  are used. When scrolling, the currently frozen column appears with a freeze bar on the right side of the column.

NOTE There can be only one freeze bar in the grid.



A column cannot be frozen when a field is spanned across it.

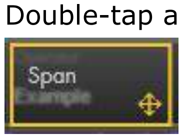
To move the freeze bar:

1. Select a column.
2. Select Freeze.

Spanning Fields

A field may be stretched across multiple columns or rows using the span feature. A field cannot be spanned without adjacent empty fields. Span can be used in Single- and Multi-selection modes. Fields cannot be spanned across a freeze bar.

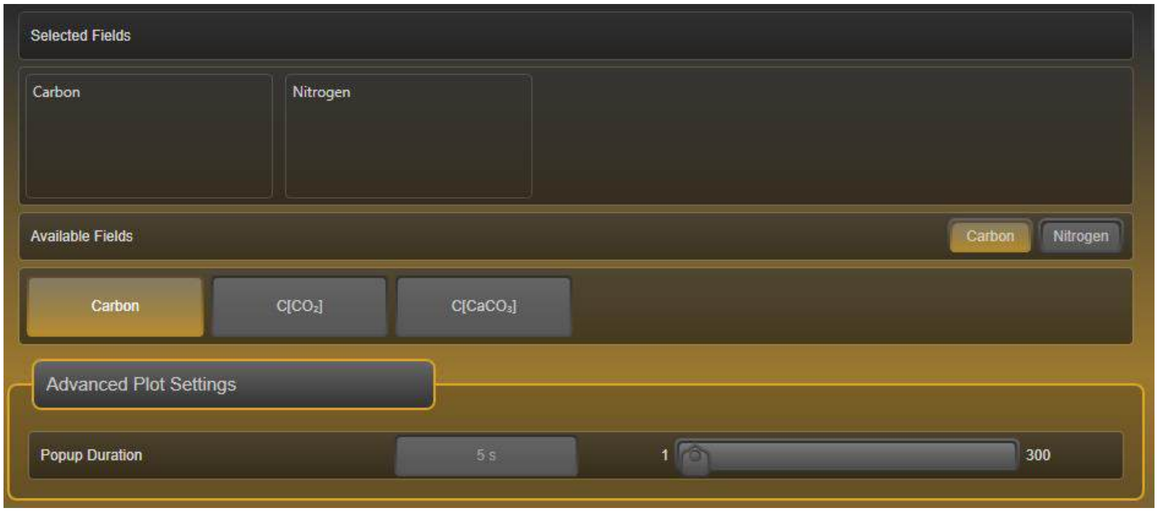
1. Double-tap a field to select and enable Span.

2. Drag the cursor to stretch field across the desired columns or rows.

Plots Tab



Available Fields—Some custom fields may be displayed as an option.

NOTES

- The following options are available only when Advanced Plot is selected on the Analysis screen.
- Show Blend Range is not available on all instrument configurations.
- Ambient Trace Data is not available on all instrument configurations.

Show Blend Range—In the plotting window for dual-range analytes in the advanced mode, this setting activates markers to indicate when the data enters the range crossover region as controlled in the method settings. This option is available only for dual-range instruments.

Popup Duration—If a single time point is selected for detailed information on the Analysis screen in the Advanced plot mode, this is the length of time the information window will stay open.

Ambient Trace Data—If a single replicate is selected and a plot window is in the Advanced information mode, the setting can activate additional plotting of furnace information.

Use the following steps to edit plot features.

1. Select Plots from the display editor screen.
2. Select the desired field. Available Fields include custom fields. Refer to Creating and Editing Fields, page 4–25.
3. Select Enter.
4. Select Save to keep the changes, or select Cancel to return to Settings.

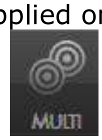
Editing the Display

1. Select Settings and then Display.
2. Select a sample display.
3. Select Edit.

Editing Styles

A style is a collection of settings that controls how information is displayed. Styles can be edited for fields in Display, Reports, and Transports. The style for each field is unique to each Display, Report, or Transport configuration.

NOTES

- The style will be applied only to the field or fields currently selected. Use Multi 

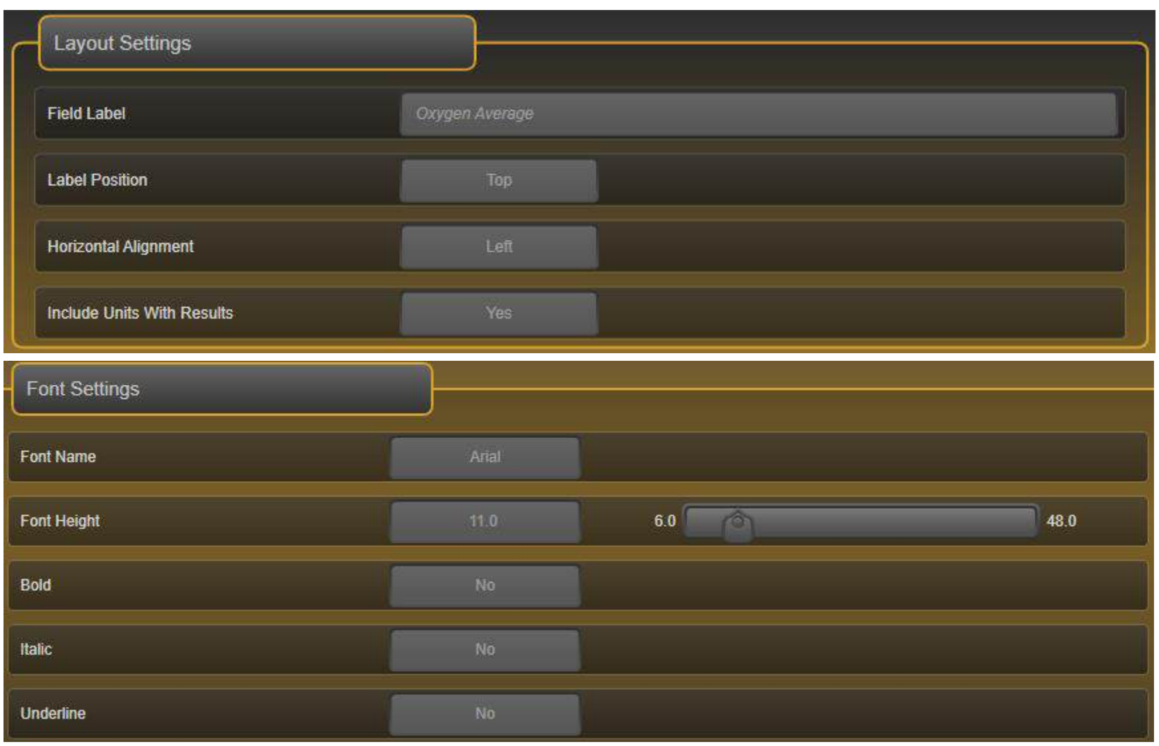
 or Select All 

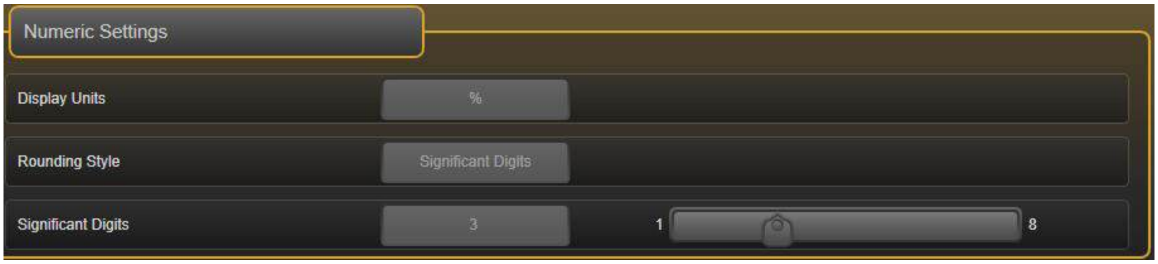
 to apply a style to multiple fields.
- Repeatedly selecting Select All will first select all available fields, then will select all fields for a single analyte.

1. Select the desired field(s).
2. Select Style 

. A default style format will appear.

NOTE Depending on the instrument configuration, the following screens may not appear exactly as those on your instrument.





3. Change fields as needed. A sample of the output for the field will be displayed at the top of the screen. Refer to *Cornerstone* Brand Software Rounding, page 7–19, for more information.

   Display Units—The reporting units for results.

   Rounding Style—The method used to determine the number of significant digits to display.

   Fixed Decimals—Shows results rounded to a specified number of digits after the decimal point.

   Significant Digits—Shows results rounded to a specified number of significant digits.

   Variable Rounding—Shows average results rounded to the number of fixed decimals needed to match the decimal position of the significant digits in the standard deviation. When there is only one replicate in a set, the result is displayed with a specified number of digits after the decimal point. Appears only for analyte results.

NOTES

- Display units will be editable only if all numeric entries selected are of the same type. Mass and Mass Ratio fields cannot be mixed. When multiple types of numeric fields are selected, Display Units will read "Incompatible units selected."
- An empty entry indicates that one or more fields are currently using different values. If unchanged in styles, these values will be retained even after saving other changes.

4. Select Save 

.

Applying a Display

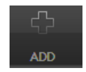
1. Select Settings, and then select Display.
2. For Current Sample Display, select the desired display.

3. Select Enter.

Creating and Editing Methods

A method is a set of analytical parameters used to control the instrument during analysis and calculation of the final result. A method must be created before a sample can be analyzed. Once a method is created, it will appear in a list on the Methods screen. The following section explains how to create and edit methods. For an explanation of method parameters, refer to Method Parameters, page 4–15.

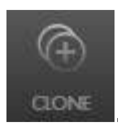
NOTE Methods are not accurate until they are blanked and calibrated. Once the following steps have been completed, refer to Performing Blanks, page 3–39, and Performing Calibrations, page 3–40.

1. Select Settings, and then select Methods.
    - To create a new method, select Add 

.
    - To edit an existing method, select the method, and then select Edit 

.
2. Select the Name field. A keyboard appears.
3. Enter a name for the method.
4. Enter a description if desired.
5. Enter the method parameters. Refer to Method Parameters, page 4–15.

Cloning a Method

1. Select the desired method.
2. Select Clone 

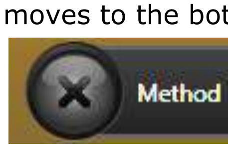
. The cloned method appears in the list as “XX Copy,” where “XX” is the name of the method that was cloned.

Deleting Methods

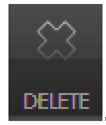
The following section explains how to delete a method from the software.

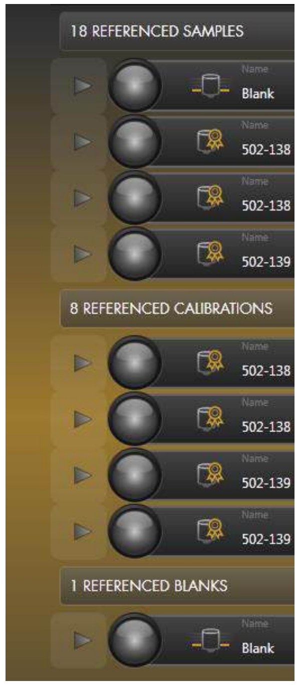
IMPORTANT When a method is deleted, all associated items such as samples, calibrations, and blanks that are referenced by that method will also be permanently deleted.

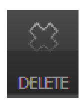
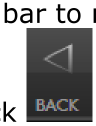
1. Select the method to delete, and then select Exclude 

on the Action bar. The method moves to the bottom of the list.
2. Select the excluded method 

.

3. On the Action bar, select Delete . A list of the samples, calibrations, and blanks associated with the method appear.

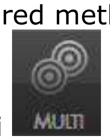


4. Select Delete  on the Action bar to remove the method and all associated items, or select Back  to return to the previous screen without deleting items.

Viewing Method History

NOTE Viewing Method History is not available on all instrument configurations.

History of specific methods can be viewed from the Methods screen.

1. Select the orb next to the desired method. If more than one method is desired, select Multi  on the Action bar, and then select the orbs next to the desired methods.
2. Select History . Then, refer to History, page 5–17.

Method Parameters

The following section explains the parameters used to create methods. The definitions can assist when creating methods for specific applications.

General Parameters

NOTE Some parameters are available only with certain instrument configurations.

Gas Type—the inert gas type expected at the time of analysis.

NOTE An analysis will automatically abort if the gas type set in the replicate's method does not match the gas type set in the System Parameter. Refer to Inert Gas Type, page 5–35.

Furnace Temperature—the furnace temperature expected at the time of analysis. If the furnace is not at this temperature, the software will change the setpoint and wait for the furnace to ramp appropriately to this target before continuing the analysis. This value should be modified based on sample application.

Afterburner Temperature—the afterburner temperature expected at the time of analysis. If the afterburner is not at this temperature, the software will change the setpoint and wait for the afterburner to ramp appropriately to this target before continuing the analysis. This value should be modified based on sample application.

Nominal Mass—allows the user to set the nominal sample mass that appears automatically when a blank sample is logged in. The nominal mass is method based, and the mass of a blank cannot be changed on the Analysis screen.

Purge Cycles—the number of purge cycles to perform prior to sample combustion. Reducing the number of purge cycles can decrease cycle time, but sample results may worsen.

Ballast Equilibrate Time—the number of seconds for the combustion gases to mix in the ballast after it is filled.

Ballast Not Filled Timeout—the number of seconds allowed for the ballast to fill. If the ballast does not reach the target pressure within this time period, the analysis aborts. This time should be longer than the combined time of the burn cycles.

Aliquot Loop Fill Pressure Drop—the ballast pressure drop used to fill the aliquot loop.

Aliquot Loop Equilibrate Time—the number of seconds allowed for the gas in the aliquot loop to equilibrate after it is filled and isolated.

Dose Loop Size—select the size of the dose loop to use for the analysis: 3 or 10 cm^3. Applies only to configurations with the Dual Loop Doser.

NOTE When Sample Drop Detection and Interleave Analyses are both enabled, a failed sample drop will result in both currently active analyses being aborted.

Interleave Analyses—indicates if the next sample preparation begins before the previous analysis completes. If Yes is selected, Wait for Baseline Stability is Off.

Sample Drop Detection—Enables the system to determine if the sample dropped correctly. If enabled, additional settings for sample drop detection appear in Element Parameters.

Burn Cycles

1. Enter the number of **Burn Cycles**, the number of burn profiles during sample combustion and while the ballast is filling. Multiple burn cycles can be entered with the Add  button and removed with the Subtract  button (next to Add) or with the Delete  button for an expanded burn cycle. The burn cycles can be expanded or collapsed with the Maximize/Minimize  button for easier viewing. Each burn cycle can be independently configured as needed.
2. For each burn cycle, enter the furnace flow rate to be used during the burn cycle.
3. For each burn cycle, except the final one, enter the duration of the burn cycle (in seconds) next to **Time**.

NOTE Once the final burn cycle is reached, the flows remain at these setpoints until the ballast is filled. If the ballast fills before the system enters the last burn cycle, a warning displays indicating that the burn cycles did not complete but the analysis will continue.

Element Parameters

Use the Element Parameters tab to define parameters for the analytes and ranges.

Select the tab for the target analyte. The parameters that appear depend on the selected analyte and instrument configuration.

Wait for Baseline Stability—choose to monitor the IR cell baseline for stability after each replicate analysis starts. Appears only when Interleave Analyses is set to No. Applies only to Carbon.

NOTE The parameters, beginning with Integration Delay, begin 20 seconds prior to the dose loop dumping the sample aliquot into the inert gas stream.

Integration Delay—period of time before starting baseline data is taken.

Starting Baseline—period of time during which the average baseline level is determined. It is important that this data is stable before normal pressure fluctuations occur.

Post Baseline Delay— the time after the starting baseline is taken and before the analyte data is collected. This delay should end before sample gas reaches the detectors as observed in the plot. It is intended to compensate for normal pressure fluctuations seen when the dose loop is dumped into the inert gas stream.

Use Comparator—select Yes to use a comparator to determine the end of analysis; only a beginning baseline correction will be applied. Selecting No causes the system to use a fixed integration time period.

Comparator Level—enter a value, measured as a percentage of sample peak height, that will end the analysis. This parameter appears only if Yes is selected for Use Comparator.

Minimum Integration Time—enter a minimum time in seconds for the analysis to complete. This parameter appears only if Yes is selected for Use Comparator. If comparator has not been met, analysis will continue. If comparator is met, analysis will terminate.

Maximum Integration Time—enter a maximum time in seconds for the analysis to complete. This parameter appears only if Yes is selected for Use Comparator. It will end the analysis at the selected time even if the comparator level has not been met.

Integration Time—the fixed number of seconds during which sample peaks will be collected. Appears only if Use Comparator is set to No.

Use Endline—select Yes to enable Endline correction. When set to Yes, data from the beginning and end of the analysis will be used to determine a baseline correction to be applied throughout the analysis. If the Starting Baseline is set to 0, only the Endline value will be used. Appears only when Use Comparator is set to No.

Endline Delay—period of time after the integration time and before determining the ending baseline level. Appears only when Use Comparator is set to No and Use Endline is set to Yes.

Ending Baseline—describes the time after integration during which the average endline is collected. Appears only when Use Comparator is set to No and Use Endline is set to Yes.

Use Profile Blank—Calculates the method blank using a point-by-point subtraction instead of an area subtraction. Numerical results will not change, only the appearance of the analyte trace. Available only with certain instrument configurations and method conditions.

Use Hydrogen Correction—select Yes to apply a correction to the Hydrogen data. The hydrogen correction uses the baseline, integration, and endline signals to estimate and correct for typical errors in the hydrogen integration signals due to H_2O being retained in the system from previous samples. Applies only to Hydrogen.

Sample Drop Detection Threshold—enter a threshold value and composition unit.

NOTES

- When the sample result is less than the entered Sample Drop Detection Threshold value, the next sample will not be analyzed. This is intended to stop analyses when using a sample carousel and the sample does not drop correctly.
- When 0 is entered as the Sample Drop Detection Threshold, the software will not check the result for the analyte.
- The sample drop is considered successful when any of the analytes exceed the threshold value.
- If notifications are enabled, the software will notify the user when sample drop detection fails. Refer to Setting Up Notifications, page 4–62.

Calculations

Use this section to view, edit, or manage existing calibrations, drifts, and blanks.

1. To view, select Calibration, Drift, Manage Drift Standards, or Blank.
2. If changes are necessary, select Edit.
    - For more information on calculating calibrations, refer to Calculation of the Calibration Equation, page 7–10.
    - For more information on calculating drifts, refer to Drift Correction, page 7–9.
    - For more information on managing drift standards, refer to Managing Drift Standards, page 3–48.
    - For more information on calculating blanks, refer to Blank, page 7–8.

Configuring Quality Control

Quality Control (QC) is a procedure intended to ensure that the instrument adheres to a defined set of quality criteria or meets the requirements of the client or customer.

QC Method uses procedures such as blanks, standard checks, calibration, and drift standards to verify that the instrument met quality standards while the analysis was run. These quality procedures are assigned by the user to run at predefined intervals.

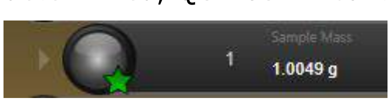
NOTE Using Quality Control requires a registration key configured with QC.

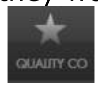
The parameters controlling the QC feature are located within a method. Within the method definition, QC is comprised of settings controlling the analysis of blanks, check standards, and calibration standards. Each of these may be enabled or disabled independently of each other, and the entire QC functionality can also be enabled or disabled. This allows the user to customize QC for their exact scenario.

When QC is enabled for a particular method, the current QC status will be displayed next to the designated method for any unanalyzed samples. If QC is considered "in control," then this status will be indicated with a green star. If QC is considered "not in control," then this status will be a warning icon.

These status indicators are only visible on unanalyzed samples that have been assigned a method for which QC has been enabled.

After an analysis is complete, the replicate will be assigned the QC state that was in effect at the time the analysis started. If QC was "in control" at the start of the analysis, the sample will be affixed with a green star, which indicates that at the time the sample results were determined, QC was "in control."

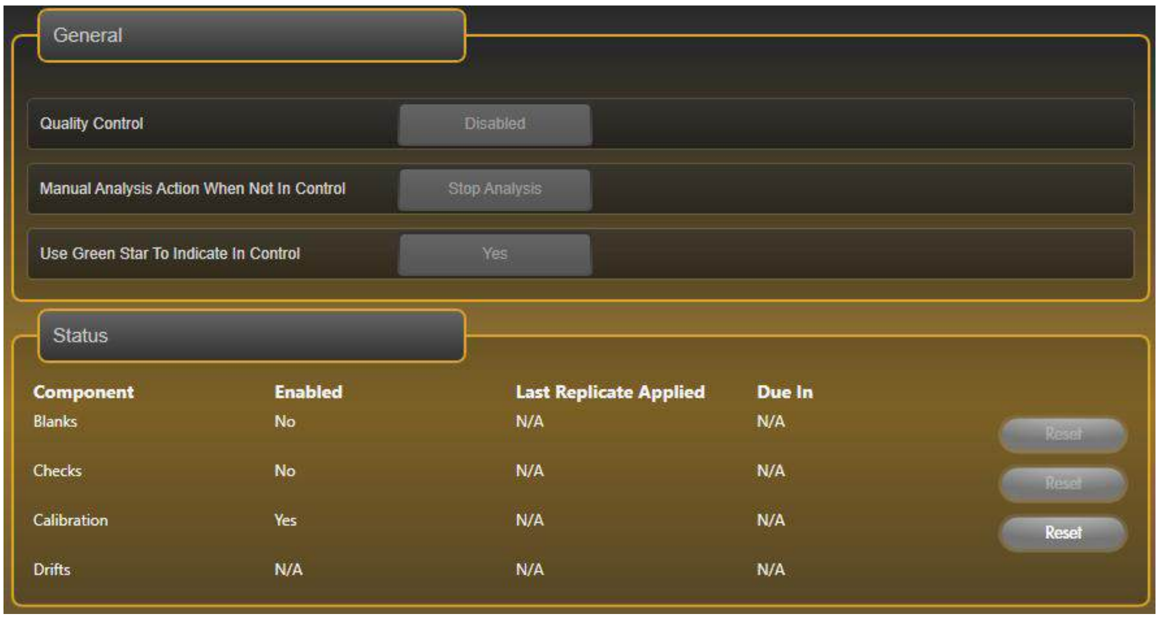


A user can select the set they would like to run “in control” and then select the Quality Control 

action bar. The software then automatically logs in the necessary QC blanks, checks, and calibration standards before the sample set selected.

QC Status

In the Quality Control section of the desired method, select the Status button.



The method’s QC Status screen provides a dashboard containing the state of all QC components. It also allows for the following parameters to be set.

The entire QC functionality can be enabled or disabled. If disabled, then QC steps will not be undertaken to bring the instrument into control and the QC green star and warning icons will not be displayed on the Analysis screen.

- If QC is enabled and in control, this screen will display a green star icon.

- If QC is enabled and not in control, this screen will display a warning icon that includes an explanation for why QC is not in control.

The desired action to be taken when running a manual analysis and QC is found to not be in control can be selected. Next to Manual Analysis Action When Not in control, select Continue Analysis With Warning or Stop Analysis.

Sample replicates can be adorned with a green star to indicate their Quality Control state at analysis time. Next to Use Green Star to Indicate in Control, select Yes or No.

From this status screen, the user can force the requirement of blanks and check standards by selecting the appropriate Reset button in the dashboard. This action may be desired after instrument maintenance has occurred.

QC Blanks

The parameters controlling the analysis of blanks for a method are found in the method's Quality Control Blanks screen. Once analyzed on the Analysis screen, set the Blank. This will reset the QC blanks setting to be in control. Refer to Performing Blanks, page 3–39.

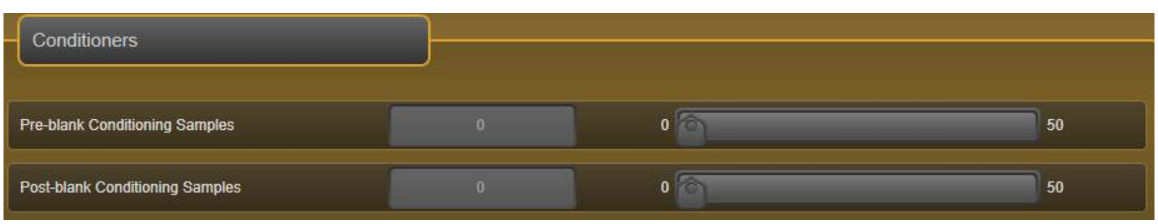
General

Select Enable to define standard blanks as part of the QC Method, and then enter the desired number of Blanks to Analyze and Blanks to Calculate.

Blanks to Calculate—This value indicates the number of replicates from which to calculate the standard deviation. The replicates used will be the last of the analyzed set, so this value should be less than the number of Blanks to Analyze.

Conditioners

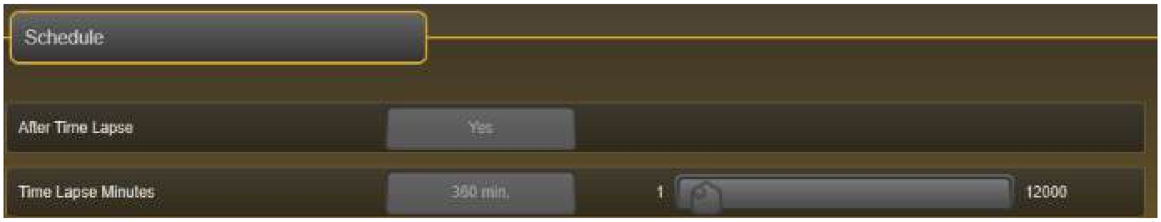
Enter the number of conditioning samples to run before and after the QC blanks. Some instruments do not support pre-blank and/or post-blank conditioning samples.



Schedule

Blanks can be required after a user defined time has elapsed.

Select Yes for After Time Lapse, and enter a time in the box to schedule the blank analysis after a certain length of time.



Threshold

Select Enable for each analyte to enable a standard deviation threshold. This setting indicates if the standard deviation of the Blanks to Calculate must be below a threshold to be considered in control.

QC Checks

The parameters controlling the analysis of check standards are found in the method’s Quality Control Checks screen.

General

Only standards that have one or more elements with Check Standard set to Yes in the Standards screen will be viewable within QC checks.

Select Enable in the include check standards as part of the QC routine.

Choose the minimum number of check replicates required to be run in order for QC to be satisfied. Refer to the example in Check Standards, page 4–23, for more information.

Schedule

Check standards can be required after different specified events to confirm that the instrument is still providing expected results.

Select Yes for After Blanks to schedule a check after running blank analyses.

Select Yes for After Calibrating to schedule a check after calibration.

Select Yes for After Drifting to schedule a check after running a drift standard.

Select Yes for After Time Lapse and enter the length of time lapse in the box to run a check standard after the determined length of time.

Check Standards

The specific standards to be analyzed are selected in this section and the number of replicates to analyze applies to each selected standard.

Check marks to the right of the certified and uncertainty values indicate which elements are set as Check Standards in the Standards screen.

Example: If three check standards are selected and the number of replicates to analyze is set to 2, then a total of six analyses will need to be performed: two for each standard.

Once analyzed on the Analysis screen, select all the check standards sets. Select the Check button on the action bar to reset the QC check standards setting to be in control.

When Quality Control (QC) Steps are Executed

NOTE It is important to understand when the required QC steps will be executed. Read the following section carefully.

Given that the parameters controlling QC blanks and check standards contain a time lapse field, it is common to think that QC will display a warning the moment the specified time lapse has occurred. However, this is **not** the case.

QC will wait until a sample analysis is logged in before checking the QC status. At this point QC will allow the analysis to continue if it is in control, or it will require QC steps to be performed.

The Quality Control 

button on the action bar can be selected for the software to automatically insert the necessary blank and check standard replicates as specified on the QC method screens, before the user sample.

These QC replicates will be analyzed and at their completion, QC will again determine if it is in control.

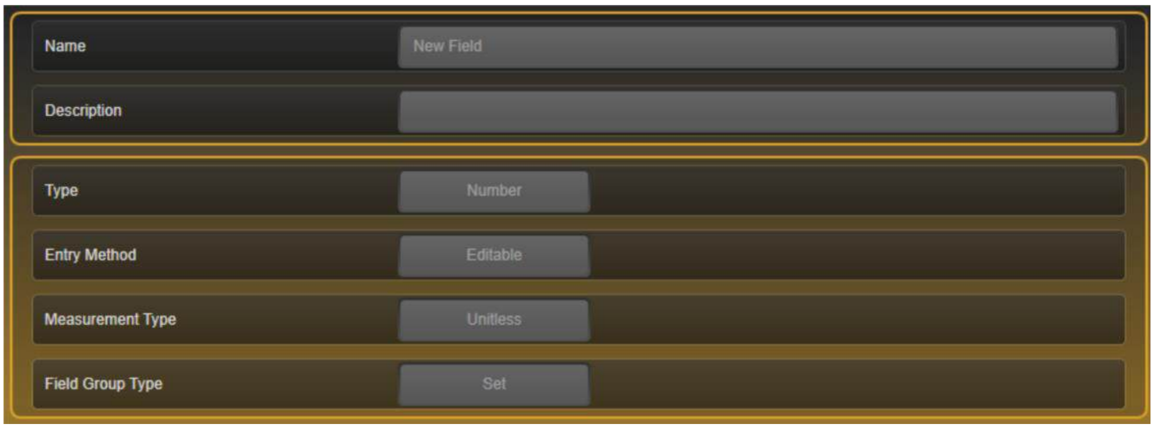
- If QC is in control, then the user's sample analysis will be performed.
- If QC is not in control, the necessary QC steps will continue to be requested to be performed until QC is in control. Instrument maintenance may be required.

Creating and Editing Fields

NOTE Depending on your configuration, the following screens may not appear exactly as the screen on your instrument.

Creating a Field

1. Select Settings, and then select Fields.
2. Select Add  to create a new custom field.

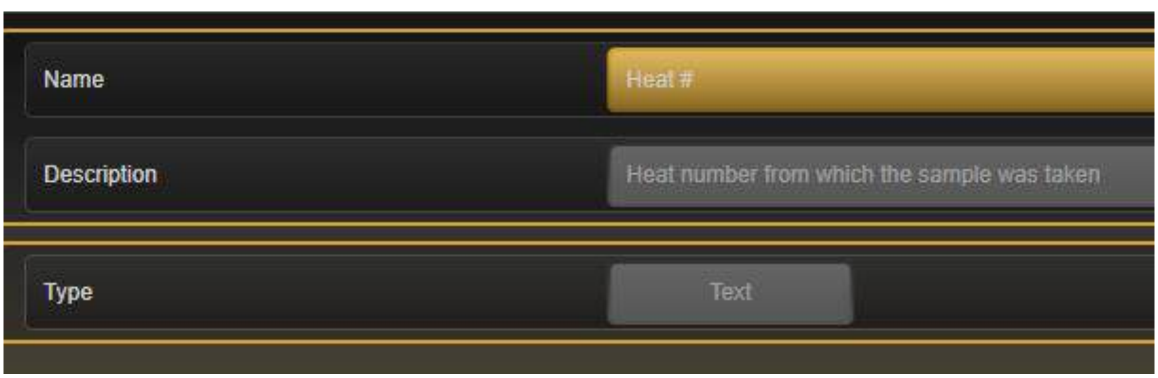


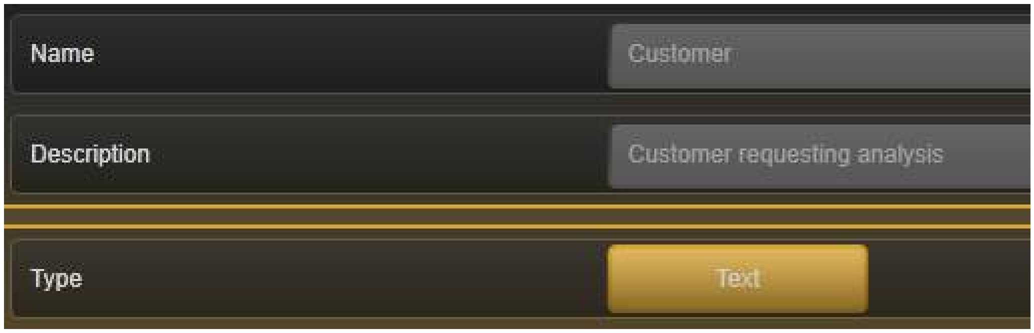
3. Enter a name for the new field, and enter a description if desired.
4. Select the Type.

   Number—Provides a number.

   Text—Provides text. The following screenshots are examples of text fields.

   Field—Provides another field as the result of a calculation expression.





5. Make the following selections depending on what was chosen in step 4, previous.
   - Entry Method. This parameter is available if Number or Text is chosen. Field is by default a Calculated entry method.
   - **Editable**—Used to display numeric or text entry.

     Calculated—The value displayed is calculated from other fields. For more information on creating a calculated field, refer to Using the Equation Editor, page 4–27.
   - Measurement Type. This parameter is available if Number has been selected for the Type. The Measurement Type is the type of base unit for the field, which allows for conversion to the defined unit. The choices are: Unitless, Mass Ratio, Mass, and User Defined.

     Unitless—The measurement has no unit or the unit does not match the other defined measurement types.

     Mass Ratio—The measurement is a composition that can be scaled. The output unit is %, ppm, or similar and can be changed using Analyte Units or the Styles button within Display, Reports, or Transports.

     Mass—The measurement is a mass value.

     User Defined—The measurement unit is supplied by the user. Once a user-defined field is created, the user can set the units in the field using the Style button.
   - Field Group Type. This parameter is available if Editable is chosen. The Field Group Type allows the field to be marked to be used in a Set or Rep.

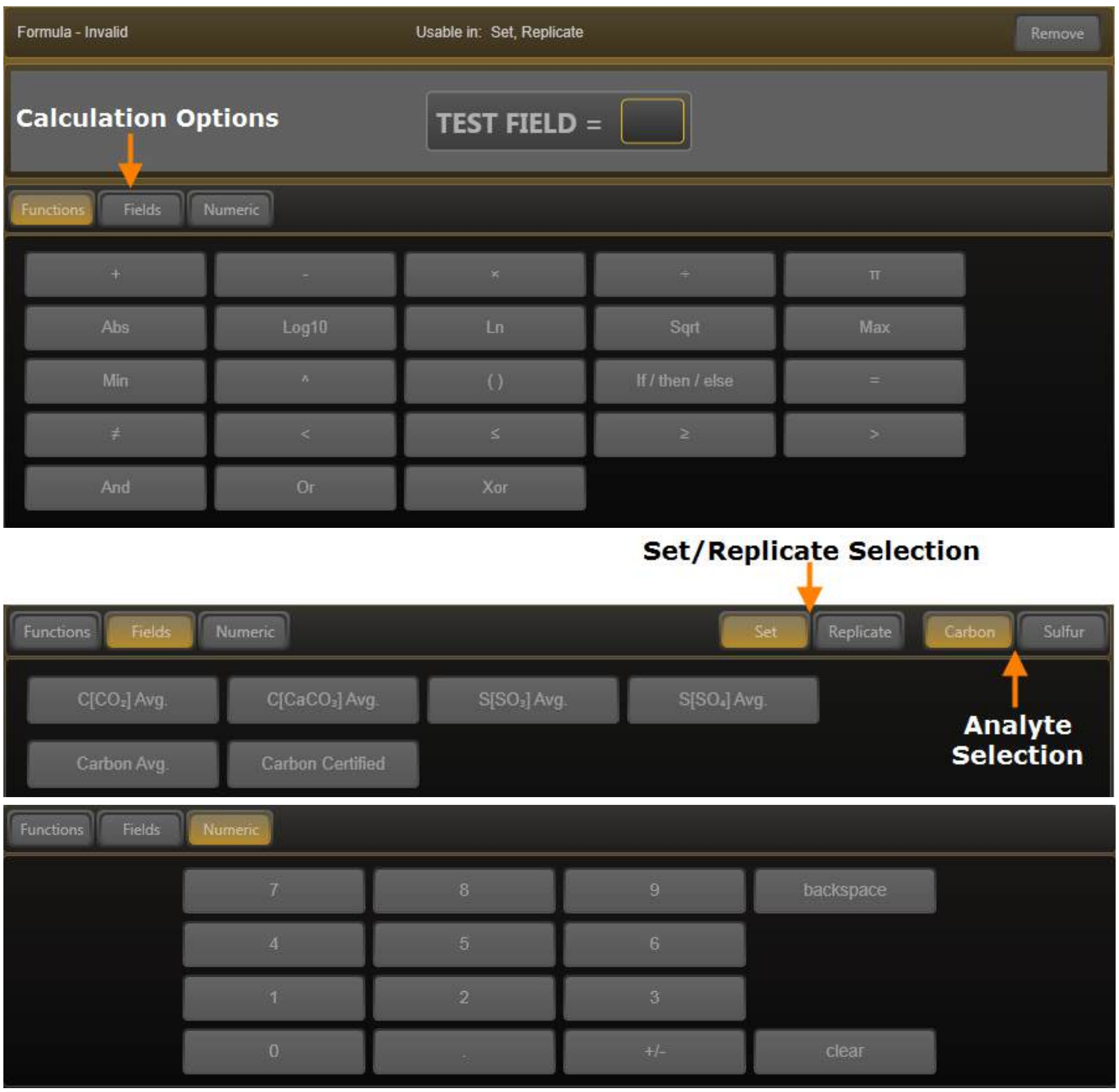
Editing a Field

1. Select Settings, and then select Fields.
2. Select a field.
3. Select Edit, and then refer to Creating a Field, page 4–25, for instructions on editing field parameters.

Using the Equation Editor

A calculated field can be created using the equation editor. A calculated field can be set to use set data or replicate data. Calculated fields can use any of the provided functions and fields to create an equation. Additionally, any user-created fields are available to create new calculated fields.

1. Create a calculated field or edit an existing calculated field. Refer to step 5 of Creating a Field, page 4–26.
2. Select the Functions, Fields, or Numeric tab from the calculation options. Each tab contains different elements that can be used in building a calculation. For a list of definitions of the available functions, refer to Functions, page 4–29.
3. For the Fields tab, select Set or Replicate, and then select the appropriate analyte button. The selection of these buttons will affect which fields are available to use in the equation editor.



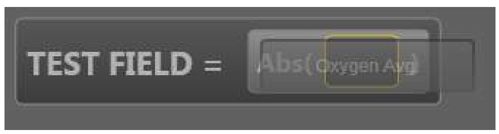
4. Elements can be added in two ways:
   - Select an element to add it to the current equation.
   - Drag an element to the equation and drop it.

NOTES

- The yellow highlight shows what is currently selected.
- The new element will be positioned within the currently selected item in the equation.
- For example, in the following screenshot, a new element added to the equation will appear inside the parentheses.

- In the following screenshot, a new element will replace the Abs() element.

5. Drag an element within the equation editor to rearrange it. When dragging elements, wait to release the element until the desired area is highlighted in yellow. Refer to the following screenshot.

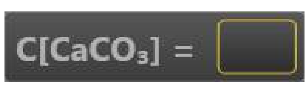


6. Elements can be removed in two ways:
   - When the desired element is highlighted, select Remove.
   - Drag the element outside the editor area. The element will disappear from the editor only if it is not part of the current equation.

Field Creation Example

The following section is an example of creating a calculated field. The specific fields shown will not be available on all models.

1. Create a new field named C[$CaCO_3$].



2. Add the multiply function from the Functions tab of the calculation options.

3. Add Carbon from the Fields tab. Carbon is available only when Replicate and Carbon are selected.

4. Use the Numeric tab to enter 8.333.

Functions

Numeric Functions

Input—Expression that evaluates to a number

Output—Numeric results of operation

Function	Definition	In Use
+	Plus	
-	Minus	
x	Multiply	
÷	Divide	
π	Pi (constant value of 3.14…)	
Abs	Absolute value	
Log10	Log base 10	
Ln	Natural log	

Function	Definition	In Use
Sqrt	Square root	
Max	Maximum value	
Min	Minimum value	
^	Raise to the power	

Parentheses Function

The parentheses function is used to group elements of an equation together to clarify which parts are evaluated first.

Function	Definition	In Use
()	Parentheses	

If/then/else Function

Input for If—Expression that evaluates to true or false

Input for Then and Else—Expression that evaluates to a number

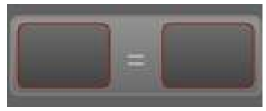
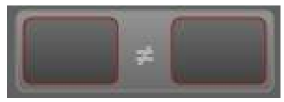
Output—Then or else value, depending on the result of the "if" statement.

Function	Definition	In Use
If/then/else	“If/then/else” statement	

Comparison Functions

Input—Expression that evaluates to a number

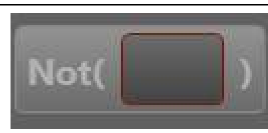
Output—Logical result of the operation (true or false)

Function	Definition	In Use
=	Equal to	
≠	Not equal to	
<	Less than	
<=	Less than or equal to	
>=	Greater than or equal to	
>	Greater than	

Logic Functions

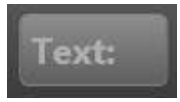
Input—Expression that evaluates to true or false

Output—Logical result of the operation (true or false)

Function	Definition	In Use
And	"And" logic statement	
Not	"Not" logic statement	
Or	"Or" logic statement	
Xor	"Exclusive Or" logic statement	

Text Function

This function lets the operator enter text into the equation editor.

Function	Definition	In Use
Text	“Text” Statement	
Text=	Text Equal To	
Text≠	Text Not Equal To	
If/then/else	“If/then/else” statement	

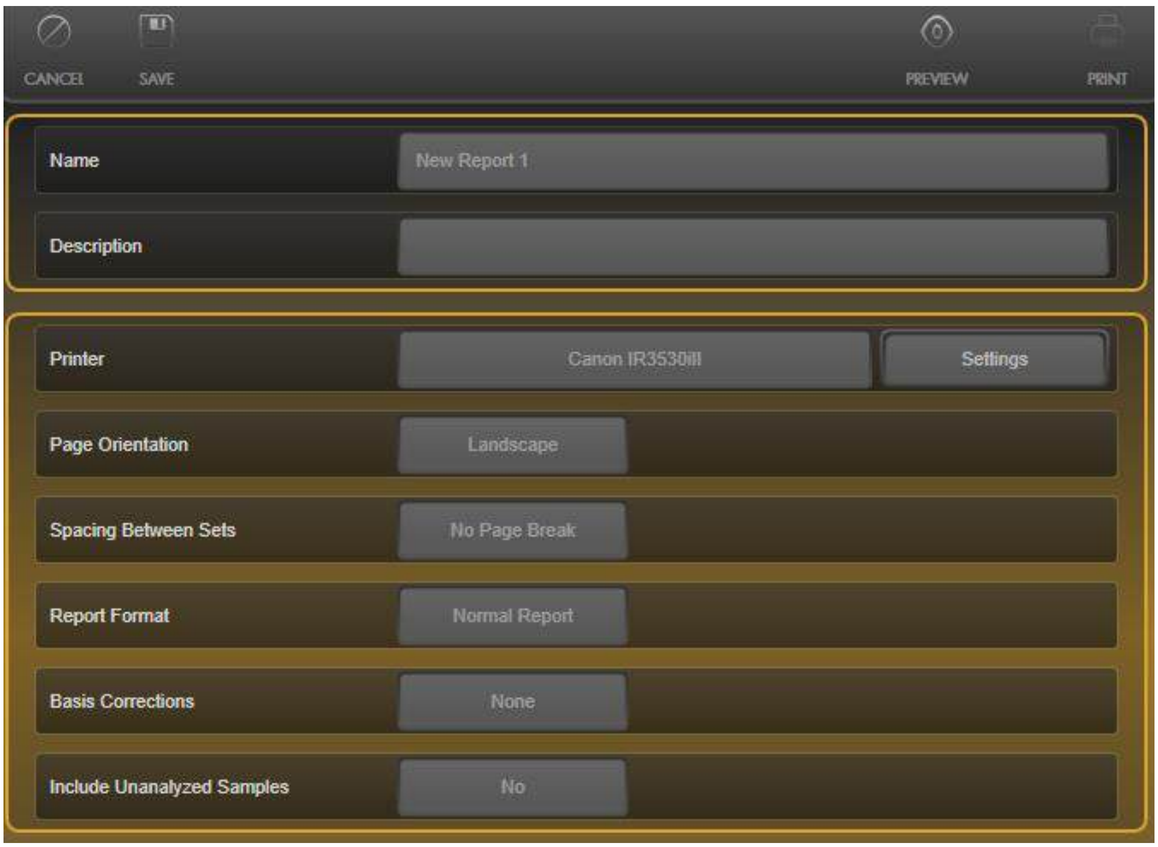
Creating and Editing Reports

NOTE Depending on your configuration, the following screens may not appear exactly as the screen on your instrument.

Creating Reports

1. Select Settings, and then select Reports.
2. Select Add 

. A default print setup is automatically created.



3. Enter a name for the new report, and enter a description if desired.
4. Next to Printer, select the printer to be used.
5. Next to Page Orientation, select the portrait or landscape page orientation needed.
6. Next to Spacing Between Sets, select the desired spacing between sets: a page break or no page break.
7. Next to Report Format, select Normal Report or Grouped Report. When a grouped report is generated, the software calculates the statistics of each report field for replicates with the same set name.

8. Next to Basic Corrections, select the moisture basis for display of results.

NOTE Composition results will appear in orange type on the main analysis screen until all fields that are necessary for basis calculations are filled in. White type indicates that all parameters required are given.

- None performs no corrections on analysis data and reports the results as-is.
- Dry(d) corrects results to report on a dry basis. The moisture content of the sample set is represented by the Moisture(ad) field in the display layout and is given in units of %. Moisture(ad) is removed from the analysis results of all replicates in the given set.
- As Received(ar) corrects results to report on a chosen moisture basis. The Moisture(ar) field represents this moisture basis and is given in units of %. Moisture(ar) is added to the analysis results of all replicates in the given set.

9. Next to Include Unanalyzed Samples, select whether to include unanalyzed samples in the report.
10. Change the available field settings (located at the bottom of the default print setup window) as needed. Refer to Configuring the Display, page 4–5.
11. Edit the styles for Selected Fields if desired. Refer to Editing Styles, page 4–11.
12. Select Preview 

on the Action Bar to evaluate the setup of the report and determine if the widths of the fields are appropriate.

Editing Reports

1. Select Settings, and then select Reports.
2. Select a Report.

3. Select Edit, and then refer to Creating Reports, page 4–33, for instructions to edit report parameters.

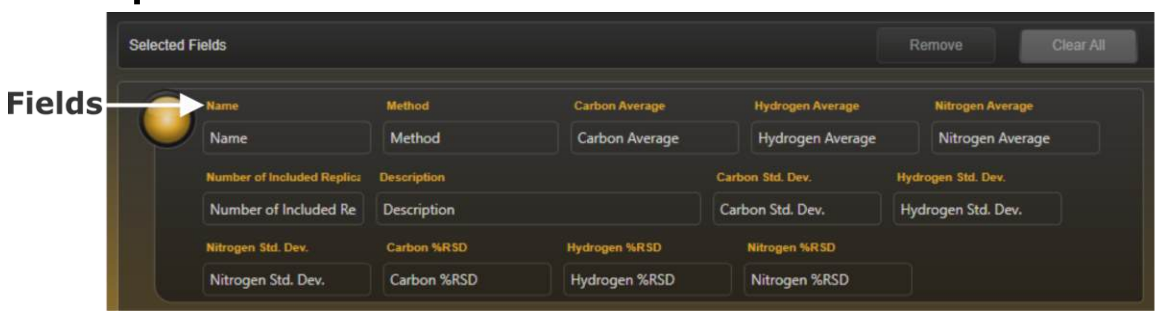
Font Settings Tab

Select the font settings, as desired, to apply to the report.

Analyte Units Tab

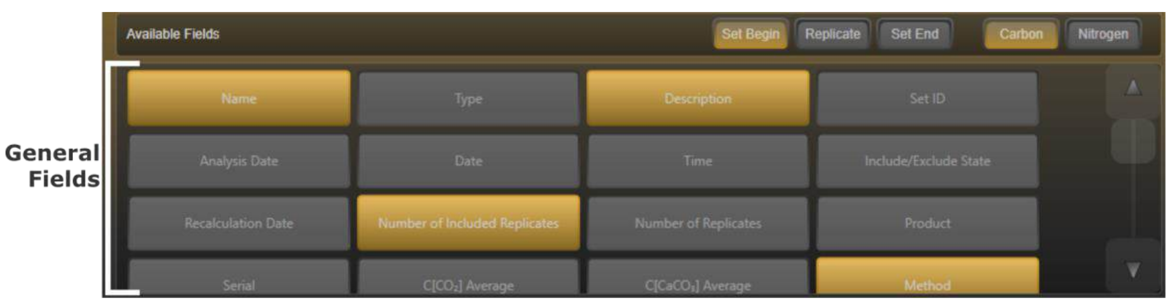
For more information on setting analyte units, refer to Analyte Units Tab, page 4–6.

Samples Tab



Selected Fields—Shows what will be printed. Drag fields to reorder.

Available Fields—Located under the display area and shows the available fields (buttons) that can be added to the report. General fields will be shown first, followed by element-specific fields.



To select available fields so that they will be part of the report:

1. Select which type of fields to see; available fields for that type will be shown.
2. Select Set Begin 

or the TOP orb  in the display area. Select the set fields to be shown BEFORE the replicate information.
3. Select Replicate 

or the MIDDLE orb  in the display area. Select the replicate fields to be shown.
4. Select Set End 

or the BOTTOM orb  in the display area. Select the set fields to be shown AFTER replicate information.

Within each Set Begin, Replicate, and Set End:

A. Select Element.
B. Select the fields to be shown for that element.

NOTE When switching between elements, the fields are displayed in the same order for easy location.

Select Fields:

A. The new field will appear at the end of the display area.
B. Drag the field to the desired place in the report.

Plots Tab

1. Select Plots.
2. Use adjustment tools inside the lower-right of the rectangles to resize the rectangle. This will not affect the alignment. The nature of each plot can also be adjusted by selecting it and selecting the Configuration Options underneath the Setup window.
3. Drag plots to change desired order.

To select available fields so that they will be part of the report:

A. Select Set or Replicate.

   Set Plot—Applies to each set of replicates; will print at the end of each set.

   Replicate Plot—Applies to an individual replicate of data only; will print after each replicate.
B. Select type of plot desired (Curve and/or Scatter).

Within each Set Plot and Rep Plot:

A. Select Element.

B. Select type of plot to be shown for that element.

NOTE If no "Available Fields" are selected for a plot, that plot will not be printed.

Customizing Print Header with Logo

The following procedure explains how to personalize the software's print head with a company logo.

1. Shut down the *Cornerstone* brand software.
2. Name or rename the image file "CustomPrintHeaderLogo.png" or "CustomPrintHeaderLogo.jpg." The file must be a .png or .jpg image to work properly.
3. Place the custom print header logo .png or .jpg file here:
   C:\ProgramData\LECO\CustomPrintHeaderLogo.png
   Or
   C:\ProgramData\LECO\CustomPrintHeaderLogo.jpg
   The file name must match exactly.
4. Restart the *Cornerstone* brand software.

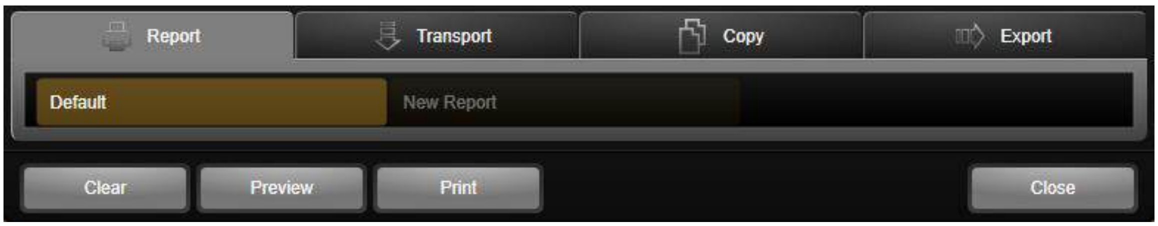
Editing Styles

For more information on editing styles, refer to Editing Styles, page 4–11.

Printing Reports

NOTE When printing or previewing a report, a progress indicator appears while the report(s) are being prepared. Selecting outside this progress indicator will cancel the report preparation.

1. Select the set(s) to print.
2. Select Output  on the Action bar.
3. Select the Report tab.

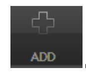
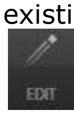


4. Select the report(s) to be printed.
5. Select one of the following options:
   - **Clear—**Deselects any selected reports.
   - **Preview**—Used to see how printed data will look.
   - **Print**—Prints the selected set(s) using the selected report(s).
   - **Close**—Closes the Report tab.

Creating and Editing Standards

A Standard is a sample of known type and value used to calibrate the instrument for best accuracy. A Standard can be used to perform automatic calibration checks if the upper and lower control limits have been set. Because Standard Calibration is saved with each method, each method must be calibrated after it is created.

For check standards, results that are out of range will be indicated by orange text in the software; saturated cell results will be indicated by blue text in the software.

1. Select Settings, and then select Standards.
   - To add a new standard, select Add .
   - To edit an existing standard, select the standard, and then select Edit .
2. Enter a name for the standard. The part number and lot number of the standard is recommended to be used as the name.
3. **OPTIONAL:** Add a description. The type of standard can be entered as the description.

NOTE Last Used and Last Modified display information about the standard. These fields cannot be edited.

4. Select the tab for the desired analyte. The parameters that appear depend on the selected analyte.

   Range—select the calibration range or ranges for which this is a valid standard.

NOTE Range is not available on all instrument configurations.

Certified—enter the certified composition of the standard. The units entered can be changed within the keyboard. Certified values should be entered on dry basis.

Uncertainty—enter the uncertainty of the certified value.

Lower Control Limit—enter the lowest value in which the standard is still considered within range. If the standard analysis result is below this value and Yes is selected for Check Standard, then the result will appear in orange type. The software automatically sets the value to the certified value minus the uncertainty.

Upper Control Limit—enter the highest value in which the standard is still considered within range. If the standard analysis result is above this value and Yes is selected for Check Standard, then the result will appear in orange type. The software automatically sets the value to the certified value plus the uncertainty.

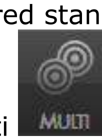
Check Standard—select Yes if the standard will be used as a check standard. If the standard result is outside the Lower or Upper Control Limit values, then the result will appear in orange type. If No is selected, the instrument will not check the standard result. This parameter is an option only if there is an Uncertainty entered.

5. Select Save to keep the information, or select Cancel and the standard information will not be saved.

Viewing Standard History

NOTE Viewing Standard History is not available on all instrument configurations.

History of specific standards can be viewed from the Standards screen.

1. Select the orb next to the desired standard. If more than one standard is desired, select Multi 

on the Action bar, and then select the orbs next to the desired standards.

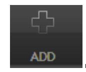
2. Select History 

. Then, refer to History, page 5–17.

Creating and Editing Templates

Templates allow the user to quickly add a predefined group of samples for analysis. Depending on the instrument configuration, the group of samples will be a single batch or a group of sets and replicates.

NOTE Some sample types are available only on certain configurations.

1. Select Settings, and then select Templates.
   - To add a new template, select Add 
.
   - To edit an existing template, select the template, and then select Edit 
.
   - To import an existing template, select Import. Refer to Importing and Exporting, page 3–22.

IMPORTANT Before importing a template, import its referenced method in order to avoid a blank method field in the template.

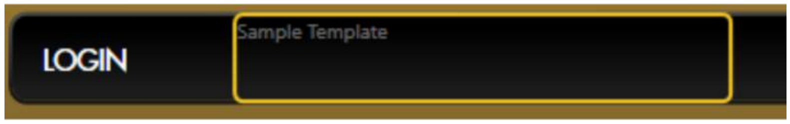
2. Enter a name for the template.
3. Add a description for the template, if desired.
4. Select the template type: Single Sample or Multi Sample. The Template Type option is available only when editing Single-Sample types that were created prior to *Cornerstone* brand software version 2.8.2. LECO recommends changing any such templates to Multi-Sample types so that they behave in the same way as new sample templates. Refer to Using Sample Templates, page 4–42.
5. Select the method to be used for the template.
6. Use the login bar to add blanks, standards, drifts, samples, and/or gas doses to the template as described in Logging in a Sample, page 3–33, and Logging in a Standard, page 3–32. Fill in all relevant fields to properly run an analysis.
7. Select Save to keep the information, or select Cancel and the template information will not be saved.

Using Sample Templates

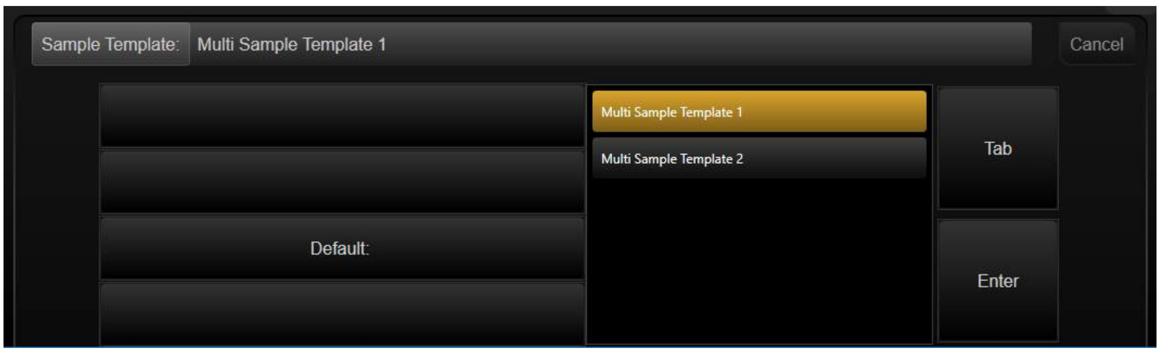
Complete the following steps to apply a sample template.

1. Select Analysis.
2. Select the Template 

button on the Login bar. The sample template login bar displays.



3. Select the desired template from the list at the bottom of the software screen.



4. Select Enter or Tab to enter the selected sample template (or select Cancel to cancel the login process). The samples specified by that sample template are logged in.
5. **OPTIONAL:** The blanks, standards, drifts, samples, and/or gas doses added with a template can be edited once added from the Login bar. Any changes made apply only to the current batch being analyzed. The sample template will not change.
6. Select Analyze to begin the analysis.

Using Single-Sample Templates

Complete the following steps to apply a single-sample template.

NOTE Single-Sample templates are available only when Single-Sample templates were created prior to *Cornerstone* brand software version 2.8.2. LECO recommends changing any such templates to Multi-Sample types so that they behave in the same way as new sample templates. Refer to Using Sample Templates, page 4–42.

1. Select Analysis.
2. Select the Sample  button on the Login bar.
3. Select the drop-down menu next to the Name field at the bottom of the software screen, and select the desired single-sample template.

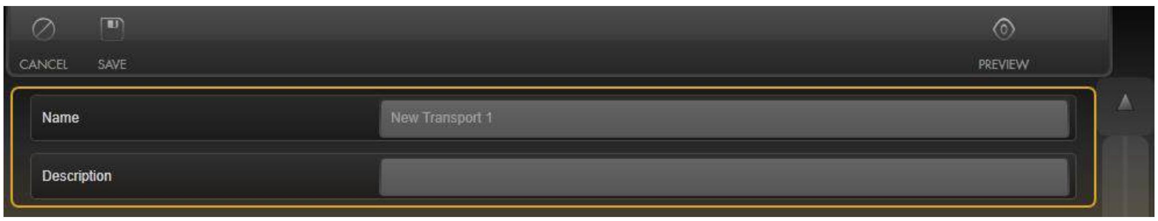
Creating and Editing Transports

The Transport feature is a data output format such as File Export, Ethernet Export, or Serial Port Transmit.

Creating Transports

1. Select Settings, and then select Transports.
2. Select Add 

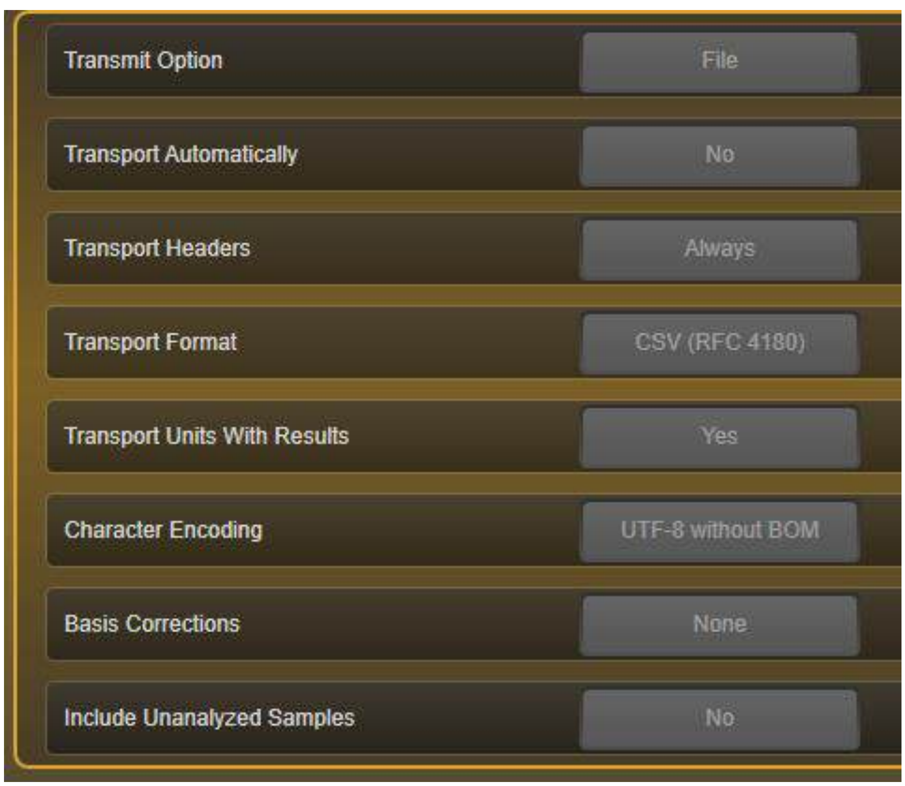
. A default transport format appears.



3. Enter a name and description, if desired, for this transport format.
4. Select and edit parameters and files required to create the output format.

Transmit Option

Transmit Option determines the format for the transport (File, Ethernet, Serial Port).



File

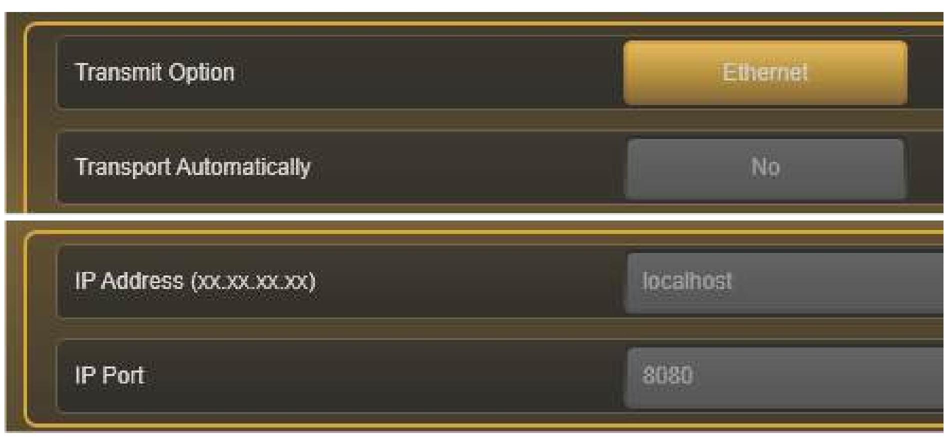
Export Options—Determine how the file is created (Append, Overwrite, or Auto Increment). If Auto Increment is selected, a date/time string is appended to the file name.

Export File Name—The file name or path to which data transmitted to a file is entered.

NOTES

- [default] can be used to direct transport data to the default file location, which is: C:\ProgramData\LECO\XXXXX####\Transport.
- XXXXX is the model number and #### is the serial number of the analyzer.
- Alternatively, a specific file name may be entered in this location following a standard folder path.
- For example: C:\Users\LECO\Desktop\Output.txt

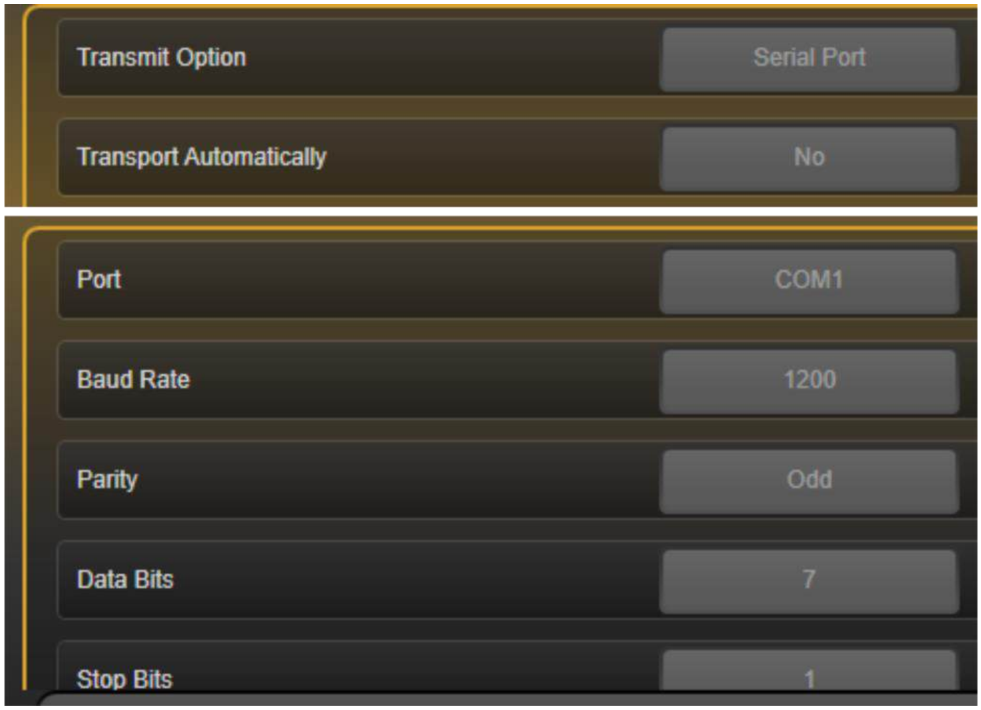
Ethernet



IP Address {xx.xx.xx.xx}—The Internet Protocol address of the target network device.

IP Port—the Internet Protocol port of the target network device.

Serial Port



Port—the COM port is used for this transport format (for example: COM1, COM2).

Baud Rate—bits per second data transmission rate used to configure the COM port.

Parity—data transmission parity used to configure the COM port.

Data Bits—number of data bits used to configure the COM port.

Stop Bits—number of stop bits used to configure the COM port.

Transport Automatically

Transport Automatically determines if results are automatically transported at the end of the analysis.

Transport Only When All Replicates Within Set Analyzed—Determines whether the transport is delayed until all replicates within a set are analyzed.

Transport Headers

Transport Headers determines when to transport set and rep headers. Select Never, Once per Transport, or Always.

Transport Format

Transport Format determines the format of the output created: CSV (RFC 4180), Delimited, XML Format.

Special Fields

The following fields are available only when using the delimited transport format.

Transmit Begin—The first character in the data transport format.

Transmit End—The last character in the data transport format.

Set End—The last character that follows the selected Set fields in the data transport format.

Replicate End—The last character that follows the selected Rep fields in the data transport format.

Field Begin—The character that precedes each field in the data transport format.

Field End—The character that will follow each field in the data transport format.

Special Field Reference Table

ACK	acknowledge
BEL	bell
BS	back space
CAN	cancel
CR	carriage return
CRLF	carriage return line feed
Comma	comma
DC1	device control 1
DC2	device control 2
DC3	device control 3
DC4	device control 4
DLE	data link escape
EM	end of medium
ENQ	enquiry
EOT	end of transmission
ESC	escape
ETB	end of transmission block
ETX	end of text
FF	form feed
FS	field selector
GS	group separator
HT	horizontal tab
LF	line feed
NAK	negative acknowledge
NUL	null
RS	record separator
SI	shift in
SO	shift out
SOH	start of heading
Space	space
STX	start of text
SUB	substitute
SYN	synchronous idle
Tab	tab
US	unit separator
VT	vertical tab

Transport Units with Results

Transport Units with Results determines if the results are transported with or without units.

Character Encoding

Select the type of character encoding desired for transmitting data: ASCII, UTF-8, UTF-8 without BOM, Unicode, Unicode without BOM.

Basis Corrections

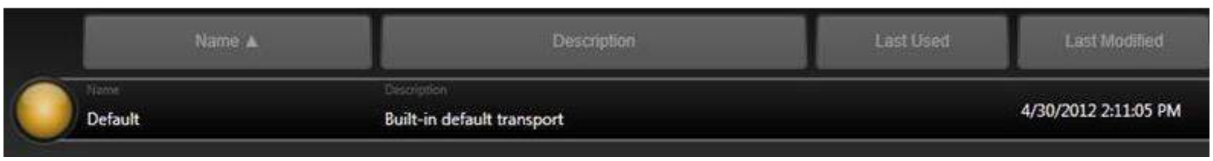
Select the moisture basis desired for display of results: None, Dry(d), As Received(ar).

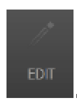
Include Unanalyzed Samples

Select whether to include unanalyzed samples in the transport.

Editing Transports

1. Select Settings, and then select Transports.
2. Select a Transport.



3. Select Edit 

. Transports can be prioritized by selecting from Name, Description, Last Used, or Last Modified. Refer to Creating Transports, page 4–44, for instructions to edit transport parameters.
4. Select Preview 

 on the Action Bar to evaluate the setup of the transport.
5. Select Print 

 to print the transport report.

Analyte Units Tab

For more information on setting analyte units, refer to Analyte Units Tab, page 4–6.

Samples Tab

For more information on setting the transport layout, refer to Samples Tab, page 4–35.

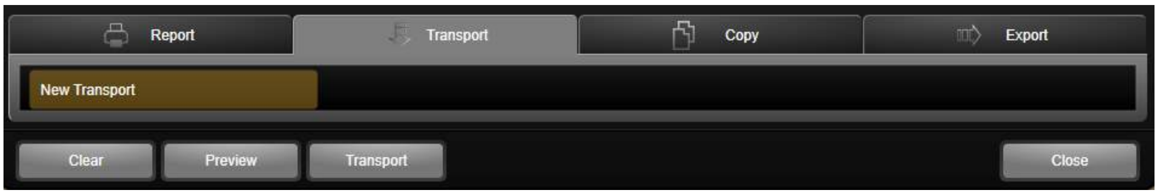
Editing Styles

For more information on editing styles, refer to Editing Styles, page 4–11.

Transport Output

1. In the main Analysis screen, select the set(s) to transport.
2. Select Output 

on the Action bar.
3. Select the Transports tab.



4. Select the Transport format. If only one is available, it will be automatically selected.
5. Select one of the following options:
   - **Clear—**Deselects any selected transports.
   - **Preview**—Used to see how transported data will look.
   - **Transport**—Used to transport data.
   - **Close**—Closes the Transport tab.

Working with User Permissions

User permissions allows the user to edit, add, include, exclude, delete, and clone user accounts to limit what different users can change within the software. Once user accounts are created, users can log in and out of the software by selecting the Session button at the top of the screen.

There are two user accounts set on the instrument by default: Administrator and Guest.

- Administrator has complete control over user permissions. The Administrator account permissions cannot be changed. The purpose of the Administrator account is to set up and edit any additional user accounts. The Administrator account is also used to enable/disable User Security in the software.
- The Guest account allows only read-only permission to the software. The Guest account permissions cannot be edited.

When user permissions are enabled in the Administrator account, a new user account can be created only by the Administrator or other users that are set up with permission to edit user accounts. In order to add, edit, delete or clone a user, the currently logged in user must have permission to edit user accounts and enter their password.

NOTE The Remote Query (RQ) option must be enabled on the security key in order to allow mobile application access to user accounts. Refer to Adding Options to the Registration Key, page 2–31, for more information.

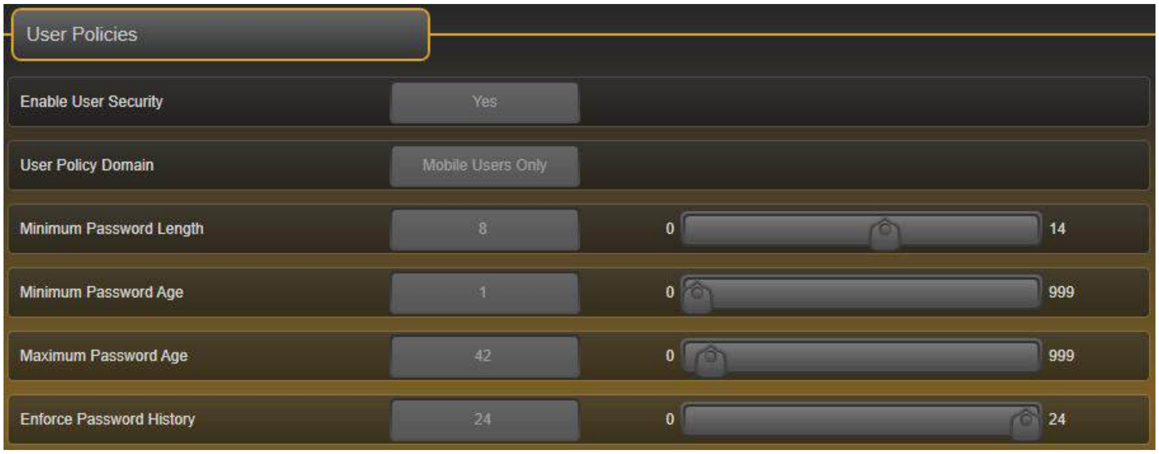
Enabling User Permissions for the Administrator Account

User Policies can be set to ensure that safe security practices are followed by all users. These features are especially important when the Remote Query option is being used, as well as when data is reviewed remotely, when data may be accessed over the Internet.

NOTE The User Policies field is available only when editing the Administrator user account. The User Policy Domain option in the User Policies section controls which set of users are bound by the policies.

1. Select Settings, then Users, and then select Administrator.
2. Select Edit on the Action Bar.
3. Enter your password if prompted to do so. The user permissions screen appears.
4. Select the box next to Enable User Security. Select Yes to enable user security.
5. Select the box next to User Policy Domain and choose the users group to be affected by the user policy settings: No Users, Mobile Users Only, or All Users.

6. Select and edit parameters to create the desired user security requirements as follows.



Minimum Password Length—enter the desired minimum number of characters that must make up a password. The value may range from 0 to 14.

Minimum Password Age—enter the desired minimum number of days between password changes. Minimum password age and password history prevents a user from cycling through a set of passwords to reuse a favorite password.

Maximum Password Age—enter the desired number of days after a password change before the password becomes invalid and must be changed. A dialog box displays when a user tries to log in with an expired password, requiring a password change. The value may range from 1 to 999 days.

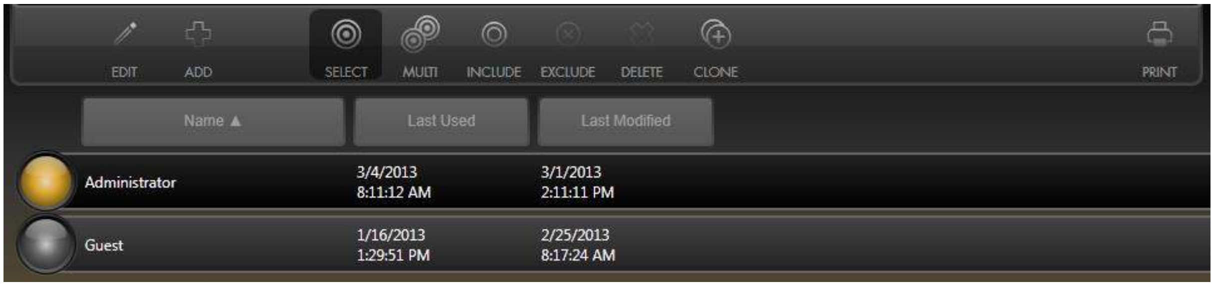
Enforce Password History—enter the desired number of prior passwords that the system will remember for a user. Users may not set a new password to one that is in their password history. The value may range from 0 to 24.

7. Complete steps 5 through 11 of Adding a New User Account, page 4–54.

8. Select Save on the Action Bar when done.

Adding a New User Account

1. Select Settings, and then select Users. A list of users appears.

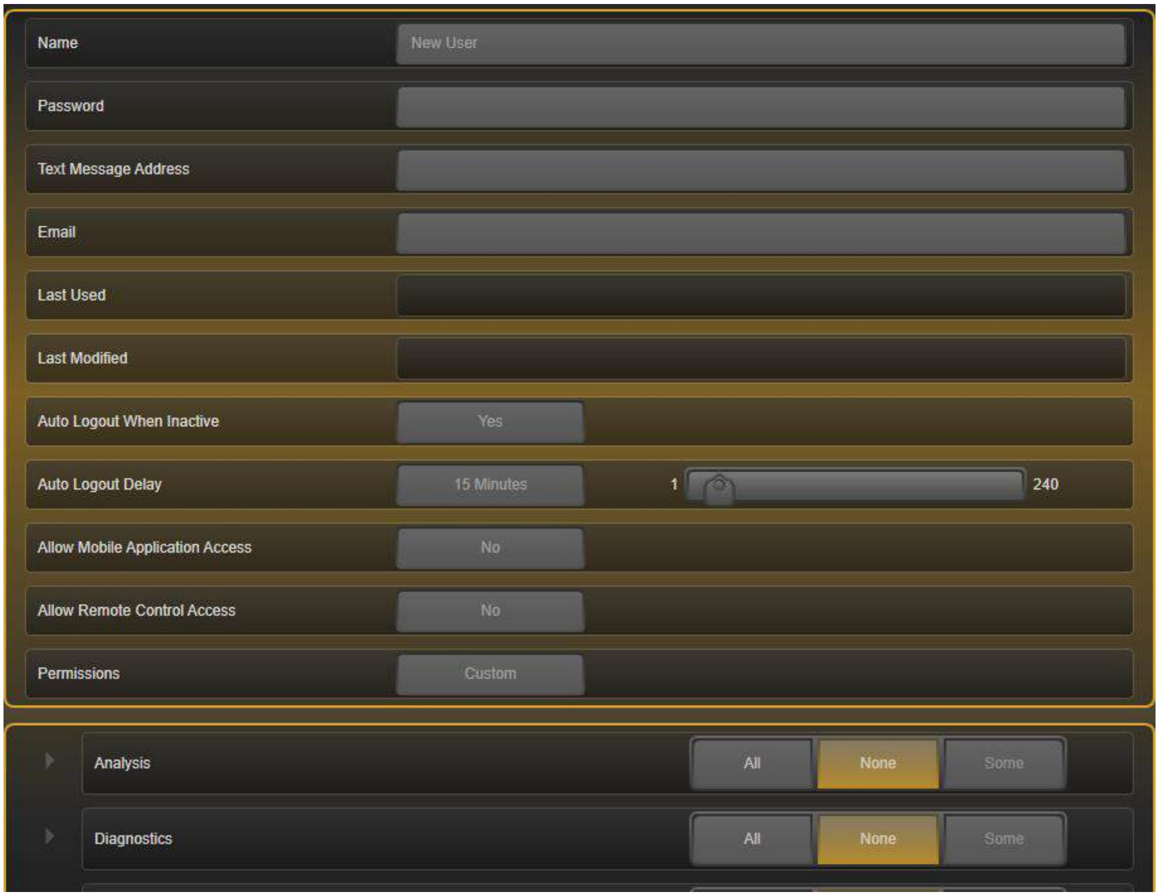


2. Select Add on the Action Bar.
3. Enter a password.

4. Enter the Text Message Address and Email, if desired. Refer to Setting Up Notifications, page 4–62, for more information.

5. Select and edit parameters to create the desired user security requirements as follows.

NOTE The Text Message Address, Email, and Allow Mobile Application Access fields appear only with the RQ option enabled. The Allow Remote Control Access appears only with the RSL, RC, or RQ option enabled.



6. Next to Auto Logout When Inactive, select Yes or No.

7. Next to Auto Logout Delay, enter the length of inactivity (in minutes) before the software automatically logs out the user.

8. Next to Allow Mobile Application Access, select Yes to allow the user’s credentials to be used by the *Cornerstone* mobile or a custom remote control app to view instrument data.

9. Next to Allow Remote Control Access, select Yes to allow the user’s credentials to be used by a custom remote control app to control the instrument.

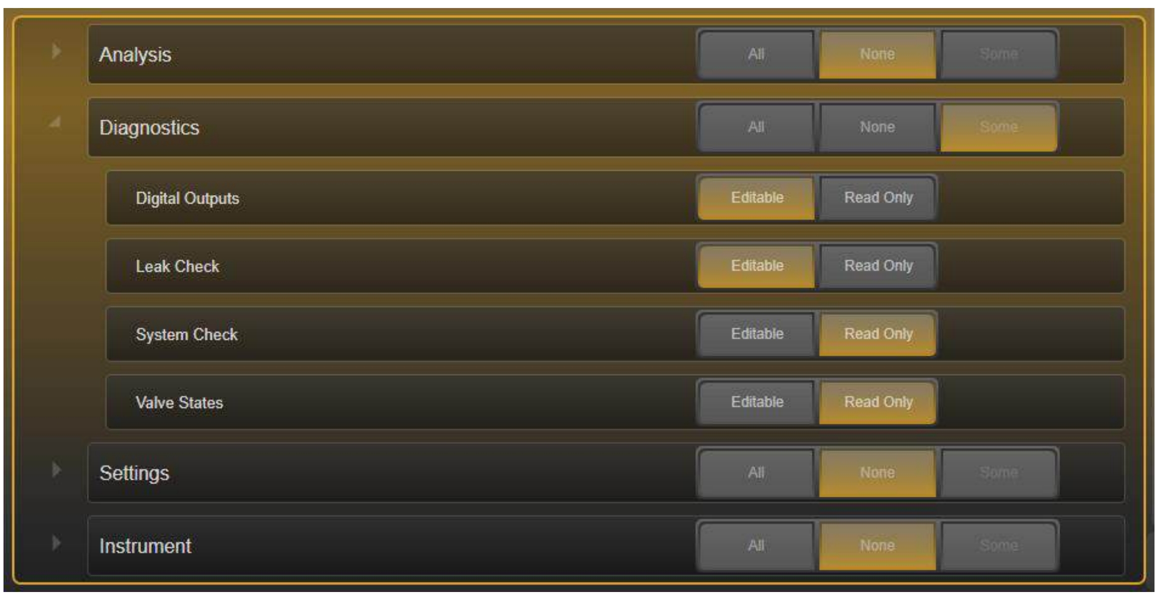
10. Select Custom, Full, or Basic in the permissions field.

    Custom—Allows you to customize user permissions individually from the Menu Bar items; Analysis, Diagnostics, Settings, and Instrument.

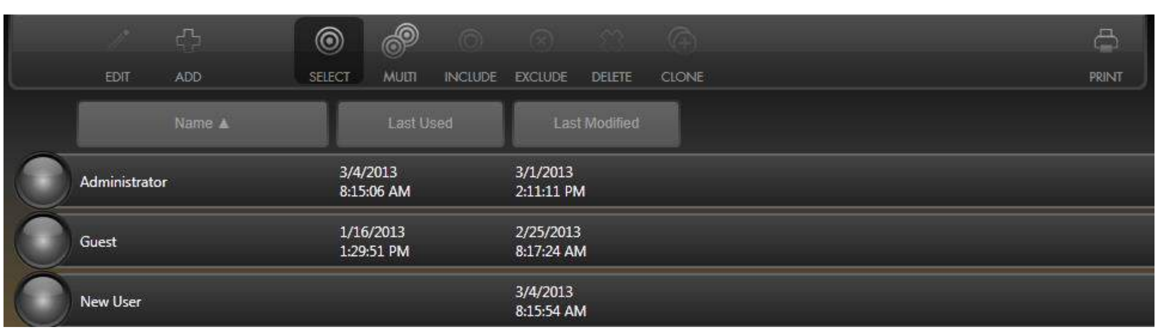
    Full—Changes every user permission setting to "All," and the user may edit everything in the software with the exception of the Administrator's account.

    Basic—Gives the user permission to perform common tasks in the software in order to run the instrument. The user is not allowed to perform calculations or edit users.

11. All or None may be selected from the list of Menu Bar items to choose what the user may access. Certain functions within these Menu Bar items, such as Editable or Read Only, may also be selected for the user account by selecting the expand/collapse arrow next to the Menu Bar item's name. Some is selectable only if the menu bar items have a mixture of Editable and Read-Only functions selected.

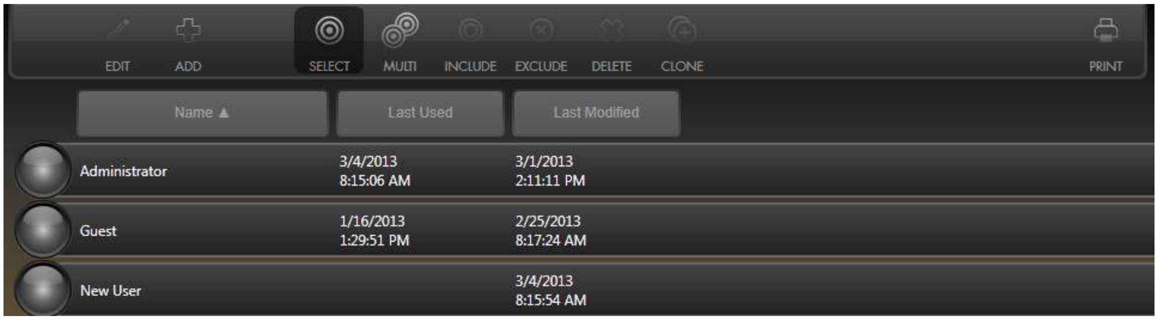


12. Select Save on the Action Bar when done. The new user will now appear in the list of users.



Editing User Account Settings

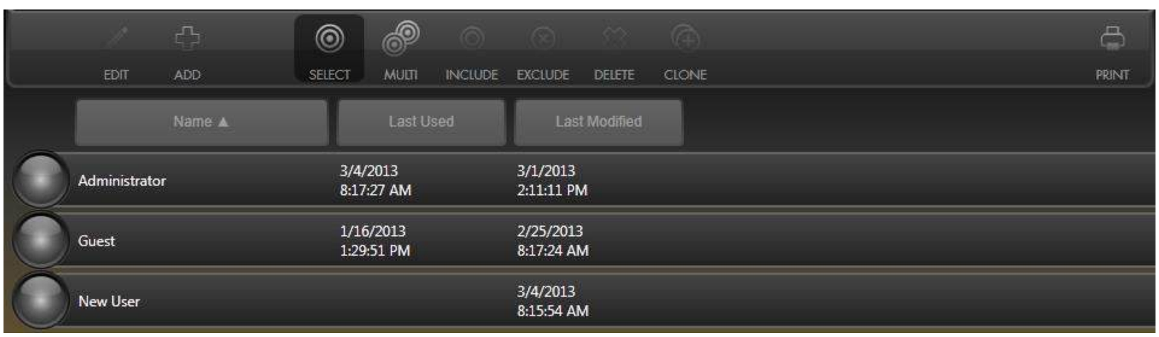
1. Select Settings, and then select Users. A list of users appears.



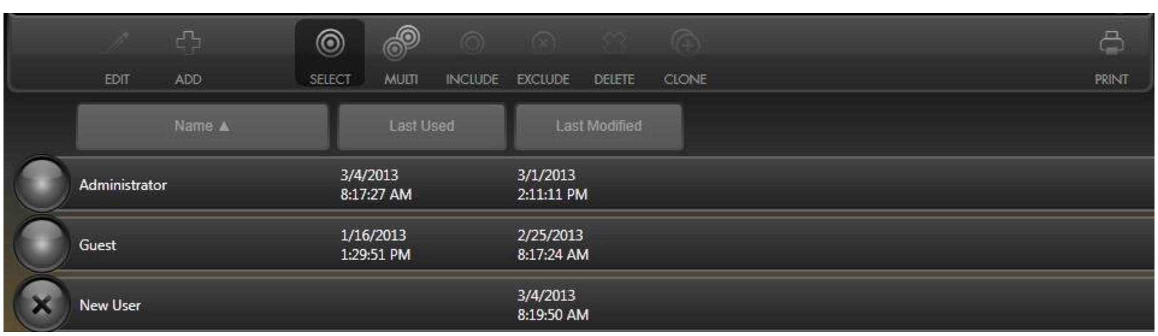
2. To edit a user account, select the user from the list by selecting the orb next to their name and then selecting Edit on the Action Bar. Enter the password if prompted to do so.
3. Complete steps 5 through 11, as desired, of Adding a New User Account, page 4–54.
4. Select Save on the Action Bar when done.

Deleting a User Account

1. Select Settings, and then select Users. A list of users appears.



2. From the list of users, Select the user account to delete by selecting in the orb next to the user account, and then selecting Exclude on the Action Bar.

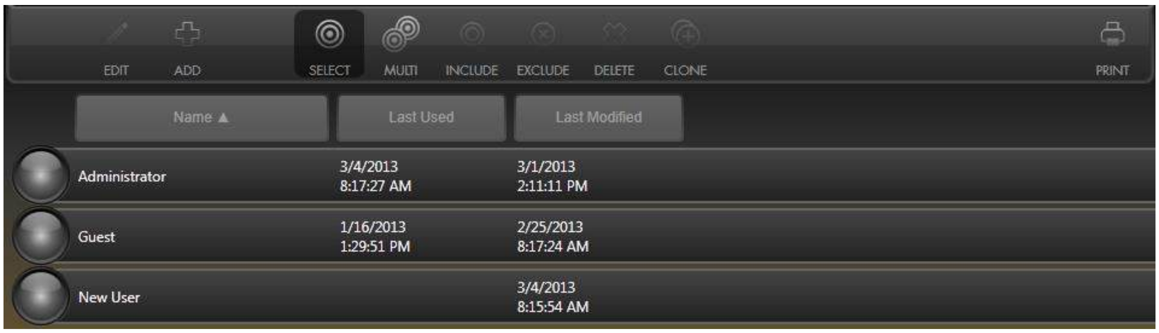


NOTE Administrator and Guest cannot be deleted from the list of user accounts.

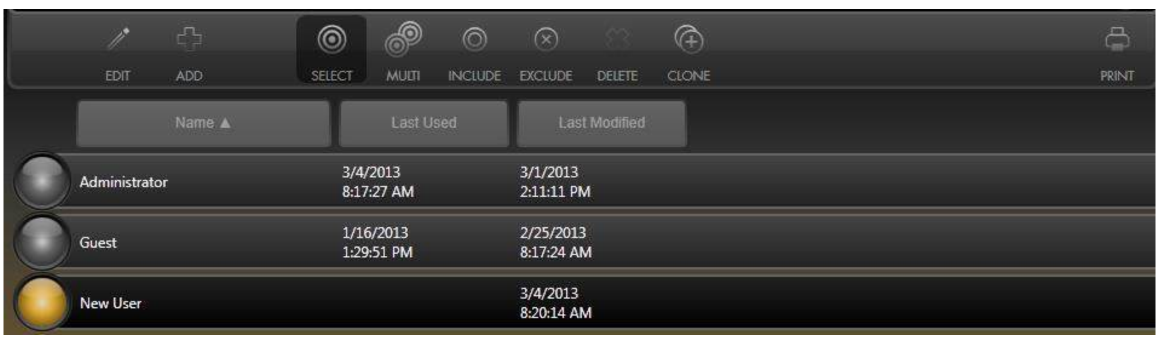
3. Reselect the user account to delete by selecting the orb next to the user account. Select Delete on the Action Bar to delete the user account.

Cloning a User Account

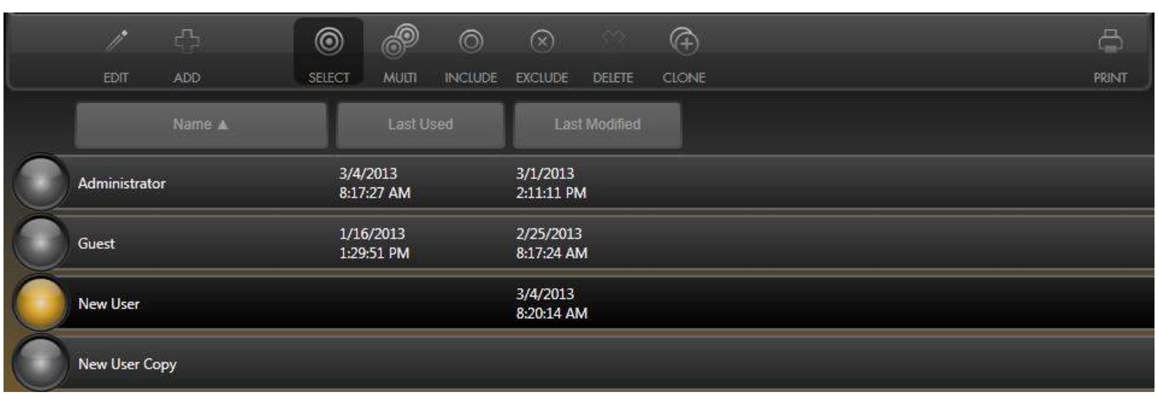
1. Select Settings and then select Users. A list of users appears.



2. From the list of users, select the user account to clone for a new user account.



3. Select Clone on the Action Bar. A copy of the selected user account will appear in the list of users.



4. Select the new user account and edit any necessary information by selecting Edit on the Action Bar.

Selecting a Different User Account

1. Select the Session button on the Title bar.
2. A window pops up that gives you the option to select a different user account, log out, go back, or exit the software.

3. To change the user account, select the name of the currently logged in user.
4. Select the desired user account from the list of users and select Enter.

5. Enter the password if necessary.

Resetting the Password for the Administrator Account

NOTE → This process can be used to reset only the password of the built-in Administrator user account.

1. Close the software, and then restart it.
2. Select Administrator under Username.
3. Select Reset Password.
4. Contact LECO Service and relay the challenge key found on the Reset Password screen.
5. LECO Service personnel will provide a challenge response.
6. Enter the challenge response in the appropriate area.
7. Enter and confirm a new password.
8. Select the Enter button.

LECO Cornerstone® for Mobile Devices

NOTE Depending on the instrument configuration, the following screens may not appear exactly as the screens on your instrument or mobile device.

LECO *Cornerstone* Mobile is a subscription-based service that allows smart phones, tablets, and PCs to access analytical data from LECO *Cornerstone* instruments. These devices can view analysis results, combustion plots, maintenance status, method details, current system temperatures, pressures, and more. LECO *Cornerstone* for mobile devices is a viewer application only; the instrument may not be controlled from the mobile device. LECO currently offers support for iPhone®, iPad®, Android® phones, *Android* tablets, and Microsoft® Windows® 10 PC and phones. LECO *Cornerstone* for mobile devices is available from the LECO website at http://www.leco.com/cornerstone-mobile and in the iTunes Apps Store, Google Play, and the *Microsoft* Apps store.

The Remote Query (RQ) option must be enabled on the security key in order to access mobile settings within the *Cornerstone* brand software. The subscription must be processed prior to activation within the *Cornerstone* brand software. The following terms are available: 1 Year *Cornerstone* Mobile Subscription 619-592-882-B/O and 3 Year *Cornerstone* Mobile Subscription 619-592-899-B/O. Refer to Adding Options to the Registration Key, page 2–31 , for more information. The RQ option is set with an expiration date and must be renewed periodically.

In order to access LECO *Cornerstone* from your mobile device, you must have the proper User Permissions set up in the software of your instrument. Enable User Security and Allow Mobile Application Access must be set to "Yes." Refer to Working with User Permissions, page 4–51.

Security Considerations

Each enabled *Cornerstone* instrument transmits a laboratory name and laboratory key to the server and remains connected to the server using a "long-polling" technique. When activated by the user, the mobile device transmits the user-supplied laboratory name, laboratory key, user id, and user password to the server. For each *Cornerstone* instrument connected to the server with a matching laboratory name and key, the server forwards the user id and password to the instrument for authentication.

The internet-based server passes all authentication and instrument data between the mobile devices and the *Cornerstone* instruments. User ids, passwords, and instrument data are not stored on the internet-based server. Data is only retained by the *Cornerstone* instrument itself. As soon as the *Cornerstone* instrument is disconnected from the server, its data is no longer accessible to any mobile device.

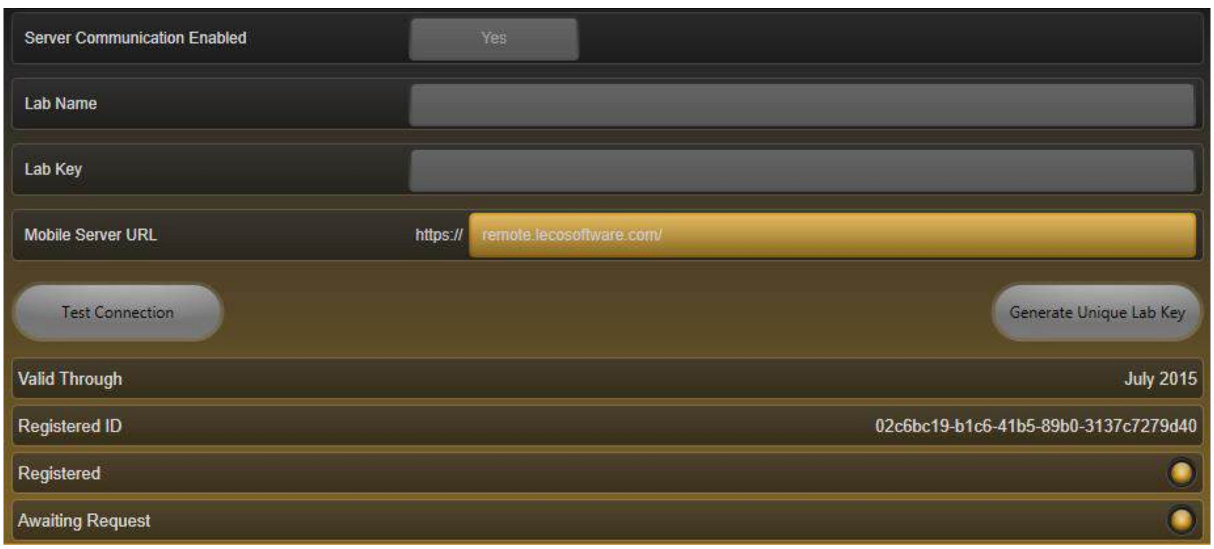
For those who prefer to avoid the public internet, LECO can supply the server software to be deployed on the customer's own private network as Network Query (NQ) option. The RQ option is still required when using the NQ option; the NQ option alone will not enable RQ capability. It is the customer's responsibility to equip the mobile devices with access to the company's private network, possibly through Virtual Private Network (VPN) or a corporate-secured Wi-Fi.

Setting Up Mobile Connectivity

The standard connectivity infrastructure consists of a publicly accessible internet-based server, which the mobile devices connect to using the https secure protocol using cellular networks or Wi-Fi connectivity.

Cornerstone instruments also connect to the server using the https secure protocol using customer-supplied internet connectivity to the instrument. No special firewall accommodations are needed in the laboratory beyond what is required for web browsing.

1. In the software, select Settings, and then select Networking.
2. Select Mobile Settings.



3. Ensure Server Communication Enabled is set to Yes.
4. Enter the Lab Name and Lab Key in the appropriate fields. The Lab Name and Lab Key should be set up by the Administrator.

   Lab Name—Segregates instruments into logical groups for mobile access. The user can choose any name desired for the lab name and each *Cornerstone* instrument with a similar lab name will be grouped together and viewed together. An Administrator can provide certain users mobile access to only specific instruments by controlling the lab names.

   Lab Key—Provides a safeguard for login credential uniqueness. The Lab Key can be made as complex as necessary. Enter any desired value for the key, or use the Generate Unique Lab Key button to have a unique key automatically generated.

5. Test the connection to the mobile server by selecting the Test Connection button.
6. On the mobile device, download LECO *Cornerstone* if you have not already done so.
7. Enter the user credentials, and then select Login. The Username, Password, Lab Name, and Lab key must match those set up in the *Cornerstone* instrument.

Setting Up Notifications

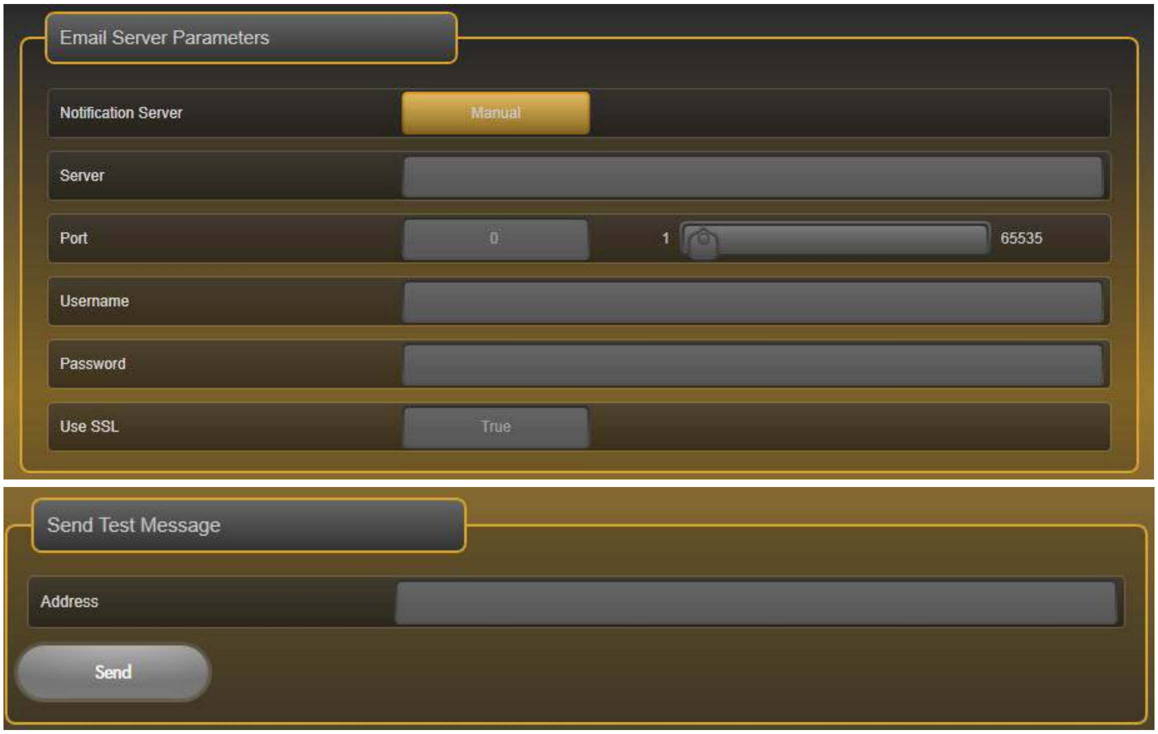
The RQ option can be used to notify users of instrument events.

1. In the software, navigate to Settings ➤ Networking ➤ Email Server Parameters.
2. Select the desired notification server by completing the following steps.
   - **To send notifications using LECO's *Cornerstone* Cloud Server:**
     a) Select the parameter field next to Notification Server.
     b) Select Cornerstone Cloud Server in the Notification Server window at the bottom of the screen, and then select Enter.

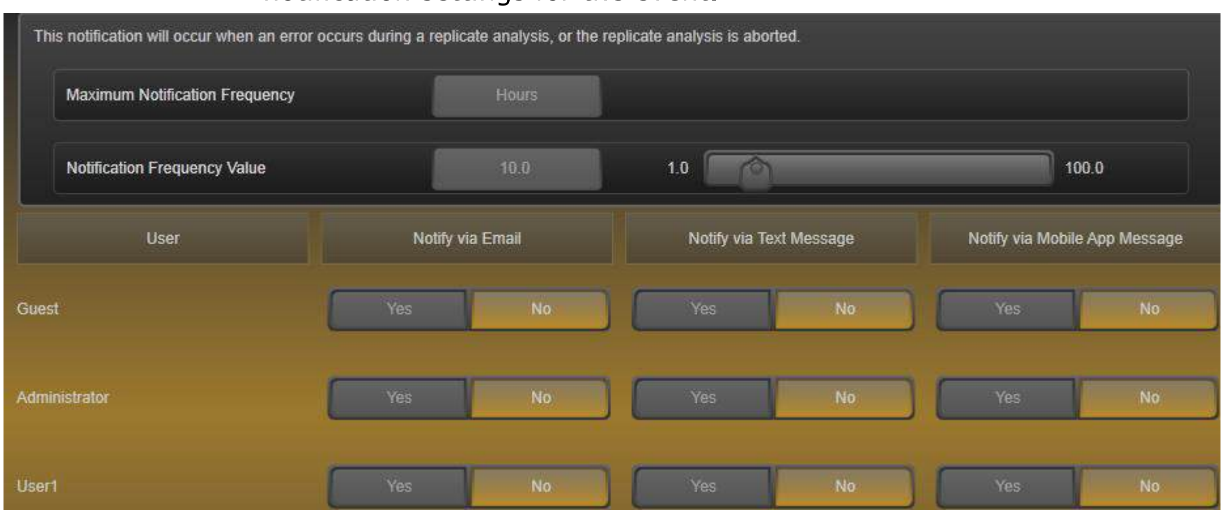
NOTE If the *Cornerstone* Health Management (CHM) participation level is Not Specified, a notice will appear. CHM-0 or CHM-1 must be chosen to use the *Cornerstone* Cloud Server. Refer to Cornerstone® Health Management, page 5–30.

   - **To send notifications using another server:**
     a) Select the parameter field next to Notification Server.
     b) Select Manual in the Notification Server window at the bottom of the screen, and then select Enter.
     c) Enter information for applicable fields in the Email Notification Information area. These settings are used to set up the instrument to send emails. The information for these fields is typically provided through an IT department within the user’s organization.

d) **OPTIONAL:** To test the settings entered in the Email Server Parameters, enter an email address in the parameter field next to Address, and then select Send. An email is received at the entered email address that says "Test email sent from Cornerstone instrument…."



3. Select Settings, and then select Notifications. This screen displays the types of events that users can be notified of.
4. Select an event, and then select Edit in order to change the notification settings for the event.

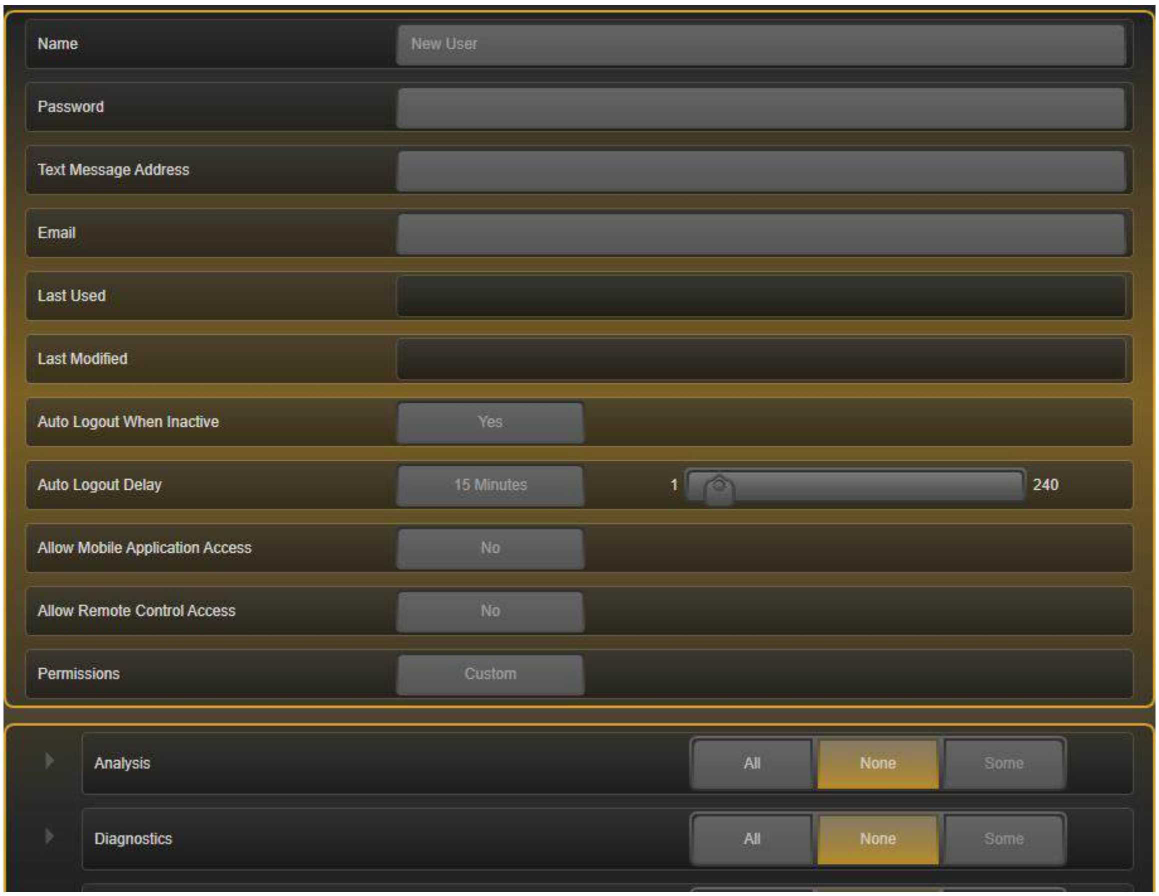


5. Select the Maximum Notification Frequency to the desired unit of time or to set the frequency to each occurrence of the event.
6. Set the Notification Frequency Value to the desired interval for notifications of the event.

7. Set the notification channels for each user.

NOTE For users who are set to receive notifications via email or text message, their email and text message addresses must be entered on their Users screen in order to receive the notifications. For more information on Working with User Permissions, page 4–51.

8. Select Save on the Action Bar when done.
9. Select Settings, and then select Users.
10. Select the desired user, select Edit, and then enter a password if applicable.
11. Enter the appropriate information in the fields for Email and Text Message Address if notifications will be received in those forms.



NOTE The text message address can be found in the documentation for the phone service; it can also be retrieved by sending a new SMS (not MMS) text message to an email address from the phone. Contact the phone service to find out if your phone is set up for SMS or MMS text messages.

Using Assign Notify

The Assign Notify button  can be selected to alert the user when a replicate analysis is completed.

1. From the Analysis screen, select an analyzing or unanalyzed replicate.
2. Select Assign Notify .
3. A notification will be sent via the channel selected in the Notifications settings screen. Refer to Setting Up Notifications, page 4–62.

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5 Instrument

The Instrument chapter describes common procedures and options related to configuring the analyzer.

HAZARDOUS VOLTAGE WARNING
During installation and operation of this instrument, the ON/OFF switch must be easily accessible. The ON/OFF switch is located on the right side of the instrument.

Illustrations

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Installing the Balance

A Sartorius® analytical balance is available as an option. The following procedures should be performed to install a balance. For additional information, refer to the manual supplied with the balance.

Two balances are available: Secura and Entris II. When the procedures in this section are noted to be different, follow the appropriate instructions for the balance being used.

NOTE The instrument will only support *Sartorius* analytical balances. Other balances may be used; however, LECO is not responsible for their installation or proper operation.

After the balance is set, do not change any of the configuration parameters. The configuration parameters can be changed to custom configure the balance, but only after the installation procedure is completed and the balance is properly operating with the instrument.

NOTE To restore the balance to factory defaults, refer to Resetting the Balance, page 5–13.

1. Set up the balance in the location where it will be used. Be sure the balance location chosen is on a stable, even surface that is not exposed to vibrations. Refer to the manual supplied with the balance for more information. Refer to Preparing the Balance, page 5–5.
2. Follow the procedure in Setting the Data Characters Parameters, page 5–6.
3. Set up communication between the balance and instrument software. Refer to Setting Up Communication with the Balance, page 5–6.
4. Test the balance to ensure proper operation. Refer to Testing the Balance, page 5–13.
5. Complete the Warranty Registration Card that came with the balance and return it to the balance manufacturer.

Preparing the Balance

1. Unpack the balance and assemble it as shown in the manual supplied with the balance.
2. Plug the AC adapter, supplied with the balance, into facility power.
3. Connect the AC adapter cable to the power-input jack on the rear of the balance.
4. Level the balance by completing the appropriate step depending on your balance model.
    - **For Secura balance only:** Level the balance by following the instruction manual supplied with the balance.
    - **For Entris II balance only:** Manually adjust the two front feet until the air bubble is centered within the circle of the level indicator.

Setting the Data Characters Parameters

NOTE The parameters do not have to be adjusted for the Entris II balance to work with the Cornerstone® brand software.

Set the data character according to the instructions in the manufacturer's manual supplied with the balance.

Setting Up Communication with the Balance

The following sections explain how to set up communication between the computer and the external balance.

Complete the appropriate set of instructions depending on your balance model.

Secura Balance: Secura Balance, following

Entris II Balance: Entris II Balance, page 5–10

Secura Balance

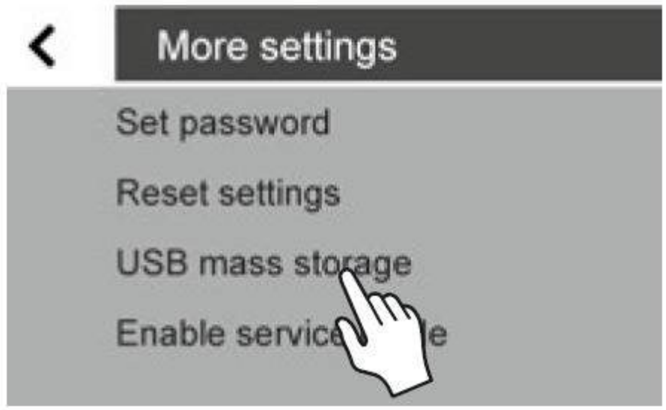
NOTE Complete the instructions in this section for the Secura balance only. For the Entris II balance, complete the following steps in Entris II Balance, page 5–10.

A USB driver is required to connect the balance to a USB port on the computer. The driver creates a Virtual COM on the computer, which emulates a serial interface (COM port). The USB Driver is stored on the balance and can be downloaded by connecting the balance to the computer with a USB Mini-B to USB Type-A cable.

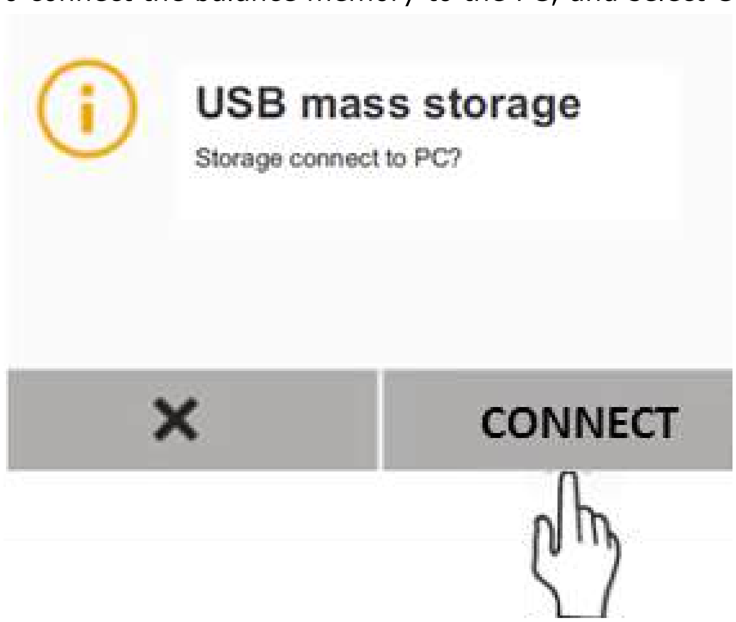
NOTE If using Microsoft® Windows® XP, then Service Pack 3 or newer is required to install the driver.

Installing the USB Driver

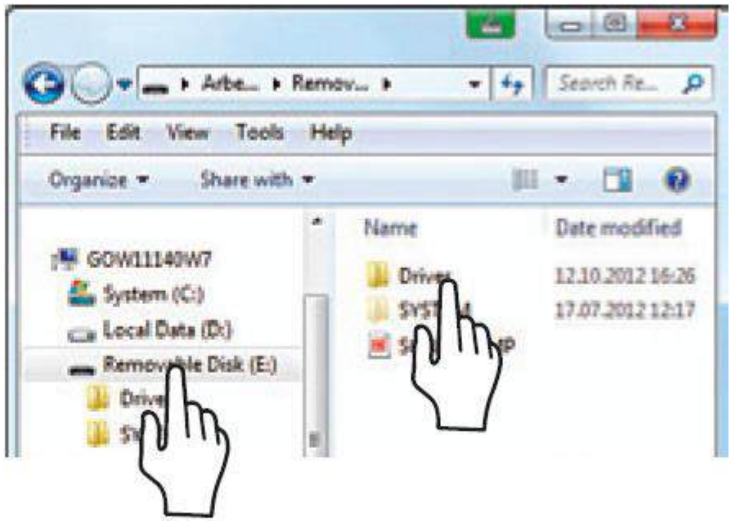
1. Connect the balance to the PC using the supplied USB cable.
2. To access the balance systems settings, select (Setup) from the balance menu on the balance control panel.
3. To access the USB mass storage menu option on the balance, go to More Settings and select USB Mass Storage.



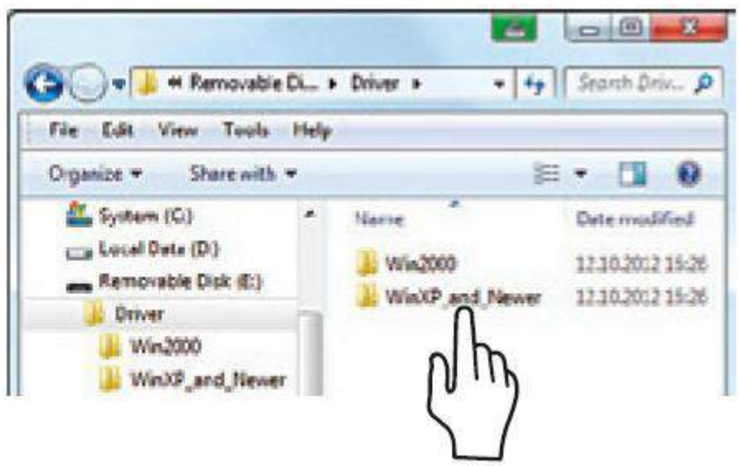
4. To connect the balance memory to the PC, and select Connect.



5. To install the installation program for the USB driver on the PC, select the appropriate removable data carrier (in this case, the E: drive), and then select the Driver folder.



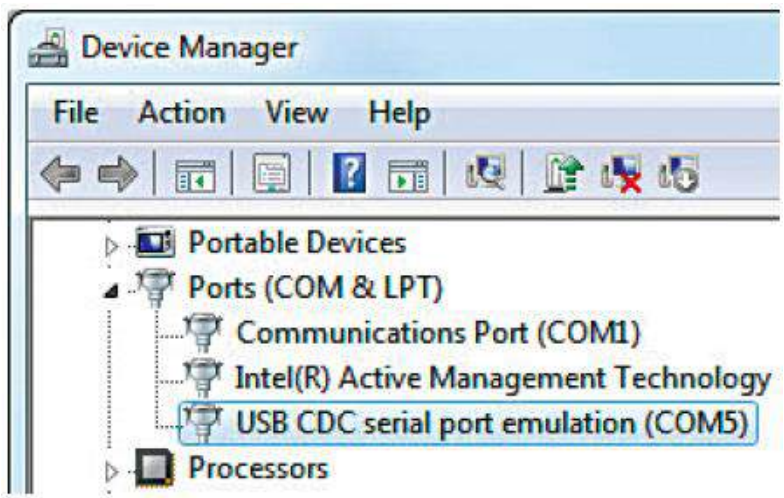
6. Select the appropriate *Windows* version for your PC, and then select the folder.



7. Select the file called InstallDriver.exe and follow the onscreen instructions.

8. Once the driver is installed, Direct data transfer to PC is available for both balance operating modes (PC-SBI and PC-xBPI). Select Disconnect to return to the main balance menu.

9. The USB CDC Serial Port connection appears in the Device Manager of the PC under Connections.



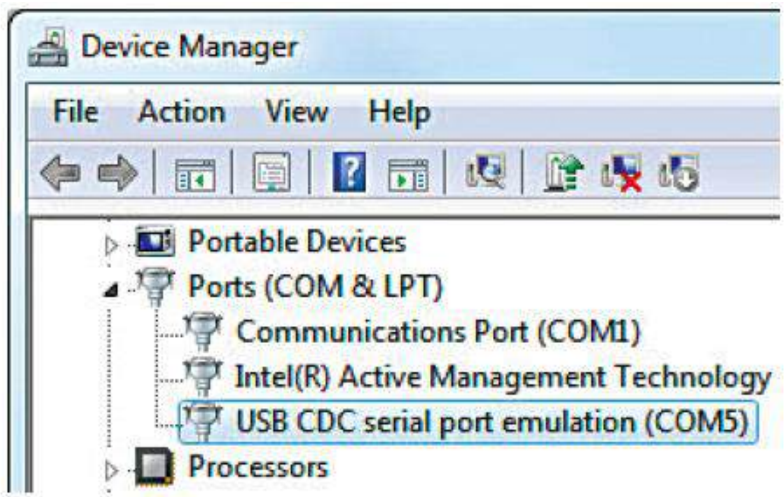
10. If the software does not recognize the balance upon installation of the driver and selection of the correct COM port, complete the following steps:
    A. Change to a different COM port.
    B. Turn Off the LECO software
    C. Restart the LECO software.
    D. Select the new COM port.
11. Continue to Configuring the Software, page 5–11.

Entris II Balance

NOTE Complete the instructions in this section for the Entris II balance only. For the Secura balance, complete the following steps in Secura Balance, page 5–6.

A driver is not required to be downloaded for the Entris II balance. The balance emulates a serial interface (COM port) when the balance is connected to the computer with a USB-C to USB-A cable.

1. Connect the balance to the PC using the supplied USB cable.
2. The USB CDC Serial Port connection appears in the Device Manager of the PC under Connections.



3. If the software does not recognize the balance upon installation of the driver and selection of the correct COM port, complete the following steps:
   A. Change to a different COM port.
   B. Turn Off the LECO software
   C. Restart the LECO software.
   D. Select the new COM port.

Configuring the Software

NOTE The following screenshot illustration is an example only and may or may not be applicable to specific procedures.

1. Select the Instrument tab and then select Balance.

2. The Connection Type is set to RS-232 for the serial transmission of data and is not editable.
3. Select the communication port the balance is connected through by selecting the Port box. Then, select the communication port in the LECO software that was specified in step 9 of Installing the USB Driver for Secura Balance, page 5–9, or in step 2 of Entris II Balance, page 5–10.
4. Select the baud rate for the balance by selecting the Baud Rate box and then selecting the desired baud rate from the list.
5. Select the Parity by selecting the Parity box and then selecting either odd or even.
6. Select the Data Bits by selecting the Data Bits box and then selecting the desired value from the list.
7. Select Stop Bits by selecting the Stop Bits box and then selecting either 1 or 2 from the list. Refer to the *Sartorius* Instruction Manual.
8. Select the desired decimal places to set the number of digits to be displayed after the decimal place for the sample mass. You may either select the Decimal Place box, and then set the decimal place, or use the slider. The decimal place range is 1 through 6.
9. Set the balance to Manual Data Output by completing the appropriate steps for your balance model.

For Secura balance only:

A. From the main software screen on the balance, select (Menu), and then select (Setup).
B. Select Printout from the Settings menu, and then select Manual Print from the list.
C. Select Manual Print Format, and then select Value w/o Identifier from the list.
D. To return to the main menu, select the arrow in the upper left corner.

For Entris II balance only:

A. From the main software screen on the balance, select (Menu).
B. Use the (Down arrow) to scroll down the main menu until "DATA.OUT." is highlighted. Then, select (Confirm).
C. From the "DATA.OUT." menu, select the "COM.SBI" menu. Then, select (Confirm).
D. From the "COM.SBI" menu, select the "COM.OUTP." parameter. Then, select (Confirm).

E. From the “COM.OUTP.” parameter menu, use the (Down arrow) until “IND.AFTR.” is highlighted (for manual data output after stability). Then, select (Confirm).

F. Select the (Back arrow) until the Main screen is reached.

NOTE If a parameter has been changed, the balance will beep and appear to reset itself when the Main screen has been reached after exiting the menu.

Testing the Balance

Select the Get Mass button. The weight displayed in the software screen should match the weight displayed on the balance control panel.

Resetting the Balance

Refer to the manufacturer’s instruction manual supplied with the balance. Consult the LECO Service Department before resetting the balance to factory defaults.

Data Management

Database

The database is an organized collection of information from each analysis. The database keeps track of setup parameters, calibration settings, and other information, and it is vital to the software and instrument's performance.

Validating the Database

1. In the software, navigate to Instrument ➢ Data Management ➢ Database Validator.
2. Choose Yes or No for the options of tasks to be performed during validation.
3. Select Validate to begin validation. The database validator log indicates when the database validation is finished.
4. Select Cancel to stop validation if necessary.
5. **OPTIONAL**: After validation, select Copy to copy the database validator log.

Database Information

In the software, navigate to Instrument ➢ Data Management ➢ Database Information to view the location of the database and the number of sets and reps that have been analyzed.

Backing Up the Database

In the software, navigate to Instrument ➢ Data Management ➢ Database Backup to set the database backup parameters for both automatic and manual backups.

Backups can be scheduled to occur automatically at the same time of day and at the desired frequency. Refer to Automatic, page 5–15.

To manually back up the database at any time, select Backup 

from the Action Bar.

1. Select the desired backup location.
   - To use the default backup location, select No next to Use Custom Location. The default backup location appears next to Location.
   - To choose a different backup location, select Yes next to Use Custom Location. Select the box next to Location and choose the desired file location. Then select Accept.

NOTE The field next to Last Backup displays the date and time that the last backup occurred.

2. Select Yes or No next to Delete Old Samples After Backup.
   - If Yes is selected, enter the age (in days) of the samples to keep in the box next to Delete Samples Older Than. Sample sets that are not referenced by functions, such as Calibration, that do not have any unanalyzed (or analyzing) reps, and that are older than the age entered next to Delete Samples Older Than will be removed from the current database after they are backed up.
   - If No is selected, samples will remain in the current database after they are backed up.
3. Select Save to save the settings and exit this screen, or continue with Automatic, following, to schedule an automatic backup.

Automatic

1. Turn On automatic backups by selecting On next to Automatic. Select Off to disable automatic backups.
2. Select the box next to Interval, and then enter the desired backup interval (in days).
3. Select the box next to Time, and then enter the time of day for the backup to occur. It is recommended that you choose a time when the software will not be analyzing samples and no one will be using the instrument.

NOTE Once saved, the box next to Next Backup displays when the next scheduled backup will occur.

4. Select Save to save the settings and exit this screen.

Restoring the Database

1. In the software, navigate to Instrument ➢ Data Management ➢ Database Restore to set the database restoration parameters.
2. Select the location of the database backup to be restored.
   - To use the default restoration location, select No next to Use Custom Location. The default restoration location appears next to Location. The default restoration location will be the location set in Backing Up the Database, page 5–14.
   - To choose a different restoration location, select Yes next to Use Custom Location. Select the box next to Location and choose the file location. Then select Accept.
3. Select the box next to Backed Up Database to Restore, and specify which backup to restore. The backups are named by the date and time that they were backed up, and the most recent are listed first.
4. Select the box next to Restored Database Name, and then enter a new name for the restored database, if desired.

5. Select Restore 

from the Action Bar to restore the database. A new, restored database is created.
6. Open the new database by completing the actions in Choosing a Startup Database, following.

Choosing a Startup Database

To open a different database, exit the software, and then follow the instructions in Starting the Software, page 3–16.

Exporting the Database

Complete the following steps to create a simplified database, designed for starting fresh. The exported database will contain only sample sets associated with method calculations.

1. In the software, navigate to Instrument ➢ Data Management ➢ Database Export.
2. To choose a new export location, select the box next to Location. The file browser opens.
3. Navigate to the location to export the database folder using the file browser. Use the Add, Rename, and Delete buttons to modify folders on the computer.
4. Select Accept.
5. To enter a name for the database folder, select the box next to Name. The keyboard appears. Enter the name as desired, and then select Enter.
6. To export the database, select Export 

.
7. To use an exported database, exit the software, and then follow the instructions in Starting the Software, page 3–16.

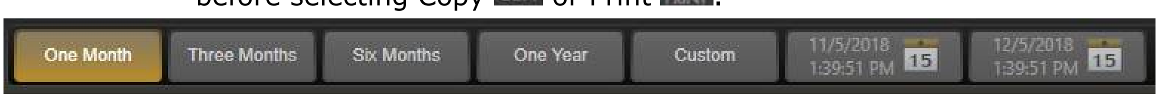
Viewing Message History

In the software, navigate to Instrument ➢ Data Management ➢ Message History to view a list of messages that have recently been displayed to the user.

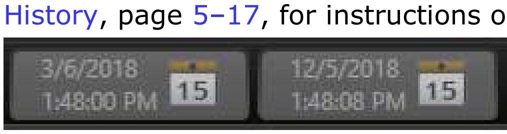
Select the desired tab below the Action bar to filter the date range before selecting Copy 

or Print 

.



Use the Start and End tabs to create custom date filters. Refer to History, page 5–17, for instructions on using the calendar.



Maintenance Counters History

Select Instrument, Data Management, and then Maintenance Counters History to view the history of maintenance performed on the instrument.

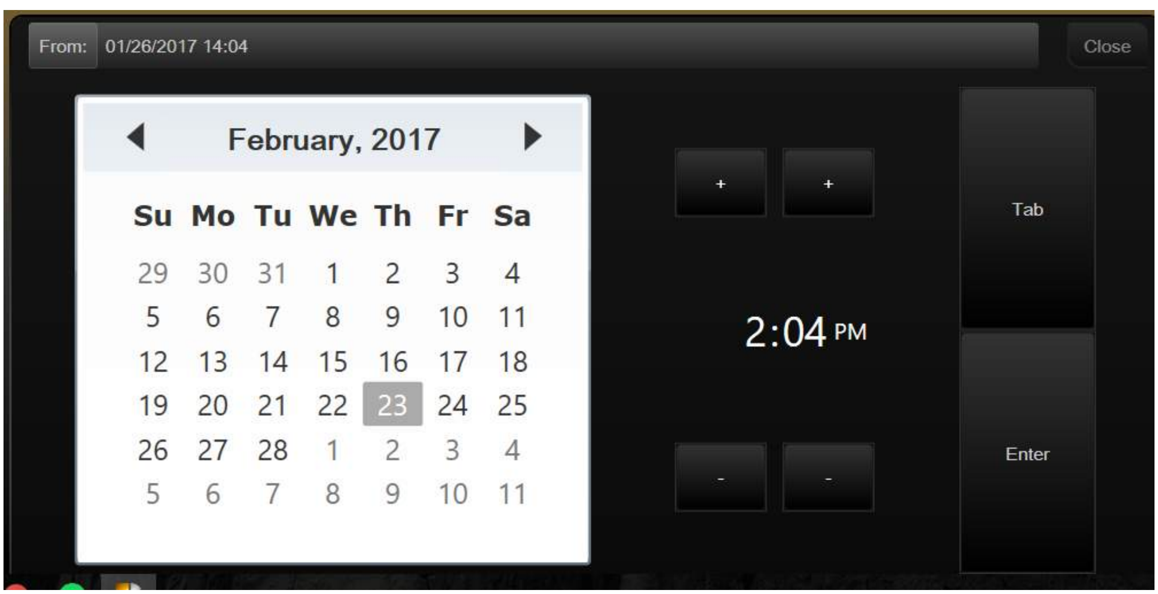
Select the desired tab below the Action bar to filter the date range before selecting Copy  or Print .

Use the Start and End tabs to create custom date filters. Refer to History, page 5–17, for instructions on using the calendar.

History

NOTE History is available only with the AT option. When the AT option is activated within the software, the feature is enabled automatically and cannot be disabled.

1. In the software, navigate to Instrument ➢ Data Management ➢ History to access the history. Any existing history appears on the History screen and can be exported to a file.
2. Select the box next to Time. The calendar appears.



3. Select the desired date and time for the starting date to view the history from by using one of the following methods.
   - Use the keyboard to enter the desired date and time in the text box.
   - Use the calendar to select the desired date and time.
4. Select Enter.

5. Select the box next to To. The calendar appears.
6. Repeat steps 3 and 4 to set the desired date and time for the end of the history.

NOTE If History  was selected from the Methods, Standards, or Analysis page, steps 7 through 9 do not apply.

7. Select the box next to File. A list of file types appears. Select which file type to include in the history: All, Standard, Method, or Sample.
8. Select Enter.
9. If Standard, Method, or Sample was selected in step 7, a box appears in the File row and a list of all the files of that type appears in the bottom of the screen. Select the desired files to include in the history, and then select Enter.
10. Select the box next to User. A list of all Users appears. Select the name of the user to include the history of changes made to the files by that user.
11. Select the box next to Modification. A list of the types of modifications that have been made appears. Select which types of modifications to include in the history: All, Changed, Added, Removed, or Tampered.

NOTE “Tampered” refers to files that have been detected as being modified outside of the *Cornerstone* brand software system.

12. Select Enter.
13. If desired, select Export to export the query results, or select Print to print them.

Detectors

Detectors provides the means to view the settings for each detector installed in the analyzer. A separate tab will be displayed for each detector.

The following actions can be performed:

- Detector settings can be imported and exported by selecting the buttons labeled Import and Export. Import new settings to overwrite the existing settings for all detectors.

- Detector settings can be printed by selecting the button labeled Print. A table of values will be printed for all Detectors installed in the analyzer.

- The Check Signals button provides a way to determine if the detectors within the instrument are working properly. Accurate results can be measured only when the analyzer has been stable for an appropriate amount of time. The value reported will reflect any signal disturbances recorded during that period, so it is critical that the detector outputs are stable, with the gas flow On, in order to obtain results. If results are unable to be determined due to poor input data, an exception will display at the top of the screen. Passing results will be indicated by a “Pass” beside the result. A “Fail” indicates that the result failed.

Infrared (IR) Cells

The following information is displayed for each IR cell installed in the analyzer.

NOTE Infrared (IR) Cell information is not available on the following model: FP828.

Graph of IR cell voltage as a function of time

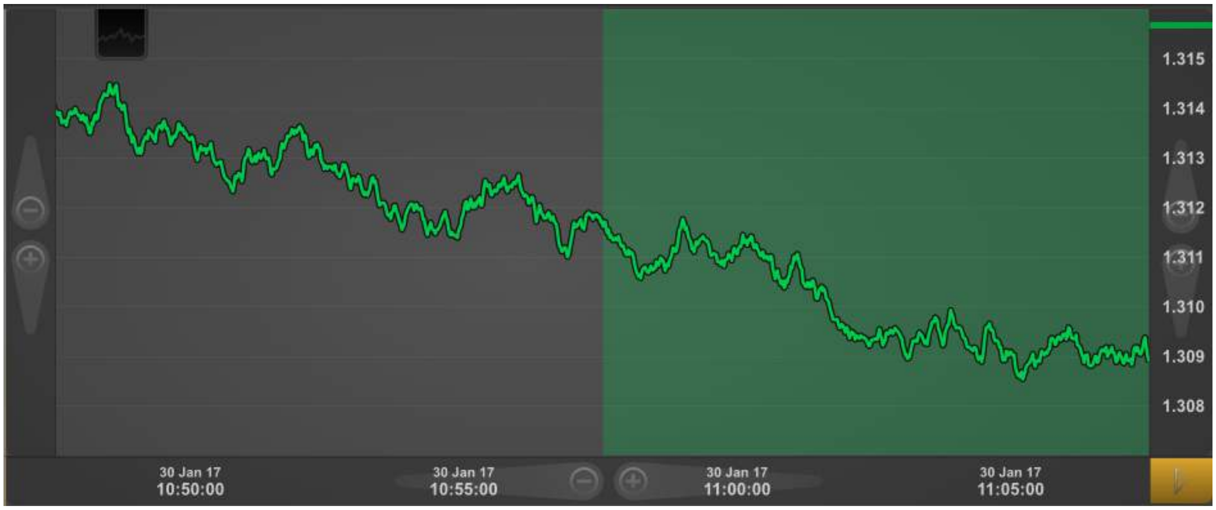


Table of IR cell settings and readings

Last Modified	11-Jan-16 10:42:26 AM	
Reference	1.664451 V	
Saturation	0.006829 V	
Signal	1.66	Pass
Signal-to-Noise Ratio	4.73	Pass
Signal Quality	1.06	Pass
Tune Emitter and Perform Diagnostic Test	Run	Pass
Emitter On Time (00011490 - 1)	116.08:15:57	06-Feb-17 1:44:18 PM

- **Last Modified—**Displays the date and time when the detector settings were last saved.
- **Reference—**Displays the initial IR cell voltage measured with no analyte present in the carrier flow. This value is used in the IR cell calculations to minimize the effects of long-term drift of the IR cell. The reference voltage is stored on each IR cell so that the value can be updated automatically if a new cell is installed into the analyzer.

- **Saturation—**Displays the initial IR cell saturation voltage determined with high amounts of analyte present in the carrier flow. This value is used in the IR cell calculations to minimize the effects of long-term drift of the IR cell and to linearize the response of the IR cell. The saturation voltage is stored on each IR cell so that the value can be updated automatically if a new cell is installed into the analyzer.
- **Signal, Signal-to-Noise Ratio, and Signal Quality**—Selecting the Check Signals button will calculate these values for all detectors. Detectors that are disabled in the System screen are not included. The calculations require the last 10 minutes of IR cell data. To obtain a valid measure, the carrier flow should be On and the analyzer stable for at least 10 minutes prior to selecting the Check Signals button.
    - **Signal**—Displays the average IR cell voltage.
    - **Signal-to-Noise Ratio—**A ratio of the magnitude of the signal relative to the variation of the signal.
    - **Signal Quality—**A measure of the amount of anomalous disturbances (spikes) present in the IR cell signal. It is a ratio of the standard deviation of the signal divided by the median absolute deviation.
- **Tune Emitter and Perform Diagnostic Test**—Displays the result of the diagnostic test. Tuning the emitter adjusts the Average Emitter Power for optimal IR cell performance. The gas must be On before this test can be run.
- **Emitter on Time**—Displays the IR cell serial number and the total time that the emitter has been On.

NOTES

- The IR cell emitter is On whenever the carrier flow is On. No appreciable signal should be observed when the IR cell emitter is Off.
- Each day, the software will check the IR cell function and, if necessary, tune the emitter to improve cell performance.

The following action can be performed:

- **Run**—Tunes the IR emitter and checks that the IR cell is functioning properly.

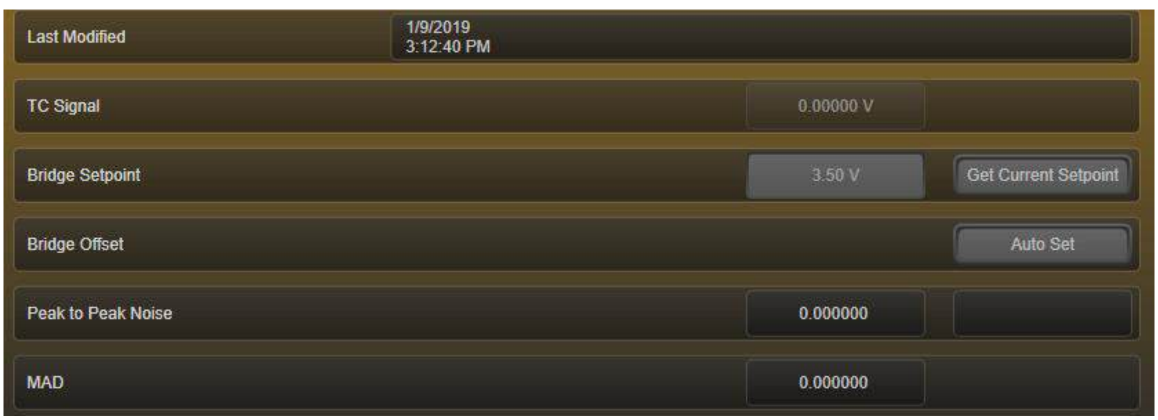
Thermal Conductivity (TC) Cell

The following information is displayed for the TC Cell installed in the analyzer.

Graph of the TC Signal Voltage as a Function of Time

Table of TC Cell Settings and Readings

NOTE The settings and readings shown may vary depending on the instrument configuration.



- **Last Modified—**Displays the date and time when the detector settings were last saved.
- **TC Signal—**Displays the current TC cell signal in volts. When the carrier flow is On and the analyzer is stable, the TC Signal should be around 0.2 ± 0.1 V with less than 0.05 mV short term noise.
- **Bridge Setpoint—**Displays the control signal that maintains the TC cell bridge voltage at a constant value.
- **Bridge Offset—**A bias voltage that is applied to the bridge circuit in order to ensure a non-zero TC signal.

- **MAD**—Displays the median absolute deviation of the TC cell signal. The value is updated every time the user presses the Check Signals button. To obtain a valid measure, the carrier flow should be On and the analyzer stable for at least 20 minutes prior to pressing the Check Signals button.
- **Peak to Peak Noise/Noise—**Displays the variation of the TC cell signal due to the electrical circuit as well as small fluctuations in flow, temperature and vibrations. The value is updated every time the user presses the Check Signals button. To obtain a valid measure of the noise, the carrier flow should be On and the analyzer stable for at least 20 minutes prior to pressing the Check Signals button.
- **Drift-to-Noise Ratio—**Displays a measure of the longer-term stability of the TC cell. Low frequency disturbances can affect the results of longer analyses. The value is updated every time the user presses the Check Signals button. To obtain a valid measure of the drift-to-noise ratio, the carrier flow should be On and the analyzer stable for at least 20 minutes prior to pressing the Check Signals button.

The following actions can be performed:

- **Get Current Setpoint—**Displays the Bridge Setpoint at the current value measured for the TC cell bridge circuit. The Bridge Setpoint can be adjusted by entering a new value.
- **Auto Set—**Adjust the TC cell circuit to set the TC signal to 0.2 ± 0.1 V. Refer to Thermal Conductivity Cell Service, page 9–7, before selecting Auto Set.

Maintenance

This feature provides access to Maintenance items, including: Counters, General Maintenance tasks, Hardware Calibrations, Error Reports, and using the Service Key. Refer to Maintenance, page 6–1.

Counters

The Counters dialog box tracks the periodic maintenance performed on selected instrument components and alerts the operator when periodic inspection or maintenance is necessary. Inspection counters can be ignored, inspected, or performed. However, Stop counters require that the specified maintenance be performed before running another analysis.

LECO provides a general guideline for periodic maintenance in the Frequency column, which may need to be adjusted depending on a particular analysis. Refer to Periodic Maintenance Schedule, page 6–5.

The list of maintenance counters can be sorted by selecting the name tab, description tab, expiration tab, and last modified tab.

Default Maintenance counters cannot be deleted, but they may be excluded. Excluded counters will not prompt the user for an action. Refer to Including and Excluding, page 3–24.

Log Entry

When the operator selects the desired maintenance item, additional comments appear in the log entry. To edit the comments, select the Comments field; the keyboard appears. Enter the desired text, and then select Enter.

Comments are logged when Perform is selected on the Action bar. Navigate to Instrument ➢ Data Management ➢ Maintenance Counters History to view the log.

Adding or Editing Maintenance Counters

1. In the software, navigate to Instrument ➢ Maintenance ➢ Counters.
2. Select Add 

to add a new counter, or select the desired maintenance item and then select Edit 

to modify an existing counter. The maintenance parameters appear.
3. For a new counter, enter a Name and Description, if desired.

   Counter Type—Select Days, Analyses, or Hours. The parameters that appear will vary, depending on the counter type selected. When Analyses is selected, Count Blanks will display. Select Yes or No.

Inspect—Select On or Off. When On is selected, enter a value in the Inspect Every field to determine when a warning message appears to indicate the need for maintenance.

Stop—Select On or Off. When On is selected, enter a value in the Perform Maintenance Every field. An analysis cannot proceed once the target value is reached.

Current Count—Displays the number of analyses run or the number of days or hours that have passed since the last time the counter was reset.

Number of Resets—Displays the number of times the counter has been reset.

Last Reset—Displays the date and time of the last reset.

4. Enter instructions for the maintenance item if desired.

General Maintenance

The General Maintenance screen provides quick access to frequently used tasks. Refer to Maintenance, page 6–1, for step-by-step maintenance procedures.

NOTE Then the TE Cooler or Ballast Oven Heater is turned Off, the associated fans will also turn Off.

Afterburner Heater—Turns On or Off the afterburner heater.

Ballast Oven and Fan—Turns On or Off the ballast oven and fan.

Furnace Heater—Turns On or Off the furnace heater.

Reduction Heater—Turns On or Off the reduction heater.

TE Cooler—Turns On or Off the TE cooler. (Applies to CN828, FP828P, and FP828 models only.)

Afterburner Temperature Set Point—Enter the afterburner temperature set point.

Furnace Temperature Set Point—Enter the furnace temperature set point.

Mass Flow Controllers

Furnace Flow—Opens or closes the Furnace Flow valve or sets the controller to 0.25 LPM.

Measure Flow— Opens or closes the Measure Flow valve or sets the controller to 0.320 LPM.

Incoming Pressure Verification

1. Select Start to check the pressures.
2. Adjust the incoming pressures as necessary to be within the required range.
3. Select End when complete.

Hardware Calibrations

Refer to Calibrating the Hardware, page 9–4.

Error Reports

Error reports provides an error report package, which can then be sent to LECO for diagnosis.

1. In the software, select Instrument, and then select Maintenance.
2. Select Error Reports.
3. Select Execute next to Create Error Report to create and save the error report.

NOTE The Error Report Path provides the user with the location that the error report was saved. It is not an editable field.

CAN Error Count

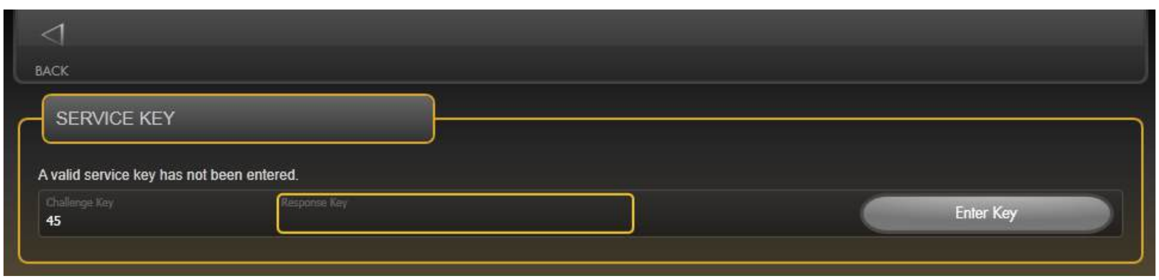
Communication errors in the instrument may result in CAN error messages, which can be used to troubleshoot the problem.

1. In the software, select Instrument, and then select Maintenance.
2. Select Error Reports.
3. Once a problem has been fixed, select Execute next to Clear CAN Error Count to reset the error.

Using the Service Key

CAUTION
Many settings that require the service key can cause damage to the instrument if handled incorrectly. If the service mode is activated, make changes only as directed or suggested by qualified LECO service personnel.

The service key provides access to areas of the software that are available only with a service key number provided from LECO Service. Contact LECO Service for additional information. This screen is also used to deactivate the key.



1. In the software, navigate to Instrument ➤ Maintenance ➤ Service Key.
2. Enter the Service Key number obtained from LECO in the Response Key field.
3. Select Enter Key.

NOTE An active Service Key expires automatically 10 hours after activation or if the *Cornerstone* brand software is restarted.

Remote Access

Remote Access includes the Remote Query (RQ) option, the Remote Sample Login (RSL) option, the Remote Control (RC) option, and Data Transmit. These software options are found on select LECO products to facilitate their use in an automated environment. They can be used to control the instrument from a remote location via network interface and/or to receive data from the instrument.

RQ allows a remote computer to request data and settings from the instrument. RQ does not allow control of the instrument, logging in samples, or modifying any data on the instrument.

RSL allows a remote computer to log in unanalyzed samples while the local computer retains control. RC allows a remote application running on another computer to control the instrument without interaction from the operator. Data Transmit allows sample data to be transmitted to a remote computer. For additional information and instructions, refer to Remote Sample Login, page 5–28; Remote Control, page 5–29; Data Transmit, page 5–29; and Analysis Results, page 5–29.

Data Transmit needs at least uni-directional communication from the local computer to the remote computer.

RSL and RC communicate with the local computer via a bi-directional communication protocol using XML commands. The remote computer exchanges commands and data with a remote computer via network connection. The network connection is a TCP/IP stream with a configurable port.

The remote computer sends commands to the local computer, and the local computer acknowledges the commands or returns the requested data. Return data will be in XML format; however, sample results are returned in the format specified by the current sample display layout for remote clients defined within *Cornerstone*. For a list of commands that can be sent to the local computer and what will be returned to the remote computer, refer to XML Command Table, page 5–29.

The text of the commands and data can be in ASCII or Unicode and are formatted in XML. The XML format is a way of tagging the commands and data fields inside of angle brackets (less-than and greater-than signs). The use of spaces, tabs, carriage returns, and line feeds are optional.

Remote Sample Login

Remote Sample Login Mode allows a remote user on a remote computer to log in samples to be analyzed and to check the overall status of the instrument. The local user running the instrument retains control of the instrument and can add the remote-login samples for analysis when convenient.

With RSL, the local computer will store sample data in temporary memory as the sample data arrives from the remote computer until the Remote Samples button on the Login bar is selected. After selecting the Remote samples button, the sample data will be entered into the application.

In order to use the RSL feature, *Cornerstone* must be running with the RSL or Remote Control option specified on the registration key.

Figure 5-1
Remote Access Screen

Remote Control

The Remote Control (RC) mode allows a remote user on a remote computer to log in samples to be analyzed, to check the overall status of the instrument, to start an analysis, and to control the instrument. In RC mode, the local user must relinquish control of the instrument; the software does not allow the operator to interact with the software. Instead, it relies completely on a remote computer to log in samples and initiate the analysis. The remote control mode is active only when the remote control monitor is displayed.

In order to use the RC feature, *Cornerstone* must be running with the RC option specified on the registration key.

Data Transmit

Data transmit mode allows sample data to be sent to a remote computer by transmitting sample results in a pre-defined (but configurable) format to a remote computer. Refer to Creating and Editing Transports, page 4–44.

Analysis Results

Analysis results can be obtained in two ways for both the Remote Sample Login and the Remote Control modes:

- By using the appropriate remote protocol XML command as defined by the XML Command Table, page 5–29.
- By configuring the software to automatically transmit the results at the end of each analysis.

Remote Connection

The port used for remote communication can be configured from the Remote Access page in the Instrument section of the software, shown in Figure 5-1, page 5–28.

The character encoding that is applied to the data sent to and from remote clients can be selected. The options are UTF-16 and UTF-8. Refer to Figure 5-1, page 5–28.

XML Command Table

LECO offers the up-to-date XML command table for download at https://github.com/LECOSoftware/Remote-Control-Client-Application/blob/master/docs/Remote%20Control.docx. Select the Download button.

System

Cornerstone® Health Management

LECO's *Cornerstone* Health Management (CHM) service is available to all customers. CHM maximizes the reliability and availability of the instrument by reporting critical system information to LECO engineers for analysis. CHM does not transmit test results and does not have access to non-*Cornerstone* program data. Participation in the CHM service is optional and can be changed at any time. A warning triangle is displayed until a CHM level has been selected.

NOTE The instrument must be connected to the Internet to send information.

1. Select Instrument, and then select System.
2. On the System screen for *Cornerstone* Health Management, select the parameter field next to Participation Level. The options are as follows:
   - **Off**—The system will not participate in the CHM service. If a software error occurs, the system will ask the user if they would like to send the error report to LECO.
   - **CHM-0—**The instrument reports its model number, serial number, software version, software options, and operating system status to LECO. This entry level service allows LECO engineers to associate errors against the basic configuration of the system. If a software error occurs, the system will automatically send the error report to LECO.
   - **CHM-1**—This is the recommended level of participation. In addition to the information the instrument reports in CHM-0, the instrument reports feedback from sensors, solenoids, switches, counters, methods, leak checks, system checks, warnings, log files, and system parameters to LECO. This level allows LECO to better identify deficiencies and search for hardware anomalies that may indicate potential problems.
3. Once a level has been selected, the CHM content is collapsed and is no longer visible. The content can be expanded by selecting the arrow next to *Cornerstone* Health Management.

Updating the Registration Key, Software, or Remote Query

NOTE Remote Query is available only with the RQ option.

A warning triangle appears on the Instrument navigation button when the registration key, software, or Remote Query is out-of-date. Complete the following steps to make the available update.

1. Select Instrument, and then select System.
2. Determine whether the software or Remote Query is out-of-date or whether a user-specific update is available for the registration key.
   - If the registration key requires an update, the warning triangle appears next to *Cornerstone* Health Management. Complete the steps in Updating the Registration Key, following.
   - If there is an updated version of the software available, the warning triangle appears next to Software Update. Complete the steps in Updating the Software, page 5–32.
   - If the Remote Query option has expired, Remote Query Expired appears on the System screen. Complete one of the following options as desired.
     - Contact the LECO sales representative to receive an updated registration key file to extend the lifetime of the option. Then, complete the steps in Updating the Registration Key, following.
     - Select Ignore, and then select Save to turn Off the notification.

NOTE The warning triangle indicating that the registration key is out-of-date will appear only if CHM-0 or CHM-1 has been chosen in the *Cornerstone* Health Management service. Refer to Cornerstone® Health Management, page 5–30.

Updating the Registration Key

Complete the following steps to update the registration key.

1. Select Update Registration Key under *Cornerstone* Health Management.
2. Restart the *Cornerstone* brand software when prompted.

Updating the Software

Select one of the following options as desired.

- Select Upgrade under Software Update to install the latest available version of the software for the instrument. Then, follow the onscreen prompts to install the software. Refer to Installing the Software, page 2–29.
    - Product Information Bulletins (PIBs) can be viewed, if desired, by selecting View PIBs. Refer to Product Information Bulletins, page 5–32, for more information.
- Select Ignore, and then select Save to turn Off the notification until the next version of the software becomes available. The software will remain available for update from the System screen until the software is up-to-date.
- Select View PIBs (Product Information Bulletins) to view more information about the changes included in the latest *Cornerstone* brand software updates. The Internet browser opens to the PIBs page. Then, follow the instructions in Product Information Bulletins, page 5–32.
    - PIBs can also be viewed from another computer. Refer to Product Information Bulletins, page 5–32.

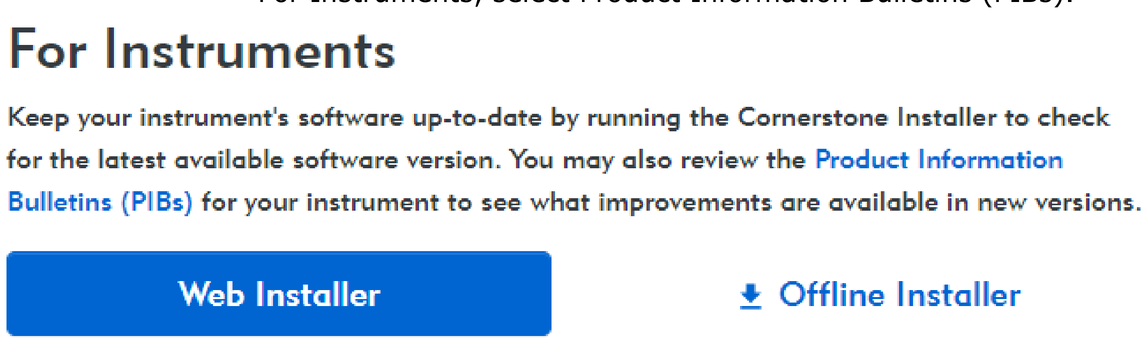
NOTES

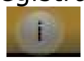
- The software upgrade notice appears only if the instrument is connected to the Internet. The upgrade can be downloaded manually, if desired, onto a flash drive or other disk from www.lecosoftware.com.
- The Software Update section appears in the software only if a newer version of the software is available.

Product Information Bulletins

Product Information Bulletins (PIBs) are available on the *Cornerstone* brand software installation website to provide instrument specific details about the latest software updates.

1. If View PIBs was selected in Updating the Software, previous, skip to step 2, following. To access the PIBs from another computer, navigate to https://www.lecosoftware.com/cornerstone. Under For Instruments, select Product Information Bulletins (PIBs).



2. If the Enter Your Registration ID box is blank, select the information button  in the upper right corner of the *Cornerstone* brand software to find the registration ID. If the registration ID already appears in the box, skip to step 4, following.
3. Enter the Registration ID found on the Information screen in the text box under Enter Your Registration ID, and then select Find.

4. Select the link to the desired PIB under Available PIBs. Review the PIB information.

Scheduling Gas Standby

Gas Standby Mode

1. Select Instrument, and then select System.
2. On the System screen for Gas Standby, select the parameter field next to Mode.
3. Select the action to be taken once the gas standby time has passed.
4. Select Enter to close the keyboard.

Gas Standby Time

IMPORTANT If using QC Wake Up, the Gas Standby Time must be longer than the length of time between the scheduled Gas Wake Up and the scheduled QC Wake Up or the instrument will switch to gas standby mode and QC Wake Up will not occur. Refer to Scheduling Gas Wake Up, page 5–34, and Logging in QC Wake Up, page 3–34.

1. Select Instrument, and then select System.
2. On the System screen for Gas Standby, select the parameter field next to Time.
3. On the keyboard, enter a value to determine the time before the instrument automatically switches to the gas standby mode.
4. Select Enter to close the keyboard.

Scheduling Gas Wake Up

The following section explains how to schedule wake up times in the software.

IMPORTANT If using QC Wake Up, the Gas Wake Up must be scheduled to occur before the QC Wake Up begins or the QC Wake Up will not occur. Refer to Logging in QC Wake Up, page 3–34.

1. Select Instrument, and then select System.
2. On the system screen for Gas Wake Up, there are three wake ups that can be scheduled: Weekday, Saturday, or Sunday.
   A. Select Enabled next to the desired wake up to schedule a wake up time; select Disabled to turn Off automatic wake up.
   B. Select Enter.
   C. When the wake up is enabled, enter a time for the instrument to wake up using the + and – buttons.
   D. Select Enter.
3. Select the parameter field next to Run Leak Check.
4. Select Yes to execute a leak check at the instrument wake up time; select No to skip the leak check. The default is No.

IMPORTANT If Yes is chosen in step 3, previous, the Leak Check must have time to complete before the QC Wake Up begins or the QC Wake Up will not occur. Refer to Logging in QC Wake Up, page 3–34.

5. Select Save to keep the changes, or select Cancel to return to Analysis.

Disabling an Analyte

NOTE Analytes can be disabled only on instrument configurations that analyze more than one analyte.

Disable an analyte to ignore it during analyses, blanks, drifts, and calibrations. The other analyte(s) will still be analyzed. A disabled analyte setting is applied to an entire set and cannot be changed via recalculation.

1. Select Instrument, and then select System.
2. Under Analytes, enable analysis of an analyte by selecting Enable next to Analyze <Analyte Name>. Selecting Disable will disable analysis of that analyte.

Leak Check

The maximum pressure change allowed during a leak check can be changed for certain leak checks, depending on instrument configuration.

NOTE Segmented leak check is not applicable to all instrument configurations.

1. Select Instrument, and then select System.
2. On the System screen for Leak Check, select the parameter field next to the desired leak check.
3. On the keyboard, enter a value for the maximum pressure change allowed during a leak check.
4. Select Enter to close the keyboard.

Configuring Other System Settings

Inert Gas Type

1. Select Instrument, and then select System.
2. On the System screen for Other System Settings, select the parameter field next to Inert Gas Type.
3. Select the inert gas type.
4. Select Enter to close the keyboard.

About Argon Carrier Gas

- Argon or helium can be used as the inert gas. The system is designed to automatically adjust the Measure Flow based on the setting in this field. However, the Reference flow requires manual adjustment (refer to Adjusting the TC Reference Flow, page 9–5).
- Switching between argon and helium on a regular basis is not recommended. If the gas type is changed, it is advised to replace the reagents in the scrubber tubes and in the reduction tube. (Refer to Replacing the Scrubber Tubes, page 6–15, and Replacing the Reduction Tube, page 6–18.) The inert gas should remain On for an extended period of time until the TC Signal is stable, indicating that the previous gas is flushed from the system.

Run TEC Fan with Gas Off

NOTE Run TEC Fan with Gas Off is not applicable to all instrument configurations.

1. Select Instrument, and then select System.
2. On the System screen for Other System Settings, select the parameter field next to Run TEC Fan with Gas Off.
3. Select Yes or No. If Yes is selected, the TEC fan will run with the gas Off. If No is selected, the TEC Fan will be turned On whenever the gas is turned On.
4. Select Enter to close the keyboard.

View Sample Burn

1. Select Instrument, and then select System.
2. On the System screen for Other System Settings, select the parameter field next to View Sample Burn.
3. Select Yes or No, depending on whether the sample drop window should be opened during the sample burn.
4. Select Enter to close the keyboard.

Auto Increment Sample Name

If Auto Increment Sample Name is enabled when a sample set is logged in, the software automatically copies the previously used sample name and increments the last numeric character, if available.

1. Select Instrument, and then select System.
2. On the System screen for Other System Settings, select the parameter field next to Auto Increment Sample Name.
3. Select Enabled and the software will auto increment a sample name that contains a numeric character.
4. Select Enter to close the keyboard.

Altitude

1. Select Instrument, and then select System.
2. On the System screen for Other System Settings, select the parameter field next to Altitude.
3. On the keyboard, enter the correct altitude for the current location.
4. Select Enter to close the keyboard.

TPH Module

Refer to Barometric Pressure Calculation, following, for more information on the TPH Module.

1. Select Instrument, and then select System.
2. On the system screen for Other System Settings, select the parameter field next to TPH Module.
3. Select Enabled or Disabled. When TPH Module is enabled, the associated ambient readings will be used in hardware calibrations and sample calculations. The TPH module supplies the External Temperature, Relative Humidity, Station Pressure, and Barometric Pressure.
4. Select Enter.

Barometric Pressure Calculation

The TPH Module provides readings of external temperature, relative humidity, and station pressure (absolute pressure, mmHg). For ease of comparison with local weather stations, the barometric pressure (equivalent pressure at sea level) is also reported. The equation for calculating barometric pressure (mbar) from station pressure (mmHg) is:

$$P_b = \frac{1.333 * P_{stn}}{\left[\frac{288.15 - 0.0065 * h}{288.15}\right]^{5.2558}}$$

where:

Pstn = station pressure (mmHg)
h = altitude (instrument elevation above sea level, m)

NOTE The altitude, h, is entered by the operator on the System screen (Instrument ➢ System).

Dose Loop Size

Select the size of the dose loop to be used for the analysis.

NOTE On configurations with the Dual Loop Doser, this parameter is automatically set to Dual and cannot be edited.

1. Select Instrument, and then select System.
2. On the system screen for Other System Settings, select the parameter field next to Dose Loop Size.
3. Select Large (10 cm^3) or Small (3 cm^3).
4. Select Enter.

Printer

Use this feature to select the printer for general printing purposes.

For printer installation, refer to the manual supplied with the printer and Installing the Computer, page 2–18.

1. Select Instrument, and then select System.
2. On the System screen for Peripheral Devices, select the Printer parameter field next to System Printer.
3. Select the desired printer name.
4. Select Enter to close the keyboard.

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6 Maintenance

The Maintenance chapter includes procedures that should be performed on a regular basis to improve the instrument's performance and lifespan. The procedures included in this chapter may require disabling power to the instrument and should be performed only by trained personnel.

HAZARDOUS VOLTAGE WARNING
During installation and operation of this instrument, the ON/OFF switch must be easily accessible. The ON/OFF switch is located on the right side of the instrument.

PROTECTIVE EYEWEAR/PROTECTIVE GLOVES
Protective eyewear and gloves should be worn when handling chemicals.

Refer to the Safety Data Sheet (SDS) for the specific chemical for additional information.

Illustrations

Periodic Maintenance Schedule

Following is a list of maintenance procedures that should be performed on a regular basis. Periodic maintenance of the instrument will result in improved instrument performance and will extend the life of the instrument. This schedule is based on typical usage. Applications where usage is lighter or heavier may require less or more frequent periodic maintenance, depending on the types of samples and methods used.

NOTES

- Always perform a leak check before and after routine maintenance.
- If a leak is detected, check the maintenance item or procedure that was last performed.
- When performing any maintenance on the instrument, make sure to turn Off the gas and allow the instrument to depressurize prior to inspecting or removing any components.

Frequency	Part	Procedure
As Needed	System Check	Perform a system check after any maintenance procedure or as a general troubleshooting tool when needed. Refer to System Check, page 8–16.
	Combustion Tube	Replace the combustion U-tube if it becomes cracked or broken or is determined to be the source of a leak. Refer to Replacing the Combustion Tube, page 6–35.
	Screen Filters	Inspect, clean, and/or replace the filters and o-rings when replacing the reagent materials. Refer to Cleaning the Screen Filters, page 6–30, and Cleaning and Greasing the O-Rings, page 6–9.
	Touch Screen	Perform as often as seen fit. Refer to Cleaning the Touch Screen, page 6–71.
	Furnace Viewing Mirror	Clean the furnace viewing mirror as needed using window or glass cleaner. Apply the cleaner to a lint-free cloth and wipe the mirror.

Frequency	Part	Procedure
As Needed (continued)	Crucible	Inspect after 200 analyses. Replace when the crucible becomes full. Excess combustion material will build up in the crucible, causing a clog in the lance. The crucible is located inside the combustion tube. Remove the loading head and use the crucible extractor tool to remove the crucible. Refer to Replacing the Crucible, page 6–31.
	Pneumatic Filter	Remove the filter assembly and then clean and grease the upper and lower o-rings. Replace when the filter has darkened significantly. Refer to Replacing the Pneumatic Filter, page 9–16, and Cleaning and Greasing the O-Rings, page 6–9.
	Load Head	Inspect periodically and clean ashes and soot if necessary. Inspect and clean the work tray to minimize debris buildup. Refer to Cleaning the Loading Head, page 6–25.
	Sample Carousel	Inspect and clean as needed. Refer to Cleaning the Sample Carousel, page 6–23.
Daily	Leak Check	Perform leak checks daily, or after any routine maintenance, to ensure the system is leak free. Refer to Leak Check, page 8–12.
	Primary Filter Tube	Remove the tube and then clean and grease the upper and lower o-rings. Replace when glass wool is visibly dirty or steel wool has oxidized. Refer to Replacing the Primary Filter Tube, page 6–10, and Cleaning and Greasing the O-Rings, page 6–9.

Frequency	Part	Procedure
Daily (continued)	Particle Filter	Remove the filter assembly and then clean and grease the upper and lower o-rings. Replace when the filter has darkened significantly. Refer to Replacing the Particle Filter, page 6–13, and Cleaning and Greasing the O-Rings, page 6–9.
	Furnace Transfer Tubing	Inspect for discoloration and replace when necessary. Refer to Replacing the Furnace Transfer Tubing, page 6–50.
Weekly	Dose Scrubber	Replace every 750 analyses when using a 10 cm^3 dose loop (or 2500 when using a 3 cm^3 dose loop) or when the LECOSORB® has turned white, the Anhydrone has caked, or nitrogen precision has diminished. Refer to Replacing the Scrubber Tubes, page 6–15.
Monthly	Reduction Tube	Repack every 1500 analyses when using a 10 cm^3 dose loop (or 4950 when using a 3 cm^3 dose loop), depending on the sample type, or when nitrogen peaks have become irregular. Refer to Replacing the Reduction Tube, page 6–18.
	Inert Gas Scrubber	Replace every 2000 analyses or when the *LECOSORB* has turned white or the Anhydrone has caked. Refer to Replacing the Scrubber Tubes, page 6–15.
	Air Filters	Inspect for dust buildup. Clean when needed. Refer to Performing Air Filter Maintenance, page 6–72.

Frequency	Part	Procedure
Monthly (continued)	Dosing Valve	Inspect the o-rings for buildup. Clean and grease or replace them as needed. Refer to Cleaning the Dosing Valve(s), page 6–67, and Cleaning and Greasing the O-Rings, page 6–9.
Every 3 Months	Ballast Assembly	Inspect the seals for discoloration and buildup. Clean and grease the seals, gaskets, and ballast tube. Refer to Cleaning the Ballast Assembly, page 6–58.
	TE Cooler Module	Inspect the Pre-Cooler and TE Cooler for buildup. Cleaning needed depends on the sample types analyzed. Refer to Cleaning the Thermoelectric Cooler (TEC) Module, page 6–76.
	TE Cooler Module Tubing	Replace every 3 months or when the tubing has darkened or yellowed, or the integrity has diminished. Refer to Cleaning the Thermoelectric Cooler (TEC) Module, page 6–76.
Every 4 Months	Pinch Valve Tubing	Replace every 4 months or when the tubing has darkened or yellowed, or the integrity has diminished. Refer to Replacing the Pinch Valve Tubing, page 6–62.

Cleaning and Greasing the O-Rings

Complete the following instructions when cleaning o-rings that require greasing.

1. Cut a lint-free foam cleaning wipe from the Accessory Pack into four pieces of approximately equal size.
2. Clean the o-ring with a piece of the foam wipe, making sure not to stretch the o-ring while wiping it. Refer to Figure 6-1, following.

Figure 6-1
Cleaning O-Ring

3. Apply a light film of silicone-based high vacuum grease from the Accessory Pack to the entire surface of the o-ring.
4. Using another piece of foam wipe, remove any excess grease according to the following guidelines. Refer to Figure 6-1, previous, and Figure 6-2, following.
   - Make sure not to stretch the o-ring while wiping off excess grease.
   - When finished, the o-ring should have a visible sheen or shininess on all surface areas.
   - Any grease that is visible greater than a sheen or shininess is excess and needs to be removed using the foam wipe.

Side A: Correct amount of sheen or shininess

Side B: Excess lubrication that must be removed.

Figure 6-2
O-Ring Shine

5. Install the o-ring, making sure it does not twist or roll and that no part of the o-ring is nicked or cut. Make sure not to pinch the o-ring between the sealing surfaces.

Replacing the Primary Filter Tube

The primary filter is located behind the instrument front door, next to the reduction heater. Refer to Figure 2-1, page 2–6, or Figure 2-2, page 2–7, depending on the instrument configuration.

CAUTION
PRIMARY FILTER TUBE PACKING
To prevent personal injury or equipment damage, replace the primary filter tube packing every 50 samples when analyzing samples with high fat or oil content.

Removing the Primary Filter Tube

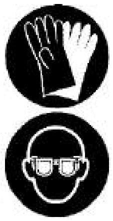
1. In the software, select the Gas button to turn Off the gas.
2. Slide the primary filter tube upward until the bottom end can swing free.
3. Tilt out the free primary filter tube end.
4. Pull the primary filter tube downward off the top port.
5. Check, clean, and grease the o-rings on the top and bottom blocks where the tube seals. Apply a thin coating of vacuum grease. Replace the o-rings if they are cracked or worn. Refer to Cleaning and Greasing the O-Rings, page 6–9.

FLAMMABLE/HEALTH HAZARD/HARMFUL/ PROTECTIVE GLOVES/PROTECTIVE EYEWEAR
Acetone is highly flammable and should be kept away from hot surfaces. It may cause eye irritation and/or drowsiness. Do not breathe fumes. Protective eyewear and gloves are required when handling acetone.

Refer to the Safety Data Sheet (SDS) for additional information.

6. If the tubes are packed, remove the spent packing material and clean the tubes. To clean the tubes, rinse them with water and then acetone if available, and then allow them to dry.
7. Pack the tubes using the appropriate steps in Packing the Primary Filter Tube, following.

Packing the Primary Filter Tube



PROTECTIVE GLOVES/PROTECTIVE EYEWEAR

Wear appropriate personal protective equipment, including safety glasses or goggles and cut-resistant gloves, when handling glass wool.

Refer to the Safety Data Sheet (SDS) for additional hazard, handling, storage, and personal protection information.

Complete the appropriate steps for the instrument configuration.

CHN828 Model

Repack the primary filter tube when the glass wool is visibly dirty. Refer to Figure 6-3, page 6–11, while completing these steps.

1. Pack the primary filter tube with approximately 0.75 g of glass wool, spread over approximately 3.5 inches. Refer to Figure 6-3, following.
2. Install the packed primary filter tube. Refer to Installing the Primary Filter Tube, page 6–12.

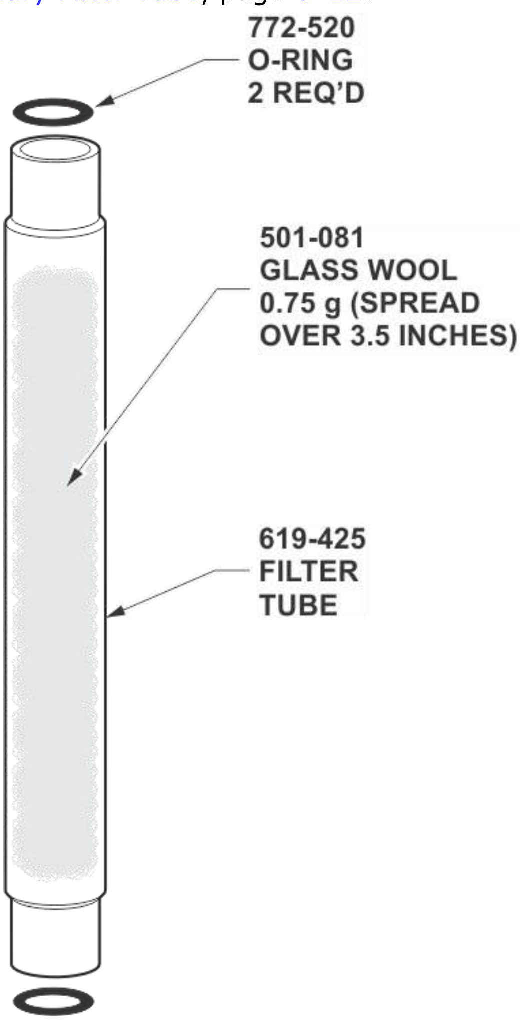


Figure 6-3
CHN Primary Filter Tube

CN828, FP828P, and FP828 Models

Repack the primary filter tube when the glass wool is visibly dirty or the steel wool is oxidized. Refer to Figure 6-4, page 6–12, while completing these steps.

1. Cut 3 inches of glass wool, and insert it into the bottom of the primary filter tube, and compress it to 1 inch. Refer to Figure 6-4, following.
2. Weigh approximately 6 to 7 grams of steel wool, insert it into the primary filter tube, and compress it to 3 inches.
3. Cut 3 inches of glass wool, and insert it into the primary filter tube on top of the steel wool, and compress it to 1 inch.
4. Install the packed primary filter tube. Refer to Installing the Primary Filter Tube, following.

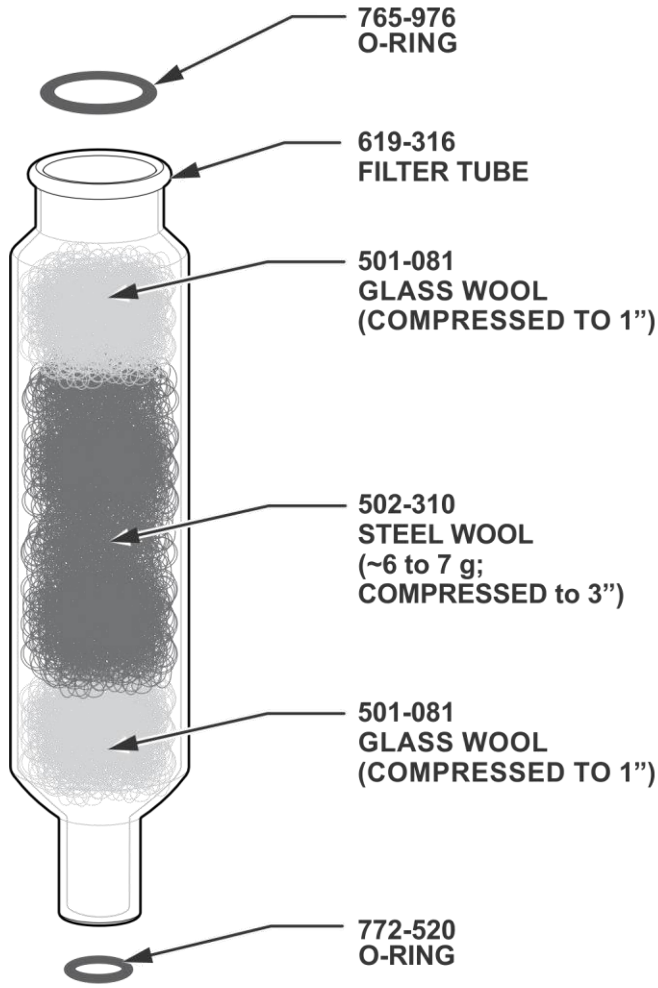


Figure 6-4
CN/FP Primary Filter Tube

Installing the Primary Filter Tube

1. Push the top end of the primary filter tube over the top port.
2. Tilt the primary filter tube inward and pull it down, pushing it over the bottom port.

Replacing the Particle Filter

The particle filter is located behind the instrument front door, next to the reduction heater. Refer to Figure 2-1, page 2–6, or Figure 2-2, page 2–7, depending on the instrument configuration.

NOTE Replace the disposable particle filter when flow is restricted or if visibly discolored (gray).

Inspecting the Particle Filter

1. Open the instrument front door, and locate the particle filter next to the reduction heater Refer to Figure 2-1, page 2–6, or Figure 2-2, page 2–7, depending on the instrument configuration.
2. Inspect the particle filter for dirt or dark deposits that may be in the filter.
3. If the particle filter is dark, replace it.

Removing the Particle Filter

1. Select the Gas button to turn Off the gas.
2. Pull the particle filter up off the bottom block, and then tilt the bottom out.
3. Pull the particle filter down off the top port block.
4. Loosen the nuts from the screws of the two adapter assemblies (nut, o-ring, and screw), and remove the adapter assemblies. Refer to Figure 6-5, following.

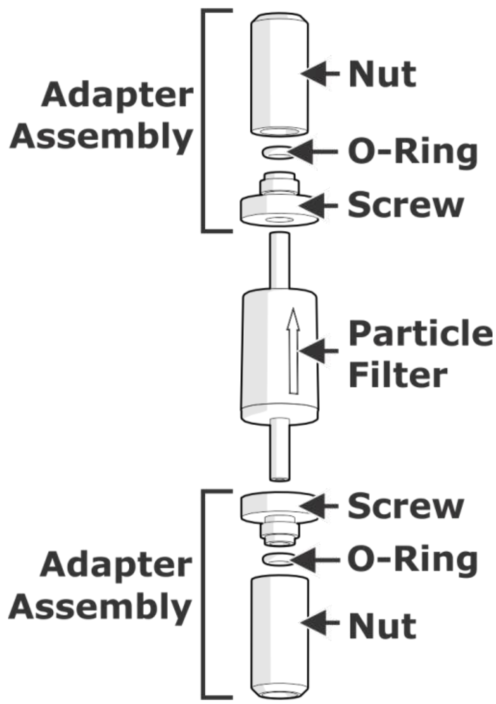


Figure 6-5
Particle Filter

Installing the Particle Filter

1. Reinstall the adapter assemblies on the new particle filter.
2. Reinstall the particle filter.
3. Turn On the gas.

Replacing the Scrubber Tubes

The scrubber tubes are located behind the instrument front door, below the reduction heater. Refer to Figure 2-1, page 2–6, or Figure 2-2, page 2–7, depending on the instrument configuration.

OXIDIZING/HARMFUL/
PROTECTIVE EYEWEAR/PROTECTIVE GLOVES

Anhydrone is an oxidizer and a strong dehydrating agent. Take the following precautions when handling Anhydrone:

- **Anhydrone may cause severe eye irritation or damage, as well as respiratory irritation. Avoid breathing Anhydrone dust.**
- **Do not heat with organic matter, flammables, or combustibles.**
- **Avoid contact with strong acids.**
- **Protective gloves and eyewear should be used at all times when handling Anhydrone.**

Refer to the Safety Data Sheet (SDS) for additional information.

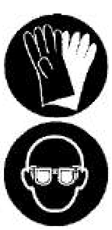
NOTE When packing the scrubber tubes, gently tap them to settle the reagents evenly. This prevents channeling and ensures efficient operation.

CORROSIVE/HARMFUL/
PROTECTIVE EYEWEAR/PROTECTIVE GLOVES

***LECOSORB* is harmful in contact with skin and may cause skin burns, corrosion, or irritation. It may also cause eye damage or irritation. Protective gloves and eyewear should be worn at all times when handling the product.**

Refer to the Safety Data Sheet (SDS) for additional information.

Repack the scrubber tubes when the *LECOSORB* has turned white or the Anhydrone has caked; or, repack the dose scrubber tube when nitrogen precision has diminished.



PROTECTIVE GLOVES/PROTECTIVE EYEWEAR

Wear appropriate personal protective equipment, including safety glasses or goggles and cut-resistant gloves, when handling glass wool.

Refer to the Safety Data Sheet (SDS) for additional hazard, handling, storage, and personal protection information.

Removing the Scrubber Tubes

1. Turn Off the gas and ensure that no errors appear, which indicates that the system has depressurized properly.
2. Open the instrument front door and locate the scrubber tube.
3. Pull the scrubber tube up off the bottom block, and then tilt the bottom out.
4. Pull the scrubber tube down off the top port block.
5. Check, clean, and grease the o-rings on the top and bottom blocks where the tube seals. Apply a thin coating of vacuum grease. Replace the o-rings if they are cracked or worn. Refer to Cleaning and Greasing the O-Rings, page 6–9.

FLAMMABLE/HEALTH HAZARD/HARMFUL/ PROTECTIVE GLOVES/PROTECTIVE EYEWEAR

Acetone is highly flammable and should be kept away from hot surfaces. It may cause eye irritation and/or drowsiness. Do not breathe fumes. Protective eyewear and gloves are required when handling acetone.

Refer to the Safety Data Sheet (SDS) for additional information.

6. If the tube is packed, remove the spent packing material and clean the tube. To clean the tube, rinse them with water and then acetone if available, and then allow it to dry.
7. Pack the tube using the appropriate steps in Packing the Scrubber Tubes, following.

Packing the Scrubber Tubes

Refer to Figure 6-6 and Figure 6-7, page 6–17, while completing the following steps.

1. Insert a screen filter into the bottom of the tube. The o-ring should be positioned toward the bottom of the tube.
2. Insert approximately 1 gram of glass wool into the scrubber tube. Use the tube packing tool from the Accessory Pack to compress the wool until it is level with the lowest mark on the tube.
3. Add approximately $2^{3}/_{4}$ inches of Anhydrone to the tube until it is level with the second mark on the tube.
4. Add approximately $5^{1}/_{4}$ inches of LECOSORB® to the tube until it is level with the third (top) mark on the tube.
5. Insert approximately 0.5 gram of glass wool to the tube, using the tube packing tool from the Accessory Pack to make sure no glass wool fibers are on the o-ring sealing surface.

6. Install the scrubber tube in the appropriately labeled position on the front instrument panel. Refer to Installing the Scrubber Tubes, following.

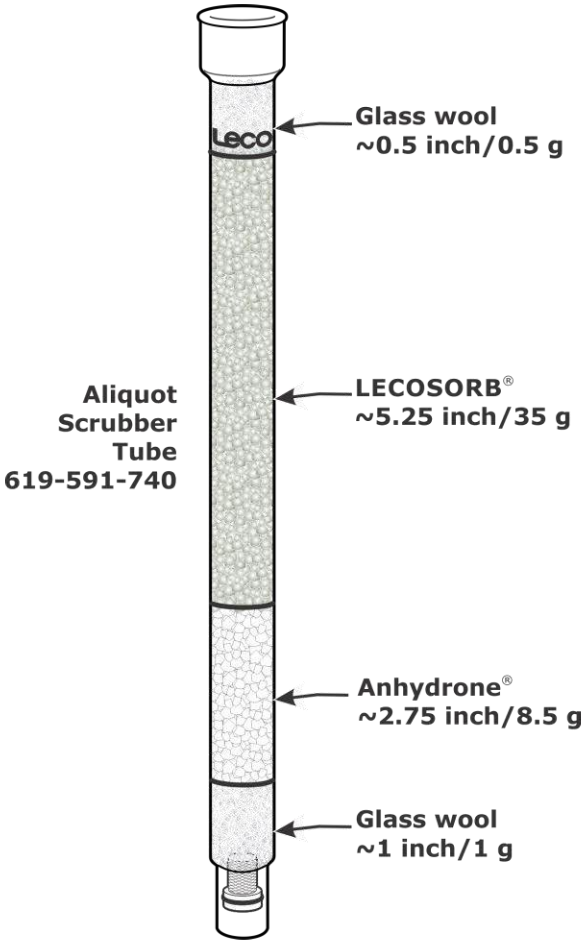


Figure 6-6
Dose Scrubber Tube

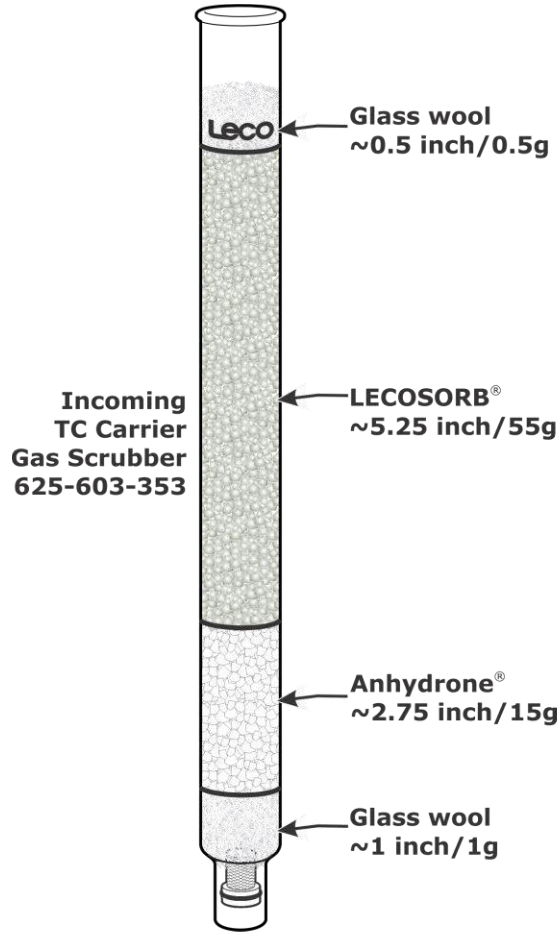


Figure 6-7
Inert Gas Scrubber Tube

Installing the Scrubber Tubes

1. Install the packed tube by inserting the top of the tube into the top block, and then pushing the bottom of the tube into the bottom block.
2. Close the instrument front door, and turn On the gas.
3. Perform a Segmented Inert Leak Check. Refer to Leak Check, page 8–12.

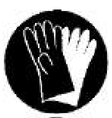
Replacing the Reduction Tube

The reduction heater tube is located behind the instrument front door, to the left of the particle filter. Refer to Figure 2-1, page 2–6, or Figure 2-2, page 2–7 (depending on the instrument configuration), for the location of the reduction tube.

NOTES

- The reduction reagent materials should be replaced approximately every 1500 analyses when using a 10 cm^3 dose loop (or 4950 when using a 3 cm^3 dose loop) if pure helium or argon (99.99% or better) is used. If the inert gas is contaminated with oxygen, the copper turnings will deplete in a shorter period of time.
- The thumbscrew on the reduction heater upper port block should only be finger tight. Do not use a screwdriver to tighten it, or damage could result.

HIGH TEMPERATURE WARNING
BURN HAZARD
Permit the reduction tube to cool to ambient temperature before removing it from the instrument.




PROTECTIVE GLOVES/PROTECTIVE EYEWEAR
Wear appropriate personal protective equipment, including safety glasses or goggles and cut-resistant gloves, when handling quartz wool.

Refer to the Safety Data Sheet (SDS) for additional hazard, handling, storage, and personal protection information.

Removing the Reduction Tube

1. Set the gas flow to Gas Off.
2. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance. Toggle the switch to turn Off the Reduction Heater.

HIGH TEMPERATURE WARNING
The reduction tube is extremely hot. Wait for the reduction tube to cool before removing it.

3. Allow the reduction heater to reach ambient temperature.
4. Loosen the captive thumbscrew in the upper block, and then remove the upper block and set it aside.

HIGH TEMPERATURE WARNING
Set the reduction tube aside on a cooling tray and allow the reduction tube to cool to room temperature before proceeding.

5. Using heat resistant gloves, carefully grab the top of the reduction tube, pull it out, and set it on a cooling tray. DO NOT touch the end of the tube that was previously inside the reduction heater.
6. Check, clean, and grease the o-rings on the upper and lower blocks where the tube seals. The heat shield can be removed to better access the bottom o-ring. Apply a thin coating of vacuum grease. Replace the o-rings if they are cracked or worn. Refer to Cleaning and Greasing the O-Rings, page 6–9.

FLAMMABLE/HEALTH HAZARD/HARMFUL/ PROTECTIVE GLOVES/PROTECTIVE EYEWEAR
Acetone is highly flammable and should be kept away from hot surfaces. It may cause eye irritation and/or drowsiness. Do not breathe fumes. Protective eyewear and gloves are required when handling Acetone.

Refer to the Safety Data Sheet (SDS) for additional information.

7. Turn the reduction tube upside down and gently tap the tube on the work surface until the contents of the tube slide out. To clean the tubes, rinse them with water and then acetone if available, and then allow them to dry.
8. Pack the tube using the appropriate steps in Packing the Reduction Tube, following.

Packing the Reduction Tube

Repack the clean or new reduction tube by completing the following steps. Refer to Figure 6-8, page 6–20 (or Figure 6-9, page 6–21, if using argon), for an illustration of a packed tube.

1. Insert approximately 10 grams of copper turnings into the bottom of the reduction tube. Use the tube packing tool from the Accessory Pack to compress the turnings until they are level with the first (lowest) mark on the tube (approximately $^{3}/_{4}$ inches).

NOTE The N-catalyst can be used twice; therefore, it is necessary to replace the N-catalyst only after every second repacking.

2. Pour N-catalyst on top of the copper turnings to the second mark on the tube (approximately $^{3}/_{4}$ inches).
3. Place about 20 grams of copper turnings on top of the N-catalyst, and use the tube packing tool from the Accessory Pack to compress the turnings until they are level with the third mark (approximately $1^{3}/_{8}$ inches).

4. Fill the reduction tube with 200 g of copper sticks. Hold the reduction tube upright and tap the bottom of the tube down on the counter or work space until the level of copper sticks is at or just below the top etch mark of the tube. This will help increase the number of analyses between reagent replacements and ensure even depletion of the reagent by preventing channeling. Refer to Figure 6-8, following.

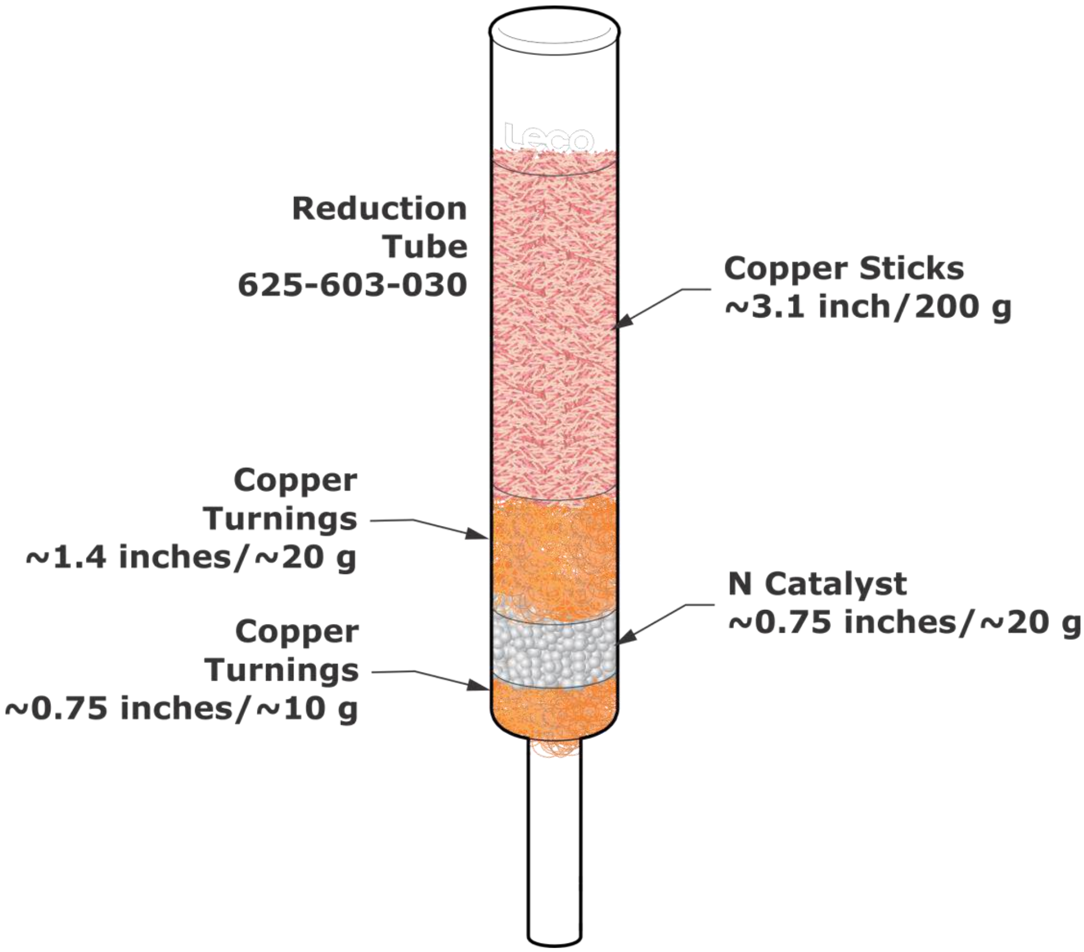


Figure 6-8
Reduction Tube Packing

5. If you are using helium, skip to step 7.
   If you are using argon, continue with step 6.

6. Insert approximately 3.5 grams of quartz wool filtering fiber on top of the copper sticks, leaving approximately a 1-inch space above the quartz wool filtering fiber. Do not over pack the quartz wool filtering fiber. Make sure that no quartz wool fibers are on the o-ring sealing surface. Refer to Figure 6-9, following.

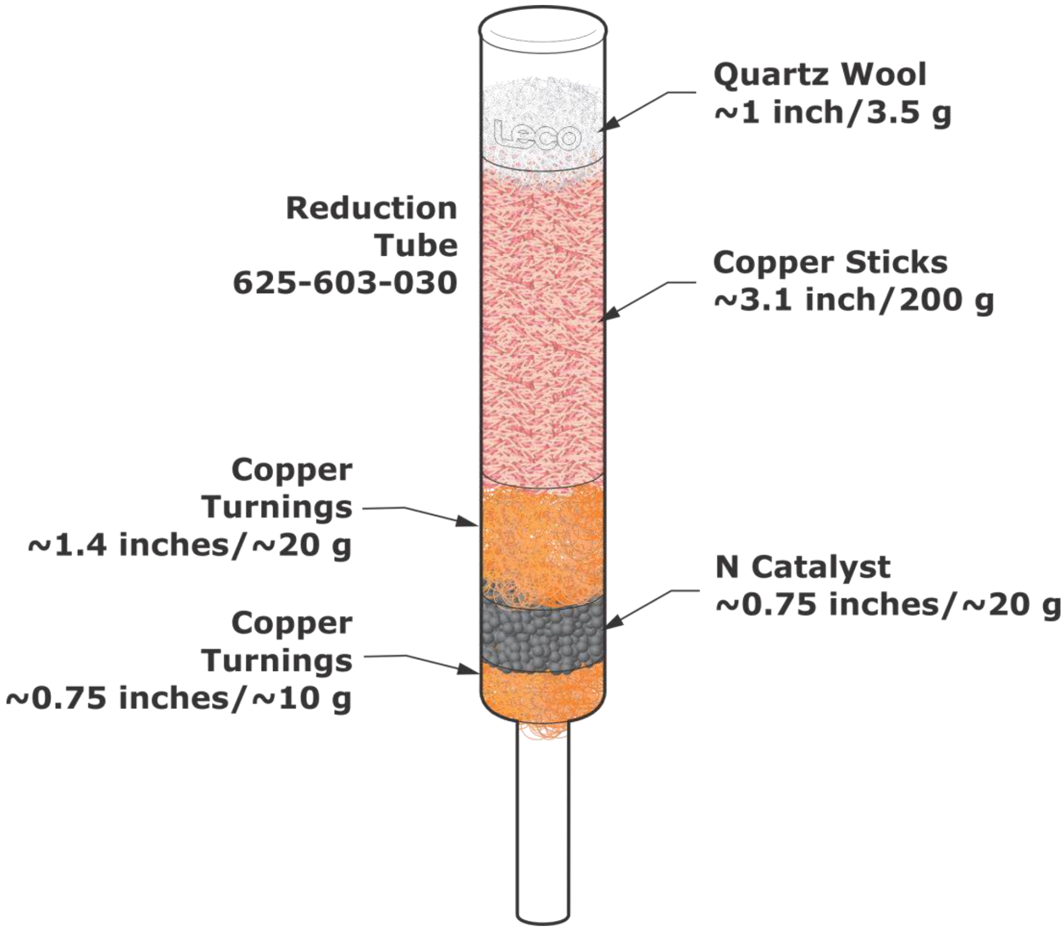


Figure 6-9
Reduction Tube Packing - Argon

7. Install the reduction tube. Refer to Installing the Reduction Tube, following.

Installing the Reduction Tube

1. Reinstall the packed reduction tube into the reduction heater assembly, making sure the bottom end of the reduction tube is positioned and sealed over the o-ring.
2. Reinstall the upper block and tighten the thumbscrew.
3. Perform and pass a Segmented Inert leak check. Refer to Leak Check, page 8–12.
4. Remove the dose scrubber tube (refer to Removing the Scrubber Tubes, page 6–16). Place a wad of lint-free cloth or a cup on top of the bottom port of the dose scrubber to catch any drops.
5. Set the gas flow to Conservation.

6. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Toggle the switch to turn On the Reduction Heater.
7. Allow the reduction tube to purge any moisture until it reaches operating temperature. This should take 10 to 15 minutes.
8. Once all moisture is visibly drained from the reduction tube, in the software, turn Off the gas by selecting Gas on the Action bar and then selecting Off.
9. Reinstall the dose scrubber. Refer to Installing the Scrubber Tubes, page 6–17.
10. In the software, turn On the gas by selecting Gas on the Action bar and then selecting On.
11. Perform a Segmented Inert Leak Check. Refer to Leak Check, page 8–12.
12. Run several blanks analyses before beginning sample analysis.

Cleaning the Sample Carousel

1. Lift up and remove the sample carousel from the loading head. Refer to Figure 6-10, following.

Figure 6-10
Sample Carousel Removal

2. Wipe the top of the sample carousel with a foam wipe from the Accessory Pack.
3. Using a Phillips screwdriver, remove the four screws securing the bottom plate to the carousel body, and then remove the plate. Refer to Figure 6-11, following.

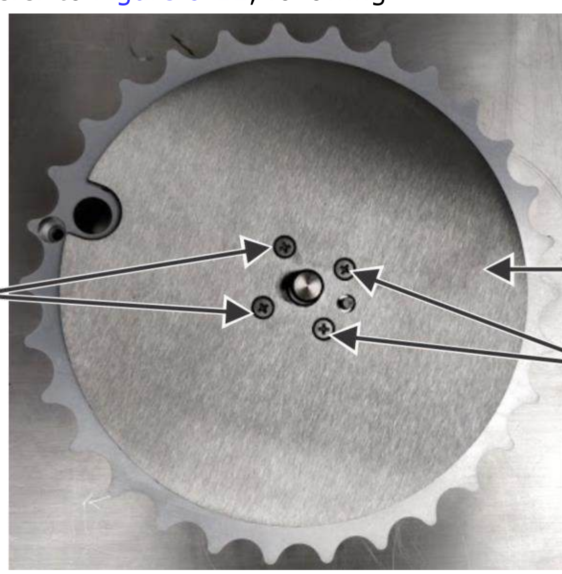


Figure 6-11
Sample Carousel Plate Removal

4. Wipe both sides of the bottom plate with a foam wipe.

5. Inspect the holes in the carousel, and clean them with a foam wipe if needed.
6. If the carousel does not move freely, complete the following steps to grease the carousel bearings.
   A. Lift off the smooth inner ring that covers the carousel bearings. Refer to Figure 6-12, following.
   B. Apply a thin coat of multi-purpose lithium-based grease to the carousel bearings. Refer to Figure 6-12, following.

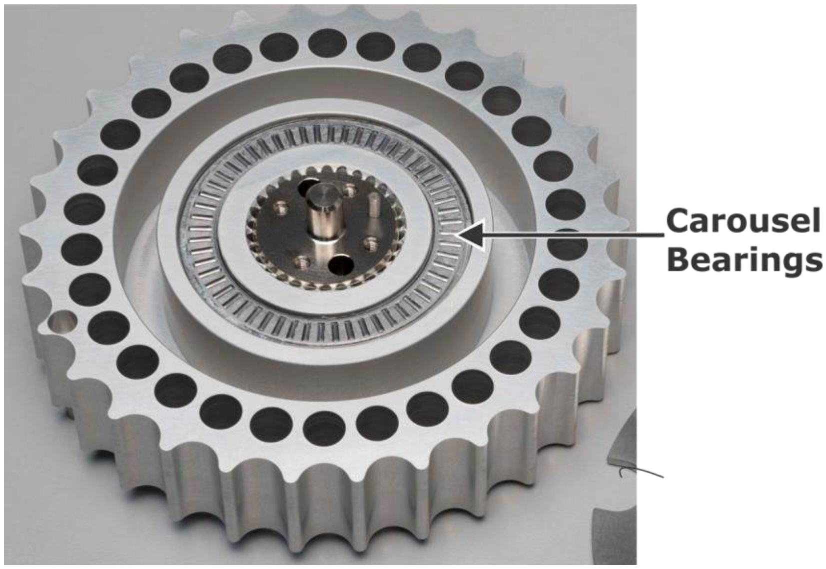


Figure 6-12
Sample Carousel Bearings

   C. Replace the smooth inner ring on top of the carousel bearings.
7. Using a Phillips screwdriver, reinstall the plate and four screws removed in step 3, previous.
8. Reinstall the sample carousel, making sure the alignment pin correctly references the loading head and the arrow is pointed to the combustion tube opening.

Cleaning the Loading Head

The loading head is located on top of the furnace shelf above the furnace assembly. This procedure should be used to clean and service the loading head interface block.

The following instructions use the lance extractor tool (included in the Accessory pack), which is stored behind the instrument front door in the tool tray. Return this tool to the tool tray when these steps are complete to avoid losing the tool. Refer to Figure 2-3, page 2–8.

Removing the Loading Head

1. In the software, turn Off the gas by selecting Gas on the Action bar and then selecting Off.
2. Lift up and remove the sample carousel from the loading head. Refer to Figure 6-13, following.

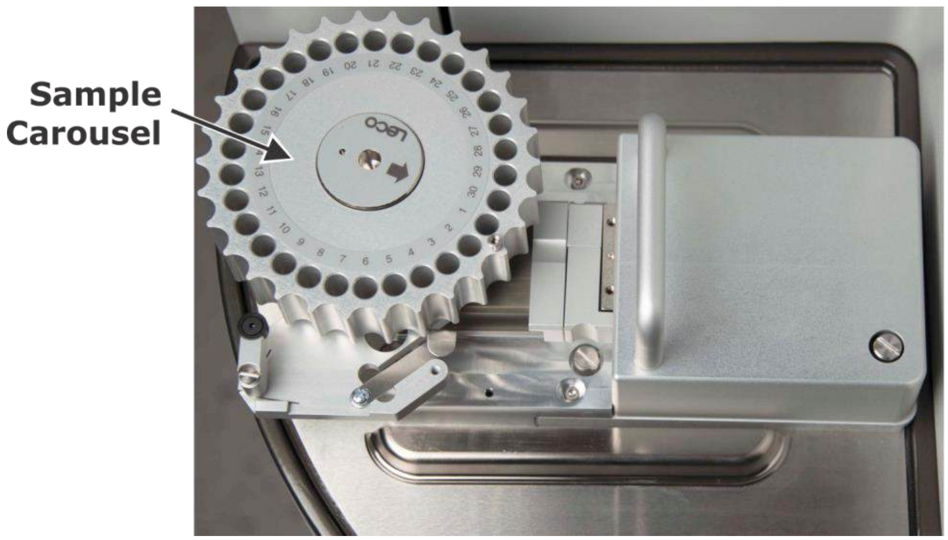


Figure 6-13
Sample Carousel Removal

3. Using a flat-blade screwdriver, loosen the four captive screws securing the loading head to the furnace. Refer to Figure 6-14, following.

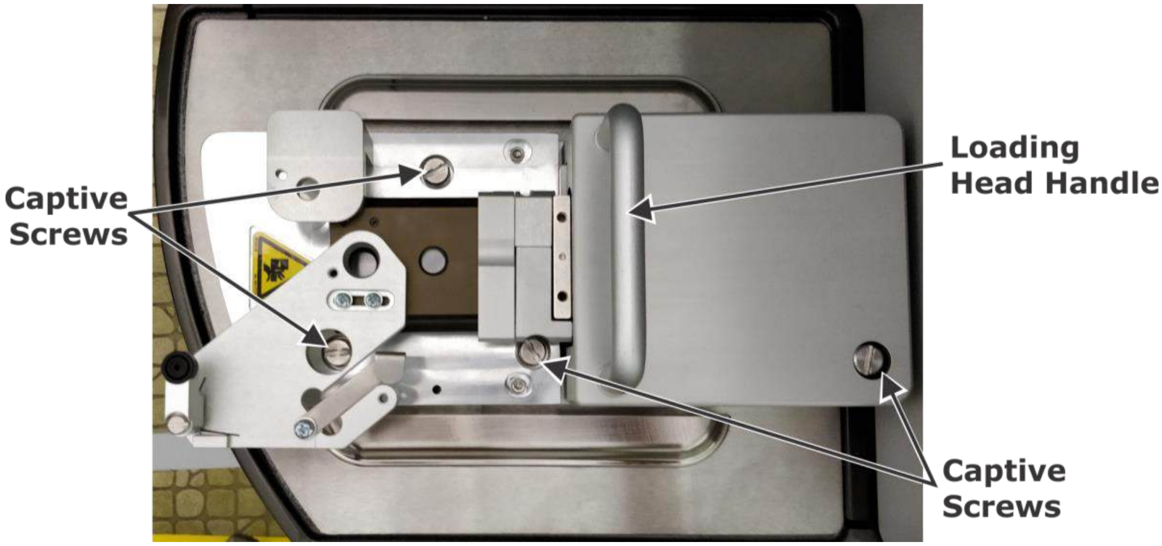


Figure 6-14
Loading Head Captive Screws

4. Using the loading head handle, lift the loading head and set it aside. Refer to Figure 6-14, previous.

Disassembling and Cleaning the Loading Head

1. Slide the slide block release in the direction indicated by the red arrow in the following photograph.

NOTE → The pneumatic coupling is labeled in the following photograph for locking the slide block in step 7 of Installing the Loading Head, page 6–29.

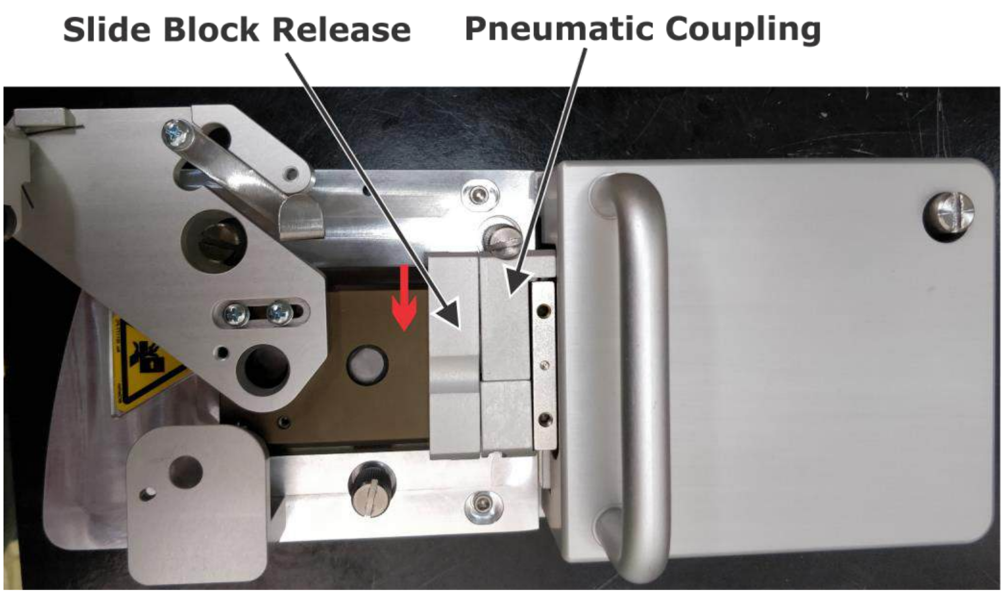


Figure 6-15
Slide Block Release

2. Remove the slide block by sliding it away from the loading head handle, and then flip over the slide block and set it on the work surface.

3. Remove the furnace seal by holding the slide block in one hand and tapping it against the other hand until the furnace seal pops out. Use a foam wipe from the Accessory Pack to wipe the surface of the furnace seal and the sealing surface underneath the furnace seal. Refer to Figure 6-16, following.

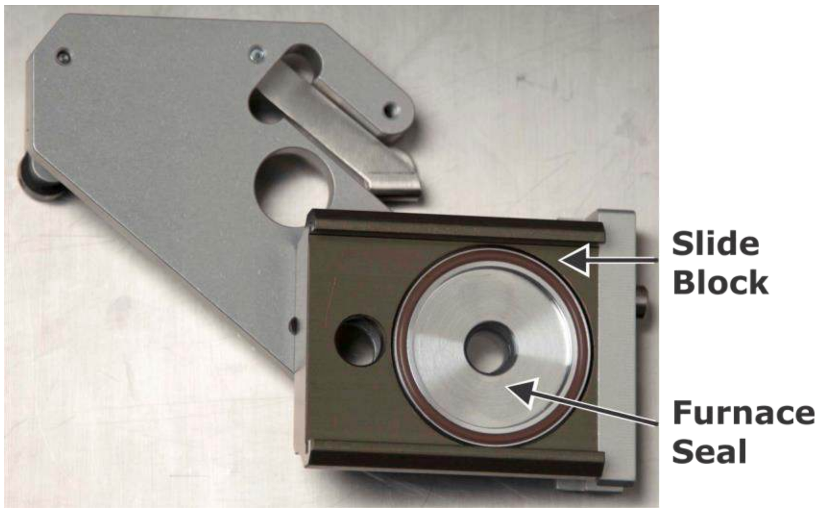


Figure 6-16
Furnace Seal Removal

4. Clean, grease, and then reinstall the two furnace seal o-rings. Refer to Cleaning and Greasing the O-Rings, page 6–9. Replace the o-rings if they are worn or damaged.

5. Use a foam wipe from the Accessory Pack to wipe the surface of the slide block.

6. Use a foam wipe from the Accessory Pack to wipe the surface of the loading head.

7. Flip over the loading head and set it on the work surface.

8. Thread the lance extractor tool from the Accessory Pack into one of the holes in the sample drop plate. Pull up on the lance extractor tool and remove the sample drop plate. Refer to Figure 6-17, following.

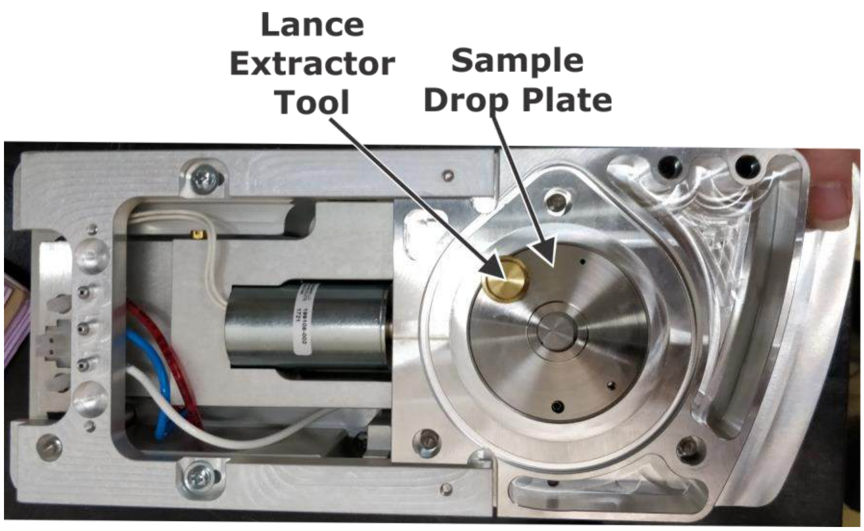


Figure 6-17
Sample Drop Plate Removal

9. Use a foam wipe from the Accessory Pack to wipe the surface of the sample drop plate.

10. Clean and grease the o-ring around the outer edge of the sample drop plate. Refer to Cleaning and Greasing the O-Rings, page 6–9. Replace the o-ring if it is worn or damaged.

11. Pop off the sample drop plate jaw. Use a foam wipe from the Accessory Pack to wipe the surface of the jaw and the area under the jaw. Refer to Figure 6-18, following.

NOTE The alignment pin shown in the following photograph is for reinstalling the sample drop plate in step 3 of Installing the Loading Head, page 6–29.

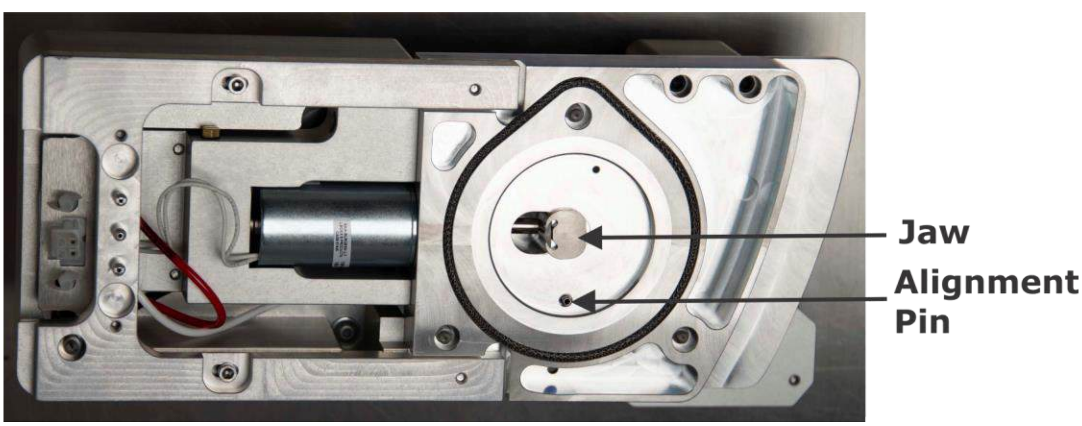


Figure 6-18
Sample Drop Plate Jaw

Installing the Loading Head

1. Reinstall the jaw.
2. Reinstall the o-ring on the sample drop plate.
3. Reinstall the sample drop plate and o-ring by aligning the pin in the loading head with the hole in the sample drop plate. Refer to Figure 6-18, previous.
4. Flip over the loading head and set it on the work surface.
5. Reinstall the furnace seal.
6. Reinstall the slide block by aligning the grooves in the sides of the slide block with the edges of the slide block sealing surface on the loading head, and then sliding it on toward the loading head handle.
7. Lock the slide block in place by sliding the slide block release until it is aligned with the pneumatic coupling. Refer to Figure 6-15, page 6–26.
8. Reinstall the loading head onto the instrument, and tighten the four captive screws using a flat-blade screwdriver. If the captive screws do not thread smoothly, refer to Aligning the Loading Head, page 9–12.
9. Reinstall the sample carousel, making sure the alignment pin correctly references the loading head and the arrow is pointed to the combustion tube opening.

Cleaning the Screen Filters

The screen filters are located in the bottom of the inert gas scrubber and dose scrubber tubes. Refer to Figure 2-1, page 2–6, or Figure 2-2, page 2–7, depending on the instrument configuration. The filters should be cleaned whenever the reagents are replaced.

The filters are easily removed using the threaded end of the tube packing tool from the Accessory pack, a threaded tool, or any #10-24 screw.

1. Remove the o-rings from the screen filters.
2. Inspect, clean, and lightly grease the o-rings. Refer to Cleaning and Greasing the O-Rings, page 6–9. Replace the o-rings if they are cracked or worn. Set the o-rings aside.
3. Insert the screen filters in an ultrasonic cleaner.
4. Sonicate the screen filters for 10 minutes.
5. Remove the screen filters from the ultrasonic cleaner and allow them to air dry.
6. Install the o-rings on the screen filters.
7. Insert the clean screen filters into their original location; or replace the clean filters with spare filters, if available, and store for future use.

Figure 6-19
Screen Filters

Replacing the Crucible

HIGH TEMPERATURE WARNING
The crucible and furnace may be hot. To avoid burns, allow the instrument to cool to room temperature before replacing the crucible.

PROTECTIVE GLOVES/PROTECTIVE EYEWEAR
Wear appropriate personal protective equipment, including safety glasses or goggles and cut-resistant gloves, when handling quartz wool.

Refer to the Safety Data Sheet (SDS) for additional hazard, handling, storage, and personal protection information.

NOTE: If the heaters are not turned Off before replacing the crucible, they may shut Off and need to be restarted.

The following instructions use the crucible extractor tool, the lance extractor tool, and the wool extractor tool (all included in the Accessory pack), which are stored behind the instrument front door in the tool tray. Return these tools to the tool tray when these steps are complete to avoid losing the tools. Refer to Figure 2-3, page 2–8.

Removing the Crucible

1. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Select Off next to Afterburner Heater and Furnace Heater to turn Off the heaters.
2. If it is installed, remove the furnace viewing mirror. Refer to Removing the Furnace Viewing Mirror, page 6–80.
3. Refer to steps 2 through 4 of Removing the Loading Head, page 6–25, to remove the loading head.
4. Screw the lance extractor tool into the small hole on the lance head and pull up on the lance to remove it. Refer to Figure 6-20, following.

Figure 6-20
Lance Extractor Tool

5. Place the lance inside the front door. Refer to Figure 2-3, page 2–8.

6. Use the crucible extractor tool to reach into the combustion tube and grasp the crucible. Lift the crucible out and discard when cool.
7. Check the quartz wool wads under the crucible, and replace any that look dirty or deteriorated. For instructions on how to pack quartz wool, refer to steps 10 through 12 of Packing the Combustion Tube, page 6–46.

Installing the Crucible

1. Using the crucible extractor tool, place a new crucible in the combustion tube.
2. Check that the crucible is in the correct position by completing the following steps.
   A. Slide the crucible extractor tool into the crucible. Make sure the tip of the crucible extractor tool rests on the top lip of the crucible. Refer to Figure 6-21, following.
   B. Mark on the crucible extractor tool where the tool meets the location where the lance sits in the load head interface block. This mark represents the distance between the top of the crucible and the surface that the lance assembly will reference. Refer to Figure 6-21, following.

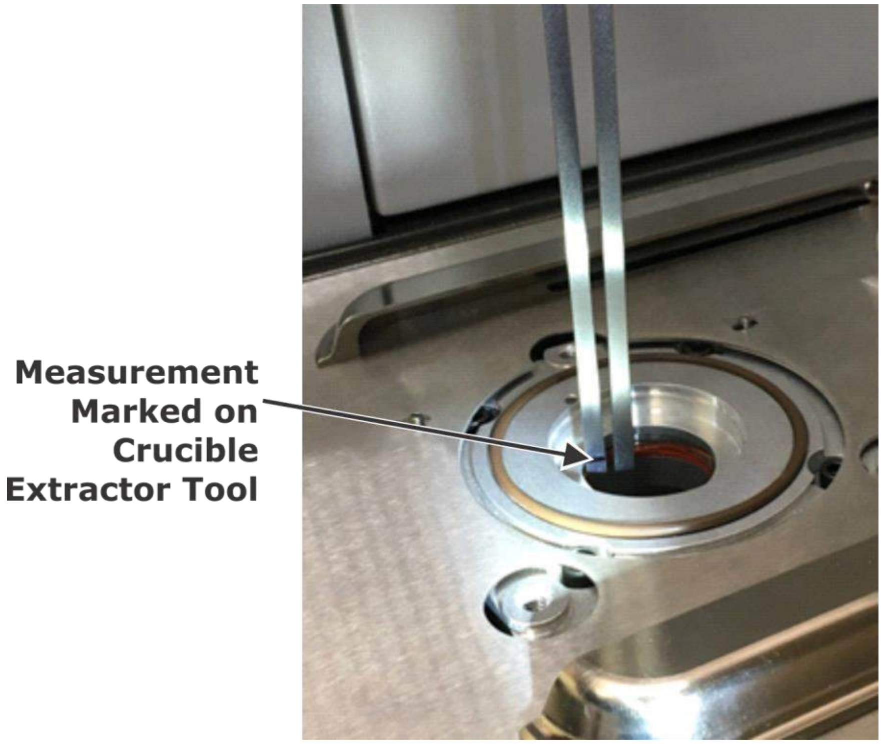


Figure 6-21
Measurement Marked

   C. Remove the crucible extractor tool from the crucible.

D. Lay the crucible extractor tool and the lance assembly next to each other on a table with the end of the crucible extractor tool pressed against the bottom of the lance holder flange. Compare the measurement marked with the length of the lance assembly. The end of the lance assembly should extend beyond the measurement marked by $^{1}/_{8}$ to $^{1}/_{4}$ inch for the tip of the lance to extend the correct distance into the crucible. Refer to Figure 6-22, following, and Figure 10-81, page 10–86.

Figure 6-22
Lance Assembly Length

3. Add or remove a small amount of quartz wool under the crucible as necessary to ensure that the bottom of the lance will rest $^{1}/_{8}$ to $^{1}/_{4}$ inch inside the top of the crucible. For instructions on how to pack quartz wool, refer to steps 10 through 12 of Packing the Combustion Tube, page 6–46.
4. Insert the lance assembly into the longer section of the combustion tube. Refer to Figure 6-23, following.

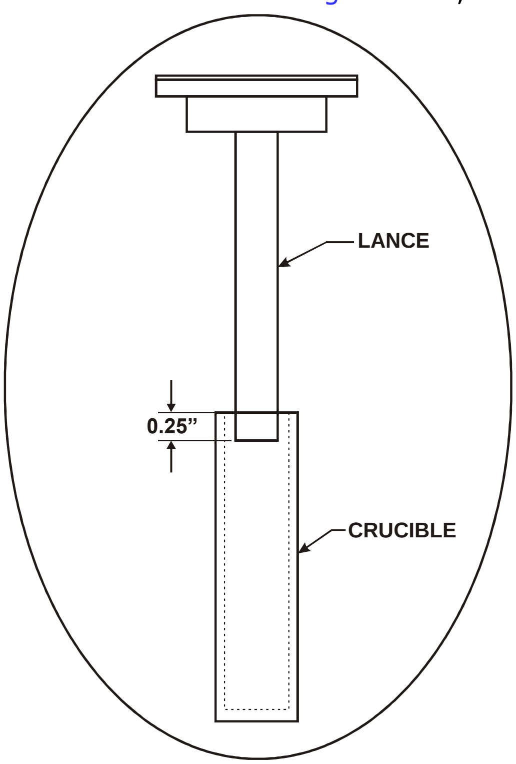


Figure 6-23
Lance Installation

CAUTION
To prevent damage to the loading head, properly align the electrical connectors before pushing the loading head onto the instrument.

5. Reinstall the loading head onto the instrument, and tighten the four captive screws using a flat-blade screwdriver. If the captive screws do not thread smoothly, refer to Aligning the Loading Head, page 9–12.
6. Reinstall the sample carousel, making sure the alignment pin correctly references the loading head and the arrow is pointed to the combustion tube opening.
7. **OPTIONAL:** Install the furnace viewing mirror. Refer to Installing the Furnace Viewing Mirror, page 6–80.
8. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance, and then select On next to Afterburner Heater and next to Furnace Heater restart the furnace.
9. Allow the crucible to reach operating temperature.
10. Reset the crucible counter. Refer to Counters, page 5–24.
11. Run two blank analyses to purge air and moisture from the system.

NOTE The crucible must be replaced more frequently when running samples with high ash content.

Replacing the Combustion Tube

The following instructions uses the lance extractor tool (included in the Accessory pack), which is stored behind the instrument front door in the tool tray. Return this tool to the tool tray when these steps are complete to avoid losing the tool. Refer to Figure 2-3, page 2–8.

Removing the Combustion Tube

PROP 65 WARNING
This product can expose you to silica, which is known to the State of California to cause cancer. For more information, go to www.P65Warnings.ca.gov.

HIGH TEMPERATURE WARNING
The combustion furnace is extremely hot. Wait for the combustion tube to cool before removing it

1. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance. Toggle the switches to turn Off the Furnace Heater and Afterburner Heater. Allow the furnace and afterburner heaters to cool to room temperature before continuing.
2. Exit the software. Refer to Exiting the Software, page 3–19.

HAZARDOUS VOLTAGE WARNING
This equipment operates from a 230V~ source. Contact with this voltage can be fatal. Disconnect the instrument from the facility AC power source before continuing with this procedure.

3. Turn Off the analyzer, and disconnect the instrument from facility AC power.
4. Remove the loading head by completing steps 2 through 4 of Removing the Loading Head, page 6–25.
5. Lift up and remove the furnace top shelf. Refer to Figure 6-24, following.

Figure 6-24
Furnace Top Shelf

6. Screw the lance extractor tool, from the Accessory pack, into the small hole on the lance head and pull up on the lance to remove it. Refer to Figure 6-25, following.

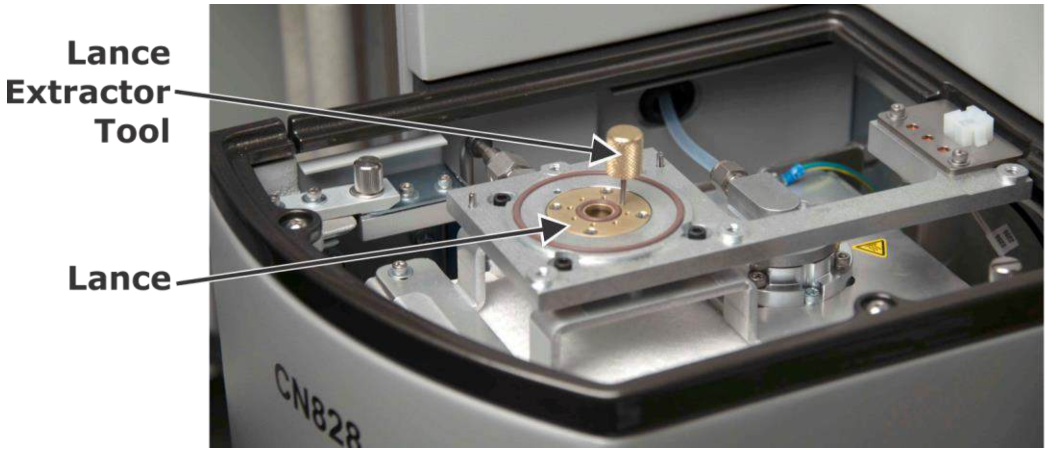


Figure 6-25
Lance Extractor Tool

7. Using a flat-blade screwdriver, remove the two furnace panel screws, and then pull the furnace panel forward and off. Refer to Figure 6-26, following.

Figure 6-26
Furnace Panel

8. Using an adjustable wrench, loosen the oxygen inlet gas line connections, and then disconnect it by hand. A grommet on the tube prevents the nut from falling out of reach. Refer to Figure 6-27, following.

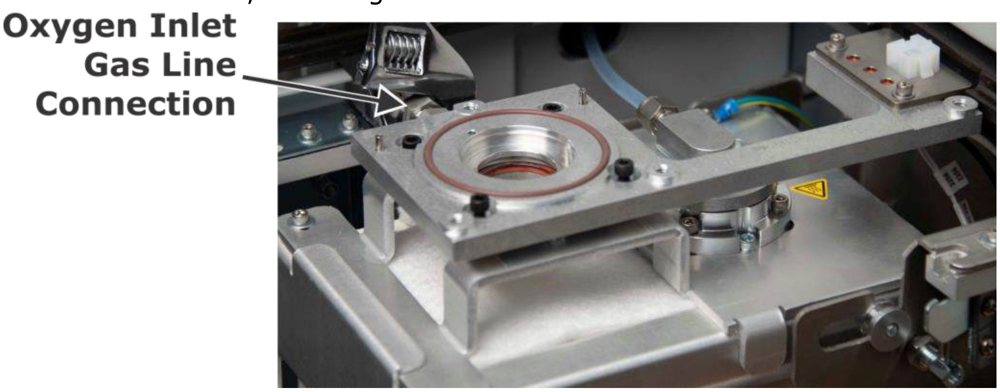


Figure 6-27
Gas Line Connections

9. Using an Allen® wrench (hex wrench), remove the four screws in the loading head interface block in an X pattern, and then remove the block. Refer to Figure 6-28, following.

IMPORTANT Do not remove the o-ring under the interface block at this time.

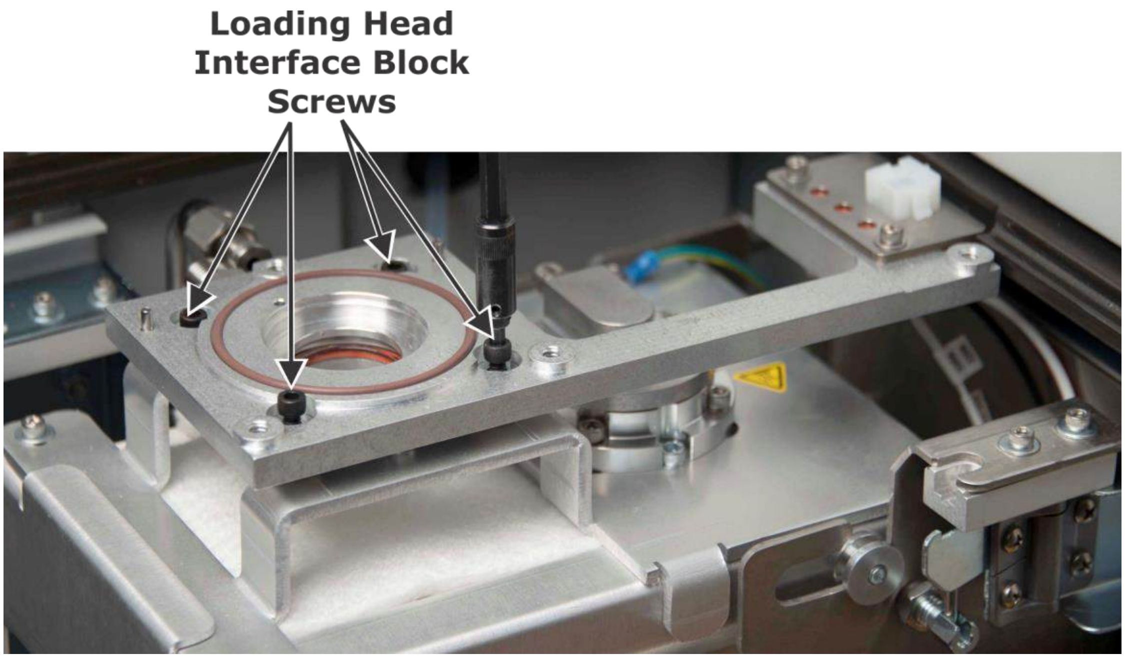


Figure 6-28
Loading Head Interface Block Screws

10. The loading head interface block can be hung out of the way without disconnecting the loading head pneumatic and sample drop electrical connections. Turn the loading head interface block bracket until it points away from the furnace. Hang the loading head interface block from the bracket. Refer to Figure 6-29, following.

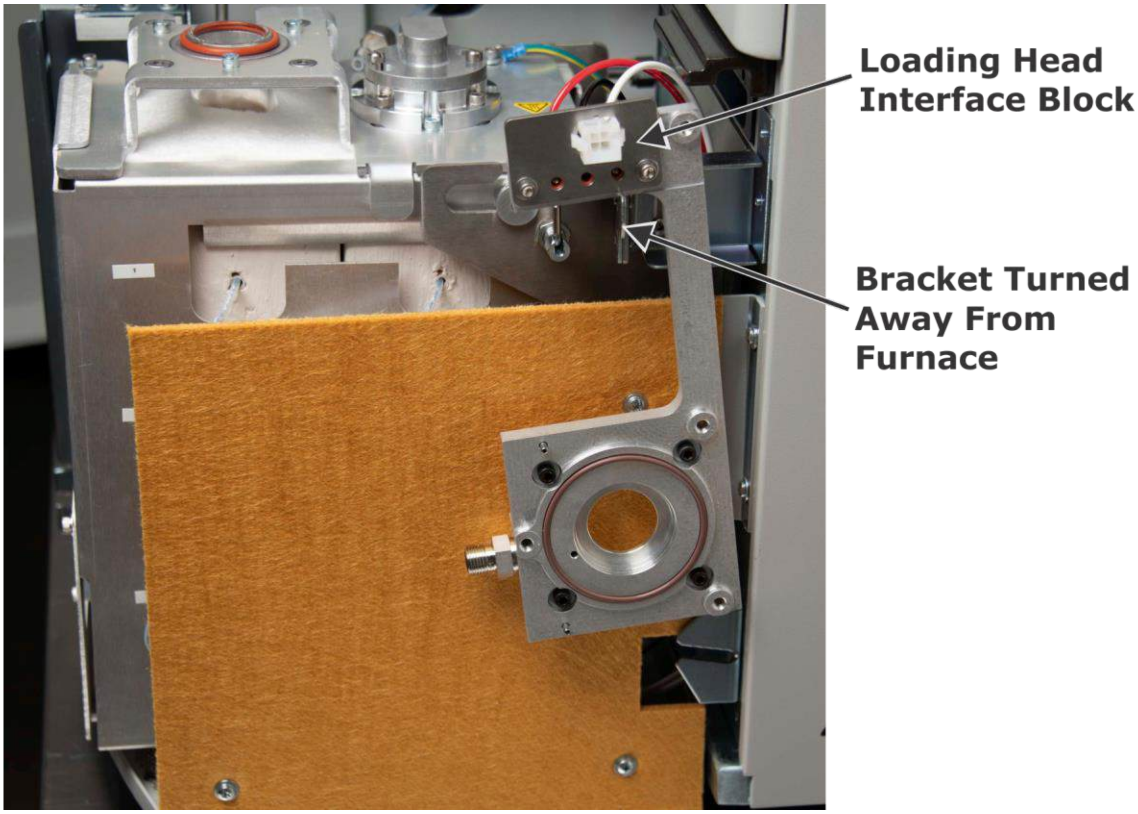


Figure 6-29
Loading Head Interface Block Bracket

11. Twist the afterburner cap clockwise and lift it to remove. Refer to Figure 6-30, following.

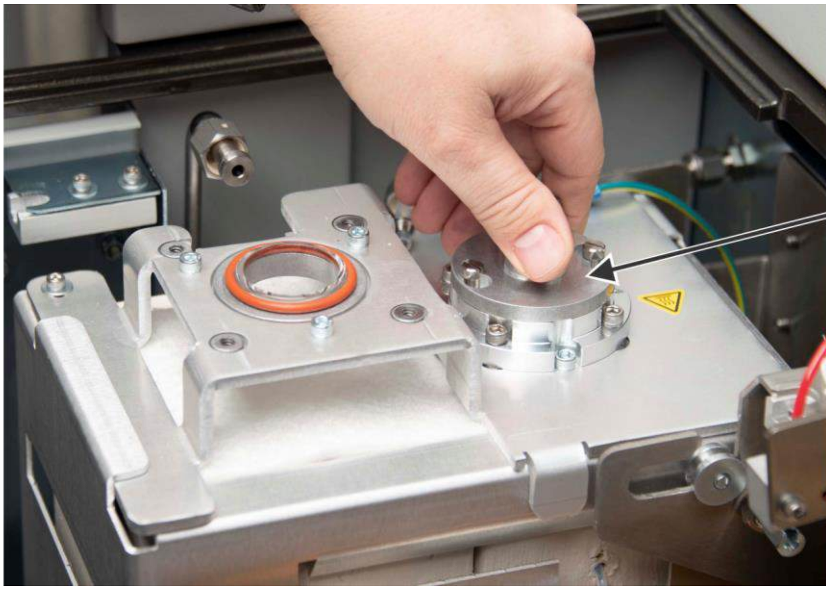


Figure 6-30
Afterburner Cap

12. Using an *Allen* wrench, remove the four hex screws in the afterburner interface block in an X pattern, and remove the block. Refer to Figure 6-31, following.

IMPORTANT Do not remove the o-ring under the interface block at this time.

13. Pull out and turn the lock pin to unlock the furnace. Refer to Figure 6-31, following.

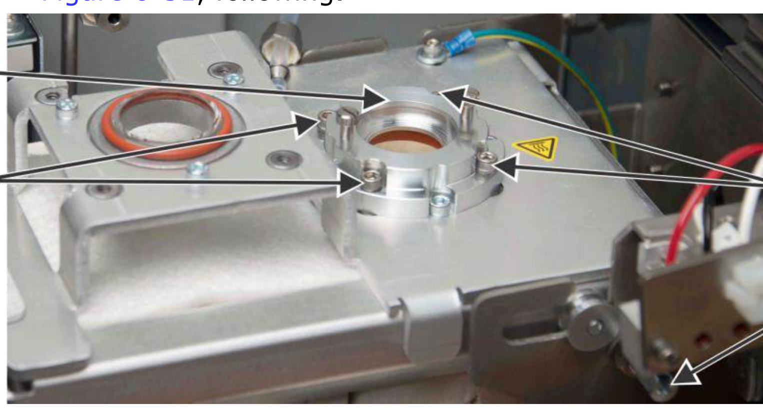


Figure 6-31
Afterburner Interface Block

14. Pull the furnace forward and tilt it back, and then turn the lock pin and push it back in to lock the furnace.

15. Using an *Allen* wrench, remove the top two hex screws on the front of the furnace. Refer to Figure 6-32, following.

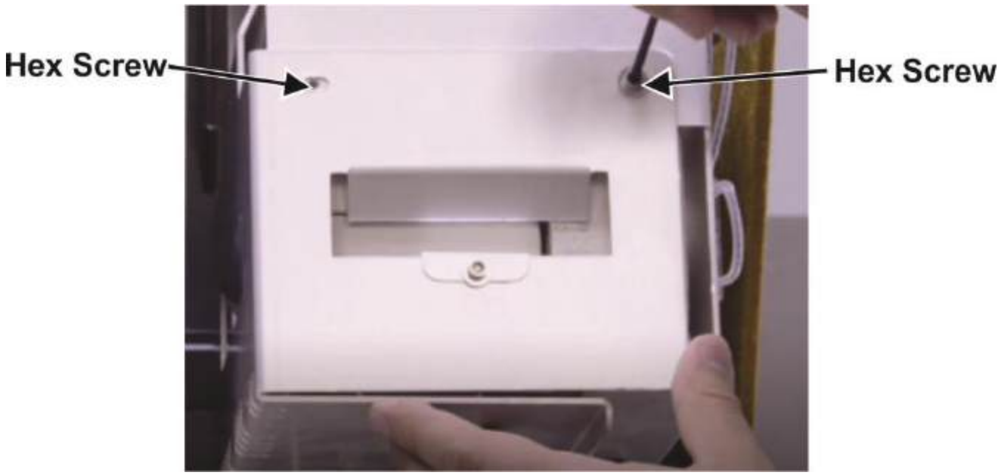


Figure 6-32
Furnace Front

CAUTION

POSSIBLE COMBUSTION TUBE DAMAGE
The combustion tube may fall free of the furnace once the furnace bottom is removed. Be prepared to prevent it from falling.

16. Drop the furnace bottom down, and then pull it toward you. Refer to Figure 6-33, following.

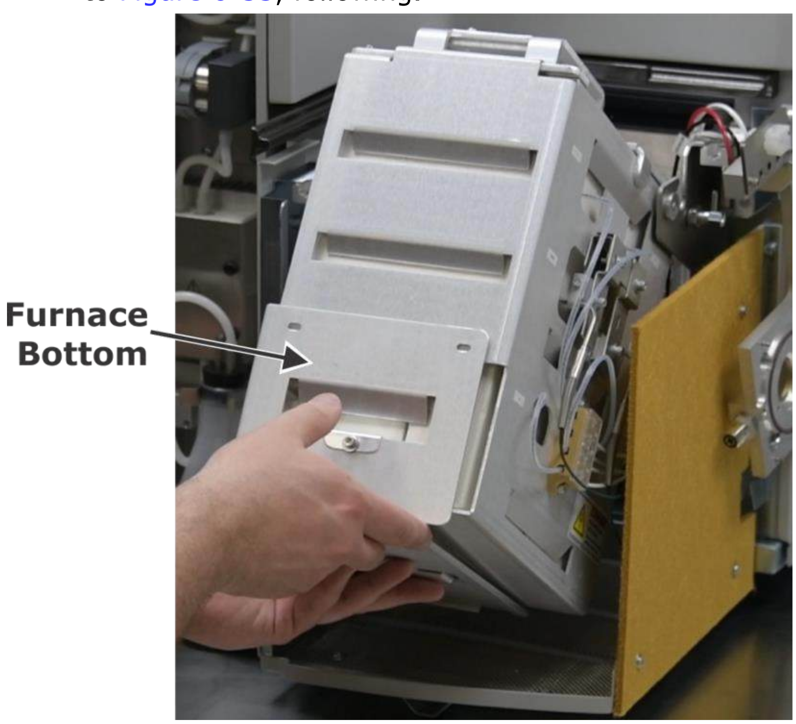


Figure 6-33
Furnace Bottom Removal

CAUTION

POSSIBLE COMBUSTION TUBE DAMAGE

Do not touch the lower portion of the combustion tube without gloves or a lint-free cloth. Body oil can promote devitrification that may cause the combustion tube to crack.

17. With a cloth or gloves, gently grasp the bottom of the combustion tube.
18. Remove the two o-rings on the top of the furnace. Refer to Figure 6-34, following.

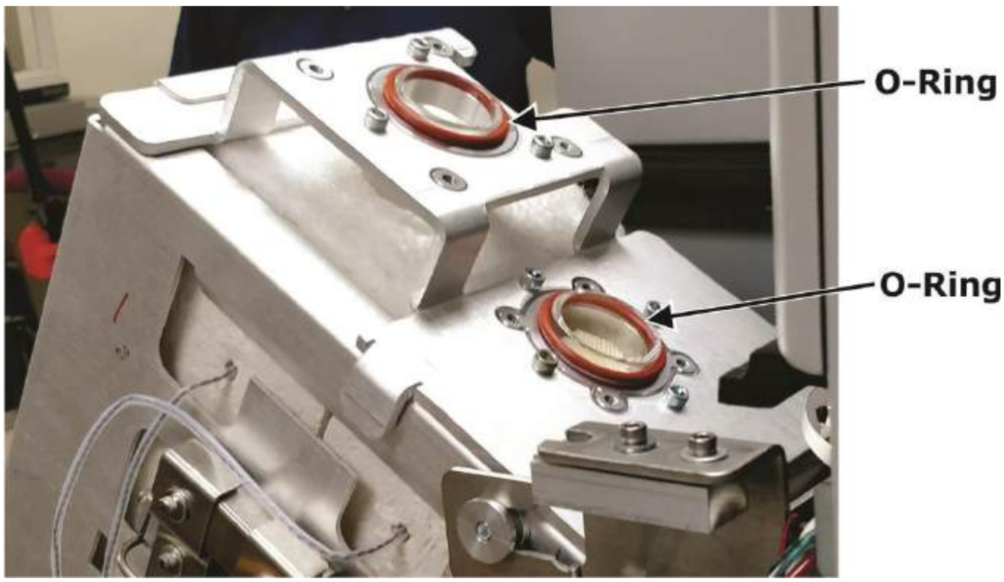


Figure 6-34
Furnace O-Rings

19. Using the cloth or gloves, remove the combustion tube by pulling down on the tube until the tube is free of the furnace. Refer to Figure 6-35, following.

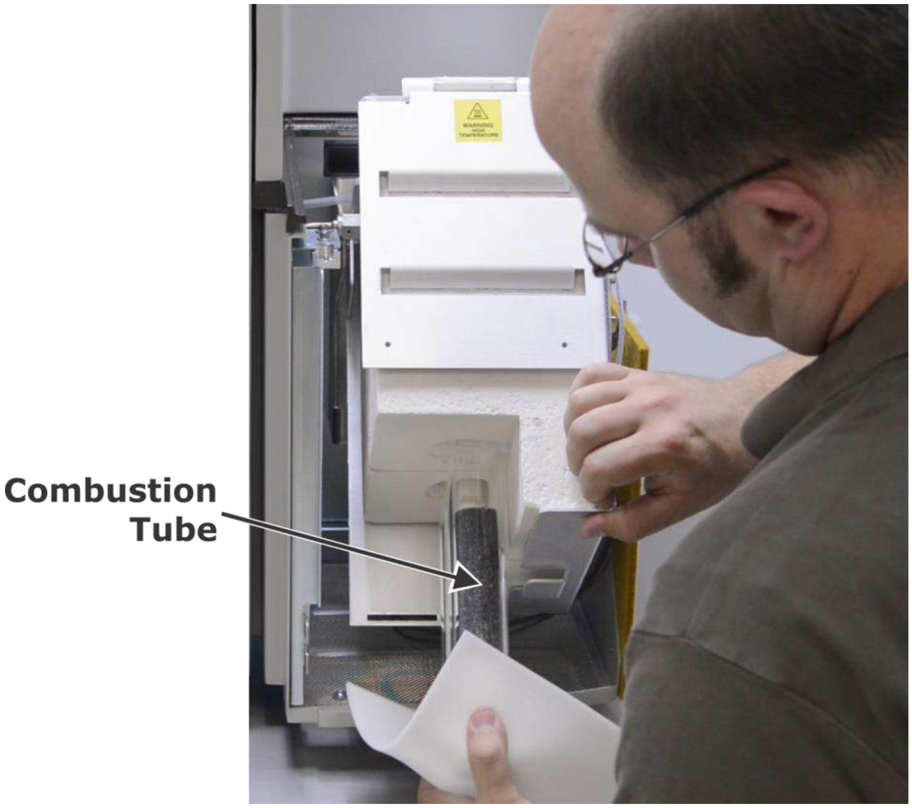


Figure 6-35
Combustion Tube Removal

Installing the Combustion Tube

CAUTION
POSSIBLE COMBUSTION TUBE DAMAGE
Do not touch the lower portion of the combustion tube without gloves or a lint-free cloth. Body oil can promote devitrification that may cause the combustion tube to crack.

1. Insert the combustion tube into the furnace from the bottom. Refer to Figure 6-35, page 6–42.
2. Reinstall the two o-rings on the top of the furnace. If the furnace has been heated, the combustion tube o-rings may be deformed and should be replaced. Refer to Figure 6-34, page 6–41.
3. Replace the furnace bottom, removed in step 16 of Removing the Combustion Tube, page 6–40, and reinstall the hex screws, removed in step 15 of Removing the Combustion Tube, page 6–40.

4. If the height of the combustion tube needs to be raised, perform the following steps. If the combustion tube height is correct, skip to step 8, following.

NOTE The correct height of the combustion tube is when there is sufficient protrusion of the combustion tube through the furnace to fully accept the o-ring.

CAUTION

COMBUSTION TUBE HEIGHT ADJUSTMENT

Only perform the next steps to adjust the height of the combustion tube. If the combustion tube height is correct, skip to step 8, following.

5. Loosen the thumbscrew in the furnace bottom. Refer to Figure 6-36, following.
6. Raise the combustion tube by adjusting the tab in the furnace bottom until resistance is met. Refer to Figure 6-36, following.

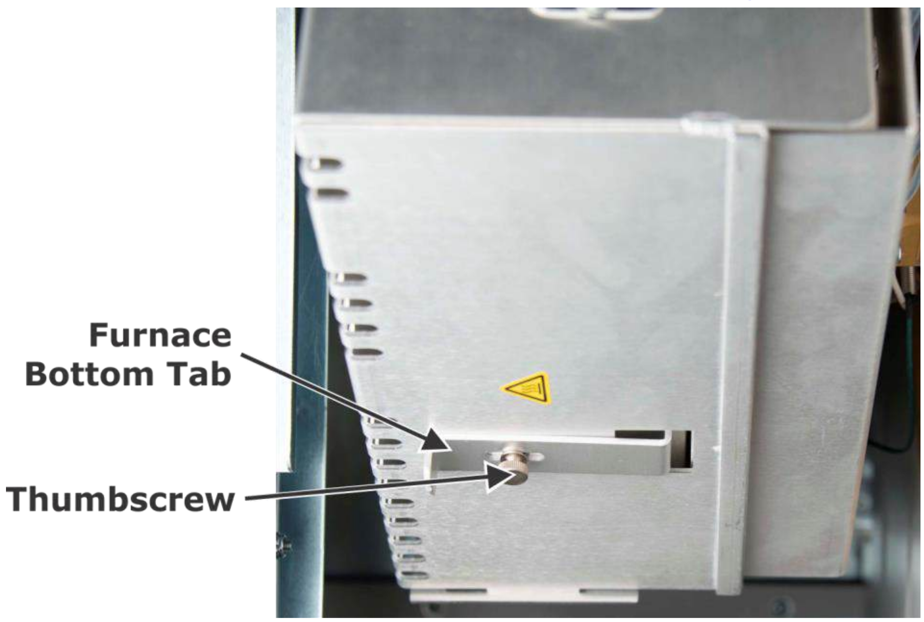


Figure 6-36
Combustion Tube Height Adjustment

7. Tighten the thumbscrew in the furnace bottom.
8. Pull out and turn the lock pin to unlock the furnace, and then push the furnace backward and tilt it back. Refer to Figure 6-31, page 6–39.
9. Turn the lock pin, and allow it to snap inward to lock the furnace.
10. Using an *Allen* wrench, reinstall the afterburner interface block, alternating a few turns of each screw in an X pattern until all four screws (removed from the block in step 12 of Removing the Combustion Tube, page 6–39) are tightened.
11. Reinstall the afterburner cap removed in step 11 of Removing the Combustion Tube, page 6–39.

12. Remove the loading head interface block from the bracket, and turn the bracket toward the front of the instrument. Refer to step 10 of Removing the Combustion Tube, page 6–38.
13. Using an *Allen* wrench, reinstall the loading head interface block, alternating a few turns of each screw in an X pattern until all four screws (removed in step 9 of Removing the Combustion Tube, page 6–37) are tightened.
14. Re-connect the gas lines by hand, and then tighten them using an adjustable wrench. Refer to Figure 6-27, page 6–37.
15. Using a flat-blade screwdriver, reinstall the furnace panel with the two furnace panel screws removed in step 7 of Removing the Combustion Tube, page 6–36.
16. Reinstall the lance by completing step 2 and 3 of Installing the Crucible, page 6–32.
17. Reinstall the furnace top shelf.
18. Reinstall the loading head onto the instrument, and tighten the four captive screws using a flat-blade screwdriver. If the captive screws do not thread smoothly, refer to Aligning the Loading Head, page 9–12.
19. Connect the instrument to AC facility power, and then turn On the instrument.
20. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance.
21. Under Heaters/Coolers, select On next to Afterburner Heater and Furnace Heater.
22. Turn On the gas by selecting Gas on the Action bar and then selecting On.
23. Perform and pass a Furnace leak check. Refer to Leak Check, page 8–12.
24. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance.
25. Under Heaters/Coolers, select On next to Afterburner Heater and Furnace Heater. Allow the temperatures to reach the setpoints and stabilize before continuing.
26. Perform and pass a Furnace leak check. Refer to Leak Check, page 8–12.
27. Complete the steps in Packing the Combustion Tube, page 6–45, to pack the combustion tube.

Packing the Combustion Tube

Replace the combustion tube if it becomes cracked or plugged. The combustion tube can be reused even if it looks cloudy.

The following instructions use the crucible extractor tool, the lance extractor tool, and the quartz wool extractor tool (all included in the Accessory pack), which are stored behind the instrument front door in the tool tray. Return these tools to the tool tray when these steps are complete to avoid losing the tools. Refer to Figure 2-3, page 2–8.

HIGH TEMPERATURE WARNING
The combustion furnace is extremely hot. Wait for the combustion tube to cool before servicing it.

CAUTION
POSSIBLE COMBUSTION TUBE DAMAGE
Do not touch the lower portion of the combustion tube without gloves or a lint-free cloth. Body oil can promote devitrification that may cause the combustion tube to crack.

PROTECTIVE GLOVES/PROTECTIVE EYEWEAR
Wear appropriate personal protective equipment, including safety glasses or goggles and cut-resistant gloves, when handling quartz wool.

Refer to the Safety Data Sheet (SDS) for additional hazard, handling, storage, and personal protection information.

IMPORTANT **For CHN828 model only:** Make sure the furnace reagents have been dried at 105 °C for 2 hours before packing the combustion tube.

1. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance. Toggle the switches to turn Off the Furnace Heater and Afterburner Heater. Allow the furnace and afterburner heaters to cool to room temperature before continuing.
2. Exit the software. Refer to Exiting the Software, page 3–19.

HAZARDOUS VOLTAGE WARNING
This equipment operates from a 230V~ source. Contact with this voltage can be fatal. Disconnect the instrument from the facility AC power source before continuing with this procedure.

3. Turn Off the analyzer, and disconnect the instrument from facility AC power.
4. Remove the furnace viewing mirror if it is installed. Refer to Removing the Furnace Viewing Mirror, page 6–80.
5. Remove the loading head by completing steps 2 through 4 of Removing the Loading Head, page 6–25.
6. Lift up and remove the furnace top shelf. Refer to Figure 6-24, page 6–35.

7. Screw the lance extractor tool (from the Accessory pack) into the small hole on the lance head and pull up on the lance to remove it. Refer to Figure 6-25, page 6–36.
8. Twist the afterburner cap clockwise and lift it to remove. Refer to Figure 6-30, page 6–39.
9. If they are already packed, unpack the tubes using the quartz wool and crucible extractor tools from the Accessory pack.
10. A full package of quartz wool strips contains ten strips, connected lengthwise in pairs. Remove one pair of quartz wool strips from the package, and separate them lengthwise into two strips. Roll each strip into a cylinder, being careful to match the outside diameter of the roll to the inside diameter of the combustion tube. Each section is approximately $^{3}/_{4}$-inch wide.
11. Repeat step 10 as more quartz wool strips are needed.
12. Using the quartz wool extractor tool (from the Accessory pack), push three rolled quartz wool strips into the primary side (furnace) of the combustion tube until the rolls are properly positioned in the combustion tube. Refer to Figure 6-37, page 6–48, or Figure 6-38, page 6–49, depending on the instrument configuration.
13. Install a new crucible and reinstall the lance by completing steps 1 through 4 of Installing the Crucible, beginning on page 6–32.
14. **For CN828, FP828P, and FP828 models only:** Complete the following steps to finish packing the combustion tube. Refer to Figure 6-37, page 6–48.
    A. Using the quartz wool extractor tool, push approximately nine rolled quartz strips into the secondary side (afterburner) of the combustion tube, leaving enough room to allow the honeycomb to sit just below the top edge of the tube.
    B. Insert a honeycomb ceramic plug into the secondary side (afterburner) of the combustion tube until it rests on the quartz wool. The top of the honeycomb should remain just below the top edge of the tube.
15. **For CHN828 model only:** Complete the following steps to pack the afterburner secondary reagent tube. Refer to Figure 6-38, page 6–49.
    A. Cut one quartz wool strip in half.
    B. Roll the half-strip into a cylinder, making sure that the outside diameter matches the inside diameter of the reagent tube.
    C. Using the crucible extractor tool (from the Accessory pack), push the rolled quartz wool strip to the bottom of the tube.
    D. Repeat steps B and C with the second half-strip.
    E. Pour 25 g of secondary furnace reagent into the tube.
    F. Cut another quartz wool strip in half, and roll each half-strip into a cylinder, as described in step B, previous.

G. Using the crucible extractor tool, push two more rolled quartz half-strips on top of the reagent.

H. Gently insert the middle tube into the secondary side (afterburner) of the combustion tube, and then insert the packed secondary reagent tube into the middle tube.

16. Reinstall the afterburner cap removed in step 8, page 6–46.
17. Reinstall the furnace top shelf removed in step 6, page 6–45.
18. Reinstall the loading head onto the instrument, and tighten the four captive screws using a flat-blade screwdriver. If the captive screws do not thread smoothly, refer to Aligning the Loading Head, page 9–12.
19. In the software, navigate to Instrument ⮚ Maintenance ⮚ General Maintenance.
20. Under Heaters/Coolers, select On next to Afterburner Heater and Furnace Heater.
21. Turn On the gas by selecting Gas on the Action bar and then selecting On.
22. Perform and pass a Furnace leak check. Refer to Leak Check, page 8–12.
23. In the software, navigate to Instrument ⮚ Maintenance ⮚ General Maintenance.
24. Under Heaters/Coolers, select On next to Afterburner Heater and Furnace Heater. Allow the temperatures to reach the setpoints and stabilize before continuing.
25. Perform and pass a Furnace leak check. Refer to Leak Check, page 8–12.
26. **OPTIONAL:** Install the furnace viewing mirror. Refer to Installing the Furnace Viewing Mirror, page 6–80.

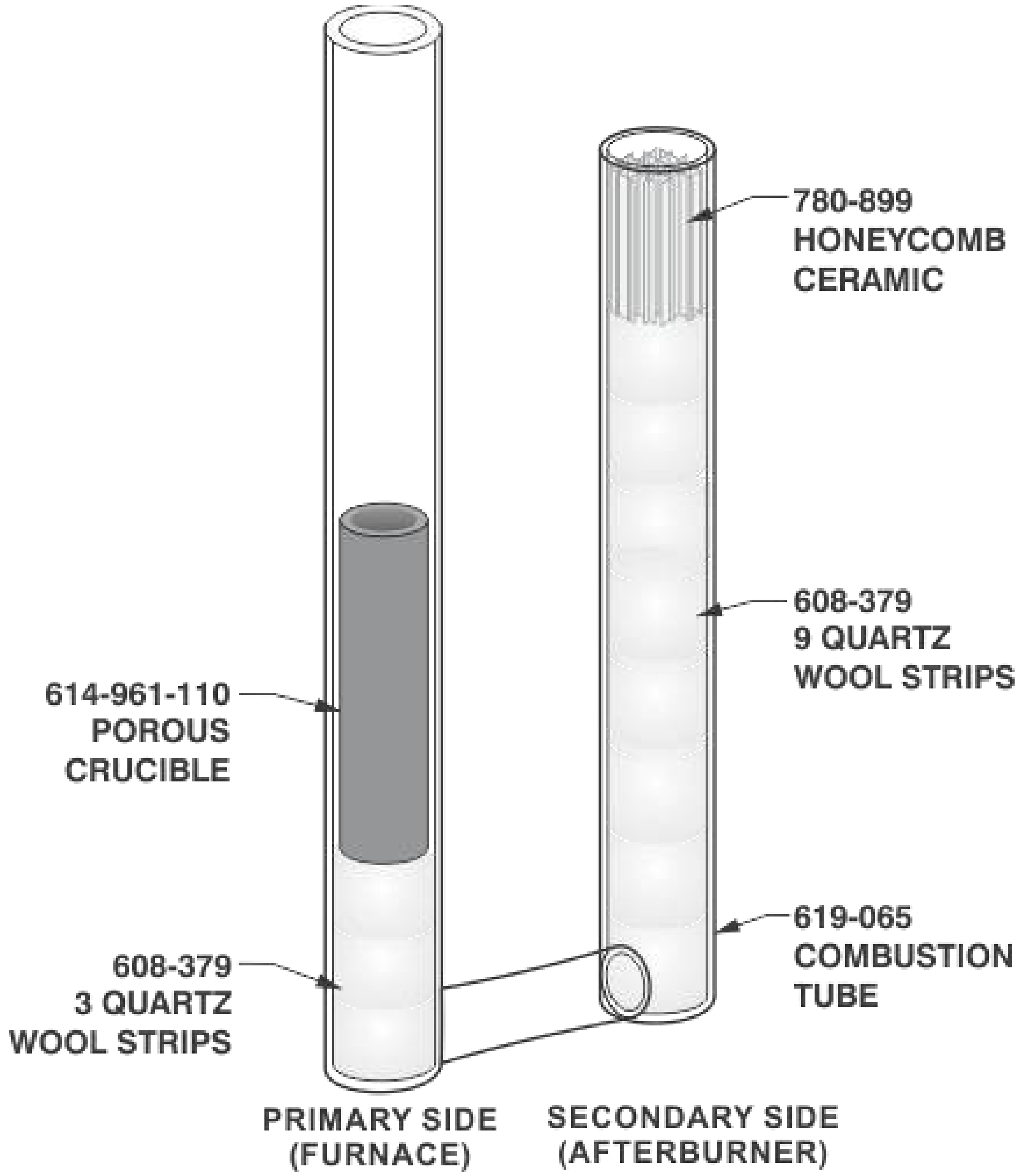


Figure 6-37
CN/FP Combustion Tube Packing

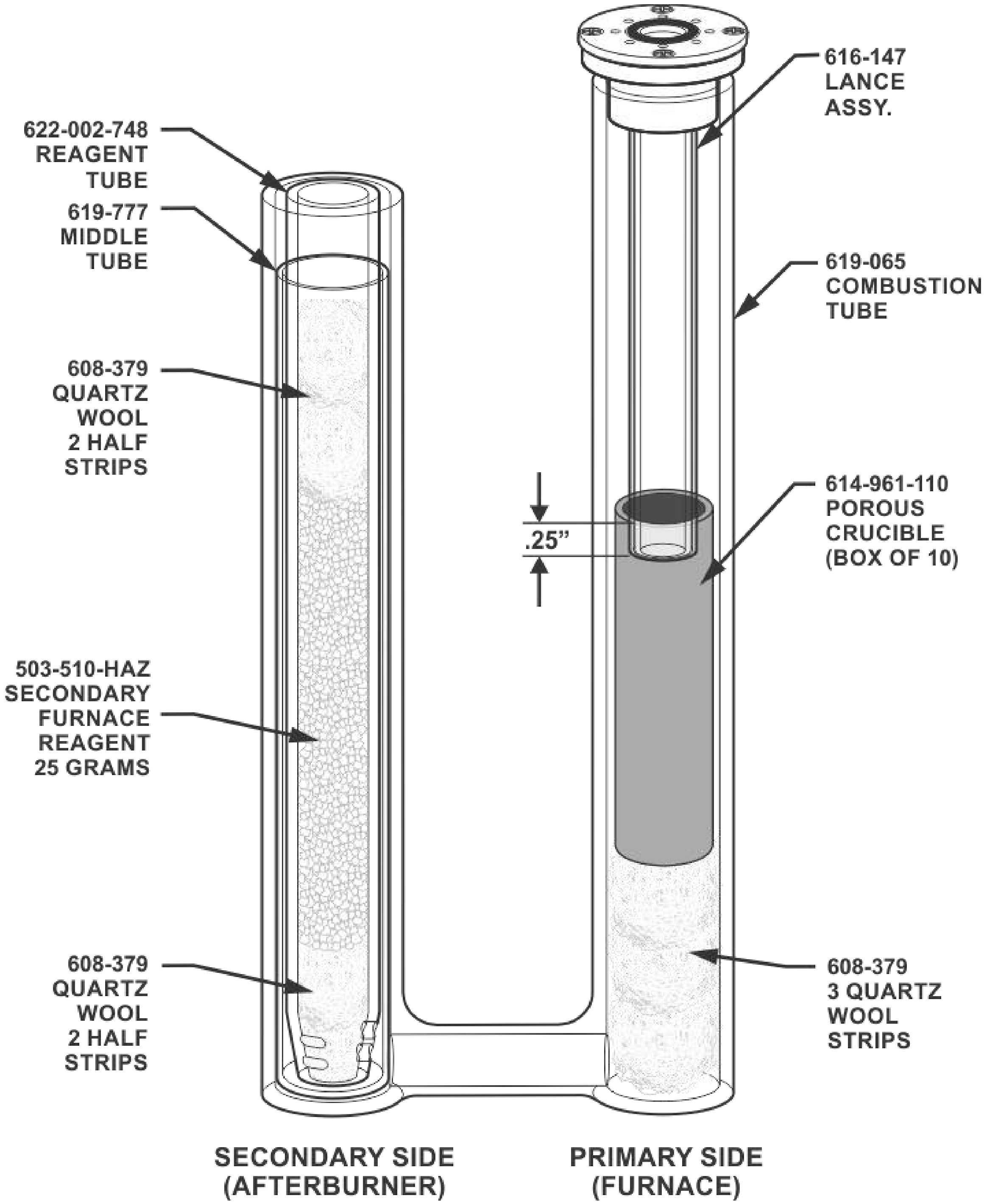


Figure 6-38
CHN Combustion Tube Packing

Replacing the Furnace Transfer Tubing

Inspect the furnace transfer tubing at the top of the primary filter daily for discoloration. When the tubing is discolored or results have diminished, further inspect or replace the tubing by completing the following steps.

1. In the software, turn On the gas by selecting Gas on the Action bar and then selecting On.
2. Perform and pass a Furnace Leak check. Refer to Leak Check, page 8–12.
3. In the software, turn Off the gas by selecting Gas on the Action bar and then selecting Off.

HIGH TEMPERATURE WARNING
BURN HAZARD
Allow the reduction heater and furnace to cool to room temperature before continuing.

4. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Toggle the switches to turn Off the Furnace Heater and Afterburner Heater. Allow the furnace and afterburner heaters to cool to room temperature before continuing.
5. Exit the software. Refer to Exiting the Software, page 3–19.

HAZARDOUS VOLTAGE WARNING
This equipment operates from a 230V~ source. Contact with this voltage can be fatal. Disconnect the instrument from the facility AC power source before continuing with this procedure.

6. Turn Off the analyzer, and disconnect the instrument from facility AC power.
7. Refer to steps 2 through 4 of Removing the Loading Head, page 6–25, to remove the loading head.

8. Lift up and remove the furnace top shelf. Refer to Figure 6-39, following.

Figure 6-39
Furnace Top Shelf

9. Unscrew the swage fitting at the afterburner interface cap, and then pull the $^{1}/_{4}$-inch PFA tubing from the fitting. Refer to Figure 6-40, following.

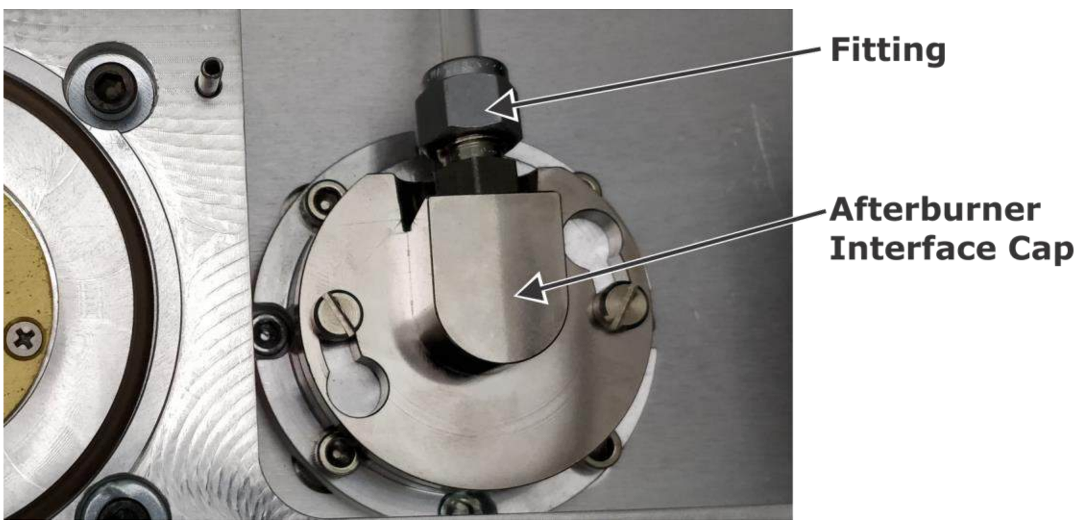


Figure 6-40
Swage Fitting

10. Open the instrument front door.
11. **For CHN828 model only:** Using a Phillips screwdriver, remove the two screws at the top of the filter slide door cover. Lift the door cover up and out, and set it aside. Refer to Figure 6-41, following.

Figure 6-41
Filter Slide Door Cover

12. Using an *Allen* wrench (hex wrench), remove the two screws that hold on the primary filter cap. Refer to Figure 6-42, following.

Figure 6-42
Primary Filter Cap Screws

13. Disconnect the $^{1}/_{4}$-inch PFA tubing from the top of the primary filter.

14. **For CN828, FP828P, and FP828 models only:** Remove the filter mounting bracket assembly by completing the following steps.

    A. Disconnect the C-Flex tubing from the bottom of the primary filter tube and from the bottom of the particle filter. Refer to Figure 6-43, following.

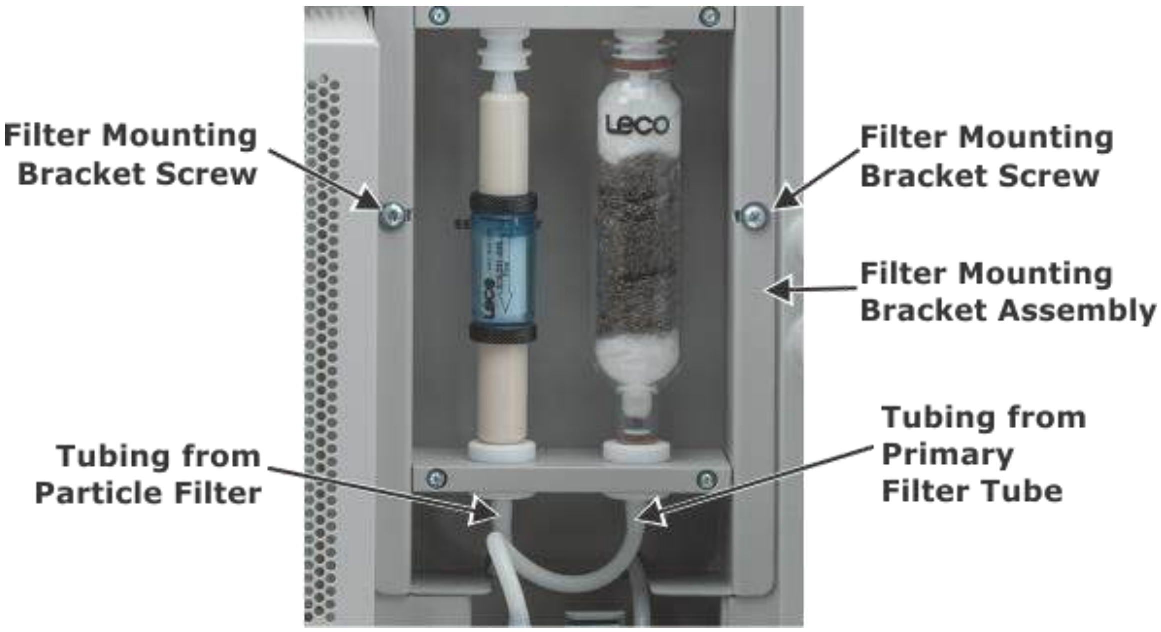


Figure 6-43
Filter Mounting Bracket

    B. Using a Phillips screwdriver, remove the two filter mounting bracket screws. Refer to Figure 6-43, previous.

    C. Pull the filter mounting bracket assembly away from the cabinet, and set it on the work station in front of the instrument. Refer to Figure 6-43, previous.

15. Slide the primary filter cap off of the $^{1}/_{4}$-inch PFA tubing, and set the cap aside. Refer to Figure 6-42, page 6–52.

16. Pull the $^{1}/_{4}$-inch PFA tubing through the grommet near the furnace.

17. Replace with new furnace transfer tubing by completing the following steps. Use the 828 Furnace Transfer Line Replacement Kit; refer to Options, page 1–45. If not using the Replacement Kit, replace with 783-771 $^{1}/_{4}$” replacement tubing.
    A. Cut the new PFA tubing to the same length as the old tubing, or 30 inches (76.2 cm) overall.
    B. Feed the new tubing through the grommet into the furnace area, and route the tubing as shown in the following illustrations. Refer to Figure 6-44, following, or Figure 6-45, page 6–55, depending on the instrument configuration.

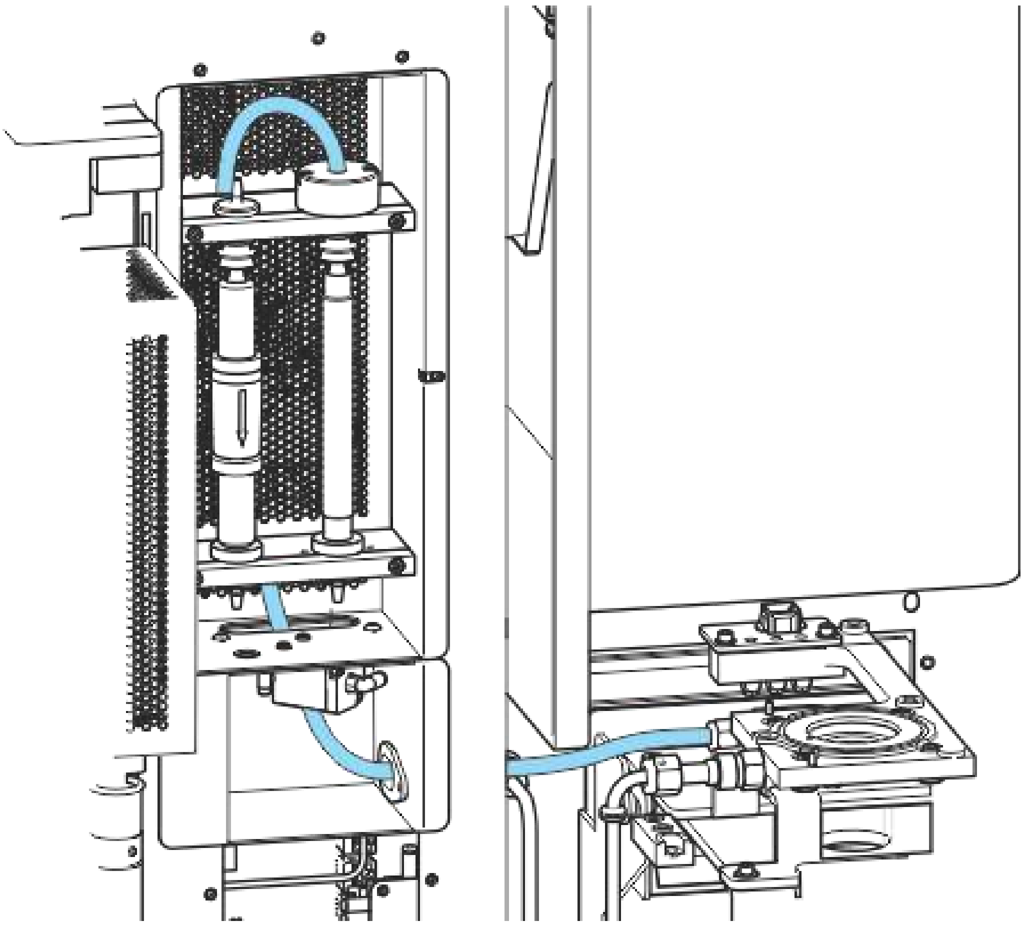


Figure 6-44
CHN Tubing Routed

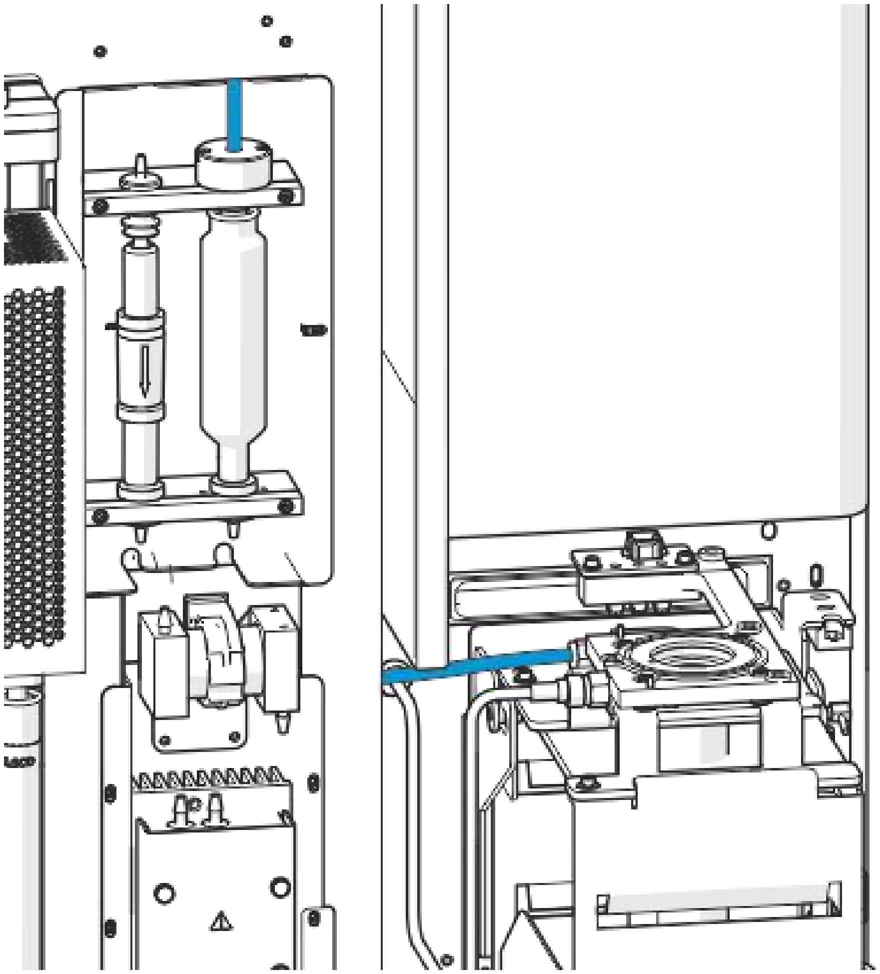


Figure 6-45
CN/FP Tubing Routed

C. Replace the old ferrules with new ones. The nuts can be reused. Refer to Figure 9-7, page 9–17, for the correct installation and orientation of the nut and ferrules.

D. Connect the new tubing at the swage fitting on the afterburner interface cap. Use the method described in Assembly, page 9–17.

18. Reinstall the primary filter cap by completing the following steps.

A. Push the new tubing through the primary filter cap and through a new flouroelastomer sleeve, ensuring that the end of the tubing extends through the ring by about $^{1}/_{4}$".

B. Insert the $^{1}/_{4}$-inch PFA tubing into the top of the primary filter.

C. Using an Allen wrench (hex wrench), reinstall the two screws previously removed in step 12.

19. **For CN828, FP828P, and FP828 models only:** Reinstall the filter mounting bracket assembly by completing the following steps.

    A. Remove the pre-cooler block by unclasping the clamp. Refer to Figure 6-62, page 6–76. Set aside the pre-cooler block.

    B. Return the filter mounting bracket assembly to the cabinet, making sure the tubing runs through the two slots in the bottom of the filter mounting bracket as follows. Refer to Figure 6-46, following.

    - Tubing from the particle filter: from inside the cabinet and out through the left slot.
    - Tubing from the TE cooler: from outside the cabinet and in through the right slot.

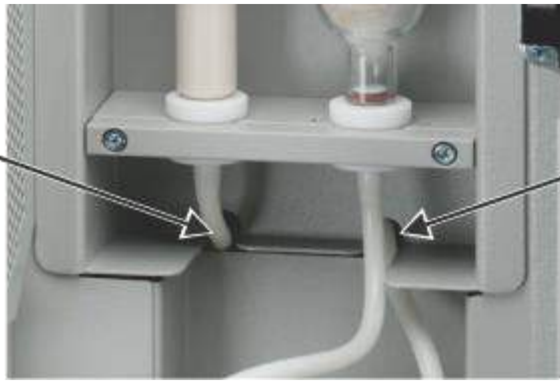


Figure 6-46
Slots in Furnace Mounting Bracket

    C. Using a Phillips screwdriver, reinstall the two filter mounting bracket screws removed in step 14.B, page 6–53.

    D. Reconnect the tubing to the bottom of the particle filter. Refer to Figure 6-43, page 6–53.

    E. Reinstall the pre-cooler block, removed in step A, previous.

    F. Reconnect the tubing to the bottom of the primary filter tube. Refer to Figure 6-43, page 6–53.

20. **For CHN828 model only:** Reinstall the filter slide door cover (removed in step 11, page 6–52) by sliding the door cover down into the slot and then reinstalling the two Phillips screws.

21. Close the instrument front door.

22. Reinstall the furnace top shelf removed in step 8, page 6–51.

23. Reinstall the loading head onto the instrument, and tighten the four captive screws using a flat-blade screwdriver. If the captive screws do not thread smoothly, refer to Aligning the Loading Head, page 9–12.

24. Reinstall the sample carousel, making sure the alignment pin correctly references the loading head, and the arrow is pointed to the combustion tube opening.

25. Plug the analyzer into facility power, and turn it On.
26. Double-click the instrument software desktop icon 

to start the software.
27. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Select Off next to each heater to turn Off all heaters.
28. Wait for the temperature and the TC cell to stabilize.
29. Perform a Furnace Segment leak check. Refer to Leak Check, page 8–12.
30. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Select On next to each heater to turn On all heaters, and wait for stabilization.
31. In the software, turn On the gas by selecting Gas on the Action bar and then selecting On.
32. Perform a Furnace Segment leak check and correct any leaks. Refer to Leak Check, page 8–12.

Cleaning the Ballast Assembly

NOTE If the ballast portion of the oxygen leak check fails repeatedly and no leaks are found in other areas, a dirty ballast tank could be the cause.

Removing the Ballast Assembly

1. In the software, turn On the gas by selecting Gas on the Action bar and then selecting On.
2. Perform and pass a Filled Ballast and Doser Leak check. Refer to Leak Check, page 8–12.
3. In the software, turn Off the gas by selecting Gas on the Action bar and then selecting Off.
4. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Toggle the switch to turn Off the Ballast Oven and Fan.
5. Using a Phillips screwdriver, remove the three screws at the bottom of the left side panel. Lift up on the side panel and remove it.
6. **For CN828, FP828P, and FP828 models only:** Remove the pinch valve plate by completing the following steps.

   A. Locate the pinch valve plate mounted in front of the ballast assembly. Refer to Figure 6-47, following.

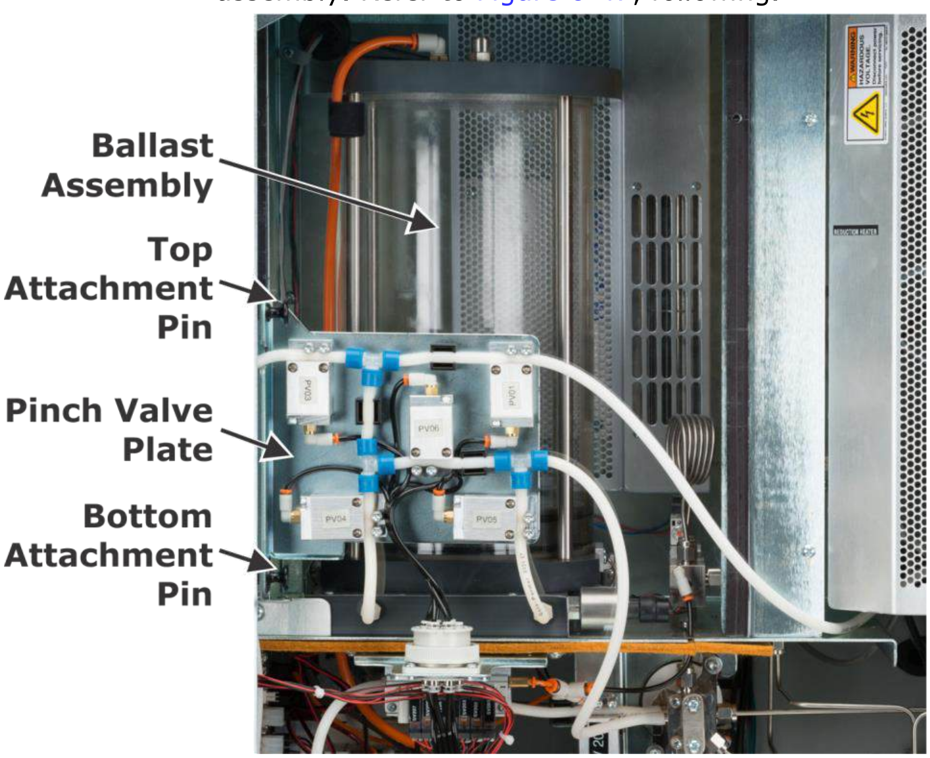


Figure 6-47
Pinch Valve Plate

B. Pull the top attachment pin to disconnect the pinch valve plate. Rotate the pinch valve plate where it is attached at the bottom pin, and then let the plate hang down below the ballast oven. Refer to Figure 6-47, previous.

7. **For models with a ballast oven cover only:** Remove the two thumbscrews at the top of the polycarbonate ballast oven cover, and remove the cover.

8. Unlock the latches on either side of the base at the bottom of the ballast assembly. Refer to Figure 6-48, following.

NOTE Depending on the instrument configuration, the area surrounding the ballast assembly may differ from what is shown in Figure 6-48, following.

9. Lift the ballast assembly from the bottom and remove it from the cabinet. Refer to Figure 6-48, following.

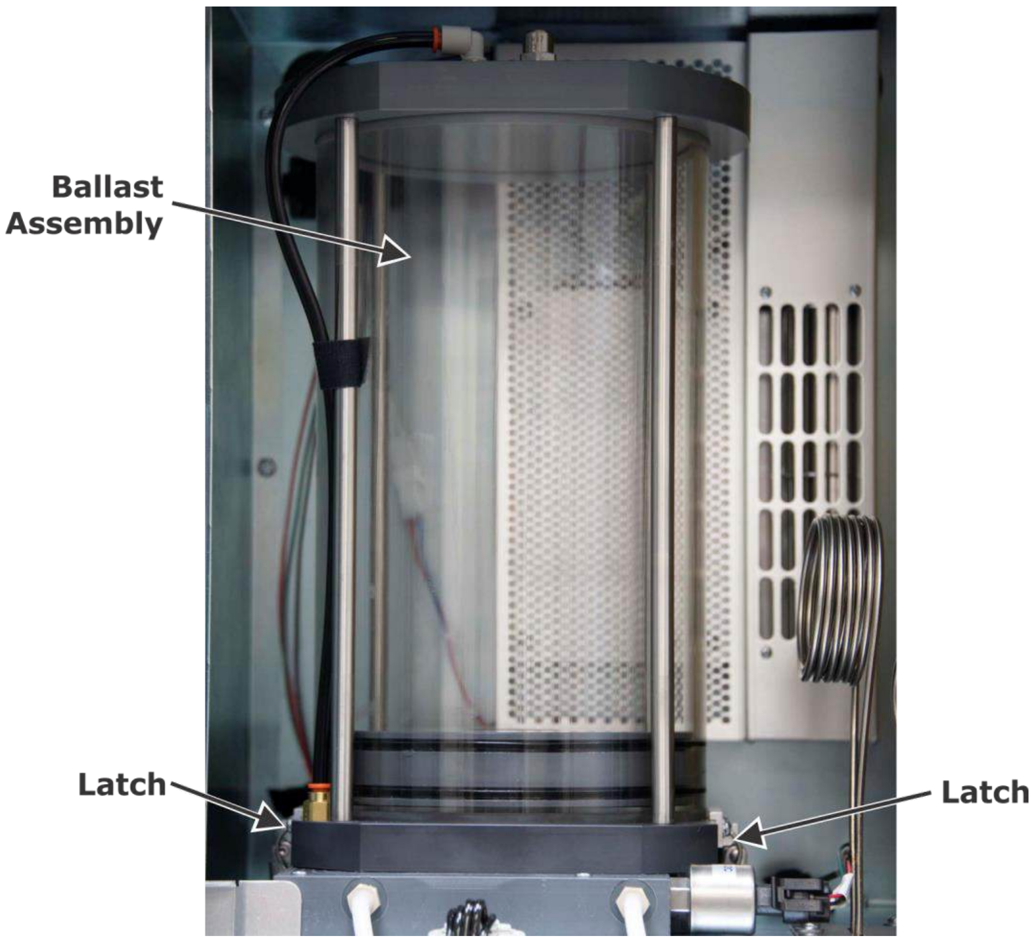


Figure 6-48
Ballast Assembly Removal

Cleaning the Ballast Assembly

1. Disassemble the ballast. Refer to Figure 10-33, page 10–38.
2. Remove the piston o-rings and neoprene gaskets.
3. Wash the piston with soapy water. Rinse the piston and let it air dry, or wipe it dry with a lint-free cloth.
4. Wash the ballast tank and ballast base (if needed) with soapy water. Rinse and let them air dry, or wipe them dry with a lint-free cloth.
5. Wipe the ballast top clean, and (if needed), wash with soapy water. Ensure that the grooves of the ballast base, ballast top, and piston o-rings are clean. If necessary, wipe with the end of a foam swab from the Accessory Pack.
6. Clean and grease new o-rings and neoprene gaskets. Refer to Cleaning and Greasing the O-Rings, page 6–9. Apply a thin coating of vacuum grease.
7. Install the new o-rings onto the piston.
8. Install the new neoprene gaskets into the ballast base and ballast top grooves.
9. Lightly grease the inside of the ballast tank by completing the following steps.
    A. Carefully position the ballast tank on its side. Use your fingers to dab grease along the length of the tank. Rotate the ballast 90°, and dab grease along the length of the tank again. Rotate the ballast 90° two more times, dabbing grease each time.
    B. Spread the grease around the inside of the tank, rotating the ballast to focus more on even spread around the inside circumference than on even spread along the length. Make sure there are no clumps of grease remaining.
    C. Carefully position the ballast tank so that the rim hangs over the edge of the bench, just enough to let air escape.
    D. Install the piston into the ballast tank.
    E. Push the piston down the ballast tank until it sits just above the bench.
    F. Flip over the ballast tank, and push the piston down again.
    G. Repeat step F until a thin, uniform film of grease can be felt along the entire inside of the ballast. Add grease as needed to ensure that the piston slides freely and that there are no dry spots on the inside of the tank.
    H. Wipe the excess grease from the top and bottom surfaces of the piston.
    I. Vertical smear lines appearing from the piston traveling through the grease is a good indicator that the ballast is well-greased.

10. Reassemble the ballast assembly by completing the following steps.
    A. Insert the ballast tank into the ballast base with the smooth side of the piston facing down.
    B. Ensure that the four rods are screwed to the ballast base.
    C. Place the ballast top onto the ballast tank, making sure that the gasket remains in place.
    D. Alternately tighten the top four screws into the rods in an X-pattern until the rods come into contact with the ballast top. Do not overtighten the screws.

Installing the Ballast Assembly

1. Reinstall the ballast assembly into the instrument by setting the assembly into the base. The ballast assembly will install in only one orientation: the tubing will be in the front.
2. Lock the latches on either side of the base at the bottom of the ballast assembly.
3. If the ballast oven cover was removed in step 7 of Removing the Ballast Assembly, page 6–59, reinstall the cover by holding the cover in place and reinstalling the two thumbscrews.
4. **For CN828, FP828P, and FP828 models only:** Reinstall the pinch valve plate (removed in step 6 of Removing the Ballast Assembly, page 6–58), by completing the following steps.
    A. Rotate the pinch valve plate and, making sure the top attachment pin is not pushed in, align the pin with the hole in the mounting bracket.
    B. Insert the attachment pin into the hole, and snap it into place.
5. Using a Phillips screwdriver, reinstall the left side panel.
6. In the software, turn On the gas by selecting Gas on the Action bar and then selecting On.
7. Perform and pass a Filled Ballast and Doser Leak check. Refer to Leak Check, page 8–12.
8. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Toggle the switch to turn On the Ballast Oven and Fan.
9. Wait for the temperature to stabilize. In the software, select Diagnostics, and then select the Ambient tab. Monitor the Ballast Oven Temperature reading. For more information, refer to Ambient Monitor Ranges, page 8–7.
10. Perform and pass a Filled Ballast and Doser Leak check. Refer to Leak Check, page 8–12.

Replacing the Pinch Valve Tubing

The pinch valve tubing on the left side panel should be replaced every four months, or sooner, depending on use and application.

1. Turn Off the gas.
2. Using a Phillips screwdriver, remove the three screws at the bottom of the left side panel. Lift up on the side panel and remove it.
3. Locate the pinch valve plate. The location depends on the instrument configuration.
   - **For CN828, FP828P, and FP828 models only:** The pinch valve plate is mounted in front of the ballast oven. Refer to Figure 6-49, following.

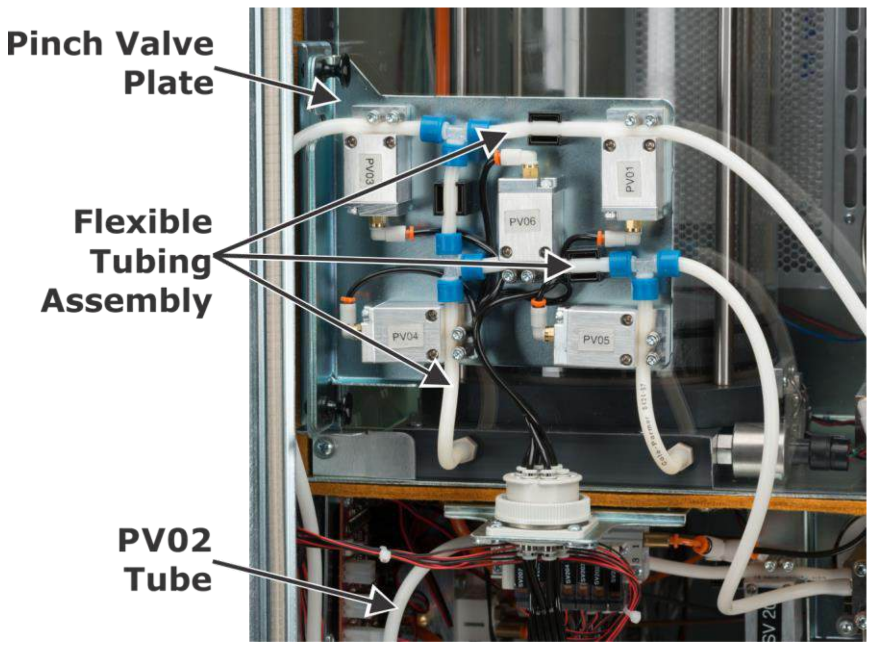


Figure 6-49
CN/FP Pinch Valve Assembly

- **For CHN828 model only:** The pinch valve plate is mounted inside the ballast oven, to the right of the ballast assembly. Remove the two thumbscrews at the top of the polycarbonate ballast oven cover, and then remove the cover. Refer to Figure 6-50, following.

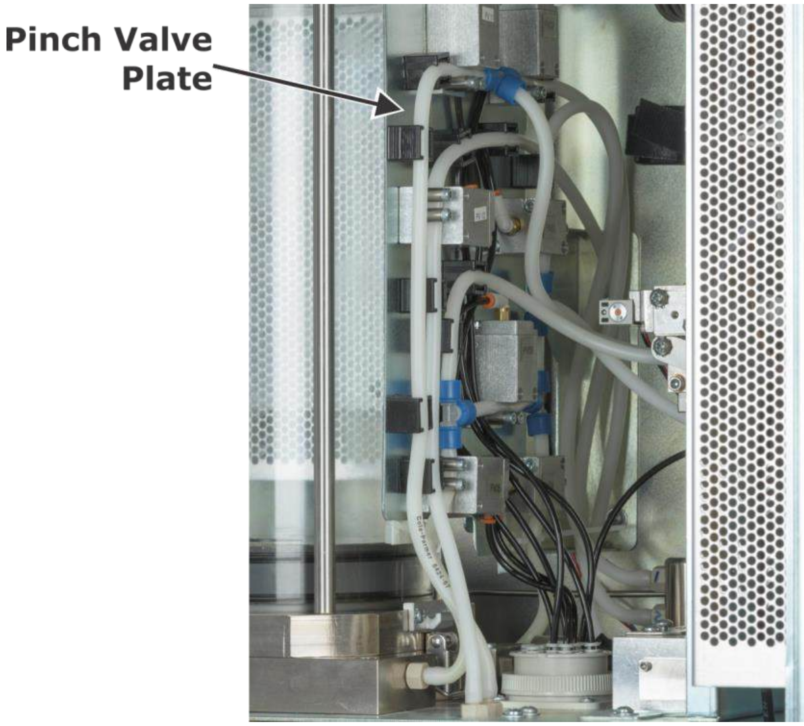


Figure 6-50
CHN Pinch Valve Assembly

4. Open the instrument front door, and then pull to disconnect the white flexible tubing from the bottom of the particle filter tube. Refer to Figure 2-1, page 2–6, or Figure 2-2, page 2–7, depending on the instrument configuration, for the location of the particle filter tube.

5. **For CHN828 model only:** Using a Phillips screwdriver, remove the two screws at the top of the filter slide door cover. Lift the door cover up and out and set aside. Refer to Figure 6-41, page 6–52, for the location of the filter slide door cover.

   Disconnect the tubing from PV1, which is mounted under the floor of the filter housing. Refer to Figure 6-51, following.

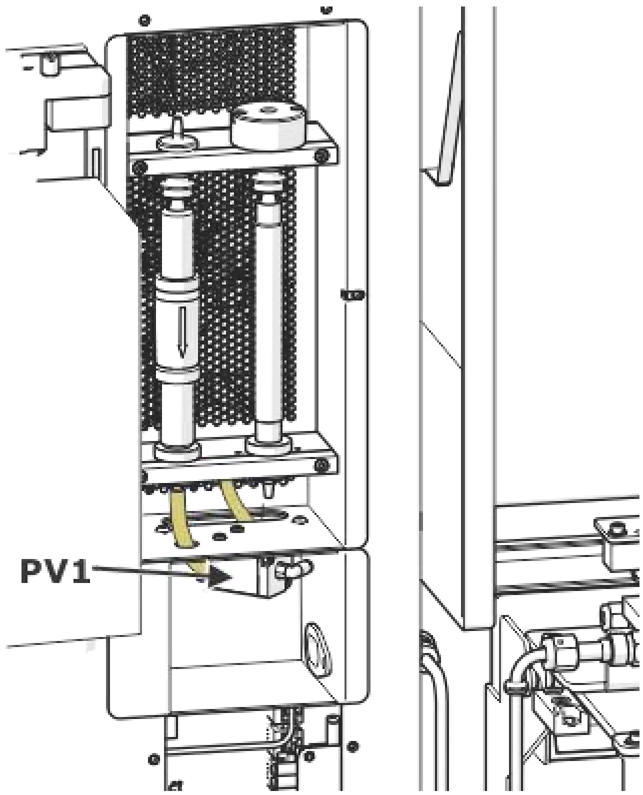


Figure 6-51
CHN Tubing Connected to PV1

6. From the left side of the instrument, pull to disconnect the white flexible tubing in four places (two on the ballast and one each on the exhaust and doser port G).
7. **For the CHN828 model only:** Pull to disconnect the white flexible tubing from the H_2O cell manifold (in two places) and from the exhaust manifold (in three places). Refer to Figure 6-52, page 6–66.
8. Replace the white flexible tubing by completing the following steps for the instrument configuration. When inserting the white flexible tubing into the valves, make sure it is pushed completely into the connection points on the pinch valves and into the black tubing holders.

NOTE For proper operation, the white flex tubing running through the pinch valves must be routed straight as it enters and exits each pinch valve.

For CN828, FP828P, and FP828 models only:

- Replace the tubing assembly with the 622-002-319 replacement Pinch Valve Tubing Assembly by removing the old white flexible tubing assembly and installing the new tubing assembly. Position the tubing as shown in Figure 6-49, previous.
- Replace the two individual c-flex tubes with 601-691 C-Flex Tubing cut to the same lengths as the old tubing in the locations described as follows. Refer to Figure 6-49, page 6–62, and Figure 6-62, page 6–76.
    - From behind the instrument front door, the first tube routes from the drain through PV07 and to the flask. Refer to Figure 6-62, page 6–76.
    - The second tube routes from doser port B to the exhaust. Refer to "PV02 Tube" in Figure 6-49, page 6–62.

For CHN828 model only:

- Remove the old white flexible tubing assemblies and install the new tubing assemblies in the locations described as follows. Position the tubing as shown in Figure 6-52, page 6–66.
    - Replace the upper tubing assembly with the 622-002-632 replacement Upper Pinch Valve Tubing Assembly.
    - Replace the lower tubing assembly with the 622-002-633 replacement Lower Pinch Valve Tubing Assembly.

- Replace the individual c-flex tube with 601-691 C-Flex Tubing cut to the same length as the old tubing from the H2O cell manifold to the exhaust manifold. Refer to Figure 6-52, following.

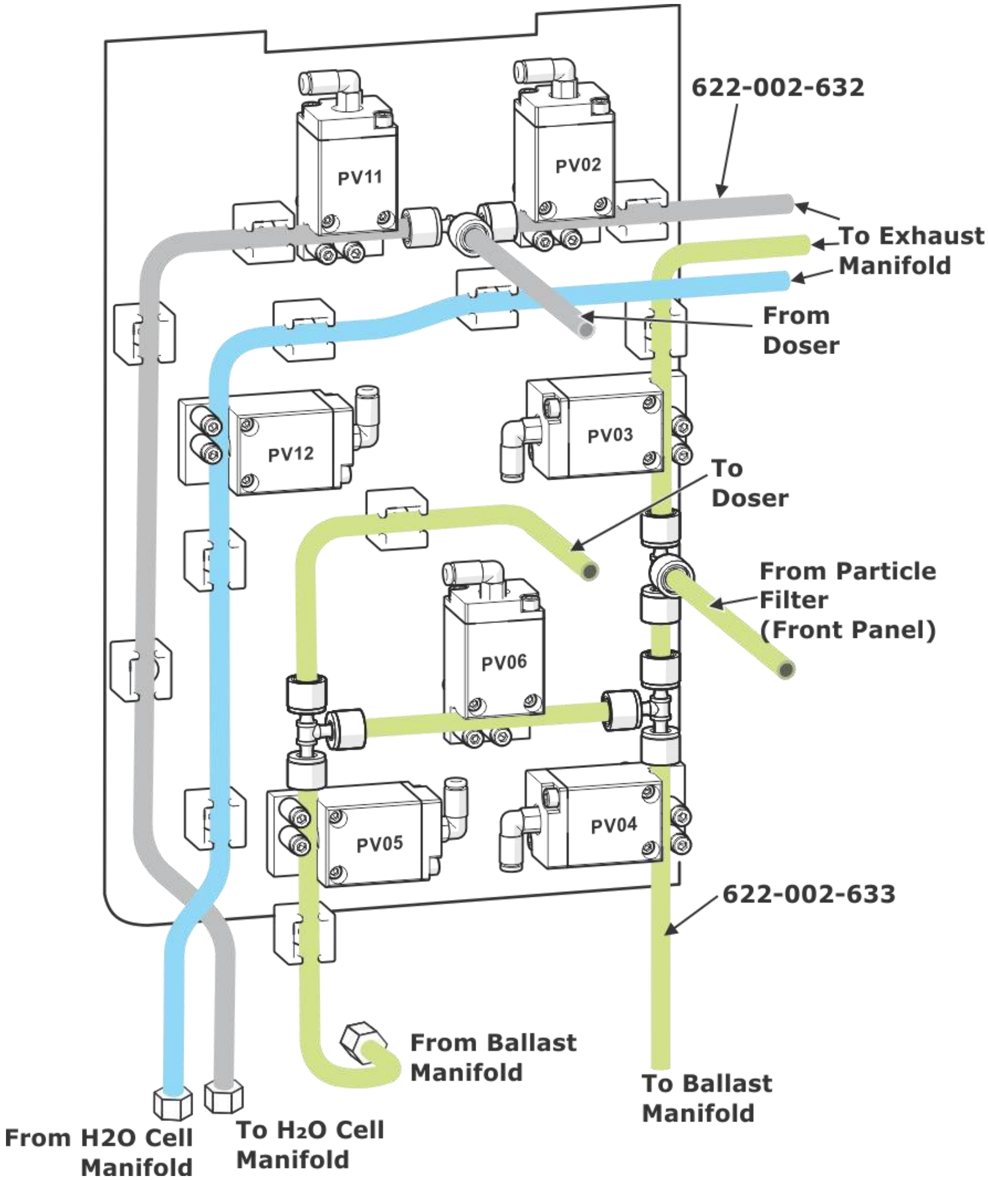


Figure 6-52
CHN828 Tubing Route

9. **For CHN828 model only:** Reinstall the filter slide door cover (removed in step 5, page 6–64) by sliding the door cover down into the slot and then reinstalling the two Phillips screws.
10. **For CHN828 model only:** Reinstall the ballast oven cover removed in step 3, page 6–62, by holding the cover in place and reinstalling the two thumbscrews.
11. Using a Phillips screwdriver, reinstall the left side panel.
12. Turn On the gas supplies.
13. Perform and pass a Leak Check. Refer to Leak Check, page 8–12.

Cleaning the Dosing Valve(s)

NOTE The dosing valve should be cleaned monthly to remove dirt and other contaminants that may cause the valve to leak.

1. In the software, turn Off the gas by selecting Gas on the Action bar and then selecting Off.
2. Using a Phillips screwdriver, remove the three screws at the bottom of the left side panel. Lift up on the side panel and remove it.
3. **For CHN828 model only:** Remove the two thumbscrews at the top of the polycarbonate ballast oven cover, and remove the cover.
4. Locate the dosing valves under the dosing loop(s).
   - **For CN828, FP828P, and FP828 models:** Located under the ballast cover.
   - **For CHN model:** Located inside the ballast oven.
5. Access the stem by completing the appropriate step, depending on your configuration.
   - **For models with a single dose loop:** Remove the top stem stop screw, and loosen the bottom stem stop screw. Refer to Figure 6-53, following.

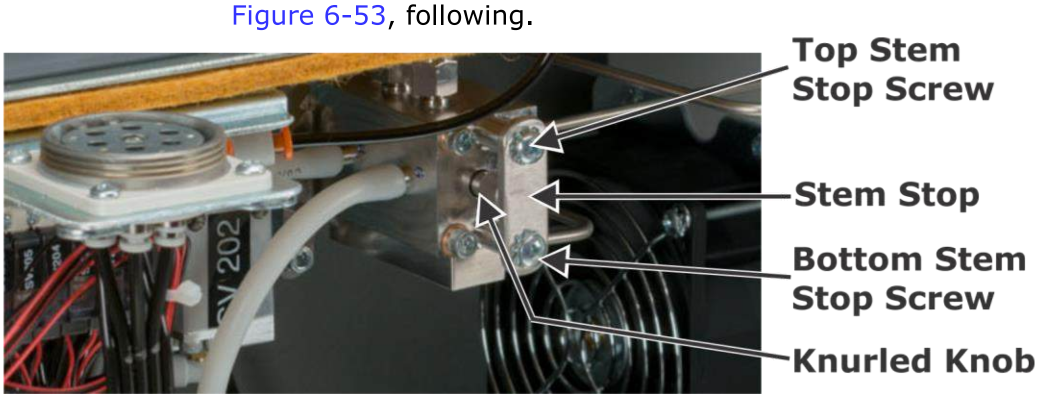


Figure 6-53
Dosing Valve – Single Dose Loop

- **For models with dual dose loops:**
  A. Models with dual dose loops have two valve stems: Dose Size Select (upper) and Dose State Select (lower). Locate the Dose State Select valve. Refer to Figure 6-54, following.

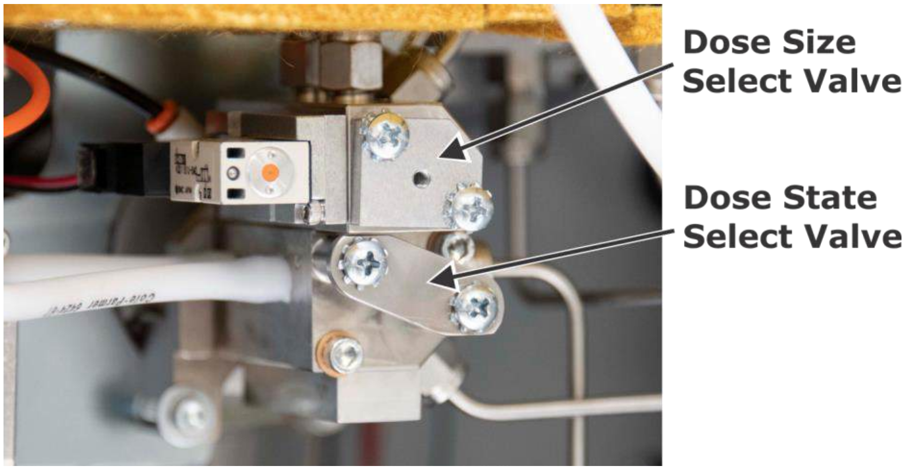


Figure 6-54
Dual Dose Valve Stems

  B. Using a Phillips screwdriver, remove the left stem stop screw, and then loosen the right stem stop screw. Refer to Figure 6-55, following.

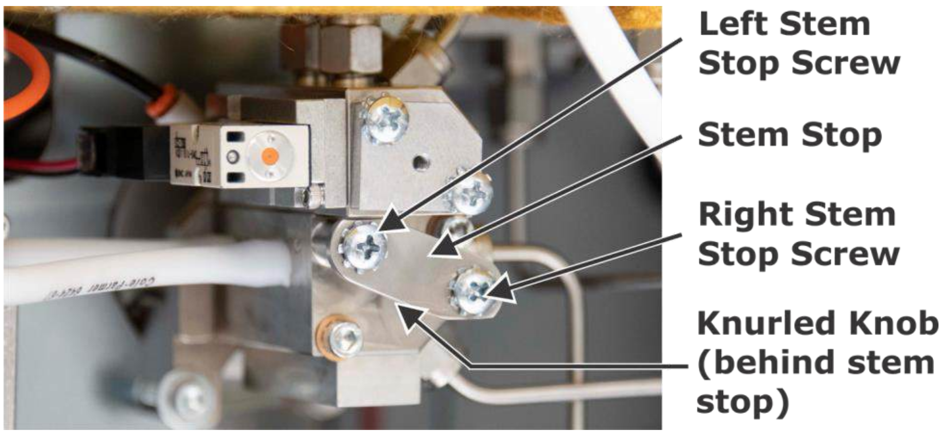


Figure 6-55
Dosing Valve – Dual Dose Loop

6. Turn the stem stop 180 degrees to access the stem.

7. Press in on the retaining clip and remove the valve stem by grasping the knurled knob and pulling it out. Refer to Figure 6-56, following.

NOTE Figure 6-56, following, shows the doser valve removed from the instrument in order to better show the location of the retaining clip.

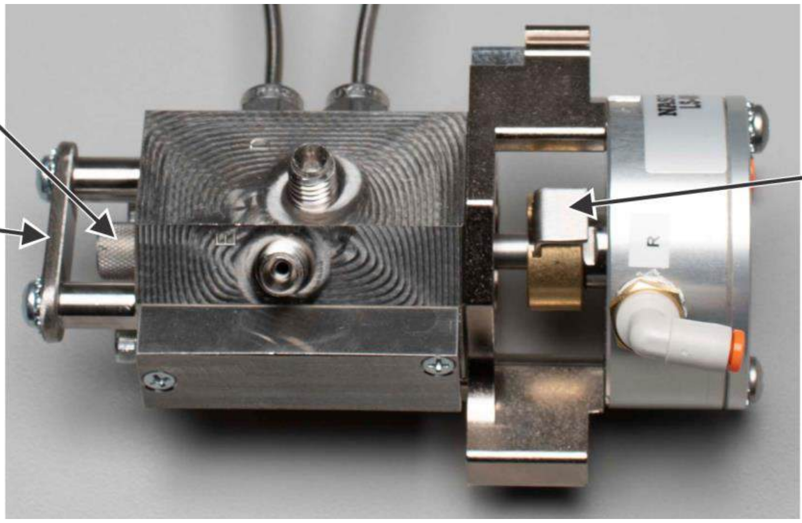


Figure 6-56
Retaining Clip

8. **For models with dual dose loops only:** Remove the Dose Size Select valve stem by completing the following steps.
   A. Locate the Dose Size Select valve. Refer to Figure 6-54, page 6–68.
   B. Using a Phillips screwdriver, remove the two screws in the valve stem cap. Refer to Figure 6-57, following.
   C. Thread the long end of the doser stem removal tool from the Accessory Pack into the valve stem cap, and pull out the cap. Unthread the cap from the tool. Refer to Figure 6-57, following.

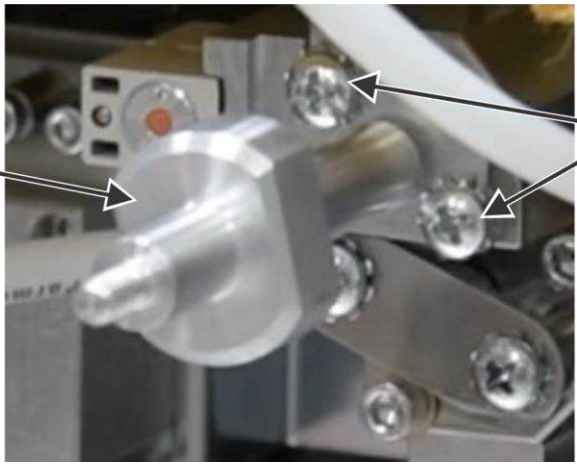


Figure 6-57
Valve Stem Cap Removal

D. Thread the long end of the doser stem removal tool into the valve stem body, and pull out the stem. Refer to Figure 6-58, following.

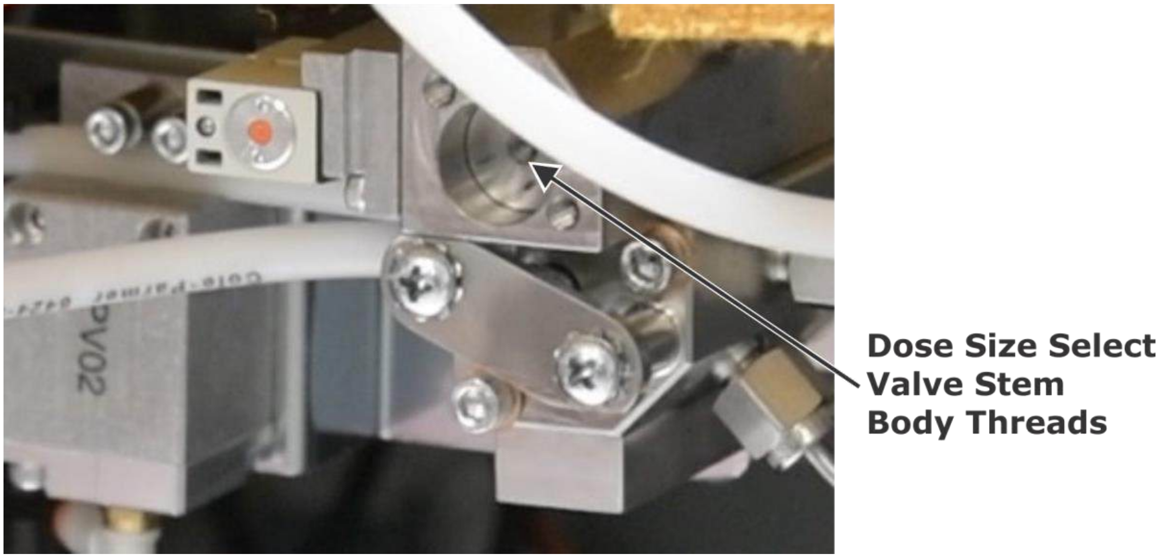


Figure 6-58
Valve Stem Removal

9. Use a foam wipe from the Accessory Pack to clean the inner bores of the valve blocks.
10. Wipe the valve stem(s) and apply a thin coat of vacuum grease to the o-rings. Refer to Cleaning and Greasing the O-Rings, page 6–9.
11. **For models with dual dose loops only:** Reinstall the Dose Size Select valve stem by completing the following steps.
    A. Reinstall the valve stem by pushing it into the dose size select valve bore (upper bore).
    B. Reinstall the valve stem cap by pushing it onto the dose size select valve block (upper block), aligning the angled side of both surfaces, and then reinstall the two screws removed in step 8.B, page 6–69, using a Phillips screwdriver.
12. Press in on the retaining clip and reinsert the valve stem into the dose state select valve bore until the valve stem locks into place.
13. Turn the valve stem stop 180 degrees and install the two screws.
14. **For CHN828 model only:** Reinstall the ballast oven cover removed in step 3, page 6–67, by holding the cover in place and reinstalling the two thumbscrews.
15. Reinstall the side panel.
16. Turn On the gas.
17. Perform and pass a Leak Check. Refer to Leak Check, page 8–12.

Cleaning the Touch Screen

CAUTION

DO NOT use alcohol (methyl, ethyl, or isopropyl) or any strong solvent. Do not use thinner or benzene, abrasive cleaners, or compressed air to clean the touch monitor.

Avoid getting liquids inside the touch screen. Never apply liquid directly on the screen. If liquid does get inside, have a qualified service technician check it before applying power.

Do not wipe the screen with a cloth or sponge that could scratch the surface.

There is no schedule for cleaning the touch screen. It can be performed as often as the user sees fit, depending on the cleanliness of the operation.

1. Turn Off the touch screen by pressing the Power button on the power strip attached to the back of the touch screen.
2. Disconnect the AC power cable.
3. To clean the touch-screen cabinet, use a cloth lightly dampened with a mild detergent.
4. To clean the touch-screen glass, use window or glass cleaner. Apply the cleaner to a clean cloth or sponge and wipe the screen. Never apply the cleaner directly to the screen.
5. Connect the monitor to AC power.
6. Turn On the touch screen by pressing the Power button on the power strip attached to the back of the touch screen.

Performing Air Filter Maintenance

There are two cabinet fan air filters located on the rear of the instrument. Maintenance should be performed on both air filters at the same time.

Air filters need to be replaced after eight cleanings, or when they begin to show wear.

1. Turn Off the analyzer and unplug it from facility power.
2. Pull out both filters from their location on the rear of the instrument. Refer to Figure 6-59, following.
3. There are two foam filters: gray (outer) and green (inner). Remove the two foam filters from their assembly.
4. Inspect the air filters every 3 to 6 months, and wash them in a mild solution of detergent and water when they are dirty. Allow them to air dry before reinstalling.
5. Reinstall the air filters when they are dry; or, replace the clean filters with spare filters, if available, and store for future use. The green filter installs first, against the analyzer, and the gray filter installs on top.

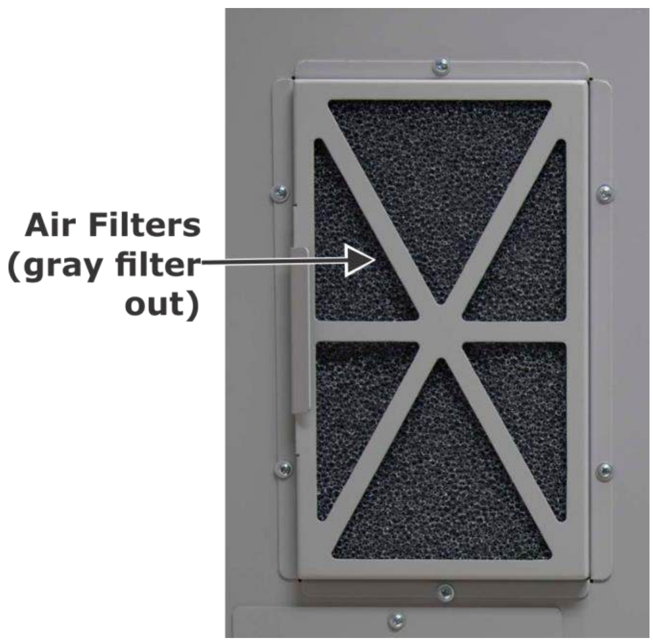


Figure 6-59
Cabinet Fan Air Filters

Switching the Dose Loop

NOTE This procedure applies only to FP828 instruments. For CHN828, CN828 or FP828P instruments, the dose loop size used in an analysis can be changed in the method settings. Refer to General Parameters, page 4–15.

The FP828 is shipped with a 3 cm^3 dose loop installed. The 3 cm^3 dose loop delivers a FP828 system optimized for maximized Reduction Tube and Dose scrubber reagent longevity. The 3 cm^3 dose loop configuration results in the Reduction Tube reagents requiring replacement approximately every 4500 analysis sequences and the dose scrubber every 2250 analyses.

Installing the optional 10 cm^3 dose loop delivers a FP828 system optimized for the lowest nitrogen range and best nitrogen precision. The 10 cm^3 dose loop configuration results in the Reduction Tube reagents requiring replacement approximately every 1500 analysis sequences and the dose scrubber reagents every 750 sequences.

1. Turn Off the gas.
2. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance. Toggle the switch to turn Off the Ballast Oven and Fan.
3. Using a Phillips screwdriver, remove the three screws at the bottom of the left side panel. Lift up on the side panel and remove it.
4. Remove the two thumbscrews at the top of the polycarbonate ballast oven cover, and remove the cover.
5. Locate the dose loop. The dose loop is located next to the ballast oven heater. Refer to Figure 6-60, page 6–74.

6. Remove the existing dose loop by completing the following steps.
   A. Loosen and remove the compression fittings from the doser assembly using the open-ended wrench from the accessory pack. Refer to Figure 6-60, following.
   B. Lift up the dose loop and slide it out through the slot in the front of the ballast oven. Refer to Figure 6-60, following.

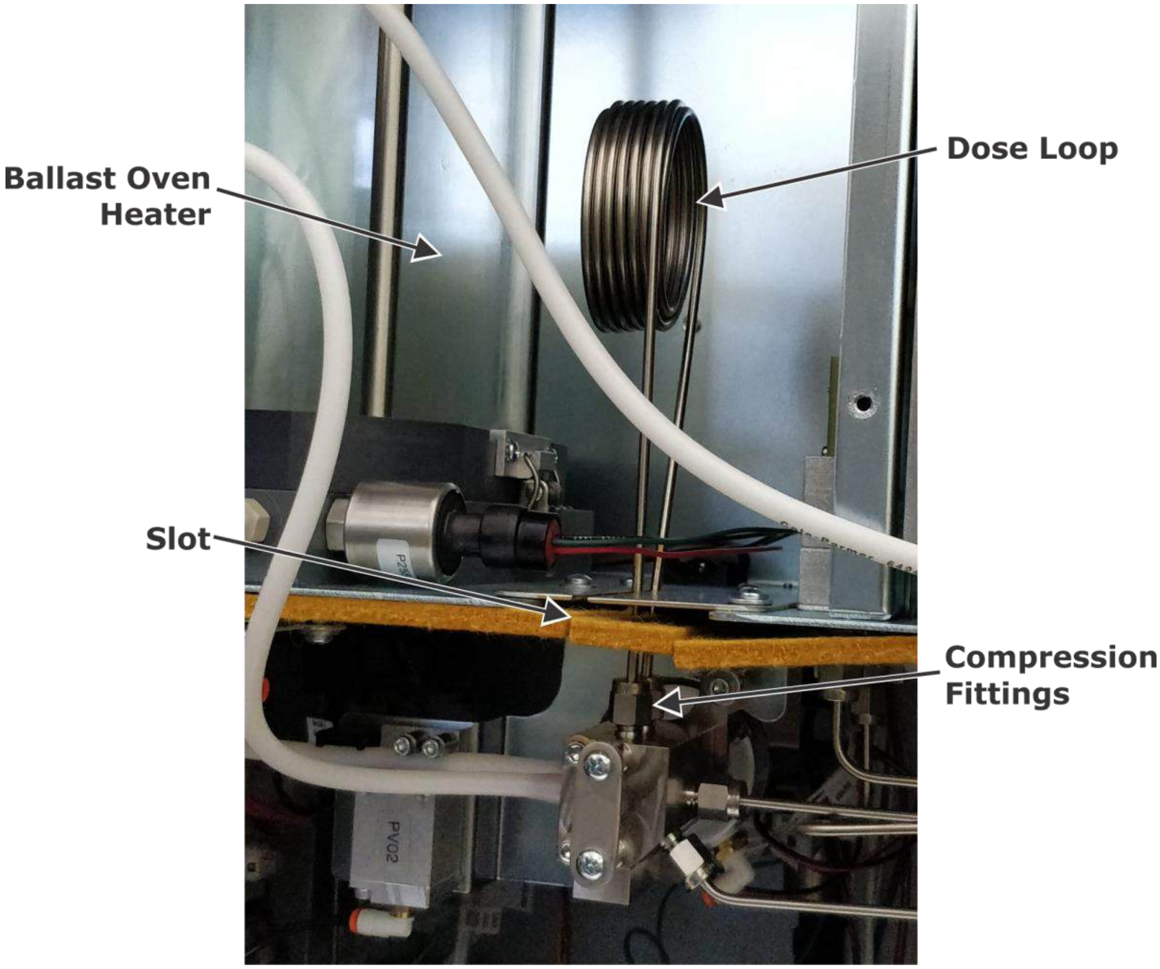


Figure 6-60
Dose Loop

7. Install the new dose loop by completing the following steps.
   A. Install the nut, back ferrule, and front ferrule onto one leg of the new dose loop tube. Refer to Figure 6-61, following, for the correct installation and orientation of the nut and ferrules.
   B. Repeat step A, previous, on the other leg of the dose loop tube.
   C. Slide the new dose loop through the slot in the front of the ballast oven case.
   D. Finger tighten the nuts. Refer to Assembly, page 9–17.
   E. Tighten the fittings $^{3}/_{4}$ turn past finger tight with the included open-ended wrench.

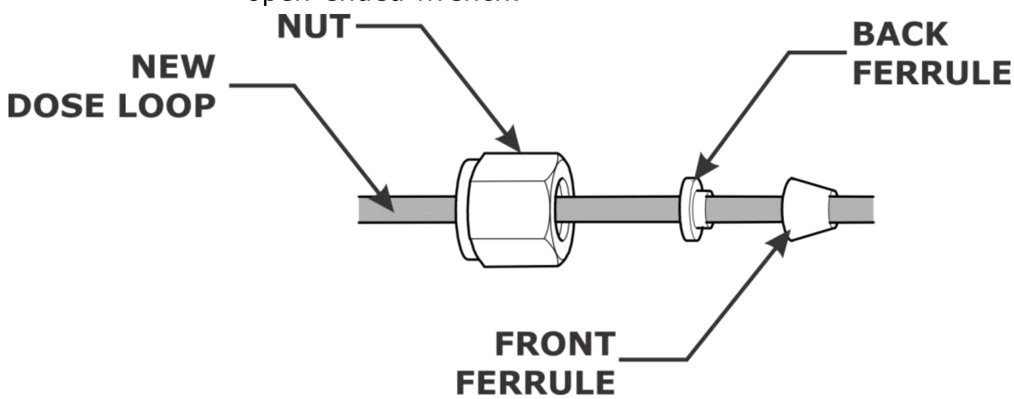


Figure 6-61
Ferrule Installation

8. Reinstall the ballast oven cover by holding the cover in place and reinstalling the two thumbscrews removed in step 4, page 6–73.
9. Reinstall the side panel.
10. Turn On the gas.
11. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance. Toggle the switch to turn On the Ballast Oven and Fan.
12. In the software, change the dose loop size setting to match the loop installed. Refer to Dose Loop Size, page 5–37.
13. Perform a leak check. Refer to Leak Check, page 8–12.

Cleaning the Thermoelectric Cooler (TEC) Module

NOTE The TEC module applies only to the CN828, FP828, and FP828P models.

1. In the software, turn On the gas by selecting Gas on the Action bar and then selecting On.
2. Perform and pass a Segmented System leak check. Refer to Leak Check, page 8–12.
3. In the software, turn Off the gas by selecting Gas on the Action bar and then selecting Off.
4. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Toggle the switch to turn Off the TE Cooler.
5. Allow the TE cooler to reach ambient temperature.
6. Open the instrument front door.
7. Locate the pre-cooler block on the front of the instrument, and disconnect the tubing going from the primary filter tube to the pre-cooler and the tubing going from the pre-cooler to the TEC module. Refer to Figure 2-2, page 2–7, and Figure 6-62, following.

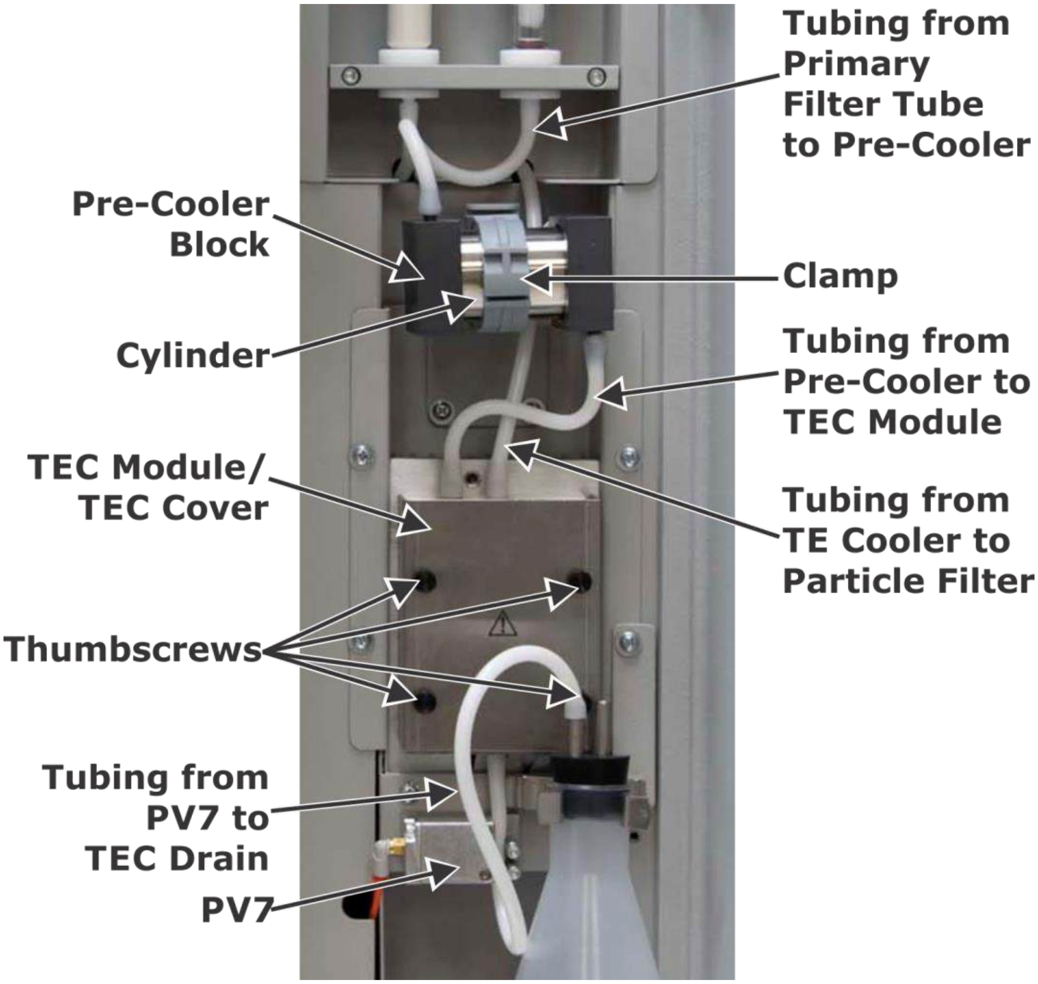


Figure 6-62
TEC Module

8. Remove the pre-cooler block by unclasping the clamp. Refer to Figure 6-62, previous.
9. Remove the four Phillips head screws to remove the clamp block plate, and disassemble the pre-cooler block by pulling the ends off of the middle tube. Refer to Figure 6-63, following.

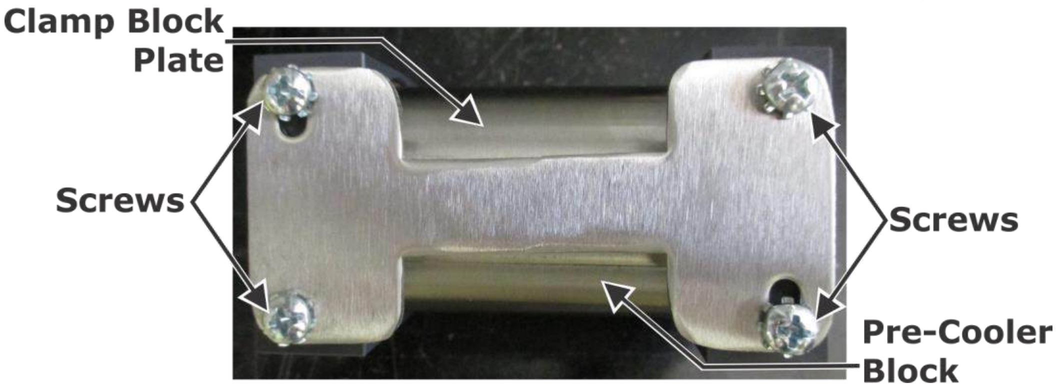


Figure 6-63
Pre-Cooler Block

10. Clean the inner diameter of the cylinder with paper towels and swabs. Clean and grease the o-rings on the end of the cylinder before reassembling the pre-cooler. Refer to Cleaning and Greasing the O-Rings, page 6–9.
11. Disconnect the tubing from the flask, and then pull the flask out of the clip.
12. Remove the four thumbscrews, and then remove the TEC cover. Refer to Figure 6-62, page 6–76.

CAUTION

To prevent instrument damage, do not remove the four black Torx® screws in the condensing block cover.

13. Remove the four Phillips head screws, and then remove the condensing block cover. Refer to Figure 6-64, following.

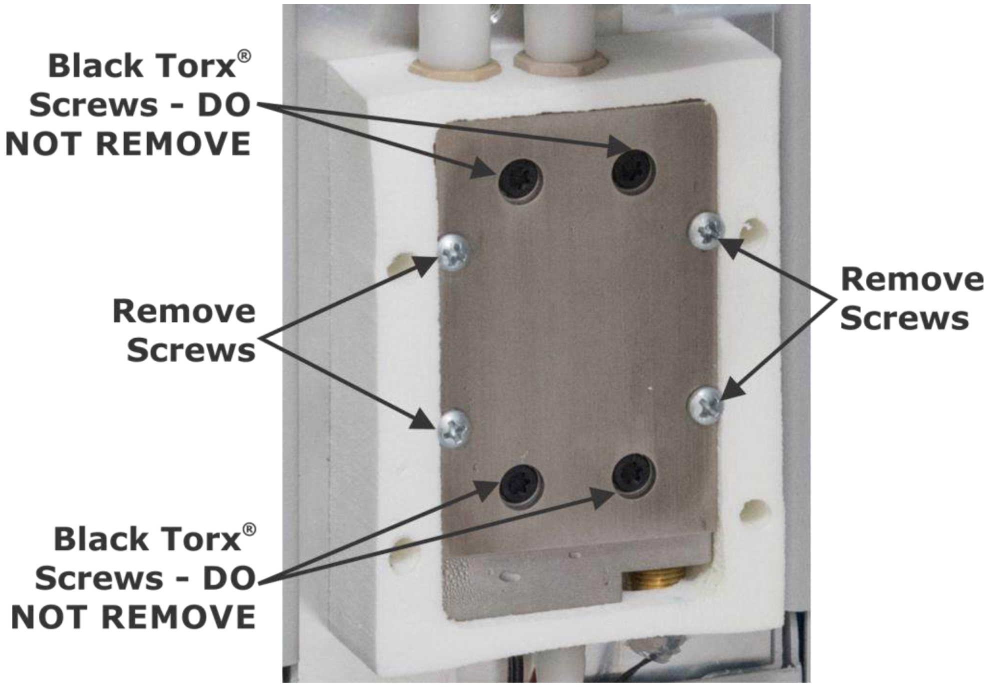


Figure 6-64
Condensing Block Cover

14. Clean the cover and the condensing block with paper towels and swabs.

NOTE

The condensing block cover is reversible. If corrosion appears on one side, it can be mounted again with the corroded side facing out.

15. Remove the condensing block o-ring, and clean it with a foam wipe from the Accessory Pack.

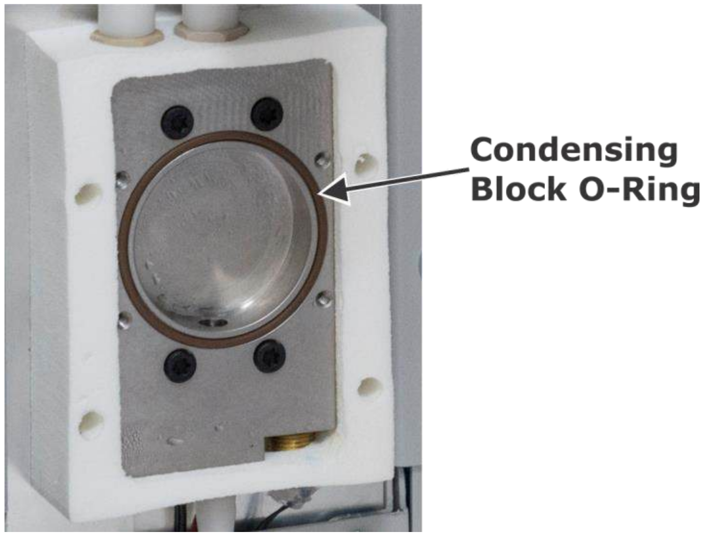


Figure 6-65
Condensing Block O-Ring

16. Lightly grease the o-ring. Refer to Cleaning and Greasing the O-Rings, page 6–9.
17. Reinstall the o-ring.
18. Inspect the three individual c-flex tubes (from the primary filter tube to the pre-cooler, from the pre-cooler to the TEC module, and from the TE cooler to the particle filter) and replace it if it is darkened or yellowed, or if the integrity has diminished. Replace with 601-691 C-Flex Tubing cut to the same lengths as the old tubing. Refer to Figure 6-62, page 6–76.
19. Reassemble the TEC module in reverse order. Refer to Figure 6-62, page 6–76.
20. Turn On power to the TEC module.
21. Wait for the temperature to stabilize. In the software, turn On the gas by selecting Gas on the Action bar and then selecting On.
22. Perform and pass a Segmented System leak check. Refer to Leak Check, page 8–12.

Adjusting the Furnace Viewing Mirror

Complete the following steps to change the tightness of the furnace viewing mirror tilt adjustment.

Removing the Furnace Viewing Mirror

Pull the mirror to the right (away from the instrument front door) to detach from the magnet and then lift the mirror stem out of the notch in the alcove. Refer to Figure 6-66, following.

Figure 6-66
Mirror in Place

Adjusting the Furnace Viewing Mirror Tilt

Adjust how easily the mirror tilts at the mirror stem by tightening or loosening the screw in the end of the mirror stem with an *Allen* wrench. Refer to Figure 6-66, previous.

Installing the Furnace Viewing Mirror

1. If the mirror has not previously been installed, remove the mirror from the tool rack by completing the following steps. Otherwise, skip to step 2.
   A. Open the instrument front door.
   B. The mirror is attached to the mirror bracket with a magnet. Pull the mirror up and away from the mirror bracket. Refer to Figure 2-3, page 2–8.
2. Insert the mirror stem into the notch in the instrument casing. The stem snaps into place with the magnet. Refer to Figure 6-66, previous.
3. If necessary, grasp the edges of the mirror and tilt it to adjust the angle of the mirror. If the tilt adjustment is too tight or too loose, complete the steps in Removing the Furnace Viewing Mirror and Adjusting the Furnace Viewing Mirror Tilt, previous.

7 Theory of Operation

The Theory of Operation chapter provides an overview of instrument operation from a theoretical perspective.

Illustrations

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828 Series Carbon/Hydrogen/Nitrogen Analyzer

NOTE Not all components are found in all configurations.

The 828 Series determines nitrogen/protein, carbon/nitrogen, and carbon/hydrogen/nitrogen in a multitude of organic matrices from food/feeds and soils to fuels. The system utilizes a combustion technique with a vertical quartz furnace designed to handle diverse sample matrices with rapid cycle times and extended reagent lifetimes, delivering unsurpassed throughput coupled with superior instrument uptime.

To begin an analysis, the sample is weighed into a tin capsule or encapsulated within tin foil and placed into the loader. A fully automated analysis sequence transfers the sample to a sealed purge chamber, where atmospheric gas is removed. The purged sample is transferred automatically into a reticulated ceramic crucible within the furnace. To ensure complete and rapid combustion (oxidation) of the sample, the furnace environment is composed of pure oxygen with a secondary oxygen flow being directed to the sample within a reticulated crucible via a quartz lance. In the FP and CN828 models, the combustion gases are swept from the furnace through a thermoelectric cooler to remove moisture, and are collected in a ballast volume. In the CHN828 model, combustion gases are swept from the furnace through an afterburner containing reagent to scrub sulfur compounds from the gas stream prior to collection in the ballast volume. The gases equilibrate and mix within the ballast before a representative aliquot of the gas is extracted and introduced into a flowing stream of inert gas for analysis. Depending upon the analyzer model, the aliquot gas is carried to a non-dispersive infrared (NDIR) cell for the detection of carbon (as carbon dioxide) and a thermal conductivity cell (TC) to detect nitrogen (N_2). In the CHN828 model, the ballast gas is also transferred to an H_2O NDIR cell for the determination of hydrogen.

Unlike NDIR cells, TC cells are chemically non-specific, so a series of reagents and scrubbers are used to ensure quantitative detection of N_2 without chemical interference. A heated reduction tube, filled with copper, is used to convert nitrogen oxide species (NO_x) to N_2 and to remove excess oxygen. Carbon dioxide (CO_2) is removed by LECOSORB®, and water vapor (H_2O) is removed by Anhydrone.

Careful sequencing of the analysis provides maximum sample throughput by interleaving the sample loading sequence with quantitation of the aliquot gases from the previous sample.

Many diagnostic sensing capabilities are included in the 828 Series analyzer. Multiple Pressure Transducers (PT) have been included to provide the ability to leak check individual segments of the flow path.

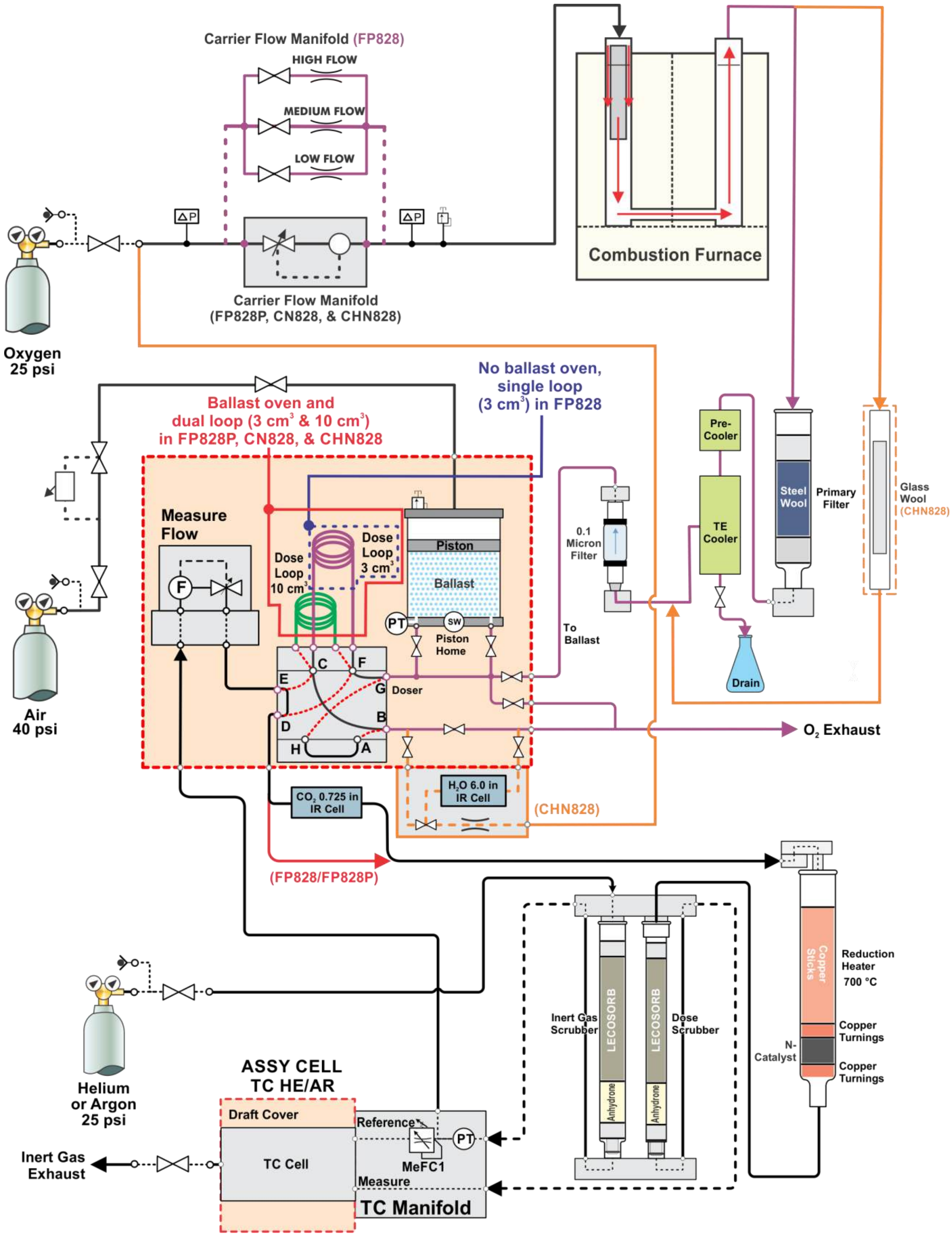

Figure 7-1
Composite Flow Diagram

Calculation of Analysis Results

Table of Symbols, Constants, and Variables			
Symbol	**Purpose (Units)**	**Type**	**Entry**
A_{adj}	**Adjusted Area (cts)** Area after corrections have been applied for blank, moisture, etc.	Calculated	Calculated for each analyte for each analysis
A_b	**Blank Area (cts)** An area representing a baseline analyte value in consumables or introduced to the system via trapped atmospheric gases. Default value is 0.	Calculated	Calculated based on user-selected samples
A	**Raw Area (cts)** The area calculated from the integration period. No blank or drift corrections have been made to this value.	Calculated	Calculated for each analyte for each sample
C	**Composition (%, ppm)** The composition of analyte in the sample given in units of % or ppm.	Calculated	Calculated for Each Sample
F_{drift}	**Drift Factor** A scalar value used to adjust for instrument drift.	Method Parameter	Calculated as Determined by User
$F_{sensitivity}$	**Sensitivity Factor** A scalar value used to convert area into mass units, adjusted to make calibration slope ~ 1	Service Constant	R&D Varies by IR Cell and by model
G	**Analyte Mass (g)** The determined mass of analyte.	Calculated	Calculated for Each Sample
G_{drift}	**Drifted Analyte Mass (g)** The mass of analyte that has been corrected for day-to-day changes in detector signal.	Calculated	Calculated for Each Sample
H_p	**Maximum Peak Height (cts)** The maximum height of an analyte peak for a given sample.	Measurement	Determine for Each Sample
m	**Sample Mass (g)** A scalar value used to record the mass of the analyzed sample.	Sample Parameter	Entered for each sample

Calculate Area

The final output signals, whether baseline corrected, wedge rule corrected, or uncorrected, are used to determine a raw peak area, A_{range}, for each analyte range. This raw area is reported in the expanded replicate information in the Cornerstone® brand software. Further corrections, as follows, are applied to the raw total area before they can be used with a calibration.

Adjusted Area

The adjusted area, $A_{adj, range}$, corrects the raw area for sensitivity factors and blank values.

Blank

The blank value, A_b, is the average raw area from a set of samples (empty crucibles, boats, etc.) determined by the user. The blank value is used to account for analyte gases that are repeatedly introduced through consumables or atmosphere. The default blank value is 0.

$$A_b = \frac{1}{n}\sum_{1}^{n} A$$

where *n* is the number of blank samples as selected by the user.

Sensitivity Factor

The sensitivity factor, $F_{sensitivity}$, is a factor that maintains a calibration slope near 1. It is used to ensure consistent slopes across all products, so it is easy to determine when cell sensitivity (the slope) is incorrect. It enables better instrument troubleshooting, though the use of the sensitivity factor means the instrument sensitivity cannot be determined from the calibration slope.

A sensitivity factor is determined for each detector in an instrument and may vary with software version.

Adjusted Area

The adjusted area can be calculated as follows:

$$A_{adj} = (A - A_b) \cdot F_{sensitivity}$$

Determine Analyte Mass

The mass of each analyte must be determined before the composition can be reported. The calibration is used for this calculation.

Apply Calibration

If a calibration exists for the method in use, the areas calculated for each range are used to determine the mass of analyte in the sample. If no calibration exists, a default of y=1x is used. The basic calibration equation is of the form

$$A_{adj} = k_0 + k_1 \cdot G$$

where *G* (grams) is the analyte mass for a given cell and the *k* values are constants determined in the calibration. The adjusted area is used and the mass result is calculated. For instruments with multiple ranges, the analyte mass is usually calculated for each range.

Drift Correction

The drift factor, F_{drift}, corrects for day-to-day changes in signal due to changing environmental, matrix, or sample conditions. It is a simple multiplicative factor applied to the final analyte mass and reduces the frequency with which new calibrations need to be set. The drift factor value is determined against a calibration and has a default value of 1.

$$G_{drift} = G \cdot F_{drift}$$

Determine Composition

The determined analyte mass, G or $G_{blended}$, is used in conjunction with the sample mass to determine the analyte composition.

Calculate Final Compositions

The total determined composition in weight percent is defined as

$$C(\%) = 100 \cdot \left(\frac{G}{m} \right)$$

The composition will also be determined in parts per million (ppm)

$$C(ppm) = 10^6 \cdot \left(\frac{G}{m} \right)$$

Calculation of the Calibration Equation

Table of Symbols, Constants, and Variables			
Symbol	**Purpose (Units)**	**Type**	**Entry**
A_{adj}	**Adjusted Area (cts)** Area after corrections have been applied for blank, moisture, etc.	Calculated	Calculated for each analyte for each analysis
C	**Composition (%, ppm)** The composition of analyte in the sample given in units of % or ppm.	Calculated	Calculated for Each Sample
G	**Analyte Mass (g)** The determined mass of analyte.	Calculated	Calculated for Each Sample
k	**Calibration Coefficient** The best-fit coefficients determined weighted least squares	Calculated	Calculated for Each Method
n	The number of replicate samples included in the calibration.	Calculated	Calculated for Each Calibration
w	**Calibration Weighting Factor** The weighting factors can be used to increase or decrease the relative importance of individual replicates included in the calibration set. The default value is 1.0.	Sample Parameter	User entered for each method

Determine the Calibration Equation

The calibration equation is an empirical model describing how the response of the analyzer changes with the analyte. A series of known calibration standards, spanning the range of interest, are measured so the response of the analyzer can be modeled as a polynomial equation.

NOTE Contact LECO Service to enable the Higher Order Calibration Option.

Calibration Equation

A weighted least squares algorithm is used to determine the polynomial coefficients, k.

$$W \cdot A_{adj} = k_0 + k_1 \cdot G$$

By selecting the Regression Type option to Force Through Origin, the operator can force the calibration equation through the origin:

$$k_0 = 0$$

If the high order calibration option is enabled, the operator can select quadratic and cubic regression orders:

$$W \cdot A_{adj} = k_0 + k_1 \cdot G + k_2 \cdot G^2 + k_3 \cdot G^3$$

Apply Calibration

Given the coefficients, K, the determined analyte mass, *G*, can be determined for each replicate by solving the following equation:

$$A_{adj} = k_0 + k_1 \cdot G$$

For higher order calibrations, *Cornerstone* brand software finds a valid solution for the following polynomial equation:

$$A_{adj} = k_0 + k_1 \cdot G + k_2 \cdot G^2 + k_3 \cdot G^3$$

Calculate Final Compositions

The total determined composition in weight percent is defined as:

$$C(\%) = 100 \cdot \left(\frac{G}{m}\right).$$

The composition will also be determined in parts per million (ppm):

$$C(ppm) = 10^6 \cdot \left(\frac{G}{m}\right).$$

Weighting Factors

Weighting factors, W, are calculated as:

$$W_i = \sqrt{\frac{\bar{g} \cdot w_i}{0.0001 + g_i^2}}$$

where

$$\bar{g} = \frac{1}{n}\sum_{1}^{n} g_i$$

g is the certified analyte mass for each replicate, *i*, included in the calibration and *w* is a user entered weighting factor. By default, the user defined weighting factors, *w*, are set to 1.0. If the higher order calibration option is enabled, the operator can view and edit the weighting factors.

Calibration Statistics—RMS Error

The Root Mean Square Error (RMS) is a measure of the accuracy of the calibration. The accuracy of the calibration improves as the RMS Error approaches zero.

The RMS Error is determined as:

$$\text{RMS Error (g)} = \sqrt{\frac{\sum_{1}^{n}\left(g_{i,measured} - g_{i,certified}\right)^2}{n - \nu}}$$

where ν is the degree of freedom as determined by the combination of Regression Order and Regression Type as follows:

Regression Order	Force Through Origin	Full Regression
Linear	1	2
*Quadratic	2	3
*Cubic	3	4

*Available only with the Higher Order Calibration Option

Calibration Statistics—Coefficient of Determination

The Coefficient of Determination, R^2, is a measure of how well the measured results fit the calibration model. The fit improves as R^2 approaches 1. R^2 is determined as:

$$R^2 = 1 - \frac{\sum_{1}^{n}\left(g_{i,measured} - g_{i,certified}\right)^2}{\sum_{1}^{n}\left(g_{i,measured} - \bar{g}\right)^2}.$$

Override Conditions

When possible, *Cornerstone* brand software chooses a Regression Order of “Linear” and a Regression Type of “Full Regression” whenever a new calibration equation is created.

To prevent invalid calibration equations, the software will automatically override user settings and defaults to ensure that a valid calibration equation is determined. The following criteria are used:

Minimum Number of Replicates

The number of replicate measurements included must exceed the degrees of freedom of the calibration. *Cornerstone* will automatically reduce the regression order until the criteria in the following table are satisfied.

Regression Order	Force Through Origin	Full Regression
Linear	1	3
*Quadratic	3	4
*Cubic	4	5

*Available only with the Higher Order Calibration Option

Single Cluster

No matter how many replicates are included, calibrations that are recognized as a single cluster of measurements will automatically be set to a Regression Order of “Linear” and a Regression Type of “Force Through Origin.”

The calibration data will be interpreted as a single cluster if any of the following criteria are true:

- The range of analyte present in the calibration data is less than three times the range of the absolute error (g) of the calibration.
  $$\max\left(analyte(g)_{cert}\right) - \min\left(analyte(g)_{cert}\right) < 3 \bullet \left[\max\left(Error(g)\right) - \min\left(Error(g)\right)\right]$$
- The minimum amount of analyte is greater than 80% of the maximum amount of analyte included in the calibration data.
  $$\max\left(analyte(g)_{cert}\right) > 80\% \bullet \max\left(analyte(g)_{cert}\right)$$
- The slope is negative.
  $$Slope < 0$$

Protein Determinators

Table of Symbols, Constants, and Variables			
Symbol	**Purpose (Units)**	**Type**	**Entry**
F_P	**Protein Factor** A scalar value used to determine the equivalent protein composition as a function of the nitrogen composition. The default value is 6.25.	Constant	User entered for each set.
C_N	**Nitrogen Composition** The composition of nitrogen given in units of % or ppm.	Calculated	Calculated for each sample

The Protein Factor is used to calculate the equivalent protein composition.

$$\text{Protein} = F_p \cdot C_N$$

The calculation occurs after drift correction.

Basis corrections can be applied to the Protein result to report the value on a dry basis or an as-received basis.

Table of Typical Protein Factors

Product	Protein Factors
Wheat Products	5.70
Almonds	5.18
Peanuts	5.46
Tree Nuts	5.30
Coconuts	5.30
Dairy Products	6.38
Other Products	6.25

Moisture Basis Corrections

Table of Symbols, Constants, and Variables			
Symbol	**Purpose (Units)**	**Type**	**Entry**
C	**Composition (%, ppm)** The composition of analyte in the sample given in units of % or ppm.	Calculated	Calculated for each sample
C_{ar}	**As Received Composition (%, ppm)** The composition of analyte in the sample calculated with the chosen moisture content given in units of % or ppm.	Calculated	Calculated for each analysis
C_d	**Dry Composition (%, ppm)** The composition of analyte in the sample calculated on a dry basis in units of % or ppm.	Calculated	Calculated for each analysis
m	**Sample Mass (g)** A scalar value used to record the mass of the analyzed sample.	Sample Parameter	User entered for each sample
M_{ad}	**Moisture As-Determined (%)** The moisture content, given in units of %, previously determined to be in the sample at the time of analysis.	Sample Parameter	User entered for each sample set
M_{ar}	**Moisture As-Received (%)** The moisture content, given in units of %, with which the results will be calculated and reported.	Sample Parameter	User entered for each sample set

Determine the Corrected Compositions

The final composition can be corrected for moisture in two ways depending on the user's *Cornerstone* brand software settings.

Dry Composition

The dry composition is determined as:

$$C_d = C \cdot \frac{100}{100 - M_{ad}}$$

As-Received Composition

The as-received composition is determined as:

$$C_{ar} = C \cdot \frac{100 - M_{ar}}{100 - M_{ad}}$$

Mass Correction in Calibration Calculations

Sample masses are corrected to a dry basis for use in calibration calculations. A dry mass is calculated as:

$$m_d = m \cdot \frac{100 - M_{ad}}{100}$$

Atmospheric Blank Corrections

Analysis of powdered samples on the instrument may require sealing the tin foil sample cup before introducing the sample into the instrument. When analyzing powdered samples using a tin foil sample cup that has been sealed, atmospheric gas, which includes nitrogen, is trapped within the sample. (Refer to Figure 7-2, following.) Typically, for a sample mass of 0.25 g, approximately 0.04% nitrogen is trapped within the sample but is dependent upon sample characteristics such as density, mesh size, shape, and mass used. Differences in the amount of trapped air between unknown samples and calibration samples can cause errors. Utilization of the Atmospheric Blank compensates the calculation of the final result for these differences.

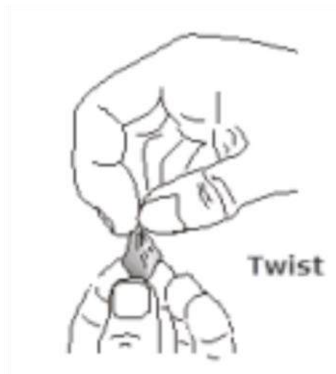

Figure 7-2
Sample Sealed within Tin Foil Cup

The atmospheric blank corrections apply only to the nitrogen result and to associated values that use the nitrogen result, such as protein. To use the atmospheric blank corrections, the display should be configured to show the Atmospheric Blank field at the set level. (Refer to Creating a Sample Display, page 4–5.) All reps within a given set will use the same atmospheric blank value. An atmospheric blank value should be determined by analyzing non-nitrogen containing material of similar density, mesh size, and mass to the samples that are to be corrected. The nitrogen result from the analysis of this material should be entered into the Atmospheric blank field in units of percent. The atmospheric blank is subtracted from the final nitrogen result and is not used in calibrations.

Atmospheric Blank Calculations

Table of Symbols, Constants, and Variables			
Symbol	**Purpose (Units)**	**Type**	**Entry**
B_{ATM}	**Atmospheric Blank** The composition of nitrogen given in units of % needed to compensate between differences in the amounts of nitrogen trapped in a prepared sample compared to calibration samples.	Constant	User entered for each set
C_N	**Nitrogen Composition** The composition of nitrogen without the atmospheric blank applied given in units of % or ppm.	Calculated	Calculated for each rep
$C_{N\text{(adjusted)}}$	**Nitrogen Composition** The composition of nitrogen with the atmospheric blank applied given in units of % or ppm.	Calculated	Calculated for each rep

The Atmospheric Blank is used to compensate for differences between the amounts of trapped air in a prepared unknown sample compared to the amount trapped in the calibration samples.

$$C_{N\,(adjusted)} = C_N - B_{ATM}$$

Protein results are calculated on the atmospheric blank corrected nitrogen value.

Cornerstone Brand Software Rounding

The following section provides examples of the different methods of rounding within the *Cornerstone* brand software. Refer to Analyte Units Tab, page 4–6, and Editing Styles, page 4–11.

NOTE Meaningful digits in the following tables are underlined.

Rounding Style: Fixed Decimal or Variable (n=1)

	Actual Result			
Decimal Places*	**12.3456789**	**1.23456789**	**0.123456789**	**0.0123456789**
1	12.3	1.2	0.1	0.0
2	12.35	1.23	0.12	0.01
3**	**12.346**	**1.235**	**0.123**	**0.012**
4**	**12.3457**	**1.2346**	**0.1235**	**0.0123**
5	12.34568	1.23457	0.12346	0.01235
6	12.345679	1.234568	0.123457	0.012346

*Decimal Places indicates the number of digits displayed to the right of the decimal.

**The default value is 4 when the units are % and 3 when the units are ppm, µg/g, or mg/kg.

Rounding Style: Significant Digits

	Actual Result			
Significant Digits*	**12.3456789**	**1.23456789**	**0.123456789**	**0.0123456789**
1	10.	1.	0.1	0.01
2	12.	1.2	0.12	0.012
3**	**12.3**	**1.23**	**0.123**	**0.0123**
4	12.35	1.235	0.1235	0.01235
5	12.346	1.2346	0.12346	0.012346
6	12.3457	1.23457	0.123457	0.0123457

*Significant Digits indicates the number of meaningful digits, including zero digits except when leading (0.001) and trailing (1000). Trailing zeros will be displayed when significant (for example: 0.0100)

**The default value is 3 for all units (%, ppm, µg/g, or mg/kg).

NOTE The software displays "0" when the rounding style is set to Significant Digits and the value observed is between -0.0000000001 and +0.0000000001.

Rounding Style: Variable (n>1)

	Actual Results	
Significant Digits (n>1)*	**12.3456789 ± 0.123456789**	**0.0123456789 ± 0.000123456789**
1	12.3 ± 0.1	0.0123 ± 0.0001
2	**12.35 ± 0.12**	**0.01235 ± 0.00012**
3	12.346 ± 0.123	0.012346 ± 0.000123
4	12.3457 ± 0.1235	0.0123457 ± 0.0001235
5	12.34568 ± 0.12346	0.01234568 ± 0.00012346
6	12.345679 ± 0.123457	0.012345679 ± 0.000123457

*Significant Digits (n>1) indicates the number of significant digits displayed in the standard deviation when more than one replicate is included in the set. The number of decimal places in the standard deviation will determine the number of decimal places displayed for the average value.

Significant Digits (n=1) indicates the number of digits displayed to the right of the decimal when only one replicate is included in the set.

NOTE Variable Rounding is applicable only to set results (analytes) for which the standard deviation is determined.

Flow Diagrams

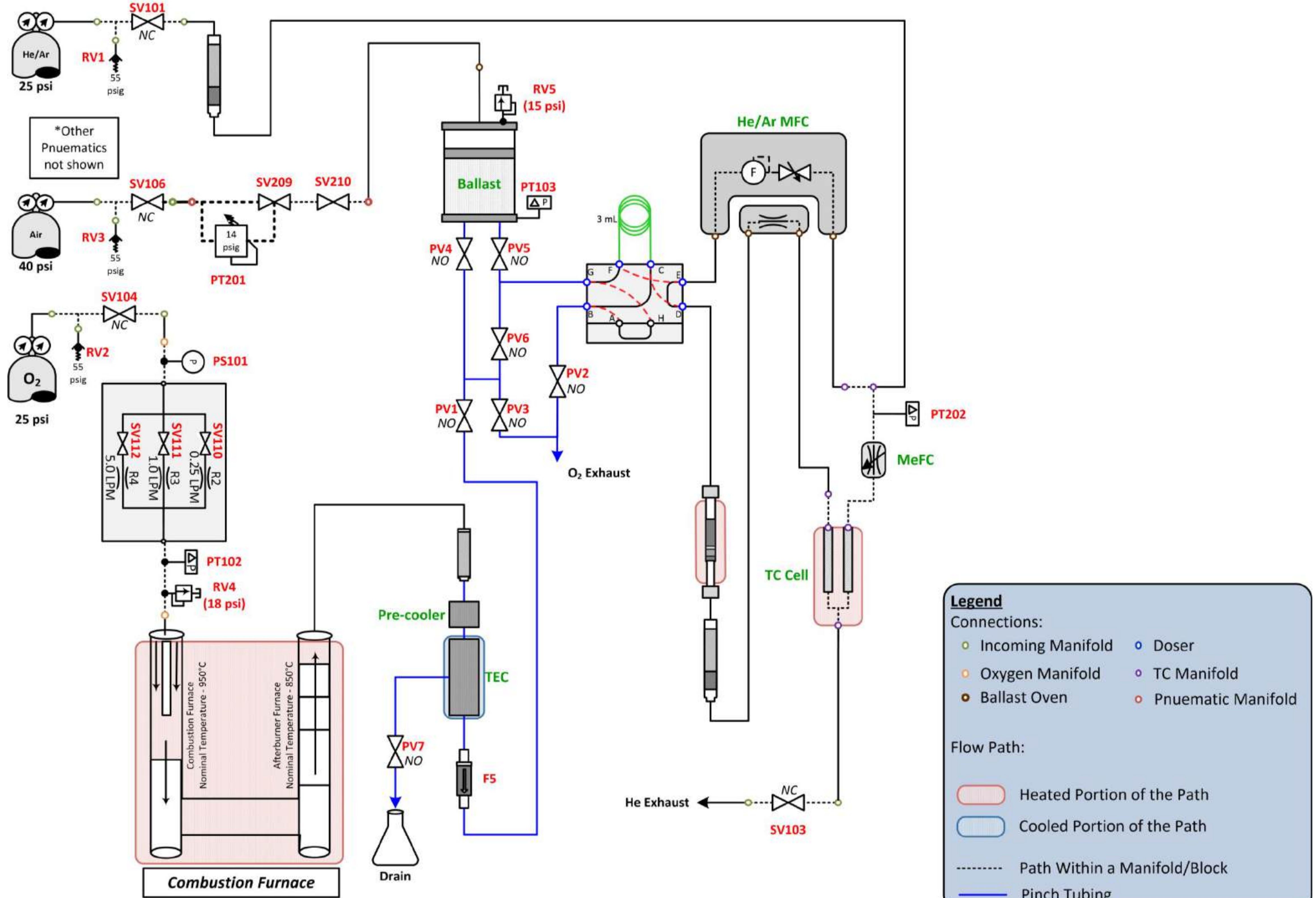

Figure 7-3
Linear Flow Diagram – FP828

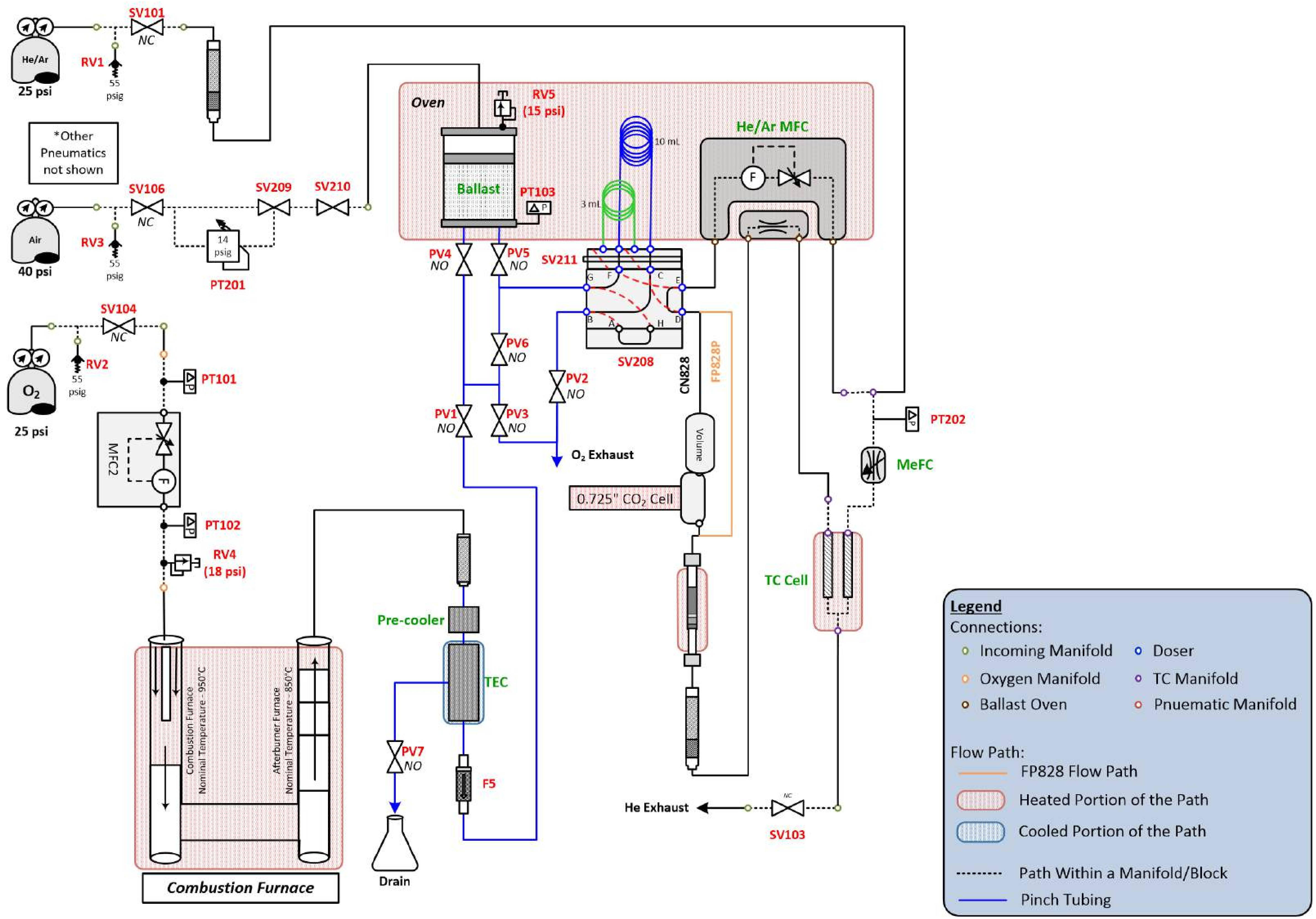

Figure 7-4
Linear Flow Diagram – CN828 and FP828P

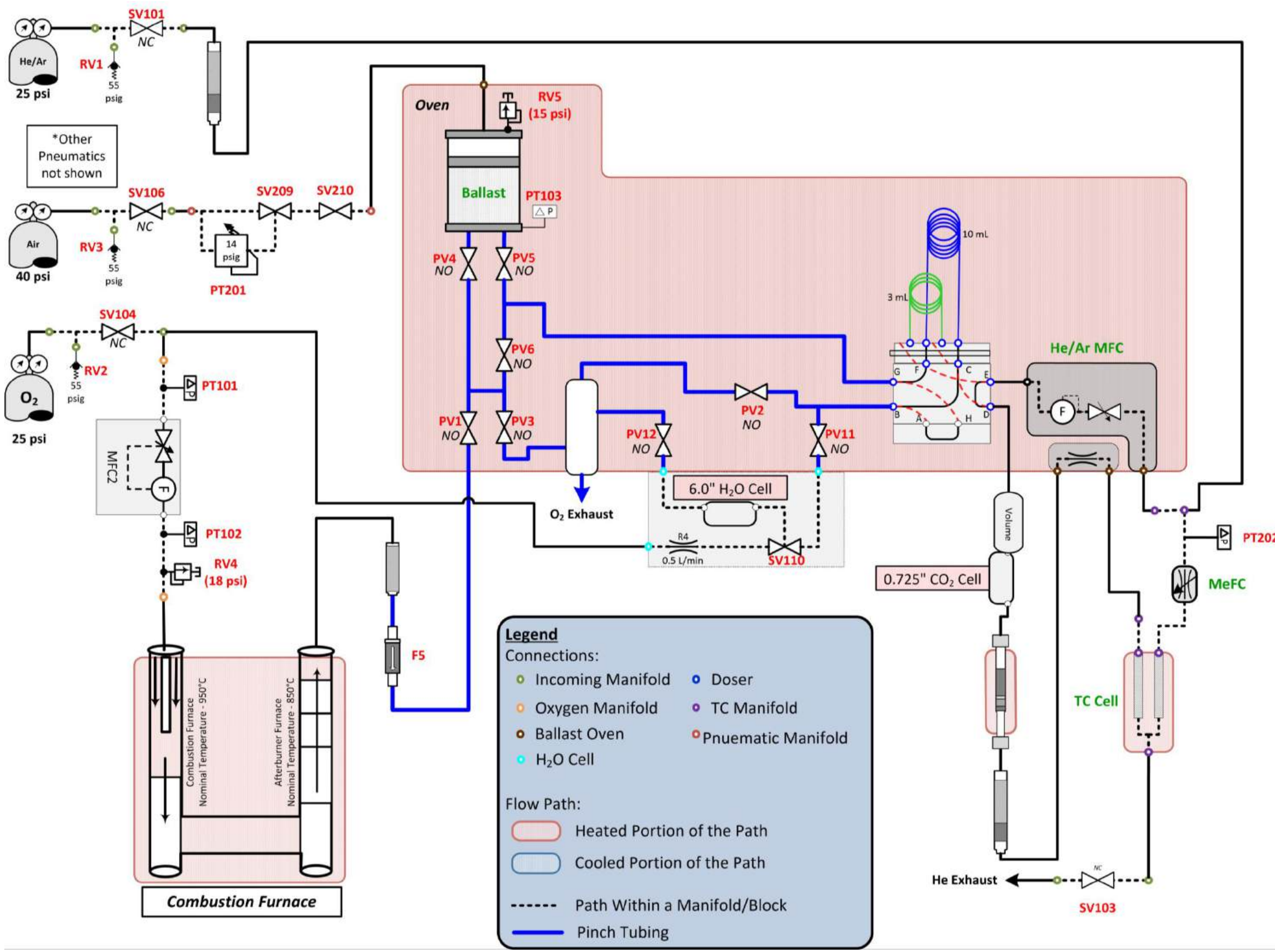

Figure 7-5
Linear Flow Diagram – CHN

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8 Diagnostics

The Diagnostics chapter explains how to monitor and check the operation of the instrument hardware, which can help determine if the instrument is operating properly. Use Diagnostics to check digital inputs and outputs, and to monitor various system hardware parameters.

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Flow

The Diagnostics Flow Tab is divided into two parts: an analytical flow diagram at the bottom and a diagnostic chart at the top. For instructions on using the diagnostic chart to plot instrument parameters, refer to Diagnostic Chart, page 8–4. The flow diagram is interactive, enabling the user to actuate valves and plot ambient parameter values by selecting the indicators within the diagram. Additionally, by examining the motion of the dashed lines in the flow diagram, the user can visualize the flow path for the current valve state.

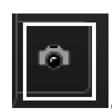
There are two states in which the user can operate the Flow Tab: locked and unlocked. The user can change the operation state by toggling between the Lock and Unlock buttons on the action bar at the top of the screen.

When the Lock button is selected, the user may plot ambient values, valve states, and interlock states on the chart. The user cannot change valve states by selecting valves within the flow diagram.

When the Unlock button is selected, the user may plot ambient values and interlock states and may actuate individual valves.

CAUTION
Actuating valves in the unlocked state will cause the valves to change and the instrument to react accordingly. Changing the state of some valves could cause the instrument to react in an unintended manner, causing personal injury or damage to the instrument. It is recommended that this diagnostic be used under the supervision of trained service engineers.

In either mode, the flow diagram shows the theoretical gas flow path for the current valve state as well as the current parameter values. A warning triangle will flash beside a readout if a parameter is outside its desired range.

The interactive flow diagram also contains camera icons . These icons can be selected to show a photograph of that specific instrument area.

Ambient

The Ambient screen allows the user to monitor instrument parameters and view their current values. The ambient screen is divided into two parts: the instrument parameters at the bottom and a diagnostic chart at the top. Select a parameter box to view its readout on the chart in relation to time.

Refer to Parameters, following, for information concerning the parameters and values displayed on the Ambient screen.

Parameters

Within each parameter box, the current value, as well as its minimum and maximum values, are displayed. Select the reset button on the action bar to reset the minimum and maximum values within the parameter box. The minimum/maximum values automatically reset when opening the software.

A warning triangle will flash within a parameter box if a parameter is outside its desired range. The warning symbol will flash in the Diagnostics button, on the Ambient tab, and in the upper left corner of a parameter box in the Ambient screen.

Diagnostic Chart

Select the desired parameter to plot the value on the diagnostics chart. The parameter value is displayed on a vertical axis, and the time is displayed on the horizontal axis. More than one parameter can be plotted on the graph at a time. Each parameter has its own unique color that is displayed when selected.

The x- and y-axes of the diagnostic chart are adjustable. The plus and minus signs on the axes indicate which direction to slide in order to zoom the desired direction. To zoom out, select the axis bar and slide to the left/up. To zoom in, select the axis bar and slide to the right/down.

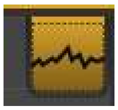
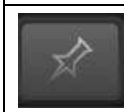
To view previous data, drag or flick in the chart area. The software automatically saves the last 30 days of ambient data. The chart's scroll speed is proportional to the speed of the flick. To stop the chart from scrolling, select and hold anywhere on the chart area.

The diagnostic chart can be paused by selecting the play button in the lower right corner of the chart. When adjusting the x-axis, or scrolling back in time, the chart automatically goes into pause mode. Selecting the play button will return to live plotting mode.

When selecting multiple parameters, the first parameter selected is automatically placed on the right side y-axis. The second parameter is automatically placed on the left side y-axis. Any subsequent parameters selected will be on their own floating axis. No values for these floating parameters will be shown; only a relative change can be viewed.

To change what parameters are viewed on each axis, select the plot tab on the upper left of the chart. The color of each parameter selected will be displayed. For each parameter, there are three plotting options: left axis, right axis, and floating axis. Each axis can display as many parameters as desired.

All parameters on the floating axis are always in zoom in/out. However, the zooming options for the right and left y-axes are adjustable within the plot tab.

Button	Name	Action
	Plot Tab	Allows the user to view plot options.
	Pause	Pauses the x-axis of the diagnostic chart.
	Play	Displays real-time data on the diagnostic chart.
	Zoom in/zoom out	Automatically zooms the y-axis in or out based on the displayed data.
	Zoom out	Zooms out only the y-axis on the displayed data.
	Lock zoom	Locks the y-axis to its current minimum and maximum values whether or not any parameters are displayed within that range.
	Pan zoom	Locks the y-axis in the range between current minimum and maximum, but follows the parameter values with time.
	Left Axis	Plots the selected data on the left axis.
	Right Axis	Plots the selected data on the right axis.
	Floating Axis	Plots selected data without the context of the y-axis.

Ambient Parameter Definitions

NOTE The following ambients may not be applicable to all instrument configurations.

Parameter	Description
TC Signal	The TC output in volts. This value should be approximately 0.2 V.
TC Temperature	The temperature of the thermal conductivity cell.
CO_2	The IR cell output voltage in volts. The emitter is turned Off in Gas Conserve and Gas Off states. The output is set by the software. To determine if the cell is working properly, refer to Detectors, page 5–19.
CO_2 Temperature	The temperature of the CO_2 IR cell.
H_2O	The IR cell output voltage in volts. The emitter is turned Off in Gas Conserve and Gas Off states. The output is set by the software. To determine if the cell is working properly, refer to Detectors, page 5–19.
H_2O Temperature	The temperature of the H_2O IR cell.
Oxygen Pressure (PT101)	The pressure of the incoming oxygen.
Furnace Pressure (PT102)	The pressure inside the furnace.
Ballast Pressure (PT103)	The pressure of the oxygen and combustion gas in the ballast.
Piston Pressure (PT201)	The pressure of the pneumatic gas. During normal operation, this is the pressure on top of the piston in the ballast. During a system check, this is used to check the incoming pneumatic pressure. (When SV209 is activated while SV210 is deactivated, this is the incoming pneumatic pressure. When SV209 is deactivated while SV210 is activated, this is the pressure on top of the piston in the ballast.)
Inert Gas Pressure (PT202)	The pressure of the incoming inert gas.
Furnace Flow	The flow rate of oxygen sweeping through the furnace.
Measure Flow	The flow rate of inert gas through the measure side of the TC cell.
Furnace Temperature	The temperature inside the furnace.
Furnace Control	The duty cycle of the furnace temperature control loop.
Afterburner Temperature	The temperature inside the afterburner.
Afterburner Control	The duty cycle of the afterburner temperature control loop.

Parameter	Description
TE Cooler Temperature	The temperature of the TE Cooler.
TE Cooler Control	The duty cycle of the TE cooler temperature control loop.
Ballast Oven Temperature	The temperature inside the ballast oven.
Ballast Oven Control	The duty cycle of the ballast oven temperature control loop.
Reduction Heater Temperature	The temperature of the heated portion of the reduction tube.
Reduction Heater Control	The duty cycle of the reduction heater temperature control loop.
CO_2 Average Emitter Power	The average power delivered to the CO_2 IR cell emitter. The emitter is turned On in the Gas On state.
H_2O Average Emitter Power	The average power delivered to the H_2O IR cell emitter. The emitter is turned On in the Gas On state.
External Temperature	The temperature of the air outside of the analyzer.
Relative Humidity	The humidity of the air outside of the analyzer.
Station Pressure	The atmospheric pressure around the analyzer.
Barometric Pressure	The atmospheric pressure around the analyzer, corrected for altitude.

Ambient Monitor Ranges

The following table describes the values that should be observed for many of the ambients under normal operating conditions. The Gas Off state will alter the values of some of these parameters.

NOTES

- If a parameter value is out of range, this symbol will flash within the parameter box to the right of its name.
- The following ambients may not be applicable to all instrument configurations.

Parameter	Minimum	Maximum	Typical
TC Signal	0.05 V	1.00 V	0.20 V
CO_2	0.0 V	4.8 V	N/A
H_2O	0.0 V	4.9 V	N/A
TC Temperature	54.99 °C	55.01 °C	55.00 °C
CO_2 Temperature	49.5 °C	50.5 °C	50.0 °C
H_2O Temperature	49.5 °C	50.5 °C	50.0 °C
Oxygen Pressure	22 psi	28 psi	25 psi
Furnace Pressure	N/A	N/A	N/A

Parameter	Minimum	Maximum	Typical
Ballast Pressure	N/A	N/A	N/A
Piston Pressure	5 psi	15 psi	14 psi
Piston Pressure (System Check)	36 psi (Incoming Pressure); 12 psi (Gas On Pressure)	44 psi (Incoming Pressure); 15 psi (Gas On Pressure)	40 psi (Incoming Pressure); 14 psi (Gas On Pressure)
Inert Gas Pressure	22 psi	28 psi	25 psi
Furnace Flow	0.24 LPM	0.26 LPM	0.25 LPM
Measure Flow	0.31 LPM	0.33 LPM	0.32 LPM
Furnace Temperature	850 °C	1050 °C	950 °C
Furnace Control	0%	100%	N/A
Afterburner Temperature	750 °C	950 °C	850 °C
Afterburner Control	0%	100%	N/A
TE Cooler Temperature	0 °C	10 °C	5 °C
TE Cooler Control	0%	100%	N/A
Ballast Oven Temperature	44.75 °C	45.25 °C	45.00 °C
Ballast Oven Control	0%	100%	N/A
Reduction Heater Temperature	690 °C	710 °C	700 °C
Reduction Heater Control	0%	100%	N/A
CO_2 Average Emitter Power	0.313	0.329	0.325
H_2O Average Emitter Power	0.313	0.329	0.325
External Temperature	N/A	N/A	N/A
Relative Humidity	N/A	N/A	N/A
Station Pressure	N/A	N/A	N/A
Barometric Pressure	N/A	N/A	N/A

Digital I/O

The Digital I/O screen allows the user to view all the digital inputs and outputs and to actuate all the digital outputs within the instrument. Similar to the ambient screen, it is divided into two parts, a diagnostic chart at the top and the digital inputs and outputs at the bottom. The current are also displayed above the list of digital outputs. For both digital inputs and outputs, a highlighted orb indicates that the digital input or output is energized, and a gray orb indicates that it is non-energized.

The Digital I/O tab can be operated in two states: locked (default) and unlocked. The user can change the operation state by toggling between the Lock and Unlock buttons at the top of the screen.

When the Lock button is selected, the state of the digital outputs cannot be changed. The digital inputs and outputs can be selected as they are in the ambient screen and can be plotted on the diagnostic chart. A thin line represents a digital input or output in the non-energized state, and a thick line represents it in the energized state. If ambient parameters have been selected from either the Flow or Ambient screens, they will also be displayed on the Diagnostic Chart in the Digital I/O screen.

When the Unlock button is selected, selecting a digital output will actuate that component.

CAUTION
Actuating valves in the unlocked state will cause the valves to change and the instrument to react accordingly. Changing the state of some valves could cause the instrument to react in an unintended manner, causing personal injury or damage to the instrument. It is recommended that this diagnostic be used under the supervision of trained service engineers.

Digital inputs cannot be energized by selecting them in an unlock state. They are used throughout the instrument as sensors to determine the status of a condition. They are not only used to control the instrument, they are also used for safety to prevent injury to the operator or damage to the instrument. All interlocks must be enabled in order to run an analysis. The interlocks operate in a chain fashion, such that all interlocks below the first disabled interlock will also be disabled.

Digital Output Definitions

Name	Label	Type	Description	Board Location	Component Location
Inert Gas Inlet	SV101	NC	Allows inert gas into the analytical system.	Flow 100 Board	Incoming Manifold
Inert Gas Exhaust	SV103	NC	Allows inert gas to exit the analytical system. Used for leak check purposes.	Flow 100 Board	Incoming Manifold
Oxygen Inlet	SV104	NC	Allows oxygen gas into the analytical system.	Flow 100 Board	Incoming Manifold
Pneumatic Inlet	SV106	NC	Allows gas into the pneumatic system.	Flow 100 Board	Incoming Manifold
Furnace Seal	SV107	NC	Seals furnace during analysis to prevent atmospheric gas from entering the system.	Flow 100 Board	Pneumatic Manifold/Load Head
Slide Block Close	SV108	4-way	Advances the sample carousel to load the next sample into the purge chamber.	Flow 100 Board	Pneumatic Manifold/Load Head
Sample Drop	SV109	NC	Drops sample into combustion tube from the purge chamber to begin combustion.	Flow 100 Board	Load Head
H_2O Conserve	SV110	NC	Allows clean oxygen to flush through the H_2O cell.	Flow 100 Board	H_2O Cell Manifold
H_2O Fill	SV111	NC/NO	Allows analysis gas to fill the H_2O Cell.	Flow 100 Board	Pinch Valve Manifold/Plate
H_2O Exhaust	SV112	NC/NO	Allows gas to exhaust from the H_2O Cell.	Flow 100 Board	Pinch Valve Manifold/Plate
Dose Loop 3 cm^3	SV211	NC	Allows gas into 3 cm^3 dose loop rather than the 10 cm^3 dose loop for systems equipped with the Dual Loop Doser.	Flow 200 Board	Doser Manifold
Furnace Exhaust	SV201/ PV01	NC/NO	Allows gas to exhaust from the furnace.	Flow 200 Board	Pinch Valve Manifold/Plate
Doser Exhaust	SV202/ PV02	NC/NO	Allows gas to exit the doser.	Flow 200 Board	Pinch Valve Manifold/Plate
Ballast Exhaust	SV203/ PV03	NC/NO	Allows gas to exit the analytical system before reaching the ballast and doser.	Flow 200 Board	Pinch Valve Manifold/Plate
Ballast Input	SV204/ PV04	NC/NO	Allows gas into the ballast from the furnace.	Flow 200 Board	Pinch Valve Manifold/Plate
Ballast Output	SV205/ PV05	NC/NO	Allows gas to exit the ballast and enter the doser.	Flow 200 Board	Pinch Valve Manifold/Plate

Name	Label	Type	Description	Board Location	Component Location
Ballast Bypass	SV206/ PV06	NC/NO	Allows gas to flow past the ballast directly to the doser.	Flow 200 Board	Pinch Valve Manifold/Plate
Condenser Drain	SV207/ PV07	NC/NO	Allows condensation collected in the TE Cooler to drain into the flask.	Flow 200 Board	Pinch Valve Manifold/TEC Module
Doser Dump	SV208	4-way	Allows either gas from the combustion system or inert gas to flow through the dose loop.	Flow 200 Board	Pneumatic Manifold/ Doser Valve
Piston Pressure Select	SV209	3-way	Routes the pneumatic gas used to lower the piston through the pressure regulator when the valve is non-energized. The valve remains in this state during normal operation and analysis.	Flow 200 Board	Pneumatic Manifold
Piston Return	SV210	3-way	Allows pneumatic gas into the top of the ballast to lower the piston. The non-energized state allows the top of the piston to exhaust.	Flow 200 Board	Pneumatic Manifold
TEC Fan	Fan 0	-	Turns on the TEC module fan. Refer to Run TEC Fan with Gas Off, page 5–35, for the option to turn this fan Off when the gas is turned Off.	TE Cooler	TEC Module
Oven Fan	Oven Fan	-	Turns On the Ballast Oven fan. This fan must stay On for the ballast oven to heat properly.	Ballast Oven Heater	Ballast Oven

Digital Input Definitions

Parameter	Description
Piston Home (SW201)	When energized, this switch indicates that the piston is in the Home position. The Home position is located at the bottom of the ballast tank.
Oxygen Pressure (SW101)	When energized, this switch indicates that the incoming oxygen pressure is sufficient to continue with an analysis. (FP828 Only)

Leak Check

The software incorporates the following automated leak check procedures: Segmented System Leak Check, Segmented Oxygen Leak Check, Furnace Leak Check, Filled Ballast and Doser Leak Check, Filled Ballast Leak Check, and Segmented Inert Leak Check. These are described in the following sections. By performing these leak checks, the user can determine if gas is leaking out of the system. Gas leaks can lead to significant errors in analytical results. Leak checks should be performed after any maintenance that involves the analytical flow path. In addition, regularly performed leak checks and records are helpful when solving problems that occur with the system.

NOTE During a leak check, the system is pressurized and sealed by the incoming and exhaust solenoids. Following a leak check, the gas is turned On. In the case of a massive leak, the gas is turned Off.

Viewing Leak Check History

The Leak Check history can be viewed from the Leak Check screen.

1. Select Diagnostics and then select Leak Check.
2. Select History 

.
3. Select the desired leak check from the drop-down menu at the top of the screen.

Segmented System Leak Check

NOTE Segmented System Leak Check is the leak check activated by the Leak Check button at the bottom left of the screen.

The Segmented System Leak Check checks for leaks by breaking the entire analytical flow path into three parts. It determines a pass/fail/aborted result for each segment.

- The Furnace and Filled Ballast/Doser segments check the oxygen flow path for leaks.
- The inert gas flow path is checked as a whole, but once with the Doser Valve in the Fill state and once with the Doser Valve in the Dump state.
  - Next to Dose Loop Size, select either Large (10 cm^3) or Small (3 cm^3) to choose which loop will be part of the flow path.
- A Segmented System Leak Check is useful on a daily basis and after routine maintenance.

Refer to Flow Diagrams, page 9–21, to view the segments of the analytical flow path that is tested by the Segmented System Leak Check.

Segmented Oxygen Leak Check

The Segmented Oxygen Leak Check checks for leaks by breaking the oxygen analytical flow path into two segments: Furnace and Filled Ballast/Doser. It determines a pass/fail/aborted result for each segment.

A Segmented Oxygen Leak Check is useful for checking only the oxygen flow path for leaks. Refer to Flow Diagrams, page 9–21, to view the segments of the analytical flow path that are tested by the Segmented Oxygen Leak Check.

Furnace Leak Check

The Furnace Leak Check checks for leaks only in the oxygen flow path in the furnace segment and determines a pass/fail/aborted result.

A Furnace Leak Check is useful for quickly checking the furnace after routine maintenance, such as replacing the furnace crucible. Refer to Flow Diagrams, page 9–21, to view the analytical flow path that is tested by the Furnace Leak Check.

NOTE A bypass plate, available in the Component Packs, can be used to bypass the loading head if a leak is discovered in the furnace segment. The bypass plate is not necessary to perform a leak check but can be used to further troubleshoot a leak in the furnace segment. The bypass plate mounts in a similar way as the load head.

Filled Ballast and Doser Leak Check

The Filled Ballast and Doser Leak Check checks the oxygen flow path in the ballast and doser. The Ballast fills and pressurizes, as it does in an actual analysis, for this leak check.

The Filled Ballast and Doser Leak Check is useful for quickly checking the ballast and doser after routine maintenance or for pinch valve leaks. Refer to Flow Diagrams, page 9–21, to view the analytical flow path that is tested by the Filled Ballast and Doser Leak Check.

Filled Ballast Leak Check

The Filled Ballast Leak Check checks for leaks only in the ballast. The ballast fills and pressurizes, as it does in an actual analysis, for this leak check.

The Filled Ballast Leak Check is useful for quickly checking the ballast after routine maintenance or for pinch valve leaks. Refer to Flow Diagrams, page 9–21, to view the analytical flow path that is tested by the Filled Ballast Leak Check.

Segmented Inert Leak Check

The Segmented Inert Leak Check checks for leaks in the inert gas flow path and determines pass/fail/aborted results when the doser is in the Fill state and when the doser is in the Dump state.

A Segmented Inert Leak Check is useful for checking only the inert gas flow path for leaks. Refer to Flow Diagrams, page 9–21, to view the analytical flow path that is tested by the Segmented Inert Leak Check.

- Next to Dose Loop Size, select either Large (10 cm^3) or Small (3 cm^3) to choose which loop will be part of the flow path.

Leak Check Procedures

1. Select Diagnostics and then select Leak Check.
2. Select the desired type of leak check to perform.
3. **For Segmented System and Segmented Inert leak checks only:** Next to Dose Loop Size, select either Large (10 cm^3) or Small (3 cm^3) to choose which loop will be part of the flow path.
4. Select Start at the bottom of the screen
5. Upon completion of the leak check, a pass/fail/aborted result will be displayed. This result will remain until the next leak check of that type is performed.

Leak Check Troubleshooting

Pressurization Failure

It is possible that the system will fail to pressurize when performing a leak check. If this occurs, there is a gross leak in the gas system. Verify that the pinch valve tubing is properly seated in the valves. If the leak occurred after maintenance, check the assembly or area that was serviced. Also make sure there is sufficient pressure at the carrier supply.

Pressure Increase

If the system pressurizes and the pressure increases during a leak check, the cause depends on the segment. For segments with heaters, the temperatures may not have stabilized. Allow the temperatures to stabilize and then perform another leak check. Additionally, check that the pinch valve tubing is properly seated in the valves in the failed segment.

Pressure Decrease

If the system pressurizes and the pressure decreases during the leak check, there is a leak in the system. In this case, check the last action or maintenance item that was performed. Something may have been disturbed or incorrectly installed during another procedure. Check to make sure the fittings are correctly tightened and, if reagent materials were changed, make sure no glass wool is interfering with the sealing surface of the o-rings. Refer to the Fitting Assembly and Reassembly, page 9–17, for the correct tightening procedures for the various fittings used throughout the system.

A typical procedure for troubleshooting leak in the flow path is given as follows:

Perform a Segmented System Leak Check.

Furnace Segment

- If there is a pressure increase, check SV104.
- If there is a pressure decrease:
  - Check that the load head is seated properly on top of the furnace.
  - Check the pinch tubing and fittings in the flow path.
  - Check that filter tubes are installed properly
  - Check PV01, PV03, PV04, or PV07.

Filled Ballast and Doser Segment

- If there is a pressure increase, check PV04 and PV06.
- If there is a pressure decrease:
  - Check PV02.
  - Check all the pinch tubing in the flow path.
  - Check the fittings around the doser.
  - Check the doser stem.
  - Check the ballast assembly.

Inert Fill and Inert Dump Segments

- If there is a pressure increase, check SV101.
- If there is a pressure decrease:
  - Check all of the fittings in the flow path.
  - Check the doser stem.
  - Check the tubes to make sure they are sealing on the o-rings.
  - Check the IR cell plate and cell.
  - Check the TC cell.

System Check

The System Check is used to check all basic functions necessary for the unit to perform an analysis. Depending on the instrument configuration, this may include checks of the communication, electrical, pressure, flow, temperature, motor(s), and interlock systems. If any of the items fail, it will be necessary for the user or service engineer to correct the problems before the unit can be used for analysis.

NOTE Prior to performing a system check, ensure that the system has been On for at least 30 min to allow all temperatures to stabilize.

Perform a System Check by completing the following steps.

1. In the software, select Diagnostics, and then select the System Check tab.
2. Select Start, and then wait for the System Check sequence to finish.
3. Address any items that do not pass.

9 Service

This section contains common service procedures that may correct operational problems with the instrument. The procedures included in this chapter may require disabling power to the instrument and should be performed only by trained personnel. If you are still experiencing difficulties after referencing the service information, please contact the LECO Service Department at 269-982-5497 for assistance.

Illustrations

Flexible Replacement Tubing

The following is a list of flexible tubing used throughout the instrument. If replacement is necessary, order tubing by the part number and length. Cut to length when installing. Additional fittings may be required.

LECO Part Number	Description	Where Used
783-771	1/4″	TC Cell Exhaust. Order by ft: 5.75 in per unit
		After Burner to Primary Filter. Order by ft: 2.5 ft per unit
625-710-795	1/8″	Pneumatics. Order by ft.
622-002-357	Assembly	Pinch Valve Harness: FP828/FP828P/CN828
622-002-632	Assembly	Pinch Valve Harness: CHN828
622-002-633	Assembly	Pinch Valve Harness: CHN828
625-602-481	3/8″	O_2 Exhaust. Order by ft: 1.75″ per unit. CHN828

Calibrating the Hardware

Hardware Calibrations allows the operator and service person to calibrate the ballast/furnace pressures, reduction heater temperature, furnace temperature, and afterburner furnace temperature, if applicable, within the unit. These hardware calibrations need to be performed only if the instrument was serviced and an assembly was reinstalled that would affect calibration. When saving a hardware calibration, the software checks the calibration to see if it falls within an appropriate range, and it will give a warning if the calibration is outside that range. Special equipment may be necessary to perform some of the calibration procedures. Contact the LECO Service Department if you have questions.

NOTES

- If hardware calibrations have not been performed or saved, the software will display warnings. In this case, it is possible to continue analysis with the default calibration.
- Hardware calibrations cannot be performed when the Service Key is inactive. Refer to Using the Service Key, page 5–26. An active Service Key is not required to export or import the current hardware calibrations. Refer to Importing and Exporting, page 3–22.

Adjusting the TC Reference Flow

HAZARDOUS VOLTAGE WARNING
During this procedure the electrical power must be left on. Use caution when accessing adjustments inside the instrument. DO NOT touch any component where high voltage is present.

CAUTION
The mechanical flow controller should not be recalibrated unless it is certain that recalibration is absolutely necessary. Contact the LECO Service Department for questions about recalibration. Improper mechanical flow controller calibration can cause problems with operation and performance of the instrument.

1. Perform and pass a leak check. Refer to Leak Check, page 8–12.
2. Obtain a flowmeter to be used during this procedure.

NOTE When checking gas flows, it is required to calibrate the flowmeter for the gas being measured.

3. Attach the flowmeter to the inert gas exhaust, located on the rear panel. Refer to Figure 2-5, page 2–10.
4. In the software, turn On the gas by selecting Gas on the Action bar and then selecting On.
5. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance. Select the parameter field next to Measure Flow, and then select Valve Closed. Select Enter.
6. Open the instrument front door to access the mechanical flow controller adjustment, located between the dose scrubber tube and the inert gas scrubber tube.

7. Use a small flat-blade screwdriver to turn the adjustment screw and adjust the mechanical flow controller until the flowmeter reads 0.045 to 0.055 L/min, with a target of 0.050 L/min. Refer to Figure 9-1, following.

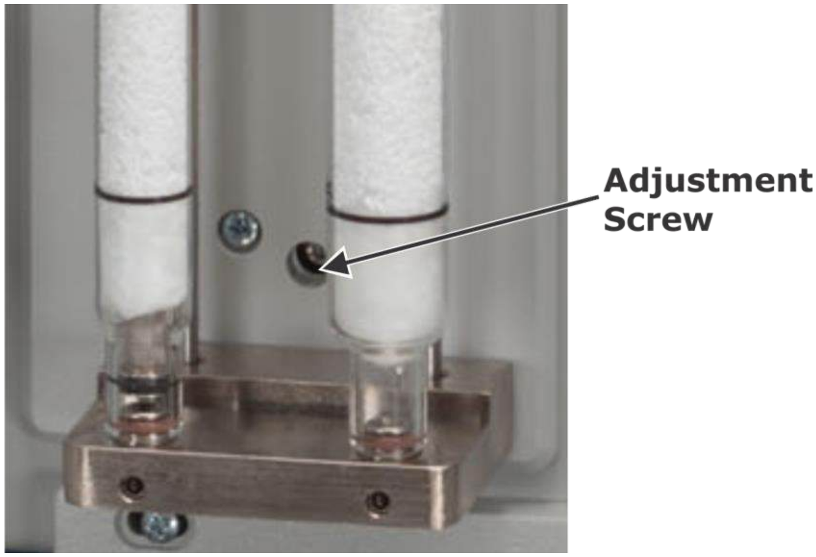


Figure 9-1
Adjusting TC Reference Flow

8. Remove the flowmeter, and close the instrument front door.

Thermal Conductivity Cell Service

Use the following procedure to set the Bridge Offset for the Thermal Conductivity (TC) Cell. This procedure should be performed only when the TC Cell Bridge Voltage is not 3.5 V or the TC signal is not 0.2 ± 0.1 V with the Inert Gas On. The cell temperature must be stable before starting this procedure.

1. Set gas state to On by selecting “GAS” at the bottom of the screen and then selecting On.
2. In the software, navigate to Instrument ➤ Detectors ➤ N2, and verify the Bridge Setpoint is 3.5 V by selecting the Get Current Setpoint button. If the setpoint is not 3.5 V, then enter 3.5.
3. Allow 5 minutes for the TC cell to stabilize.
4. In the software, navigate to Instrument ➤ Detectors ➤ N2, and then select Auto Set next to Bridge Offset to prepare the TC detector. The TC Signal should settle around 0.2 V ± 0.1 V with <0.05 mV short term noise.

Replacing the Ballast Oven Heaters

HAZARDOUS VOLTAGE WARNING
ELECTRICAL SHOCK HAZARD
To prevent an electrical shock, turn Off the analyzer and unplug it from facility power before completing this procedure.

The ballast oven heater is located behind the left side panel and the ballast oven cover, to the right of the ballast assembly. Refer to Figure 6-48, page 6–59.

1. Turn Off the analyzer and unplug it from facility power.
2. Remove the ballast assembly by completing the steps in Removing the Ballast Assembly, page 6–58.
3. Locate the ballast oven heaters located against the back wall next to the dose loops.
4. Remove the heater cover by removing the four Phillips head screws. Refer to Figure 9-2, following.

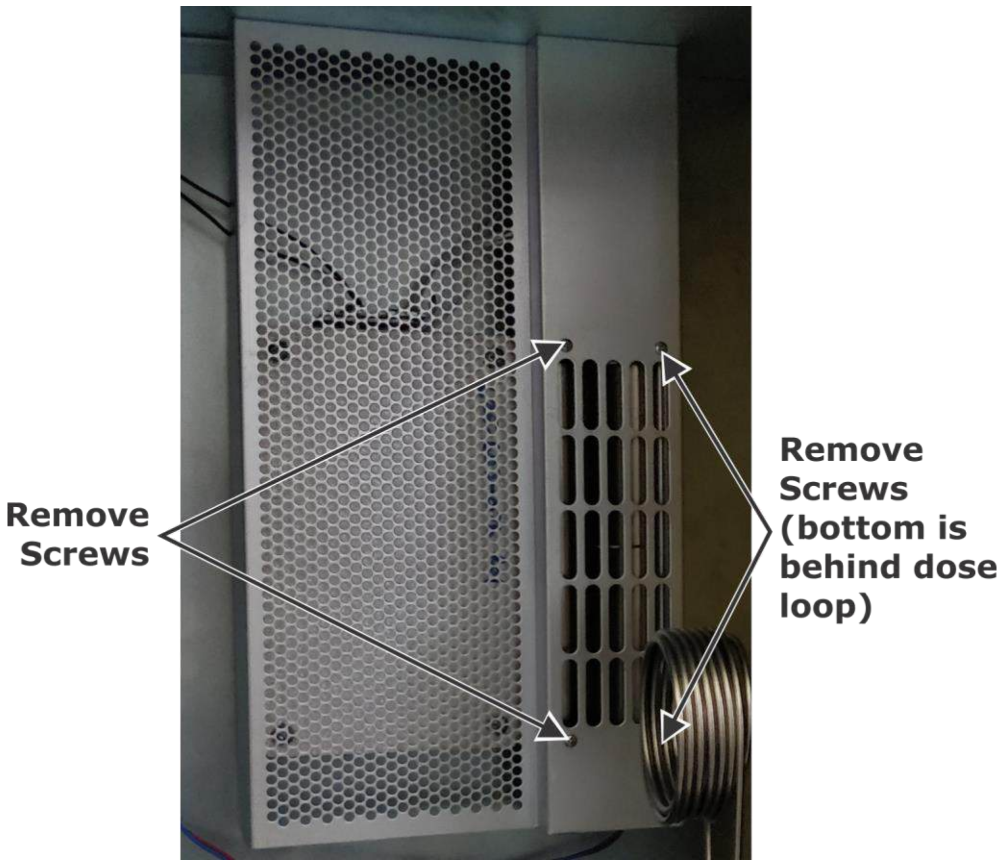


Figure 9-2
Ballast Oven Heater Covers

5. Unplug the heaters, blower, and thermistor from the harness.

6. Remove the heater assembly from the ballast oven by removing the two Phillips head screws.
7. Replace the heater(s) in the ballast heater assembly. Refer to Figure 10-31, page 10–36.
8. Replace the heater assembly in the ballast with the two Phillips head screws.
9. Plug in the heaters, blower, and thermistor to the harness.
10. Reinstall the heater cover removed in step 4.
11. Reinstall the ballast assembly by completing steps 1 through 5 of Installing the Ballast Assembly, page 6–61.
12. Plug the analyzer into facility power, and turn it On
13. Turn On the gas.
14. In the software, navigate to Instrument ➢ Maintenance ➢ General Maintenance. Toggle the switch to turn On the Ballast Oven and Fan.
15. Perform a leak check. Refer to Leak Check, page 8–12.

Replacing the Ballast Oven Thermistor

HAZARDOUS VOLTAGE WARNING
ELECTRICAL SHOCK HAZARD
To prevent an electrical shock, turn Off the analyzer and unplug it from facility power before completing this procedure.

The ballast oven thermistor is located behind the left side panel and the ballast oven cover. Refer to Figure 6-48, page 6–59.

1. Turn Off the analyzer and unplug it from facility power.
2. Remove the ballast assembly by completing the steps in Removing the Ballast Assembly, page 6–58.
3. Remove the heater cover by removing the four Phillips head screws. Refer to Figure 9-2, page 9–8.
4. Unplug the thermistor from the harness. Refer to Figure 10-31, page 10–36.
5. Push the clip to slide it away from the thermistor, and remove the thermistor.
6. Install the new thermistor in the clip.
7. Plug the thermistor into the harness.
8. Reinstall the heater cover removed in step 2.
9. Reinstall the ballast assembly by completing steps 1 through 5 of Installing the Ballast Assembly, page 6–61.
10. Plug the analyzer into facility power, and turn it On
11. Turn On the gas.
12. In the software, navigate to Instrument ➤ Maintenance ➤ General Maintenance. Toggle the switch to turn On the Ballast Oven and Fan.
13. Perform a leak check. Refer to Leak Check, page 8–12.

Replacing the Incoming Gas Filters

The incoming gas filters are located behind the incoming gas fittings on the rear panel. There is a filter for incoming O_2 and one for the incoming inert gas. Refer to Figure 10-48, page 10–53, and Figure 10-49, page 10–54.

1. Turn Off the incoming gas at the tank.
2. Disconnect the tubing from the incoming gas fitting.
3. Remove the incoming gas fitting by unscrewing it from the manifold.
4. Use the o-ring removal tool from Accessory Pack to remove the o-ring from the port, and then use the o-ring tool or a small screwdriver to guide out the filter and remove it.
5. Clean the o-ring with a lint-free cloth.
6. Clean the filter with compressed air, or replace the filter.
7. Reinstall the filter and then the o-ring to the port.
8. Reinstall the incoming gas fitting.
9. Connect the tubing to the incoming gas fitting.
10. Turn On the incoming gas at the tank.
11. Perform leak check. Refer to Leak Check, page 8–12.

Aligning the Loading Head

Complete the steps in this section if any of the following is true:

- When reinstalling the loading head, the four captive screws do not thread smoothly.
- Either of the hex screws shown in Figure 9-3, following, is loose.

1. In the software, turn Off the gas by selecting Gas on the Action bar and then selecting Off.
2. Using a flat-blade screwdriver, loosen the four captive screws securing the loading head to the furnace. Refer to Figure 9-3, following.

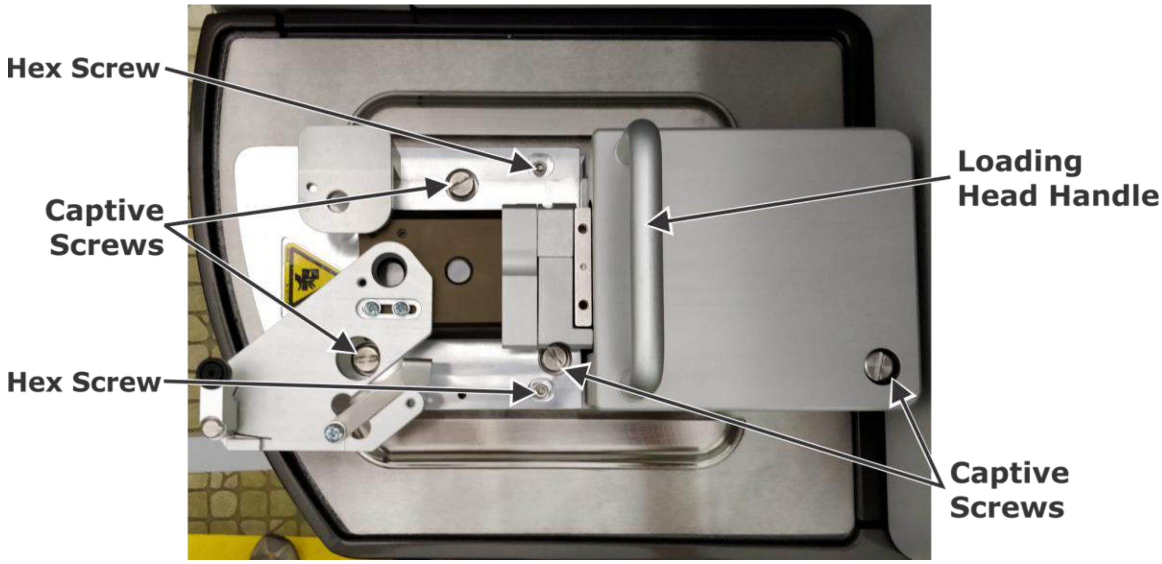


Figure 9-3
Loading Head Adjustment Screws

3. Loosen, but do not remove, the two Allen® (hex) screws. Refer to Figure 9-3, previous.
4. Using a flat-blade screwdriver, tighten the four captive screws loosened in step 2, previous.
5. Tighten the two hex screws loosened in step 3, previous.
6. Using the loading head handle, lift the loading head and set it aside. Refer to Figure 9-3, previous.
7. Check that the front and back blocks of the loading head assembly cannot be moved independently.
8. Reinstall the loading head onto the instrument, and tighten the four captive screws using a flat-blade screwdriver. Make sure the screws thread smoothly. If they do not, repeat steps 2 through 8 until they do.

Aligning the Sample Carousel

The sample carousel alignment should be checked after the loading head is aligned. Refer to Aligning the Loading Head, page 9–12.

PINCH HAZARD
Keep hands away from the carousel and loading head during operation.

1. In the software, turn Off the gas by selecting Gas on the Action bar and then selecting Off.
2. In the software, navigate to Diagnostics, and then select the Digital I/O tab.
3. Select Unlock in the Action bar.
4. Select Pneumatic Inlet SV106 to On.
5. Verify that Furnace Seal SV107 is Off.
6. Select Slide Block Close SV108 to On.
7. Lift up and remove the sample carousel from the loading head. Refer to Figure 9-4, following.

Figure 9-4
Sample Carousel Removal

8. Loosen the carousel actuator arm mounting screws just enough that the arm can be moved. Refer to Figure 9-5, following.

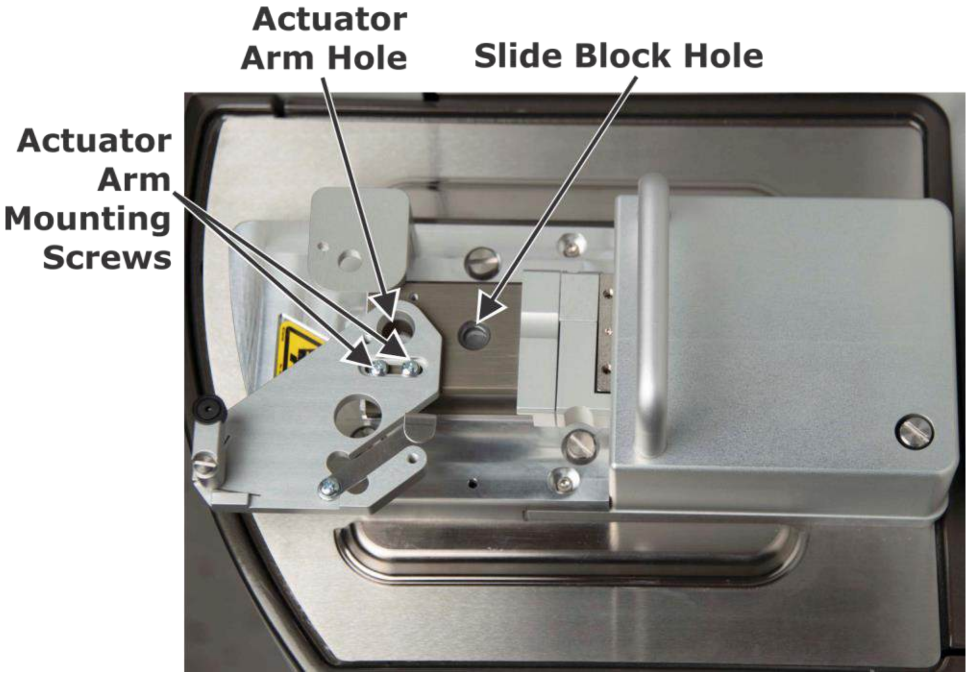


Figure 9-5
Carousel Actuator Arm

9. Position the hole in the center of the actuator arm over the hole in the slide block. Refer to Figure 9-5, previous.
10. Reinstall the sample carousel, making sure the alignment pin correctly references the loading head and the arrow is pointed to the combustion tube opening.
11. Align the hole of any position in the carousel with the hole in the center of the actuator arm.

12. The spring-loaded lever on the actuator arm should line up with the tooth on the carousel. If they not line up, move the actuator arm until they do. Refer to Figure 9-6, following.

Figure 9-6
Spring-Loaded Lever in Place

13. Once the lever is aligned, carefully remove the carousel, and tighten the two actuator arm mounting screws loosened in step 8, previous.
14. Place the carousel back on the loading head and cycle the slide block solenoid several times to ensure that it is indexing the carousel one position at a time. If it is not, repeat steps 7 through 14 until it is working correctly.

Replacing the Pneumatic Filter

Refer to Figure 10-48, page 10–53, and Figure 10-49, page 10–54.

HAZARDOUS VOLTAGE WARNING
ELECTRICAL SHOCK HAZARD
To prevent an electrical shock, turn Off the analyzer and unplug it from facility power before removing the side panel.

1. Turn Off the pneumatic gas at the source.
2. Turn Off the analyzer and unplug it from facility power.
3. Using a Phillips screwdriver, remove the three screws at the bottom of the left side panel. Lift up on the side panel and remove it.
4. Locate the incoming gas manifold on the rear panel, closest to the left-side opening.
5. Loosen the captive thumbscrew on the top block of the manifold.
6. Pull the top block up and remove it. The thumbscrew remains with the top block.
7. Pull the filter up and out of lower block, and then discard the filter.
8. Use the o-ring removal tool from Accessory Pack to remove the o-rings in the upper and lower blocks. Inspect the o-rings. Clean and grease them if needed. Refer to Cleaning and Greasing the O-Rings, page 6–9.
9. Reinstall the o-rings into the upper and lower block.
10. Replace the filter with a new one by pushing the filter down and into the lower block.
11. Reinstall the top block and tighten the thumbscrew.
12. Reinstall the left side panel.
13. Plug the analyzer into facility power, and turn it On.
14. Turn On the pneumatic gas at the source.
15. Perform a Systems Check. Refer to System Check, page 8–16.

Fitting Assembly and Reassembly

The following section provides fitting assembly instructions for compression fittings and o-ring face seal fittings.

Compression Fittings

Refer to Figure 9-7, following, for the correct installation and orientation of the nut and ferrules.

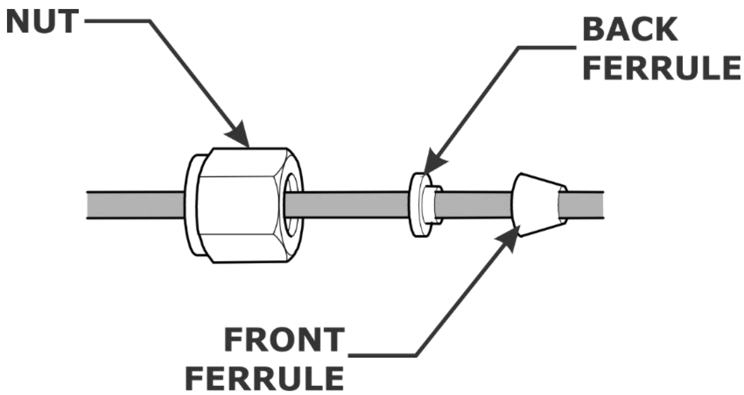
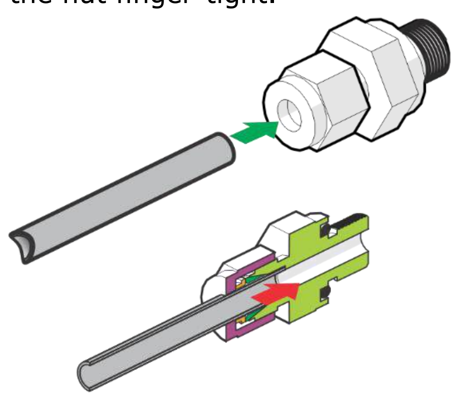


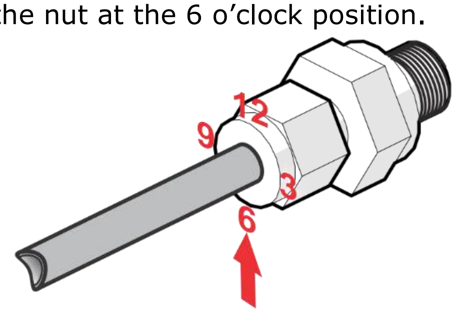
Figure 9-7
Ferrule Installation

Assembly

1. Fully insert the tube into the fitting and against the shoulder. Rotate the nut finger-tight.



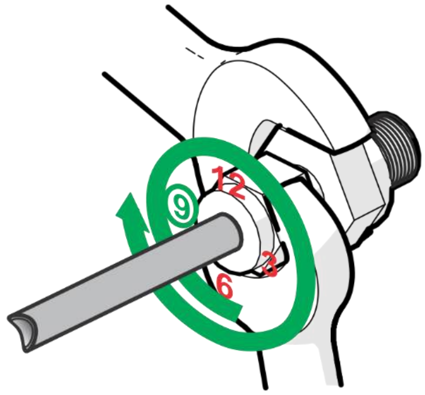
2. Mark the nut at the 6 o’clock position.



3. **For $^{1}/_{4}$-inch fittings and larger:** While holding the fitting body steady with a wrench, tighten the nut $1^{1}/_{4}$ turns to the 9 o'clock position.

   Or

   For $^{1}/_{16}$, $^{1}/_{8}$, and $^{3}/_{16}$-inch fittings or 2, 3, and 4 mm tube fittings: Tighten the nut $^{3}/_{4}$ turn to the 3 o'clock position.

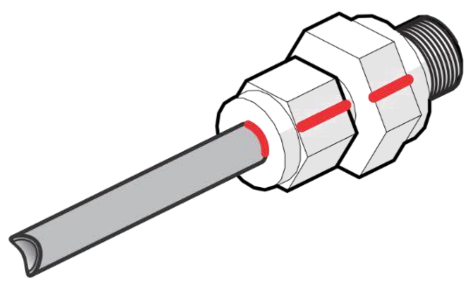


Reassembly

You may disassemble and reassemble compression tube fittings many times.

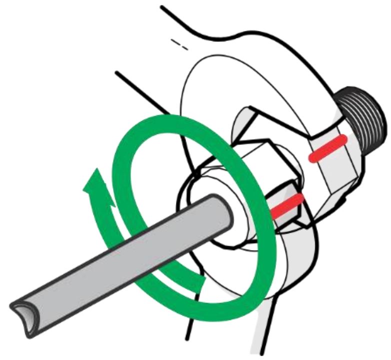
CAUTION
Always depressurize the system before disassembling a swage tube fitting.

1. Prior to disassembly, mark the tube at the back of the nut; mark a line along the nut and fitting body flats. Use these marks to ensure that the nut is returned to the previously pulled-up position.



2. Insert the tube into the fitting until the front ferrule seats against the fitting body.

3. While holding the fitting body steady, rotate the nut with a wrench to the previously pulled-up position, as indicated by the marks on the tubes and flats created in step 1, previous. A significant increase in resistance will be felt at this point. Tighten the nut slightly.



CAUTION
Do not use the compression fitting gap inspection gauge with reassembled fittings.

O-Ring Straight Thread Manifold Fittings

1. Turn the straight thread o-ring fitting to the manifold until it is finger-tight.
2. Tighten the straight thread o-ring fitting with a wrench until it makes metal-to-metal contact with the face of the manifold.
3. Tighten the fitting slightly with the wrench.

Installing Tubing into One-Touch Fittings

1. Cut the tube perpendicularly, being careful not to damage the outside surface. Use tube cutters to avoid deforming the tubing.
2. Grasp the tube and slowly push it into the one-touch fitting until the tube comes to a stop.
3. Pull the tubing back gently to make sure it has a positive seal.

Removing Tubing from One-Touch Fittings

1. Push in evenly on the release button.
2. Pull out the tube while keeping the release button depressed. If the release button is not held down, the tube cannot be withdrawn.
3. To reuse the tubing, cut off the previously lodged portion of the tube.

Zero-Clearance O-Ring Face Seal Fittings

1. Position the face seal against the fitting body.
2. Turn the nut onto the female end until it is finger-tight.
3. While holding the fitting body steady with a wrench, tighten the nut slightly (approximately 1/8 turn or 45°) with a second wrench.

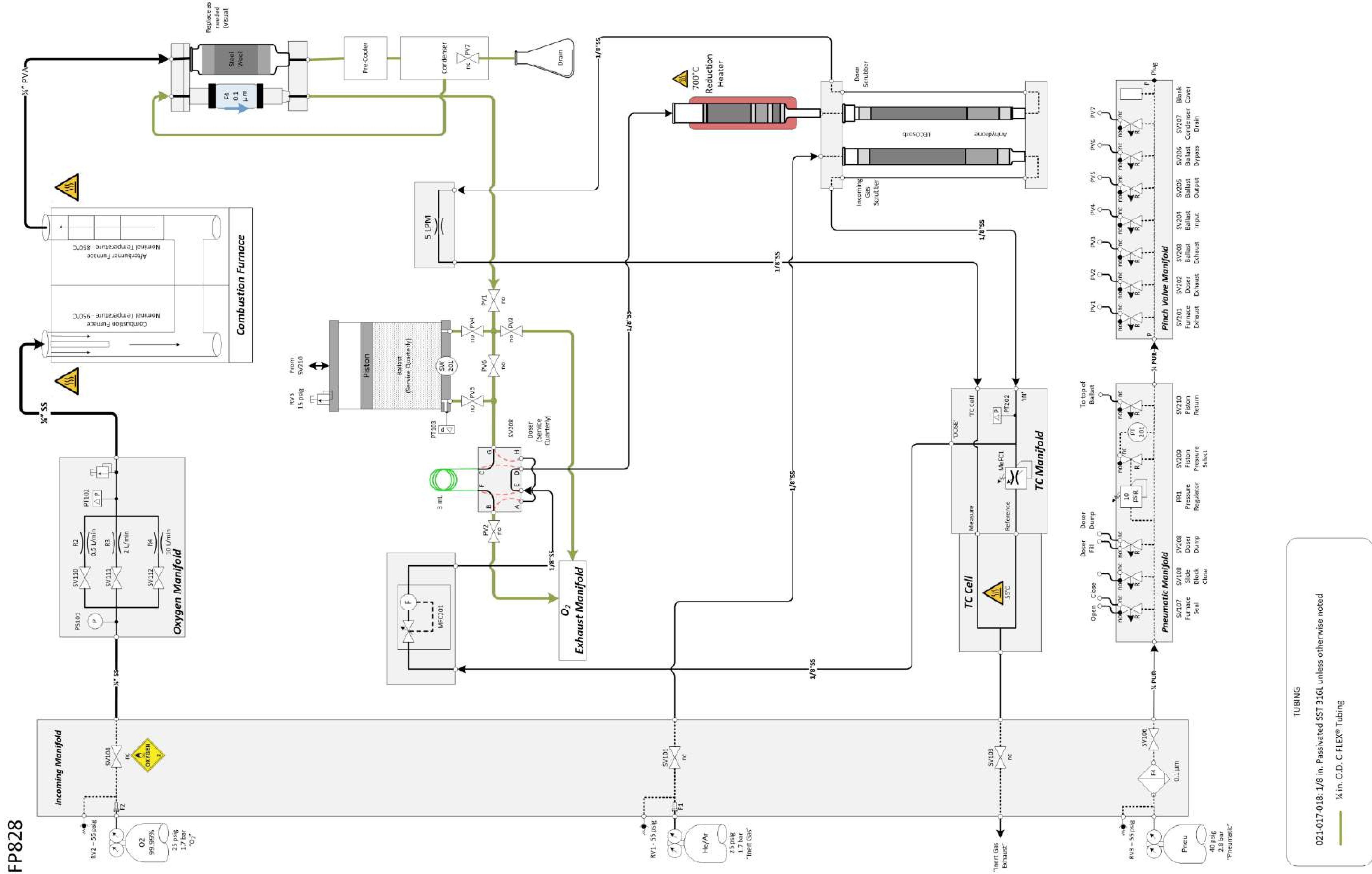


Figure 9-8
Analytical Flow Diagram – FP828

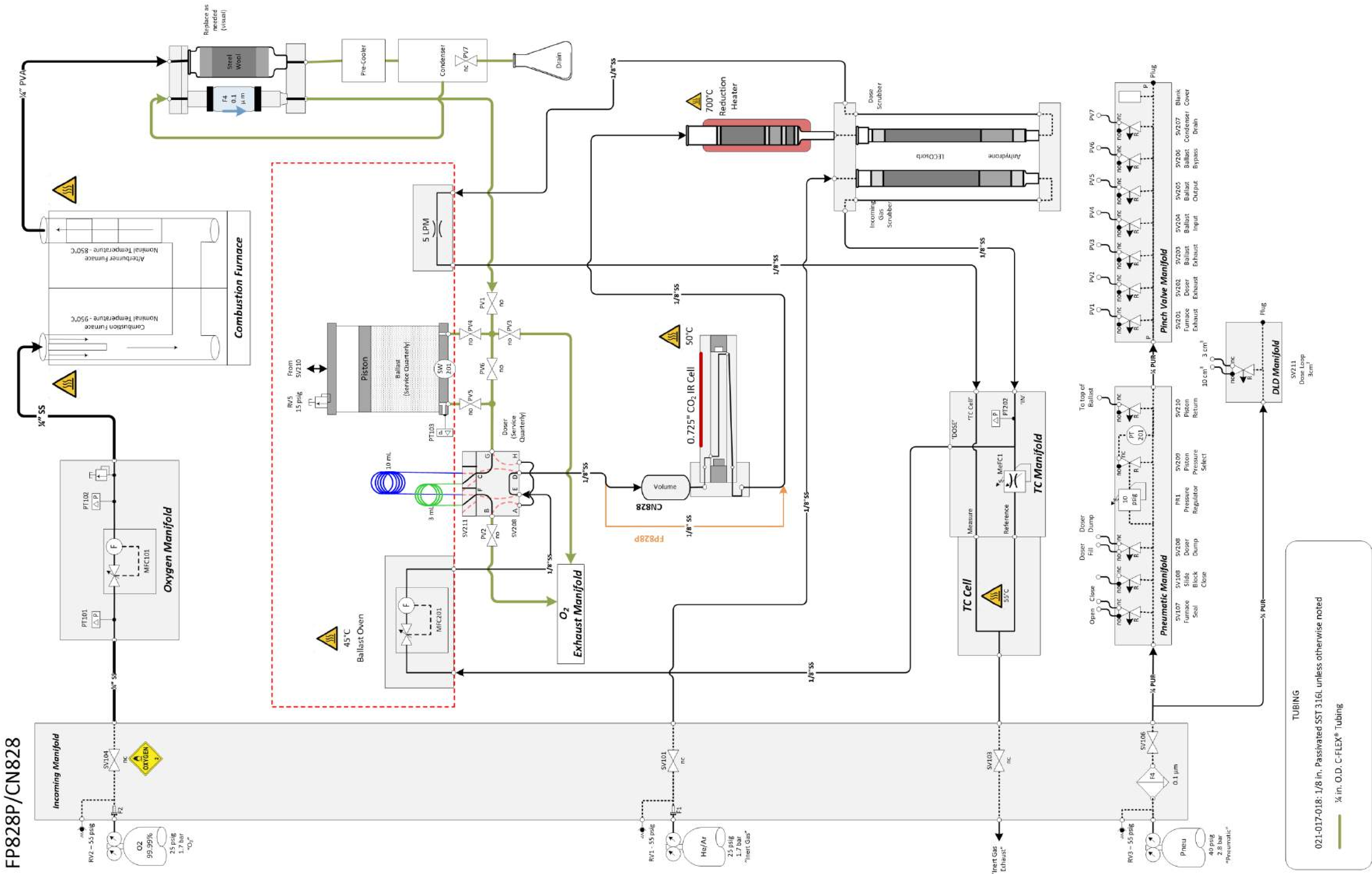


Figure 9-9
Analytical Flow Diagram – CN828 and FP828P

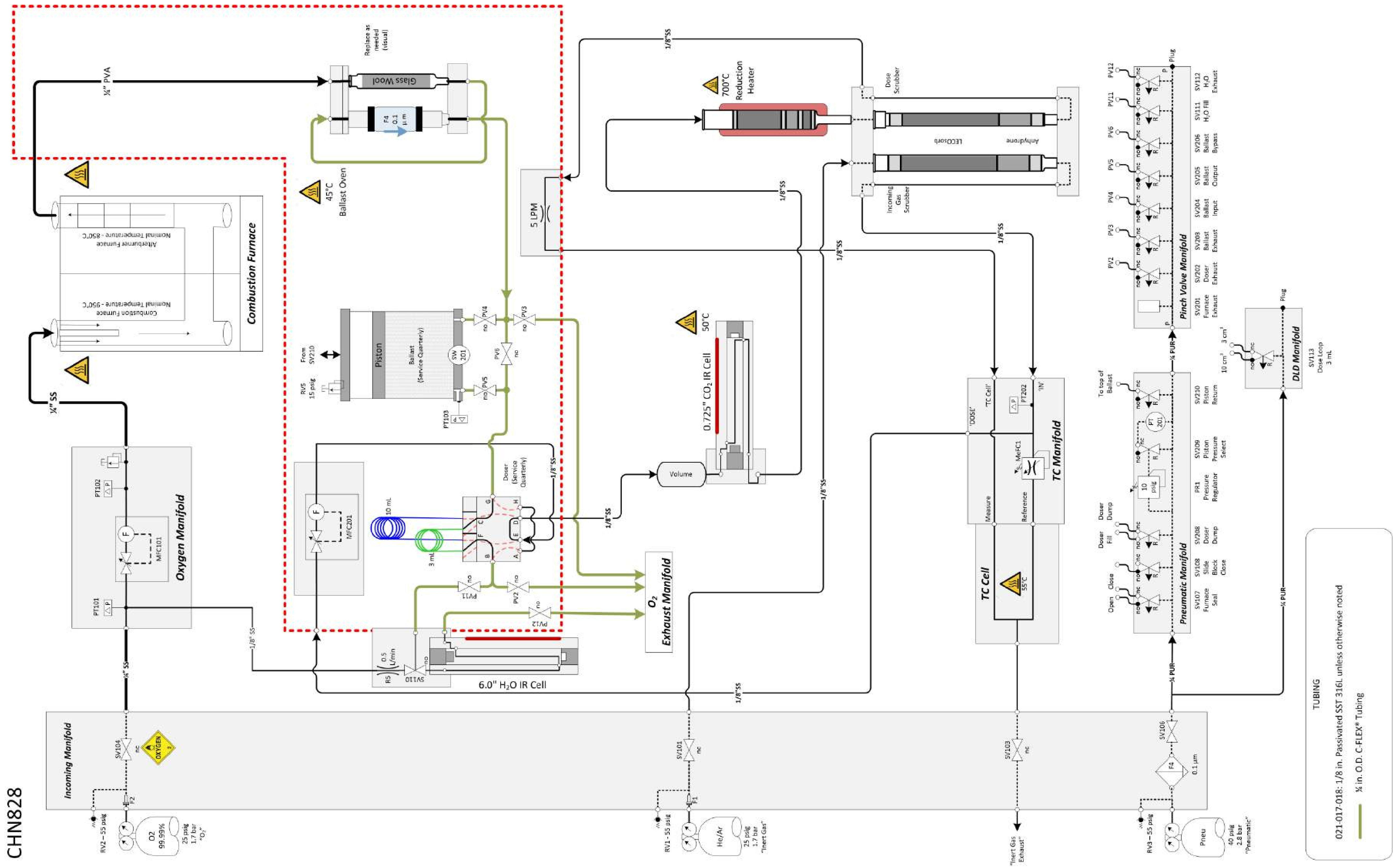


Figure 9-10
Analytical Flow Diagram – CHN828

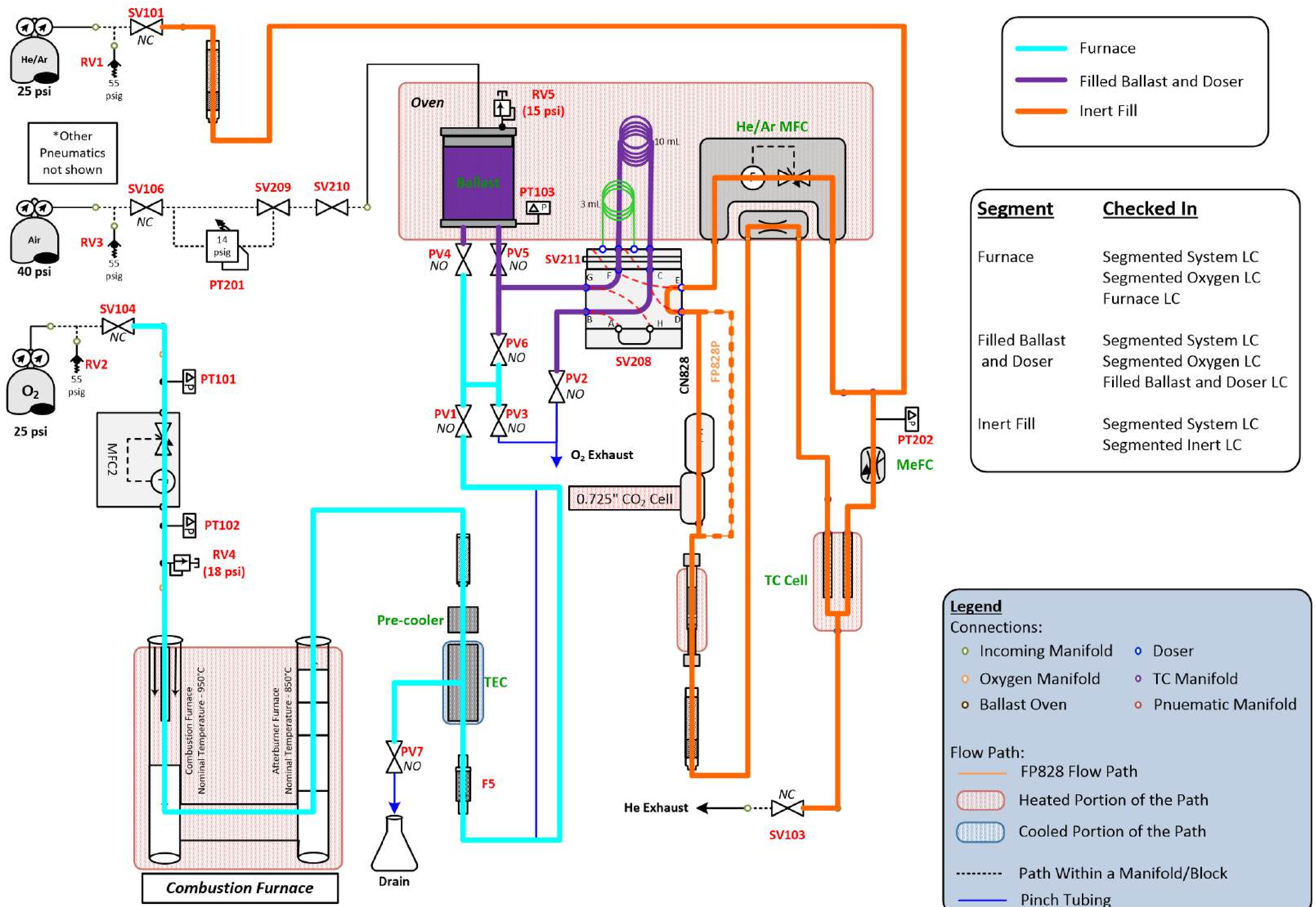


Figure 9-11
Leak Check Segment Def CN828, FP828, FP828P 1 of 2

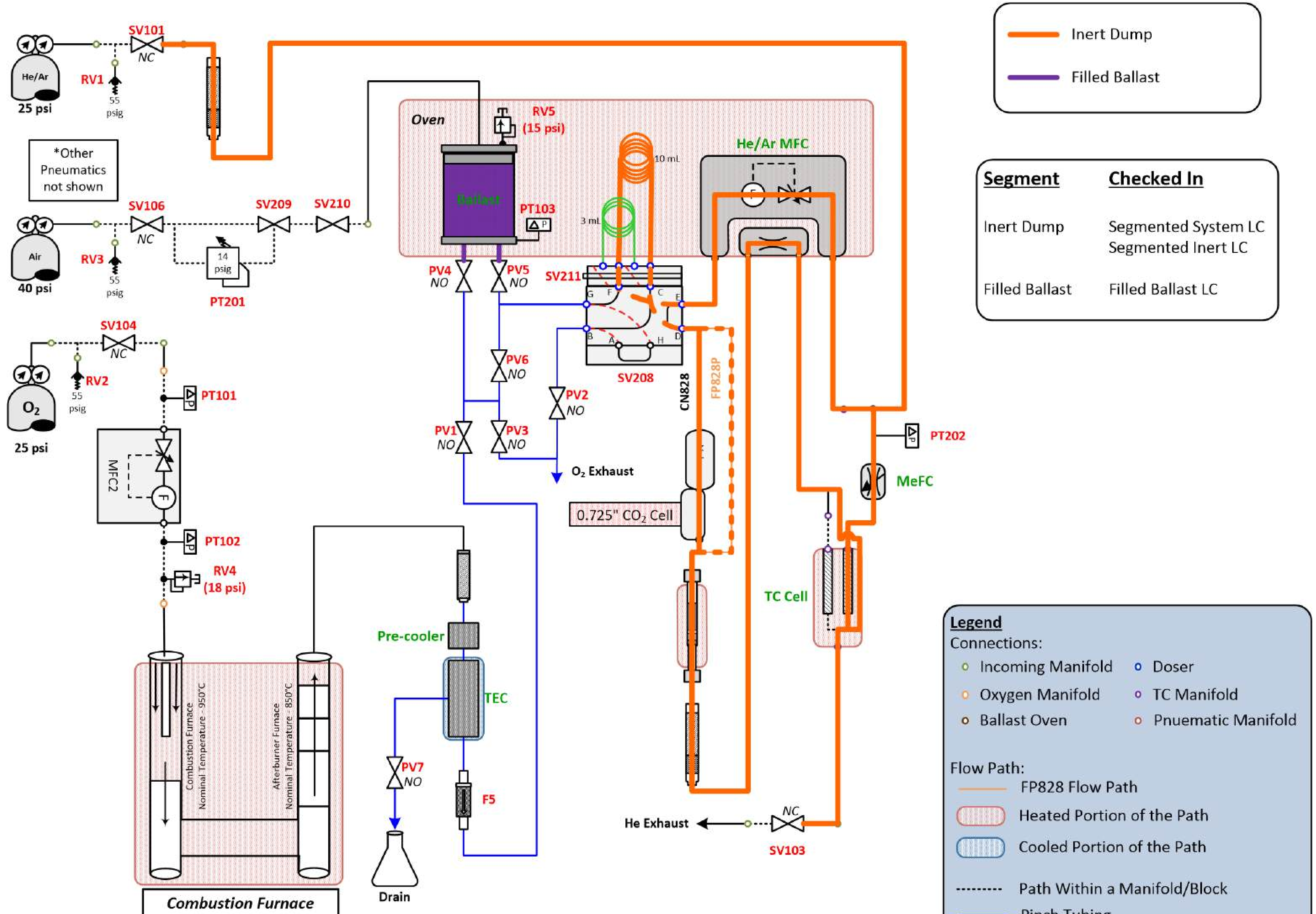


Figure 9-12
Leak Check Segment Def CN828, FP828, FP828P 2 of 2

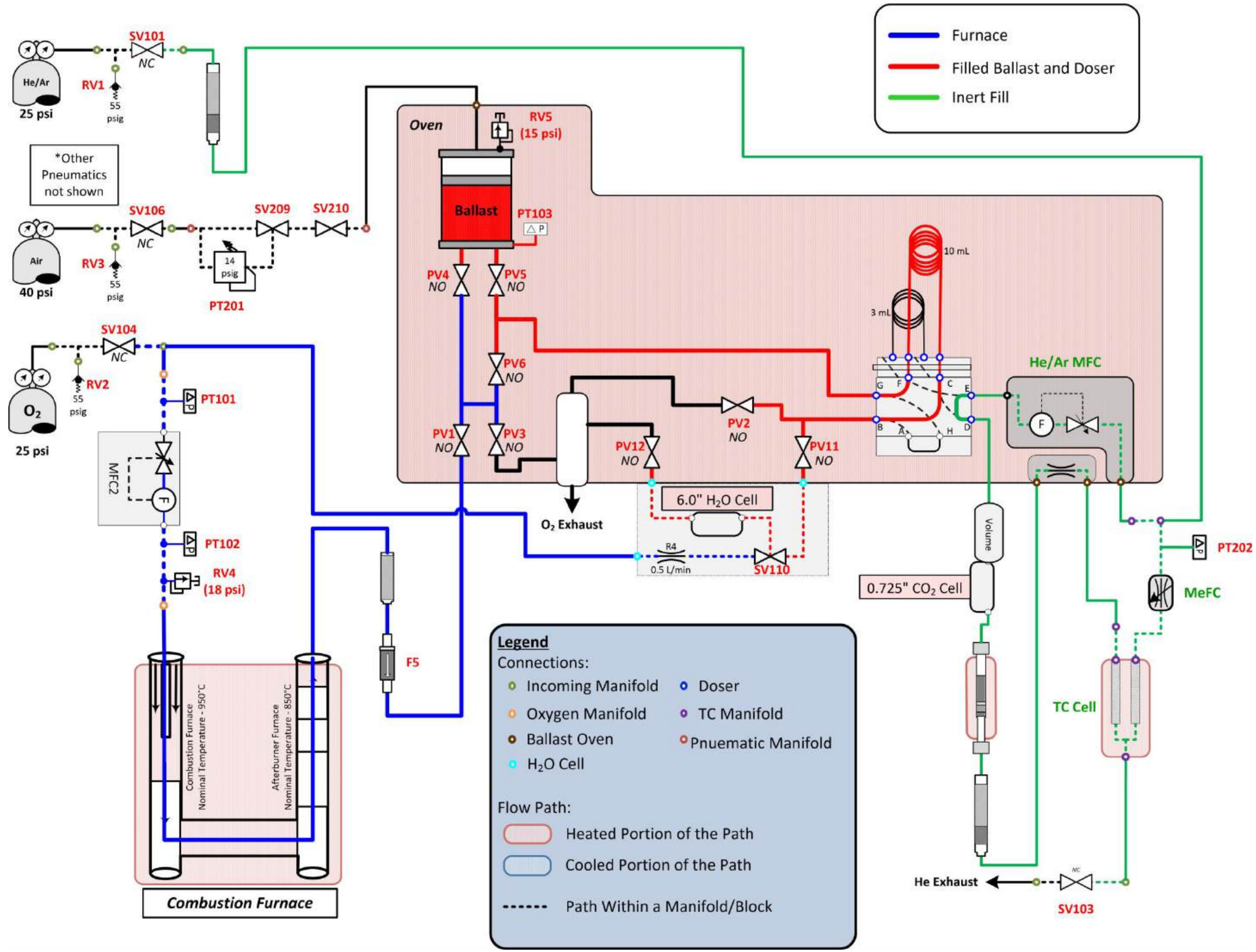


Figure 9-13
Leak Check Segment Def CHN828 1 of 2

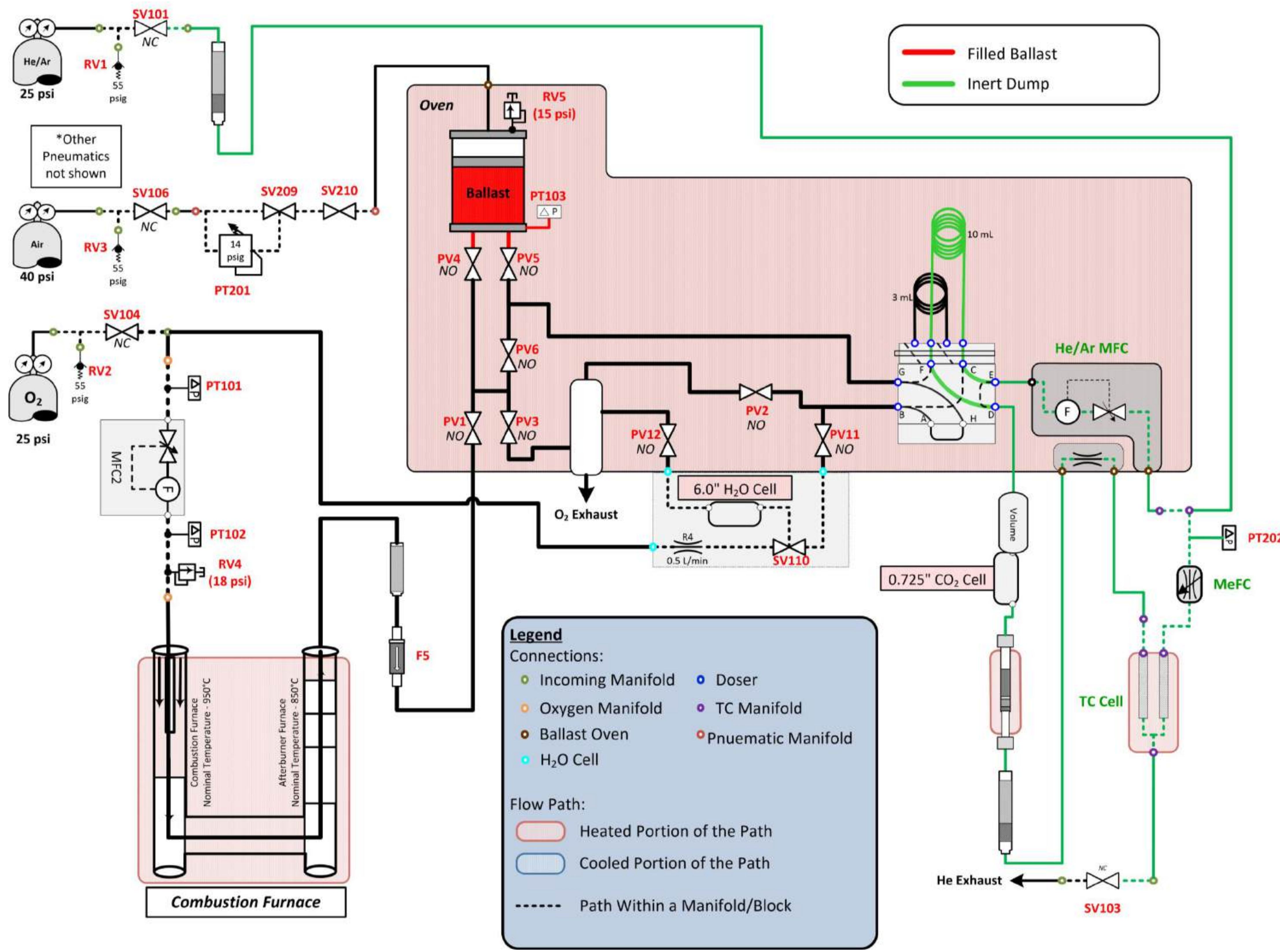


Figure 9-14
Leak Check Segment Def CHN828 2 of 2

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Viewing Valve States

The valve states are viewable in the software, but they cannot be changed. In the software, navigate to Instrument ➤ Diagnostics ➤ Valve States.

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10 Illustrations

The Illustration chapter can assist in procedures, verify information during setup, and help to locate parts within the instrument and part numbers.

NOTES

- Some illustrations in this section apply only to certain models and are labeled accordingly.
- The following items listed are subject to revision. Confirm the current parts and part numbers before ordering.

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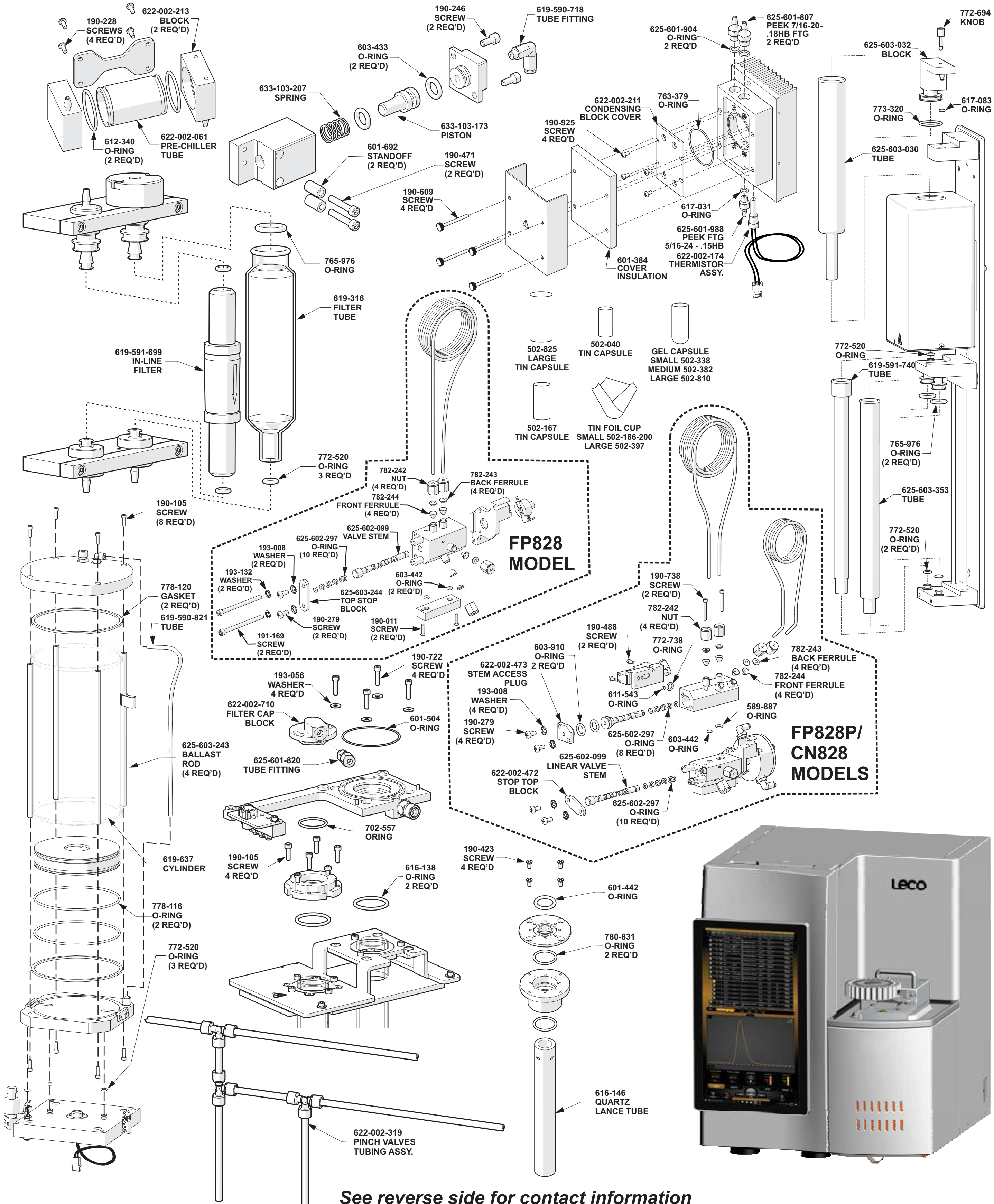
828 Series
Consumables & Spare Parts Reference Card

Note: Part numbers and standards' values may change. Consult LECO for the latest information.



See reverse side for contact information

GENERAL COMBUSTION SUPPLIES

501-171-HAZ Anhydrone 454 g (1 lb.) bottle
502-705 Copper Sticks 100 g ampule
502-878 Copper Sticks 100 g bottle
502-656 Copper Turnings 60 g bottle
501-081 Glass Wool 454 g (1 lb.) box
763-265 Glass Wool 227 g (0.5 lb.) package
502-174-HAZ Lecosorb 500 g bottle
502-049 N-Catalyst 50 g bottle
608-379 Quartz Wool Strips 10/pk
502-310 Steel Wool 454 g (1 lb.)
501-609-HAZ Furnace Reagent
622-002-319 Ballast C-Flex Replacement Assembly

CAPSULES AND CRUCIBLES

502-338 Gel Capsule, Small 400/pkg
502-382 Gel Capsule, Medium 400/pkg
502-810 Gel Capsule, Large 400/pkg
614-961-110 Porous Crucibles for solids 10/pk
617-605 Porous Crucibles for liquids 10/pk
502-040 Tin Capsules, Small 100/bottle
502-040-100 Tin Capsules, Small 1000/bottle
502-167 Tin Capsules, Medium 100/bottle
502-825 Tin Capsules, Large 50/bottle
502-186-200 Tin Foil Cups, Small 100/bottle
502-186-100 Tin Foil Cups, Small 1000/bottle
502-397 Tin Foil Cups, Large 100/bottle
502-397-400 Tin Foil Cups, Large 400/bottle

OPERATION ACCESSORIES

502-007 Tube Cleaner
601-981 Wire Brush
616-152 Crucible Extractor Tool
775-306 Secondary Filter, 10 micron
619-591-699 Filter In-Line, 0.1 micron
502-023 Funnel Quick Disc
778-321 Lance Extraction Tool
502-213 Leak Detection Solution
762-515 O-ring Tool - Removal
616-513 O-ring Tool - Installation
604-398 Sample Cup Holder, Large
604-373 Sample Cup Holder, Small
778-405 10-Sample Storage Block
501-614 Spatula
619-180-110 Stackable Carousel Assy
625-603-404 Tube Packing Tool
502-028 Tweezers
604-378 Tweezers, Curved (SST)
501-241 Vacuum Grease

COMBUSTION TUBES AND GLASSWARE

619-316 Glass Filter Tube (wide mouth top, small bottom) requires one (1) 765-976 Top O-ring and one (1) 772-520 Bottom O-ring for sealing
780-899 Honeycomb Ceramic Stop
619-065 Combustion Tube
619-591-740 Aliquot Scrubber Tube
625-603-030 Reduction Tube
616-146 Lance Tube
625-603-353 Incoming TC Carrier Gas Scrubber Tube

REFERENCE MATERIALS

LECO Corporation is A2LA accredited in accordance with International Standards Organization ISO/IEC 17025:2017 (Certificate No. 3285.01) and 17034:2016 (Certificate No.3285.02) as a reference material producer.

PURE CHEMICAL LECO Certified Reference Materials (LCRM)

Part No.	*Description*	*% C*	*% N*	*Contents*
502-205	Caffeine	49.48	5.19	25 g
502-896	EDTA LCRM	40.80–41.20	9.52–9.60	50 g
502-896-250	EDTA LCRM	40.80–41.20	9.52–9.60	250 g
502-911	Glycine LCRM	32.00	18.66	50 g
502-688	Nicotinic Acid LCRM	58.53	11.4	15 g
502-642	Phenylalanine LCRM	65.4	8.5	50 g
502-897	BBOT LCRM	72.5	6.5	25 g
502-601	Aqueous Ammonium Chloride	—	0.01	(5) 10 mL vial
502-602	Aqueous Ammonium Chloride	—	0.1	(5) 10 mL vial

NATURAL MATRIX LECO Reference Materials (LRM) and Certified Reference Materials (LCRM)

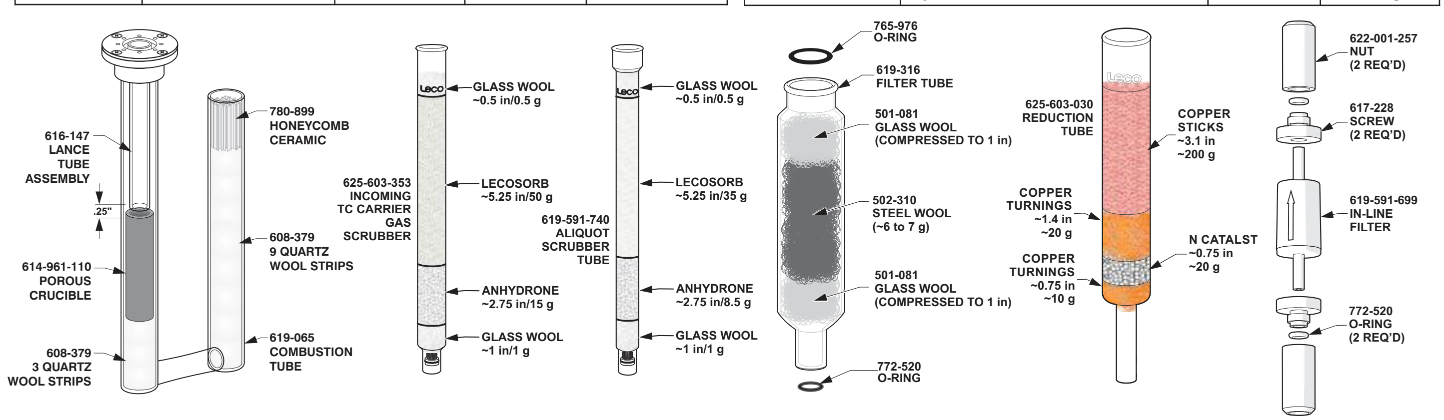
Part No.	*Description*	*% C*	*% N*	*Contents*
501-563-150	Corn Flour LRM	—	0.8–1.6	50 g
502-055	Orchard Leaves LRM	44.0–52.0	2.0–2.8	20 g
502-082	Tobacco Leaves LRM	35.0–47.0	2.0–4.0	20 g
502-932	Corn Gluten LCRM	51.0–53.0	11.0–12.0	50 g
502-273	Alfalfa LRM	45.0–47.0	2.5–5.0	50 g
502-692	Wheat Flour LCRM	44.0–46.0	2.5–3.5	50 g
502-906	Barley Flour LCRM	45.0–47.0	1.0–3.0	50 g
502-907	Rice Flour LCRM	43.0–45.0	1.0–3.0	50 g

SOILS LECO Reference Materials (LRM) and Certified Reference Materials (LCRM)

Part No.	*Description*	*% C*	*% N*	*Contents*
502-062	Soil LRM	0.75–1.25	0.09–0.15	65 g
502-697	Soil LCRM	2.5–3.5	0.2–0.3	65 g
502-694	Soil LCRM	10.0–14.0	0.3–1.0	65 g
502-814	Soil	35–45	~2	65 g

SYNTHETIC CARBON LECO Certified Reference Materials (LCRM/LRM)

Part No.	*Description*	*%C*	*Contents*
502-632	Synthetic Carbon LCRM	0.1–0.2	50 g
502-934	Synthetic Carbon LCRM	0.4–0.60	50 g
502-696	Synthetic Carbon LCRM	0.9–1.10	50 g
502-905	Synthetic Carbon LCRM	4.90–5.10	50 g



NOTES: Part numbers and standards' values may change. Consult LECO for latest information.

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LECO EMPOWERING RESULTS

622-160-020 ASSY CN/FP/CHN828 COMMON SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	169-001-730	LABEL ID CE	1
2	169-003-171	LABEL WARNING ELECTRICAL SHOCK	1
3	169-003-483	LABEL ID RCM	1
4	603-429	GROMMET PLAIN	1
5	619-590-513	CABLE TAK-TY MOUNT	18
6	619-590-521	MOUNT RESILIENT 1.00 X .75 X .250-20	3
7	619-591-614	FOOT LEVELING .375-16 X .714 STUD, 3.15 DIA	3
8	622-002-001	ASSY REAR PANEL CS-900	1
9	622-002-002	PANEL TOP P/P	1
10	622-002-041	SUPPORT CORNER FRAME SHORT	1
11	622-002-055	ASSY BASE PLT	1
12	622-002-101	ASSY BRACKET/CARD DISTRIBUTION DC	1
13	622-002-104	ASSY MANIFOLD PNEUMATIC	1
14	622-002-129	INSULATION HEATER REAGENT	1
15	622-002-135	TUBE SST O IN TO OXYGEN MANIFOLD	1
16	622-002-139	TUBE SST INCOMING INRT TO REAGENT	1
17	622-002-140	TUBE SST REAGENT TO TC IN	1
18	622-002-296	ASSY BRACKET & FLOW CARD	1
19	622-002-425	BRACKET RETAINER SENSOR AMBIENT	1
20	622-002-445	BLOCK EXTENSION FOOT FRONT	2
21	622-002-452	FOOT LEVELING .375-16 X .34 STUD, 3.15 DIA	2
22	622-002-542	ASSY CABLE TC CELL 828	1
23	622-002-674	ASSY PANEL FRONT	1
24	622-002-704	INSULATION CELL TC SUPPORT	1
25	625-603-046	ASSY MANIFOLD INCOMING GAS	1
26	625-603-189	ASSY MANIFOLD TC CELL	1
27	625-603-199	ASSY CELL TC HE/AR	1
28	625-603-316	ASSY COVER TC CELL	1
29	625-710-374	ASSY SUPPORT FRAME CORNER LEFT	1

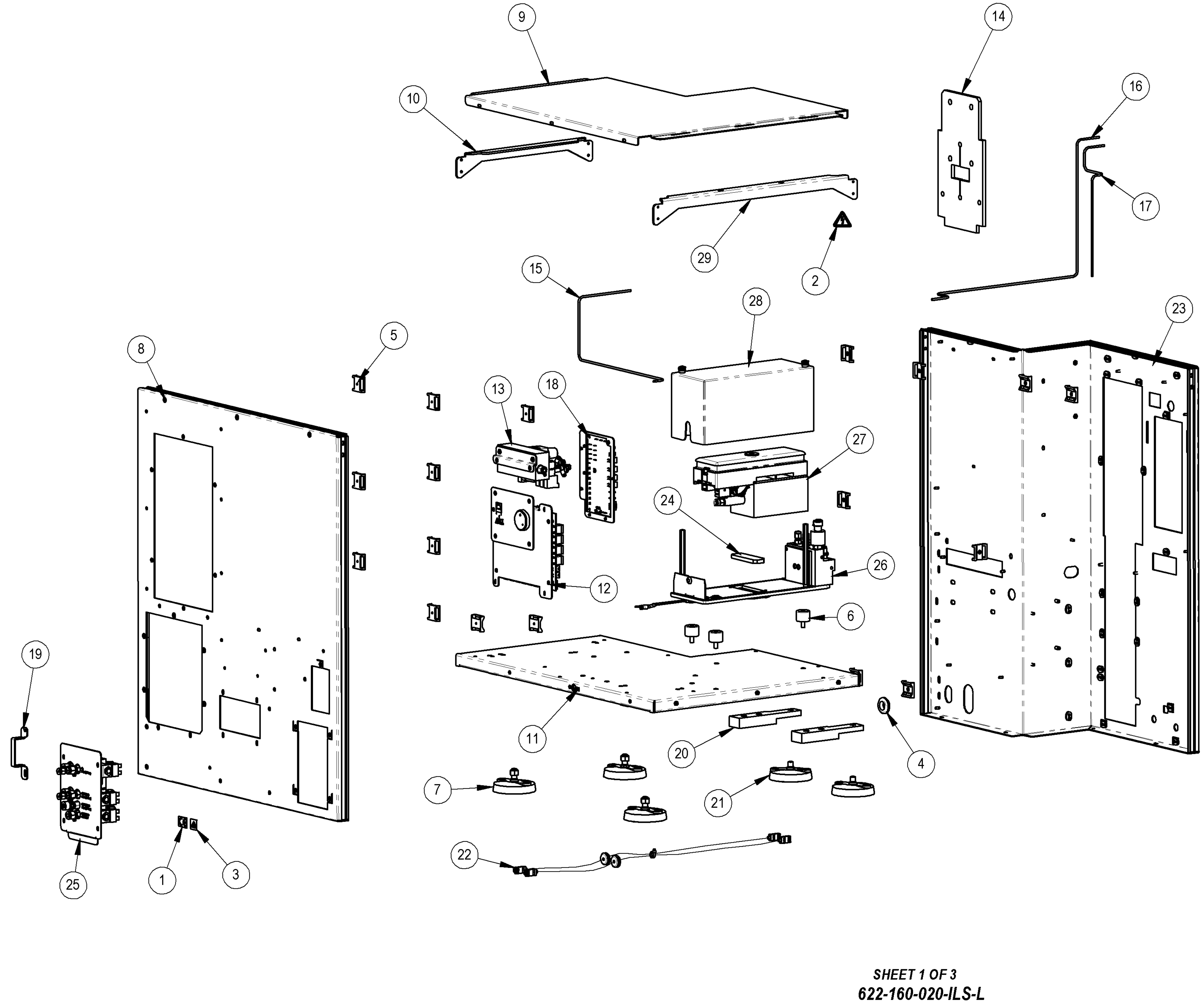


Figure 10-3
CHN/CN/FP828 Common Sub Assembly 1 of 3

622-160-020 ASSY CN/FP/CHN828 COMMON SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	615-525	PLUNGER SPRING LCK .375-16	1
2	619-591-775	NUT SPEED .125 DIA X .31 X .56 ST	2
3	622-002-058	BRACKET MTG SHADOWBOX	1
4	622-002-221	TRIM REAR MACHINED	1
5	622-002-262	ASSY IMPELLER	1
6	622-002-264	ASSY DUCT BOTTOM IMPELLER	1
7	622-002-268	DUCT TOP IMPELLER	1
8	622-002-281	BRACKET MTG FURNACE	1
9	622-002-301	ASSY FURNACE DUAL	1
10	622-002-311	ASSY ENCLOSURE MTG FILTER	1
11	622-002-326	COUPLER COOLING EXHAUST	1
12	622-002-352	ALCOVE MACH	1
13	622-002-394	ASSY FURNACE COVER	1
14	622-002-395	INSERT MESH TRAY LOWER SST	1
15	622-002-396	ASSY BRACKET LEFT SIDE INTERFACE	1
16	622-002-397	BRACKET LEFT PIN RETAINER	1
17	622-002-398	ASSY BRACKET RIGHT PIN RETAINER	1
18	622-002-399	CHANNEL LOCKDOWN, RIGHT RETANIERS AND COVER	1
19	622-002-407	BLOCK B, FURNACE COVER MTG	1
20	622-002-512	ASSY MANIFOLD HANGER	1
21	622-002-520	ASSY PANEL DISTRIBUTION AC	1
22	622-002-546	ASSY TUBE FURNACE OXY INLET	1
23	622-002-566	ASSY MAGNET CATCH MIRROR ALCOVE	1
24	622-002-623	BLOCK FURNACE COVER MTG RIGHT	1
25	626-001-214	BOX SHADOW	1
26	709-808-562	LOGO LECO FLAT ALUM CAST PNT	1

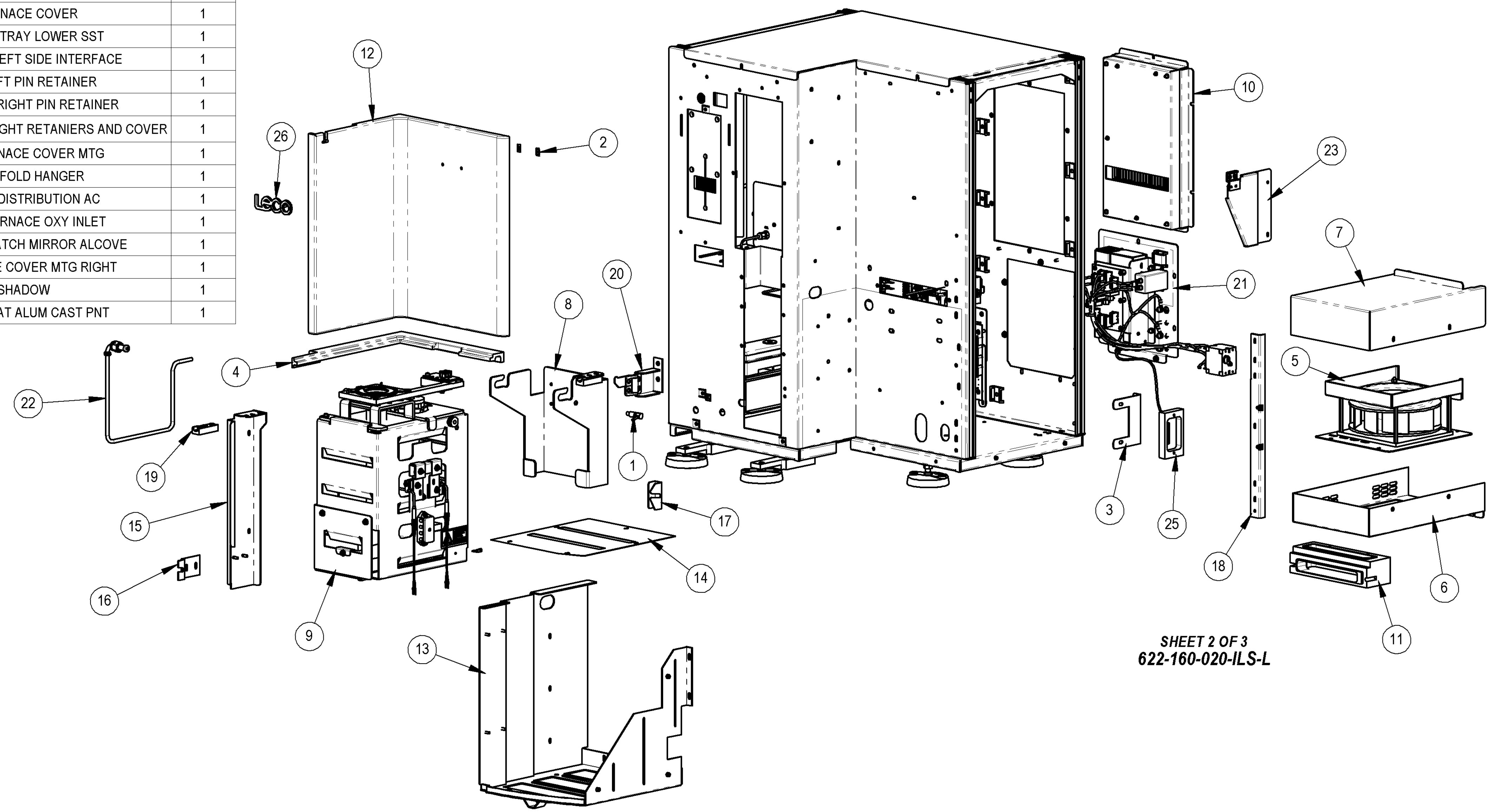
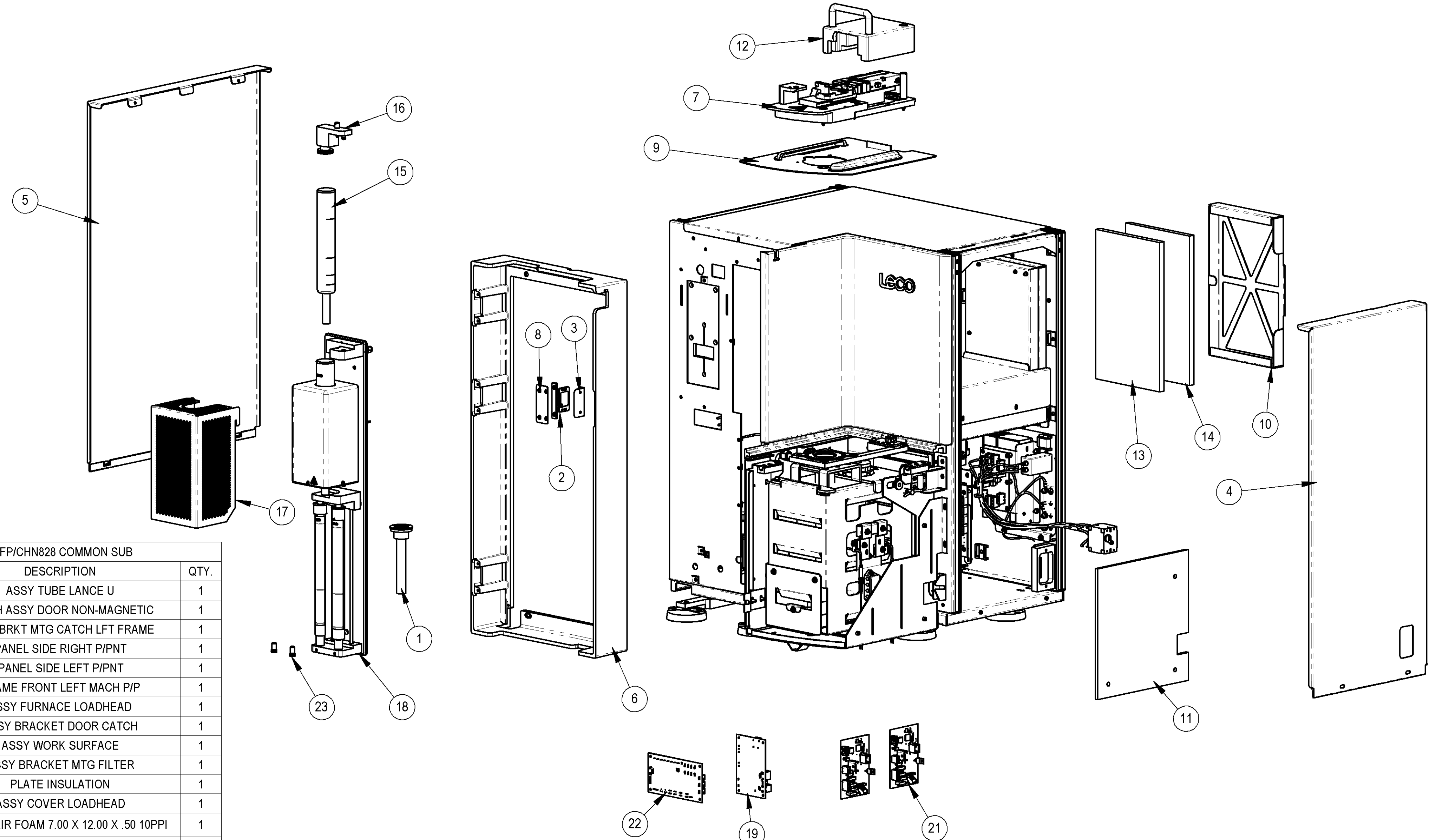


Figure 10-4
CHN/CN/FP828 Common Sub Assembly 2 of 3



622-160-020 ASSY CN/FP/CHN828 COMMON SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	616-147	ASSY TUBE LANCE U	1
2	617-713	CATCH ASSY DOOR NON-MAGNETIC	1
3	619-590-840	ASSY BRKT MTG CATCH LFT FRAME	1
4	622-002-043	PANEL SIDE RIGHT P/PNT	1
5	622-002-060	PANEL SIDE LEFT P/PNT	1
6	622-002-153	FRAME FRONT LEFT MACH P/P	1
7	622-002-240	ASSY FURNACE LOADHEAD	1
8	622-002-291	ASSY BRACKET DOOR CATCH	1
9	622-002-320	ASSY WORK SURFACE	1
10	622-002-375	ASSY BRACKET MTG FILTER	1
11	622-002-406	PLATE INSULATION	1
12	622-002-437	ASSY COVER LOADHEAD	1
13	625-515-201	FILTER AIR FOAM 7.00 X 12.00 X .50 10PPI	1
14	625-515-203	FILTER AIR FOAM 7.00 X 12.00 X .50 45PPI	1
15	625-603-030	TUBE QUARTZ 36MM OD X 10.75 OPEN END	1
16	625-603-031	ASSY BLOCK UPPER REDUCTION COMPLETE	1
17	625-603-148	COVER REAGENT HEATER	1
18	625-603-188	ASSY PANEL HEATER/REAGENT TUBES	1
19	666-669X210	ASSY CARD	1
20	666-669X410	ASSY CARD PGM LF CONTROL HEATER	1
21	666-669X411	ASSY CARD PGM LF CONTROL HEATER	1
22	666-793X210	CST FLOW MANAGER II BOARD PROGRAMMED	1
23	775-306	FILTER SECONDARY 10MICRON	2

Figure 10-5
CHN/CN/FP828 Common Sub Assembly 3 of 3

622-160-010 ASSY FP828 UNIQUE SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	603-429	GROMMET PLAIN	1
2	622-002-031	ASSY CYLINDER BALLAST 4.5L SIMPLIFIED	1
3	622-002-040	ASSY COOLER TE W/HOUSING	1
4	622-002-062	ASSY BLOCK PRE COOLER	1
5	622-002-111	CLAMP PUSH-CLOSE ADJUSTABLE	1
6	622-002-125	ASSY OVEN ENCLOSURE	1
7	622-002-151	ASSY PLATE PINCH VALVE	1
8	622-002-228	TUBE SST TC DOSE TO MFC	1
9	622-002-283	BRACKET FRONT PANEL	1
10	622-002-341	BRACKET FINGER GUARD	1
11	622-002-356	ASSY MANIFOLD EXHAUST O2	1
12	622-002-359	ASSY BRACKET & MANIFOLD PV	1
13	622-002-361	ASSY PLATE MTG FLASK	1
14	622-002-381	ASSY MANIFOLD OXYGEN SELECT	1
15	622-002-421	TUBE SST INERT HRT TO D	1
16	622-002-435	ASSY SHROUD RIGHT FP828	1
17	622-002-455	NAMEPLATE I.D. FP828 622-100-600	1
18	622-002-463	ASSY DOOR WITHOUT MONITOR	1
19	622-002-483	TUBE SST MID RTH TO SCR	1
20	622-002-484	TUBE SST TC MTR TO TC CELL	1
21	622-002-487	TUBE SST DOSE E TO INERT E	1
22	622-002-492	PLATE DOSER 1 LOOP	1
23	622-002-505	ASSY MANIFOLD INERT	1
24	622-002-513	ASSY BRACKET PRE-COOLER	1
25	622-002-613	ASSY DOSER WITH BRACKET	1
26	622-002-711	ASSY CAP BLOCK WITH FTG	1
27	622-002-752	ASSY FILTER	1
28	625-603-002	ASSY PINCH VALVE CORNERSTONE	1
29	625-603-314	HOLDER TOOL 1-1 7/8	1
30	625-603-407	CABLE ASSY POWER DC	1
31	780-899	STOP CERAMIC HONEYC 1.12D X 1.50	1

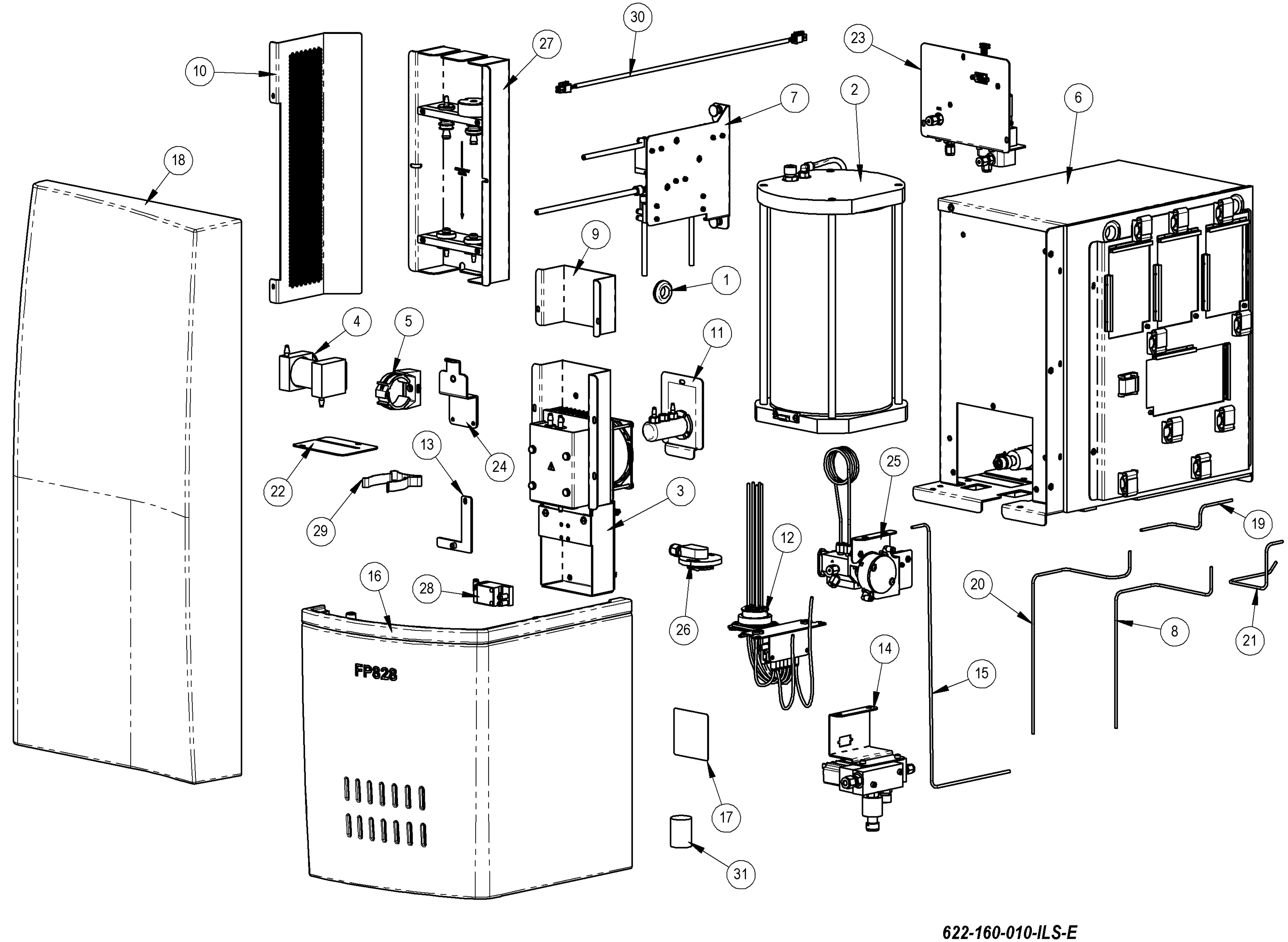


Figure 10-6
FP828 Unique Sub Assembly
(FP828 model only)

622-170-010 ASSY FP828 W/TSCRN UNIQUE SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	603-429	GROMMET PLAIN	1
2	619-316	TUBE FILTER GLASS EXTENDED USE	1
3	619-591-290	PLUNGER SPRING RETRACTABLE 5/16-18 SST	1
4	619-591-930	BLOCK CARRIAGE MONITOR PNT	1
5	619-593-339	COVER CABLE DOOR LEFT P/PNT	1
6	619-593-405	WALL MOUNT SWING ARM	1
7	619-593-575	HARNESS ASSY CONNECT MON T/SCRN DOOR D/P	1
8	622-001-258	ASSY FILTER 0.10 MICRON	1
9	622-002-031	ASSY CYLINDER BALLAST 4.5L SIMPLIFIED	1
10	622-002-040	ASSY COOLER TE W/HOUSING	1
11	622-002-062	ASSY BLOCK PRE COOLER	1
12	622-002-111	CLAMP PUSH-CLOSE ADJUSTABLE	1
13	622-002-125	ASSY OVEN ENCLOSURE	1
14	622-002-151	ASSY PLATE PINCH VALVE	1
15	622-002-228	TUBE SST TC DOSE TO MFC	1
16	622-002-283	BRACKET FRONT PANEL	1
17	622-002-341	BRACKET FINGER GUARD	1
18	622-002-356	ASSY MANIFOLD EXHAUST O2	1
19	622-002-359	ASSY BRACKET & MANIFOLD PV	1
20	622-002-361	ASSY PLATE MTG FLASK	1
21	622-002-381	ASSY MANIFOLD OXYGEN SELECT	1
22	622-002-421	TUBE SST INERT HRT TO D	1
23	622-002-435	ASSY SHROUD RIGHT FP828	1
24	622-002-456	NAMEPLATE I.D. FP828 622-100-700	1
25	622-002-462	ASSY DOOR MONITOR	1
26	622-002-483	TUBE SST MID RTH TO SCR	1
27	622-002-484	TUBE SST TC MTR TO TC CELL	1
28	622-002-487	TUBE SST DOSE E TO INERT E	1
29	622-002-492	PLATE DOSER 1 LOOP	1
30	622-002-505	ASSY MANIFOLD INERT	1
31	622-002-513	ASSY BRACKET PRE-COOLER	1
32	622-002-613	ASSY DOSER WITH BRACKET	1
33	622-002-711	ASSY CAP BLOCK WITH FTG	1
34	622-002-752	ASSY FILTER	1
35	625-603-002	ASSY PINCH VALVE CORNERSTONE	1
36	625-603-314	HOLDER TOOL 1-1 7/8	1
37	625-603-407	CABLE ASSY POWER DC	1
38	780-899	STOP CERAMIC HONEYC 1.12D X 1.50	1

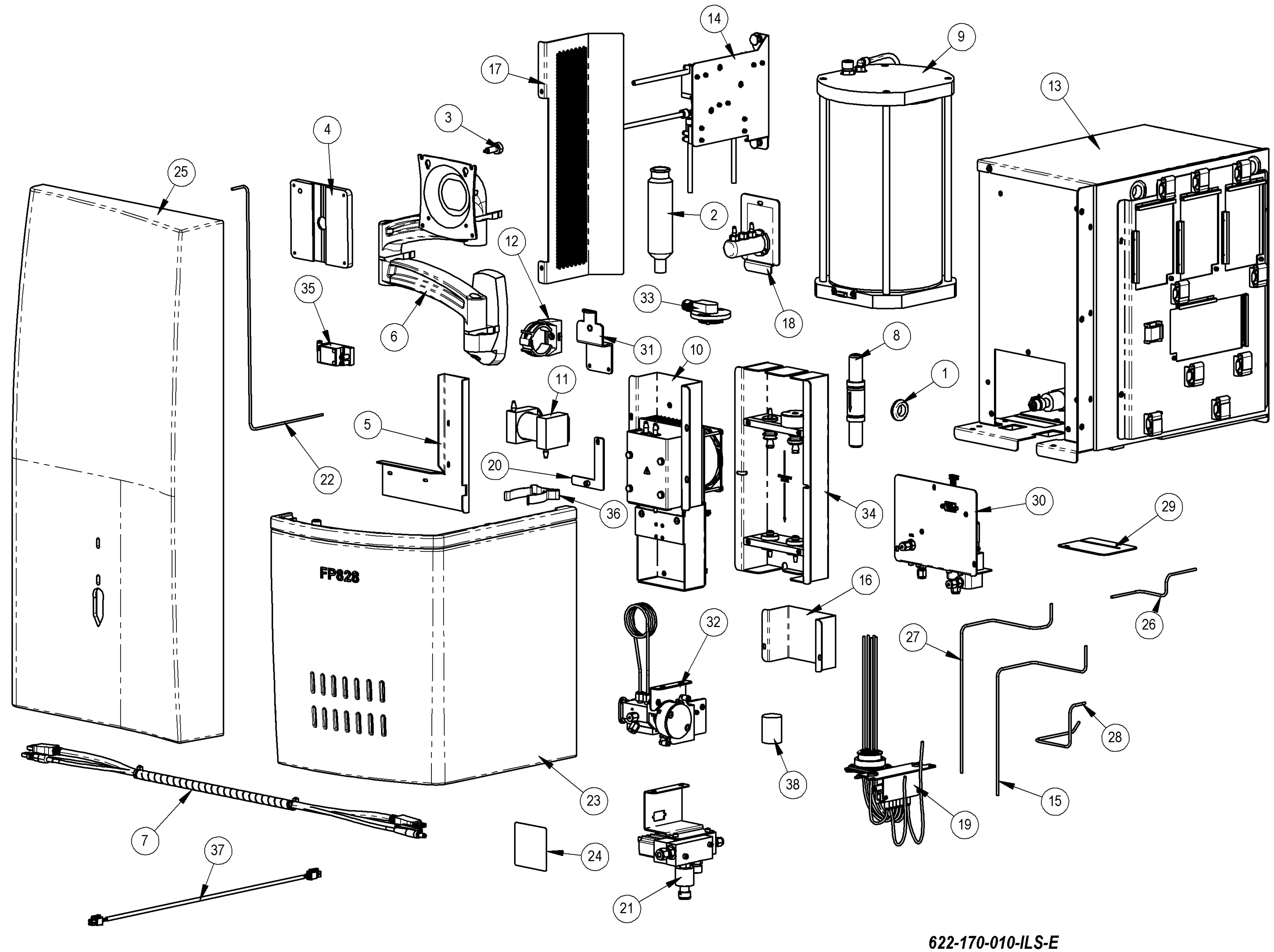
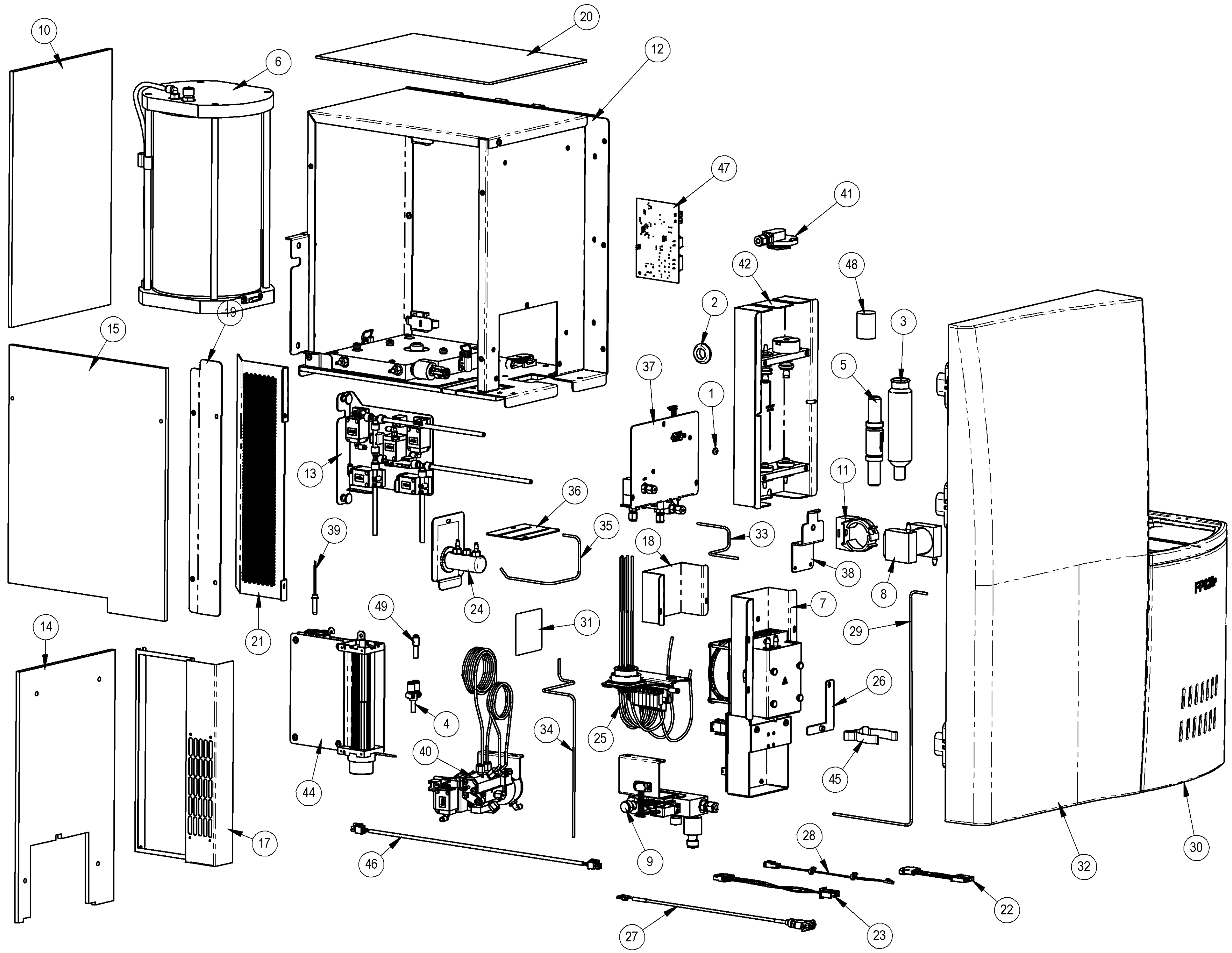


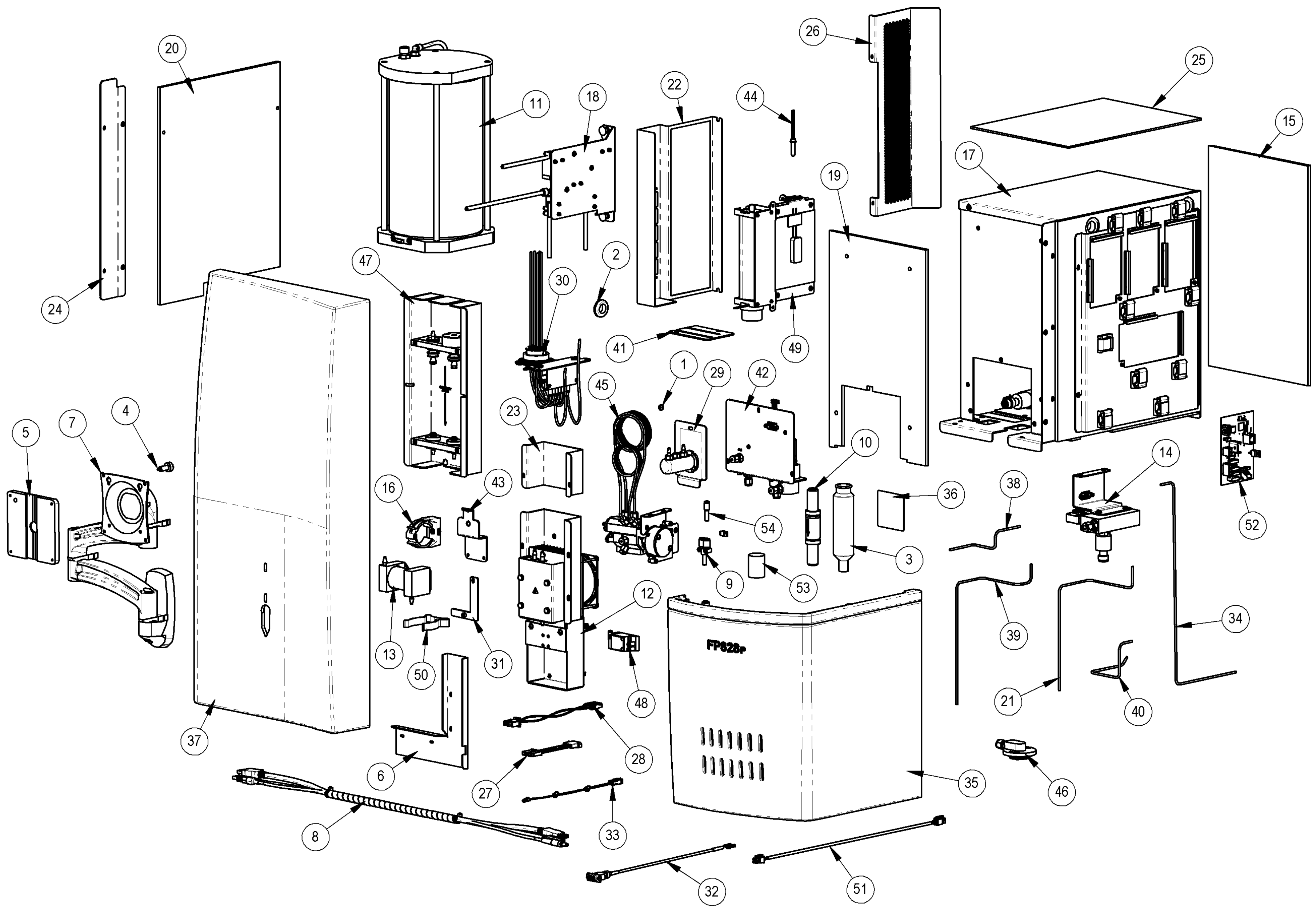
Figure 10-7
FP828 Touchscreen Unique Sub Assembly
(FP828 model only)



622-180-010 ASSY FP828 PERFORMANCE UNIQUE SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	549-073	GROMMET PLAIN	1
1	603-429	GROMMET PLAIN	1
3	619-316	TUBE FILTER GLASS EXTENDED USE	1
4	621-606-141	FTG UNION 1/4 T TO 1/4 Y	1
5	622-001-258	ASSY FILTER 0.10 MICRON	1
6	622-002-031	ASSY CYLINDER BALLAST 4.5L SIMPLIFIED	1
7	622-002-040	ASSY COOLER TE W/HOUSING	1
8	622-002-062	ASSY BLOCK PRE COOLER	1
9	622-002-073	ASSY MANIFOLD MFC FURNACE	1
10	622-002-078	INSULATION ENCLOSURE BACK	1
11	622-002-111	CLAMP PUSH-CLOSE ADJUSTABLE	1
12	622-002-125	ASSY OVEN ENCLOSURE	1
13	622-002-151	ASSY PLATE PINCH VALVE	1
14	622-002-164	INSULATION OVEN FRONT	1
15	622-002-169	COVER OVEN LEXAN	1
16	622-002-228	TUBE SST TC DOSE TO MFC	1
17	622-002-261	GUARD FINGER BLOWER/HEATER	1
18	622-002-283	BRACKET FRONT PANEL	1
19	622-002-299	ASSY PANEL OVEN SIDE	1
20	622-002-316	INSULATION TOP OVEN	1
21	622-002-341	BRACKET FINGER GUARD	1
22	622-002-350	ASSY JUMPER BALLAST HEATER	1
23	622-002-351	ASSY HARNESS BALLAST HEATER	1
24	622-002-356	ASSY MANIFOLD EXHAUST O2	1
25	622-002-359	ASSY BRACKET & MANIFOLD PV	1
26	622-002-361	ASSY PLATE MTG FLASK	1
27	622-002-376	ASSY CABLE FURNACE MASS FLOW CONTROL	1
28	622-002-403	ASSY BALLAST HEATER FAN HARNESS	1
29	622-002-421	TUBE SST INERT HRT TO D	1
30	622-002-451	ASSY SHROUD RIGHT FP828P	1
31	622-002-457	NAMEPLATE I.D. FP828P 622-100-800	1
32	622-002-463	ASSY DOOR WITHOUT MONITOR	1
33	622-002-483	TUBE SST MID RTH TO SCR	1
34	622-002-484	TUBE SST TC MTR TO TC CELL	1
35	622-002-487	TUBE SST DOSE E TO INERT E	1
36	622-002-491	PLATE DOSER 2 LOOP	1
37	622-002-505	ASSY MANIFOLD INERT	1
38	622-002-513	ASSY BRACKET PRE-COOLER	1
39	622-002-523	ASSY PROBE THERMISTOR	1
40	622-002-550	ASSY DOSER 2-LOOP WITH BRACKET	1
41	622-002-711	ASSY CAP BLOCK WITH FTG	1
42	622-002-752	ASSY FILTER	1
43	625-603-002	ASSY PINCH VALVE CORNERSTONE	1
44	625-603-184	ASSY HEATER BALLAST	1
45	625-603-314	HOLDER TOOL 1-1 7/8	1
46	625-603-407	CABLE ASSY POWER DC	1
47	666-669X310	ASSY CARD	1
48	780-899	STOP CERAMIC HONEYC 1.12D X 1.50	1
49	808-296	FITTING REDUCER QUICK DISC.	1

622-180-010-ILS-F

Figure 10-8
FP828 Performance Unique Sub Assembly
(FP828P model only)

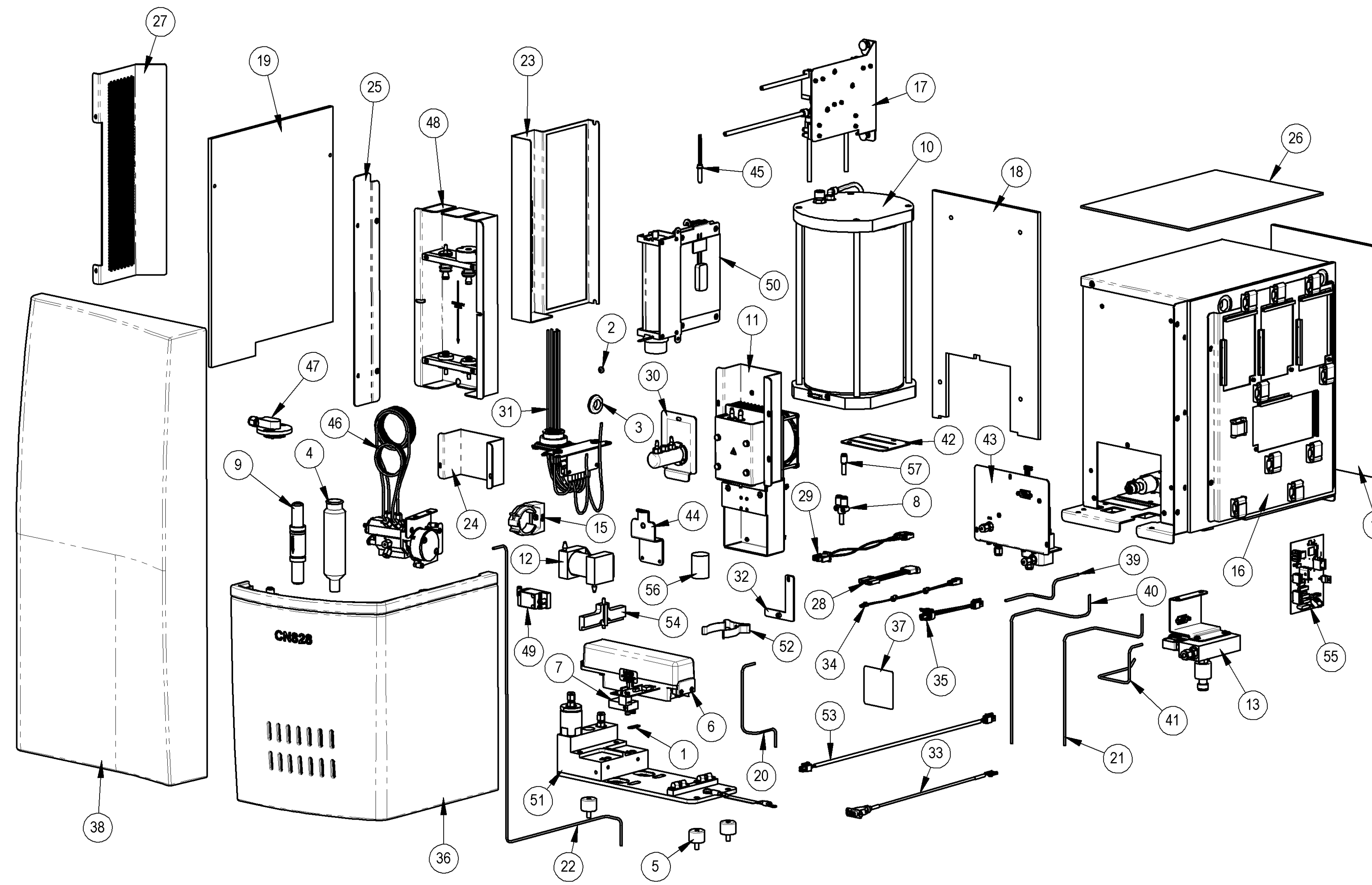


622-190-010 ASSY FP828 PREFORM/TSCRN UNIQUE SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	549-073	GROMMET PLAIN	1
2	603-429	GROMMET PLAIN	1
3	619-316	TUBE FILTER GLASS EXTENDED USE	1
4	619-591-290	PLUNGER SPRING RETRACTABLE 5/16-18 SST	1
5	619-591-930	BLOCK CARRIAGE MONITOR PNT	1
6	619-593-339	COVER CABLE DOOR LEFT P/PNT	1
7	619-593-405	WALL MOUNT SWING ARM	1
8	619-593-575	HARNESS ASSY CONNECT MON T/SCRN DOOR D/P	1
9	621-606-141	FTG UNION 1/4 T TO 1/4 Y	1
10	622-001-258	ASSY FILTER 0.10 MICRON	1
11	622-002-031	ASSY CYLINDER BALLAST 4.5L SIMPLIFIED	1
12	622-002-040	ASSY COOLER TE W/HOUSING	1
13	622-002-062	ASSY BLOCK PRE COOLER	1
14	622-002-073	ASSY MANIFOLD MFC FURNACE	1
15	622-002-078	INSULATION ENCLOSURE BACK	1
16	622-002-111	CLAMP PUSH-CLOSE ADJUSTABLE	1
17	622-002-125	ASSY OVEN ENCLOSURE	1
18	622-002-151	ASSY PLATE PINCH VALVE	1
19	622-002-164	INSULATION OVEN FRONT	1
20	622-002-169	COVER OVEN LEXAN	1
21	622-002-228	TUBE SST TC DOSE TO MFC	1
22	622-002-261	GUARD FINGER BLOWER/HEATER	1
23	622-002-283	BRACKET FRONT PANEL	1
24	622-002-299	ASSY PANEL OVEN SIDE	1
25	622-002-316	INSULATION TOP OVEN	1
26	622-002-341	BRACKET FINGER GUARD	1
27	622-002-350	ASSY JUMPER BALLAST HEATER	1
28	622-002-351	ASSY HARNESS BALLAST HEATER	1
29	622-002-356	ASSY MANIFOLD EXHAUST O2	1
30	622-002-359	ASSY BRACKET & MANIFOLD PV	1
31	622-002-361	ASSY PLATE MTG FLASK	1
32	622-002-376	ASSY CABLE FURNACE MASS FLOW CONTROL	1
33	622-002-403	ASSY BALLAST HEATER FAN HARNESS	1
34	622-002-421	TUBE SST INERT HRT TO D	1
35	622-002-451	ASSY SHROUD RIGHT FP828P	1
36	622-002-458	NAMEPLATE I.D. FP828P 622-100-900	1
37	622-002-462	ASSY DOOR MONITOR	1
38	622-002-483	TUBE SST MID RTH TO SCR	1
39	622-002-484	TUBE SST TC MTR TO TC CELL	1
40	622-002-487	TUBE SST DOSE E TO INERT E	1
41	622-002-491	PLATE DOSER 2 LOOP	1
42	622-002-505	ASSY MANIFOLD INERT	1
43	622-002-513	ASSY BRACKET PRE-COOLER	1
44	622-002-523	ASSY PROBE THERMISTOR	1
45	622-002-550	ASSY DOSER 2-LOOP WITH BRACKET	1
46	622-002-711	ASSY CAP BLOCK WITH FTG	1
47	622-002-752	ASSY FILTER	1
48	625-603-002	ASSY PINCH VALVE CORNERSTONE	1
49	625-603-184	ASSY HEATER BALLAST	1
50	625-603-314	HOLDER TOOL 1-1 7/8	1
51	625-603-407	CABLE ASSY POWER DC	1
52	666-669X310	ASSY CARD	1
53	780-899	STOP CERAMIC HONEYC 1.12D X 1.50	1
54	808-296	FITTING REDUCER QUICK DISC.	1

622-190-010-ILS-F

Figure 10-9
FP828 Performance Touchscreen Unique Sub Assembly
(FP828P model only)

622-200-010 CN828 UNIQUE SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	169-003-115	LABEL ID CELL IR CO2 0.725 02 SILVER	1
2	549-073	GROMMET PLAIN	1
3	603-429	GROMMET PLAIN	1
4	619-316	TUBE FILTER GLASS EXTENDED USE	1
5	619-590-521	MOUNT RESILIENT 1.00 X .75 X .250-20	3
6	619-590-934	ASSY CELL IR CO2 .725	1
7	619-591-181	ASSY BLOCK BYPASS	1
8	621-606-141	FTG UNION 1/4 T TO 1/4 Y	1
9	622-001-258	ASSY FILTER 0.10 MICRON	1
10	622-002-031	ASSY CYLINDER BALLAST 4.5L SIMPLIFIED	1
11	622-002-040	ASSY COOLER TE W/HOUSING	1
12	622-002-062	ASSY BLOCK PRE COOLER	1
13	622-002-073	ASSY MANIFOLD MFC FURNACE	1
14	622-002-078	INSULATION ENCLOSURE BACK	1
15	622-002-111	CLAMP PUSH-CLOSE ADJUSTABLE	1
16	622-002-125	ASSY OVEN ENCLOSURE	1
17	622-002-151	ASSY PLATE PINCH VALVE	1
18	622-002-164	INSULATION OVEN FRONT	1
19	622-002-169	COVER OVEN LEXAN	1
20	622-002-227	TUBE SST IR MANIFOLD TO DOSE D	1
21	622-002-228	TUBE SST TC DOSE TO MFC	1
22	622-002-231	TUBE SST INERT HRT TO HTR	1
23	622-002-261	GUARD FINGER BLOWER/HEATER	1
24	622-002-283	BRACKET FRONT PANEL	1
25	622-002-299	ASSY PANEL OVEN SIDE	1
26	622-002-316	INSULATION TOP OVEN	1
27	622-002-341	BRACKET FINGER GUARD	1
28	622-002-350	ASSY JUMPER BALLAST HEATER	1
29	622-002-351	ASSY HARNESS BALLAST HEATER	1
30	622-002-356	ASSY MANIFOLD EXHAUST O2	1
31	622-002-359	ASSY BRACKET & MANIFOLD PV	1
32	622-002-361	ASSY PLATE MTG FLASK	1
33	622-002-376	ASSY CABLE FURNACE MASS FLOW CONTROL	1
34	622-002-403	ASSY BALLAST HEATER FAN HARNESS	1
35	622-002-442	ASSY CABLE INCOMING OXYGEN	1
36	622-002-450	ASSY SHROUD RIGHT CN828	1
37	622-002-459	NAMEPLATE I.D. CN828 622-200-000	1
38	622-002-463	ASSY DOOR WITHOUT MONITOR	1
39	622-002-483	TUBE SST MID RTH TO SCR	1
40	622-002-484	TUBE SST TC MTR TO TC CELL	1
41	622-002-487	TUBE SST DOSE E TO INERT E	1
42	622-002-491	PLATE DOSER 2 LOOP	1
43	622-002-505	ASSY MANIFOLD INERT	1
44	622-002-513	ASSY BRACKET PRE-COOLER	1
45	622-002-523	ASSY PROBE THERMISTOR	1
46	622-002-550	ASSY DOSER 2-LOOP WITH BRACKET	1
47	622-002-711	ASSY CAP BLOCK WITH FTG	1
48	622-002-752	ASSY FILTER	1
49	625-603-002	ASSY PINCH VALVE CORNERSTONE	1
50	625-603-184	ASSY HEATER BALLAST	1
51	625-603-185	ASSY MANIFOLD CELL IR DOUBLE	1
52	625-603-314	HOLDER TOOL 1-1 7/8	1
53	625-603-407	CABLE ASSY POWER DC	1
54	625-710-868	ASSY BLOCK CLAMPING CELL IR	1
55	666-669X310	ASSY CARD	1
56	780-899	STOP CERAMIC HONEYC 1.12D X 1.50	1
57	808-296	FITTING REDUCER QUICK DISC.	1



622-200-010-ILS-F

Figure 10-10
CN828 Unique Sub Assembly
(CN828 model only)

622-210-010 ASSY CN828 W/TSCRN UNIQUE SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	169-003-115	LABEL ID CELL IR CO2 0.725 02 SILVER	1
2	549-073	GROMMET PLAIN	1
3	603-429	GROMMET PLAIN	1
4	619-316	TUBE FILTER GLASS EXTENDED USE	1
5	619-590-521	MOUNT RESILIENT 1.00 X .75 X .250-20	3
6	619-590-934	ASSY CELL IR CO2 .725	1
7	619-591-181	ASSY BLOCK BYPASS	1
8	619-591-290	PLUNGER SPRING RETRACTABLE 5/16-18 SST	1
9	619-591-930	BLOCK CARRIAGE MONITOR PNT	1
10	619-593-339	COVER CABLE DOOR LEFT P/PNT	1
11	619-593-405	WALL MOUNT SWING ARM	1
12	619-593-575	HARNESS ASSY CONNECT MON T/SCRN DOOR D/P	1
13	621-606-141	FTG UNION 1/4 T TO 1/4 Y	1
14	622-001-258	ASSY FILTER 0.10 MICRON	1
15	622-002-031	ASSY CYLINDER BALLAST 4.5L SIMPLIFIED	1
16	622-002-040	ASSY COOLER TE W/HOUSING	1
17	622-002-062	ASSY BLOCK PRE COOLER	1
18	622-002-073	ASSY MANIFOLD MFC FURNACE	1
19	622-002-078	INSULATION ENCLOSURE BACK	1
12	622-002-111	CLAMP PUSH-CLOSE ADJUSTABLE	1
21	622-002-125	ASSY OVEN ENCLOSURE	1
22	622-002-151	ASSY PLATE PINCH VALVE	1
23	622-002-164	INSULATION OVEN FRONT	1
24	622-002-169	COVER OVEN LEXAN	1
25	622-002-227	TUBE SST IR MANIFOLD TO DOSE D	1
26	622-002-228	TUBE SST TC DOSE TO MFC	1
27	622-002-231	TUBE SST INERT HRT TO HTR	1
28	622-002-261	GUARD FINGER BLOWER/HEATER	1
29	622-002-283	BRACKET FRONT PANEL	1
30	622-002-299	ASSY PANEL OVEN SIDE	1
31	622-002-316	INSULATION TOP OVEN	1
32	622-002-341	BRACKET FINGER GUARD	1
33	622-002-350	ASSY JUMPER BALLAST HEATER	1
34	622-002-351	ASSY HARNESS BALLAST HEATER	1
35	622-002-356	ASSY MANIFOLD EXHAUST O2	1
36	622-002-359	ASSY BRACKET & MANIFOLD PV	1
37	622-002-361	ASSY PLATE MTG FLASK	1
38	622-002-376	ASSY CABLE FURNACE MASS FLOW CONTROL	1
19	622-002-403	ASSY BALLAST HEATER FAN HARNESS	1
40	622-002-442	ASSY CABLE INCOMING OXYGEN	1
41	622-002-450	ASSY SHROUD RIGHT CN828	1
42	622-002-460	NAMEPLATE I.D. CN828 622-200-100	1
43	622-002-462	ASSY DOOR MONITOR	1
44	622-002-483	TUBE SST MID RTH TO SCR	1
45	622-002-484	TUBE SST TC MTR TO TC CELL	1
46	622-002-487	TUBE SST DOSE E TO INERT E	1
47	622-002-491	PLATE DOSER 2 LOOP	1
48	622-002-505	ASSY MANIFOLD INERT	1
49	622-002-513	ASSY BRACKET PRE-COOLER	1
50	622-002-523	ASSY PROBE THERMISTOR	1
51	622-002-550	ASSY DOSER 2-LOOP WITH BRACKET	1
52	622-002-711	ASSY CAP BLOCK WITH FTG	1
53	622-002-752	ASSY FILTER	1
54	625-603-002	ASSY PINCH VALVE CORNERSTONE	1
55	625-603-184	ASSY HEATER BALLAST	1
56	625-603-185	ASSY MANIFOLD CELL IR DOUBLE	1
57	625-603-314	HOLDER TOOL 1-1 7/8	1
58	625-603-407	CABLE ASSY POWER DC	1
59	625-710-868	ASSY BLOCK CLAMPING CELL IR	1
60	666-669X310	ASSY CARD	1
61	780-899	STOP CERAMIC HONEYC 1.12D X 1.50	1
62	808-296	FITTING REDUCER QUICK DISC.	1

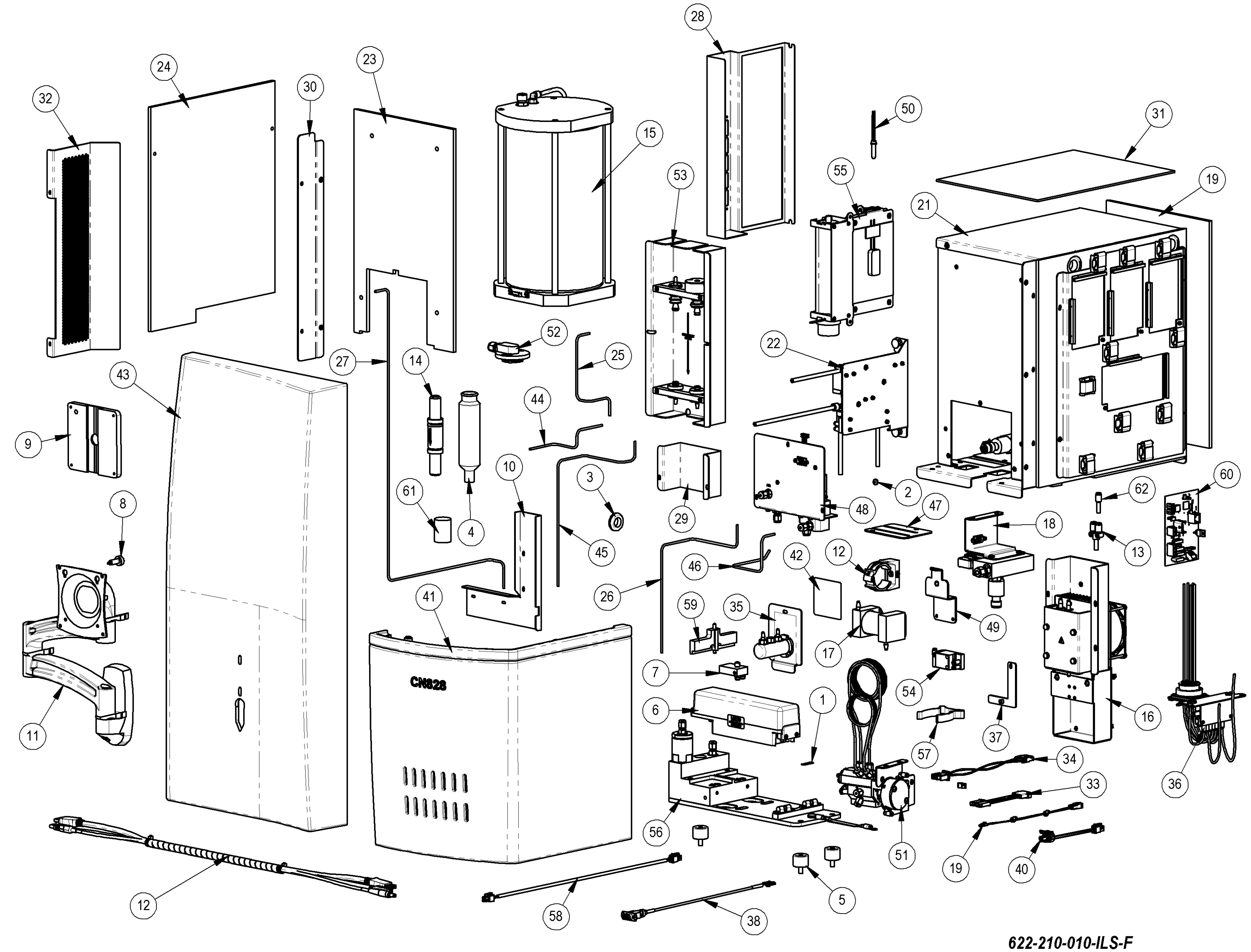


Figure 10-11
CN828 Touchscreen Unique Sub Assembly
(CN828 model only)

622-220-010 ASSY CHN828 UNIQUE SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	190-009	SCREW THUMB 8-32 X .38 BR NP	2
2	549-073	GROMMET PLAIN	1
3	619-590-935	ASSY CELL IR H2O 6.00	1
4	622-002-078	INSULATION ENCLOSURE BACK	1
5	622-002-385	ASSY DOSER DUAL LOOP	1
6	622-002-523	ASSY PROBE THERMISTOR	1
7	622-002-603	ASSY MFC He AND RESTRICTOR	1
8	622-002-608	TUBING SST E to E H	1
9	622-002-609	ASSY TUBING D TO IR CELL	1
10	622-002-620	COVER OVEN LARGE	1
11	622-002-629	GUARD FINGER BLOWER/HEATER SHORT	1
12	622-002-630	ASSY PINCH VALVE PLATE VERTICAL	1
13	622-002-643	ASSY CYLINDER BALLAST 4.5L H	1
14	622-002-659	INSULATION OVEN TOP	1
15	622-002-667	UNION QD STRAIGHT .12T TO .12T	4
16	622-002-668	BRACKET MTG UNION PNEUMATICS	1
17	622-002-678	CONNECTOR PNEUMATIC 12 PLC	1
18	622-002-682	BLOCK MTG UNION PNEUMATICS	1
19	622-002-684	ASSY MANIFOLD MFC FURNACE	1
20	622-002-687	BRACKET COVER MFC	1
21	622-002-692	ASSY MANIFOLD CELL IR SINGLE	1
22	622-002-693	TUBE SST STOP FLOW TO HYDROGEN CELL	1
23	622-002-735	ASSY OVEN ENCLOSURE	1
24	625-603-184	ASSY HEATER BALLAST	1
25	625-603-431	ASSY MANIFOLD EXHAUST O2	1
26	625-603-521	ASSY BLOCK CLAMP SINGLE CELL	1
27	666-669X310	ASSY CARD	1
28	782-504	FTG UNION BH SST .12T - .12T	1

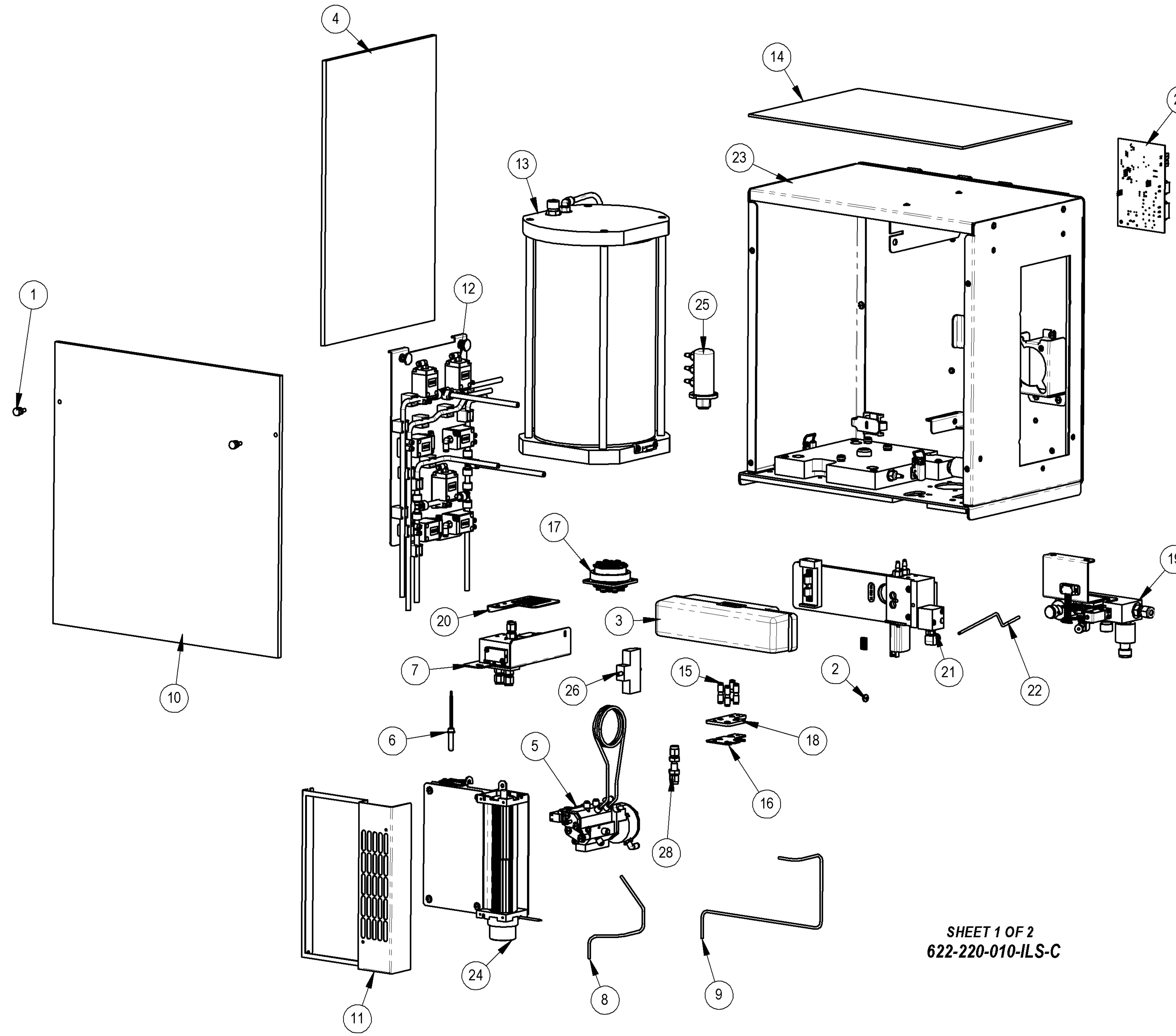


Figure 10-12
CHN828 Unique Sub Assembly 1 of 2
(CHN828 model only)

622-220-010 ASSY CHN828 UNIQUE SUB CONT...			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	169-003-115	LABEL ID CELL IR CO2 0.725 02 SILVER	1
2	619-425	TUBE GLASS STRAIGHT FILTER	1
3	619-590-521	MOUNT RESILIENT 1.00 X .75 X .250-20	3
4	619-590-934	ASSY CELL IR CO2 .725	1
5	619-591-181	ASSY BLOCK BYPASS	1
6	621-606-141	FTG UNION 1/4 T TO 1/4 Y	1
7	622-001-258	ASSY FILTER 0.10 MICRON	1
8	622-002-231	TUBE SST INERT HRT TO HTR	1
9	622-002-350	ASSY JUMPER BALLAST HEATER	1
10	622-002-351	ASSY HARNESS BALLAST HEATER	1
11	622-002-376	ASSY CABLE FURNACE MASS FLOW CONTROL	1
12	622-002-403	ASSY BALLAST HEATER FAN HARNESS	1
13	622-002-442	ASSY CABLE INCOMING OXYGEN	1
14	622-002-463	ASSY DOOR WITHOUT MONITOR	1
15	622-002-547	ASSY CABLE CAT5E IR CELL	1
16	622-002-594	ASSY FILTER	1
17	622-002-597	TUBE SST MFC DOSE TO TC DOSE	1
18	622-002-598	TUBE SST MFC TO TC CELL	1
19	622-002-599	TUBE SST MFC TO SCR	1
20	622-002-658	PANEL EXHAUST	1
21	622-002-660	TUBE SST IR CELL TO OVEN	1
22	622-002-663	ASSY BRACKET & MANIFOLD PV	1
23	622-002-675	BRACKET FINGER GUARD	1
24	622-002-677	ASSY SHROUD RIGHT CHN828	1
25	622-002-701	ASSY CABLE H20 CONSERVE	1
26	622-002-702	ASSY CABLE DOSER LOOP	1
27	622-002-721	ASSY DOOR WINDOW FILER	1
28	622-002-728	TUBE GUIDE	1
29	622-002-734	NAMEPLATE I.D. CHN828 622-200-200	1
30	622-002-741	ASSY CABLE CAT5E H2 CELL	1
31	622-002-751	ASSY CAP BLOCK WITH FTG H	1
32	625-603-185	ASSY MANIFOLD CELL IR DOUBLE	1
33	625-603-349	FTG QD UNION BH .38T - .38T BR NP	1
34	625-710-868	ASSY BLOCK CLAMPING CELL IR	1
35	808-296	FITTING REDUCER QUICK DISC.	1

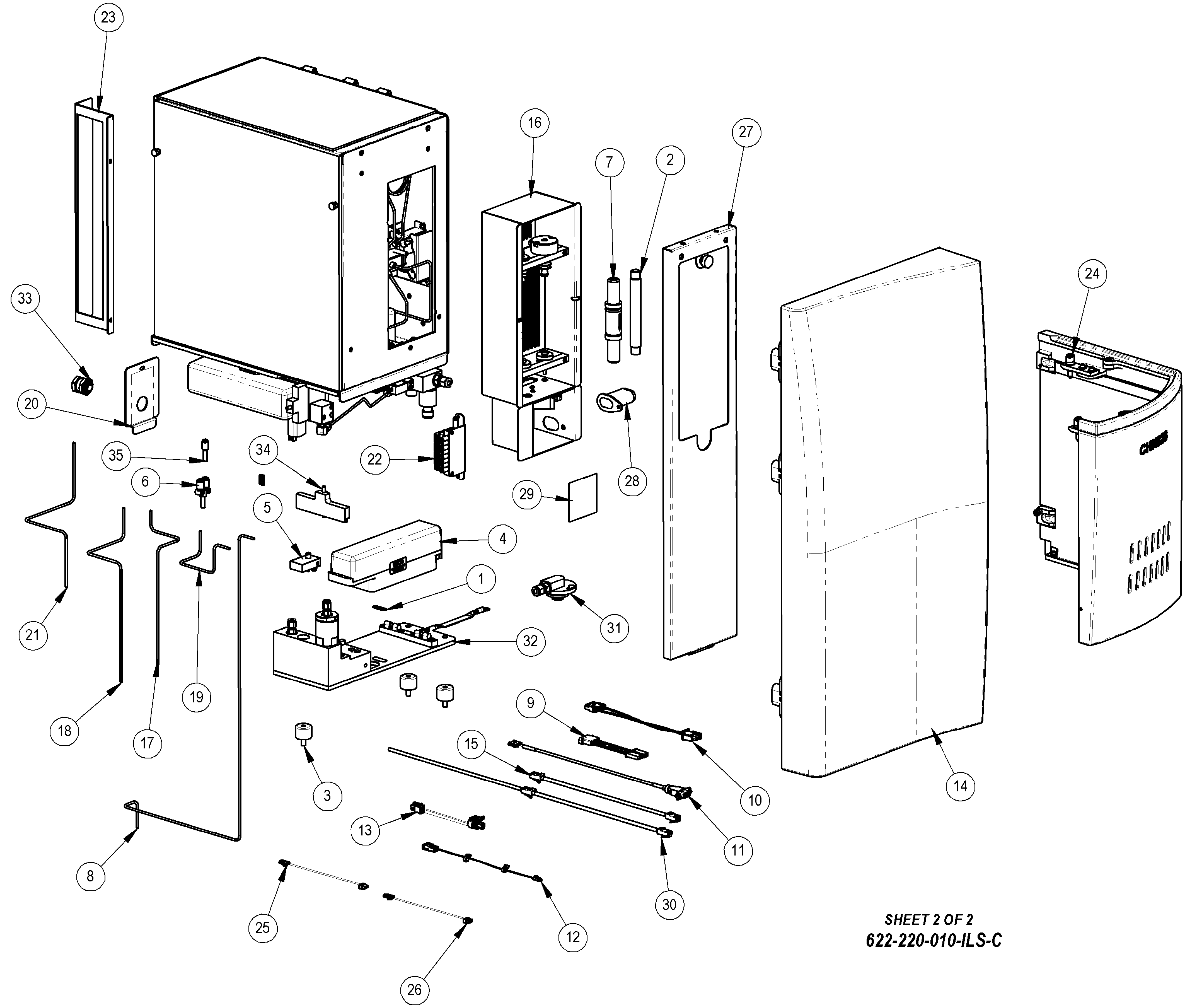
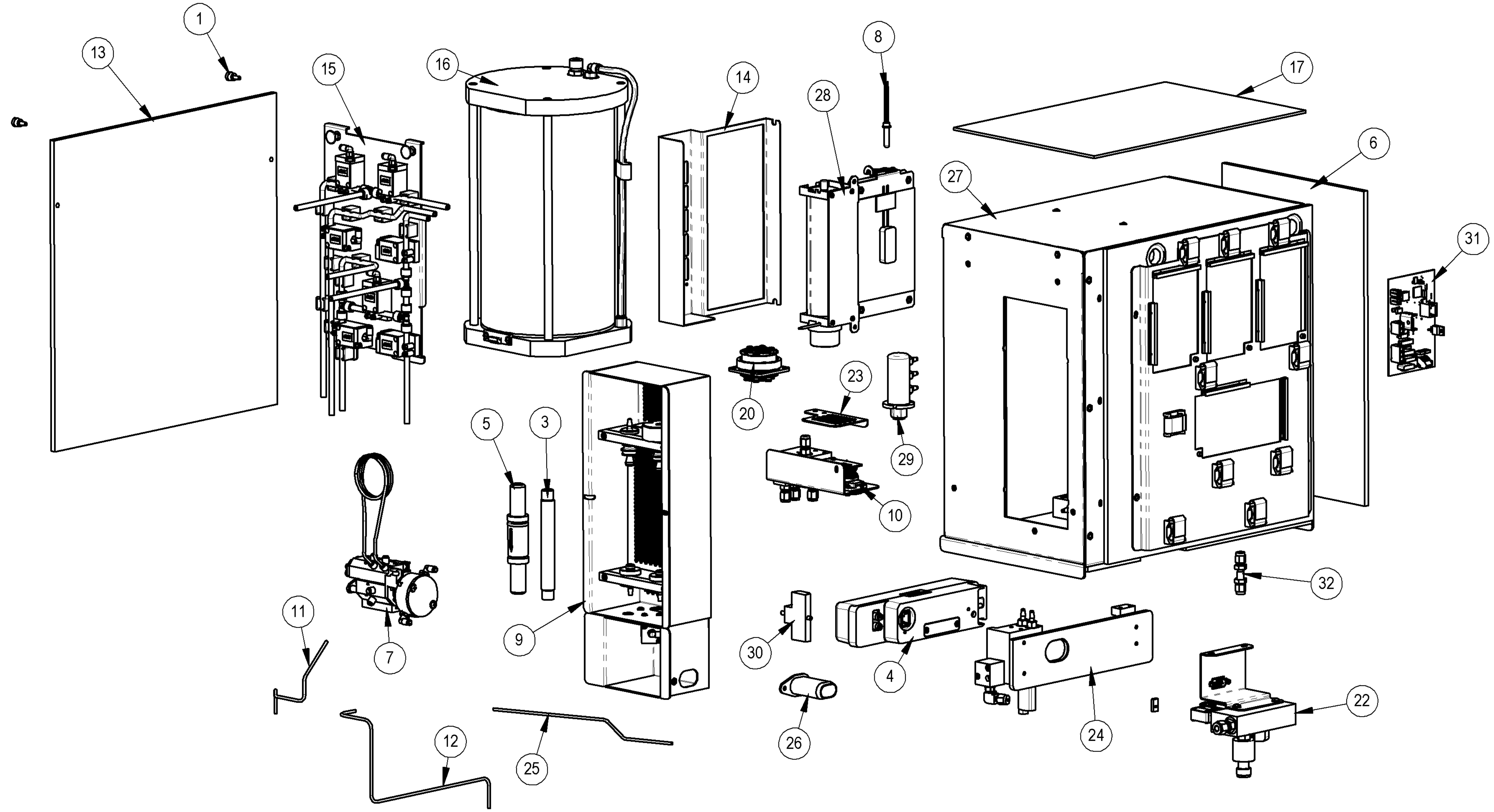


Figure 10-13
CHN828 Unique Sub Assembly 2 of 2
(CHN828 model only)

622-230-010 ASSY CHN828 W/TSCRN UNIQUE SUB			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY
1	190-009	SCREW THUMB 8-32 X .38 BR NP	2
2	549-073	GROMMET PLAIN	1
3	619-425	TUBE GLASS STRAIGHT FILTER	1
4	619-590-935	ASSY CELL IR H2O 6.00	1
5	622-001-258	ASSY FILTER 0.10 MICRON	1
6	622-002-078	INSULATION ENCLOSURE BACK	1
7	622-002-385	ASSY DOSER DUAL LOOP	1
8	622-002-523	ASSY PROBE THERMISTOR	1
9	622-002-594	ASSY FILTER	1
10	622-002-603	ASSY MFC He AND RESTRICTOR	1
11	622-002-608	TUBING SST E to E H	1
12	622-002-609	ASSY TUBING D TO IR CELL	1
13	622-002-620	COVER OVEN LARGE	1
14	622-002-629	GUARD FINGER BLOWER/HEATER SHORT	1
15	622-002-630	ASSY PINCH VALVE PLATE VERTICAL	1
16	622-002-643	ASSY CYLINDER BALLAST 4.5L H	1
17	622-002-659	INSULATION OVEN TOP	1
18	622-002-667	UNION QD STRAIGHT .12T TO .12T	4
19	622-002-668	BRACKET MTG UNION PNEUMATICS	1
20	622-002-678	CONNECTOR PNEUMATIC 12 PLC	1
21	622-002-682	BLOCK MTG UNION PNEUMATICS	1
22	622-002-684	ASSY MANIFOLD MFC FURNACE	1
23	622-002-687	BRACKET COVER MFC	1
24	622-002-692	ASSY MANIFOLD CELL IR SINGLE	1
25	622-002-693	TUBE SST STOP FLOW TO HYDROGEN CELL	1
26	622-002-728	TUBE GUIDE	1
27	622-002-735	ASSY OVEN ENCLOSURE	1
28	625-603-184	ASSY HEATER BALLAST	1
29	625-603-431	ASSY MANIFOLD EXHAUST O2	1
30	625-603-521	ASSY BLOCK CLAMP SINGLE CELL	1
31	666-669X310	ASSY CARD	1
32	782-504	FTG UNION BH SST .12T - .12T	1



SHEET 1 OF 2

622-230-010-ILS-C

Figure 10-14
CHN828 Touchscreen Unique Sub Assembly 1 of 2
(CHN828 model only)

622-230-010 ASSY CHN828 W/TSCRN UNIQEE SUB CONT...			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	169-003-115	LABEL ID CELL IR CO2 0.725 02 SILVER	1
2	619-590-521	MOUNT RESILIENT 1.00 X .75 X .250-20	3
3	619-590-934	ASSY CELL IR CO2 .725	1
4	619-591-181	ASSY BLOCK BYPASS	1
5	619-591-290	PLUNGER SPRING RETRACTABLE 5/16-18 SST	1
6	619-591-930	BLOCK CARRIAGE MONITOR PNT	1
7	619-593-339	COVER CABLE DOOR LEFT P/PNT	1
8	619-593-405	WALL MOUNT SWING ARM	1
9	619-593-575	HARNESS ASSY CONNECT MON T/SCRN DOOR D/P	1
10	621-606-141	FTG UNION 1/4 T TO 1/4 Y	1
11	622-002-231	TUBE SST INERT HRT TO HTR	1
12	622-002-350	ASSY JUMPER BALLAST HEATER	1
13	622-002-351	ASSY HARNESS BALLAST HEATER	1
14	622-002-376	ASSY CABLE FURNACE MASS FLOW CONTROL	1
15	622-002-403	ASSY BALLAST HEATER FAN HARNESS	1
16	622-002-442	ASSY CABLE INCOMING OXYGEN	1
17	622-002-462	ASSY DOOR MONITOR	1
18	622-002-547	ASSY CABLE CAT5E IR CELL	1
19	622-002-597	TUBE SST MFC DOSE TO TC DOSE	1
20	622-002-598	TUBE SST MFC TO TC CELL	1
21	622-002-599	TUBE SST MFC TO SCR	1
22	622-002-658	PANEL EXHAUST	1
23	622-002-660	TUBE SST IR CELL TO OVEN	1
24	622-002-663	ASSY BRACKET & MANIFOLD PV	1
25	622-002-677	ASSY SHROUD RIGHT CHN828	1
26	622-002-701	ASSY CABLE H20 CONSERVE	1
27	622-002-702	ASSY CABLE DOSER LOOP	1
28	622-002-721	ASSY DOOR WINDOW FILER	1
29	622-002-736	NAMEPLATE I.D. CHN828 622-200-300	1
30	622-002-741	ASSY CABLE CAT5E H2 CELL	1
31	622-002-751	ASSY CAP BLOCK WITH FTG H	1
32	625-603-185	ASSY MANIFOLD CELL IR DOUBLE	1
33	625-603-349	FTG QD UNION BH .38T - .38T BR NP	1
34	625-710-868	ASSY BLOCK CLAMPING CELL IR	1
35	808-296	FITTING REDUCER QUICK DISC.	1

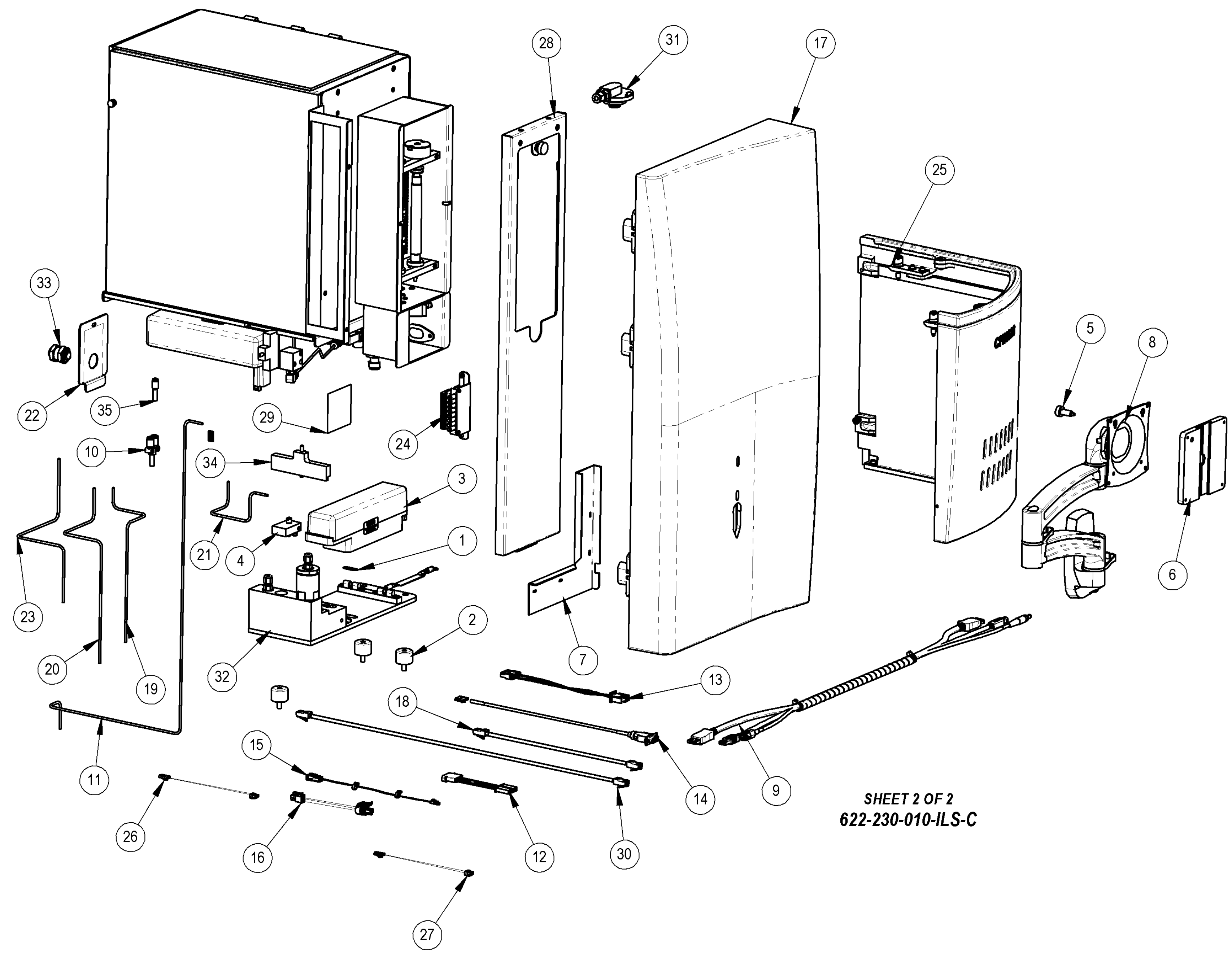


Figure 10-15
CHN828 Touchscreen Unique Sub Assembly 2 of 2
(CHN828 model only)

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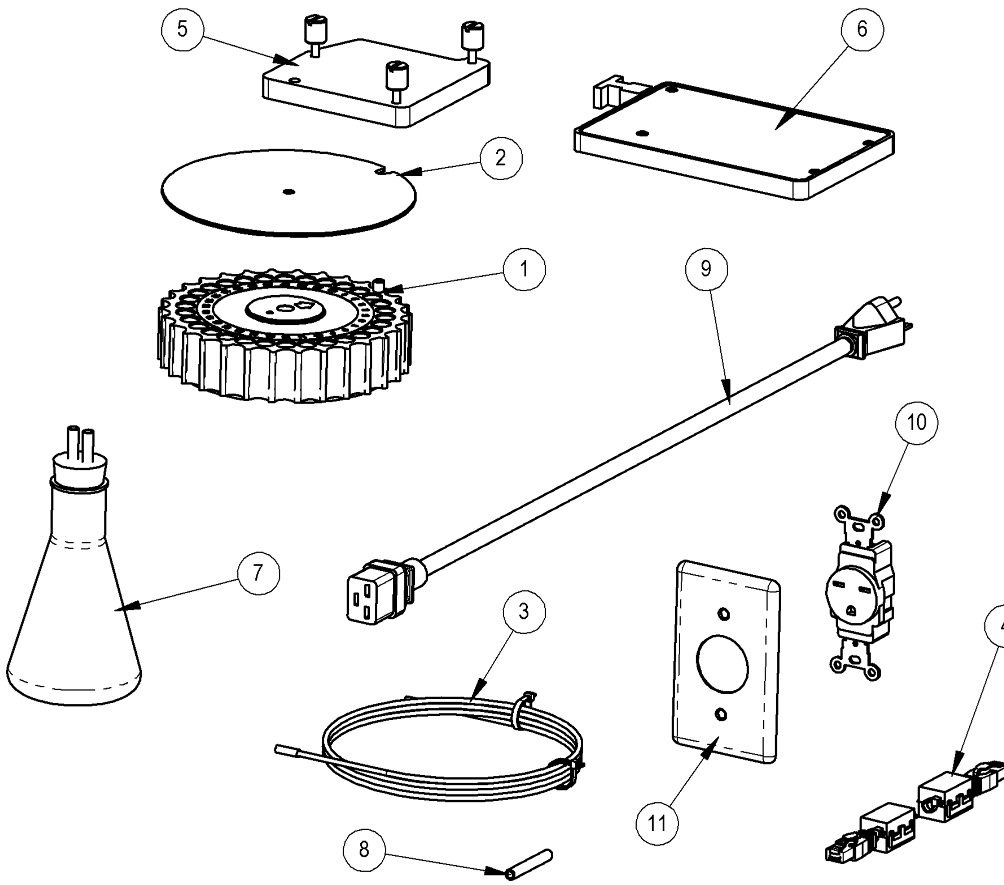
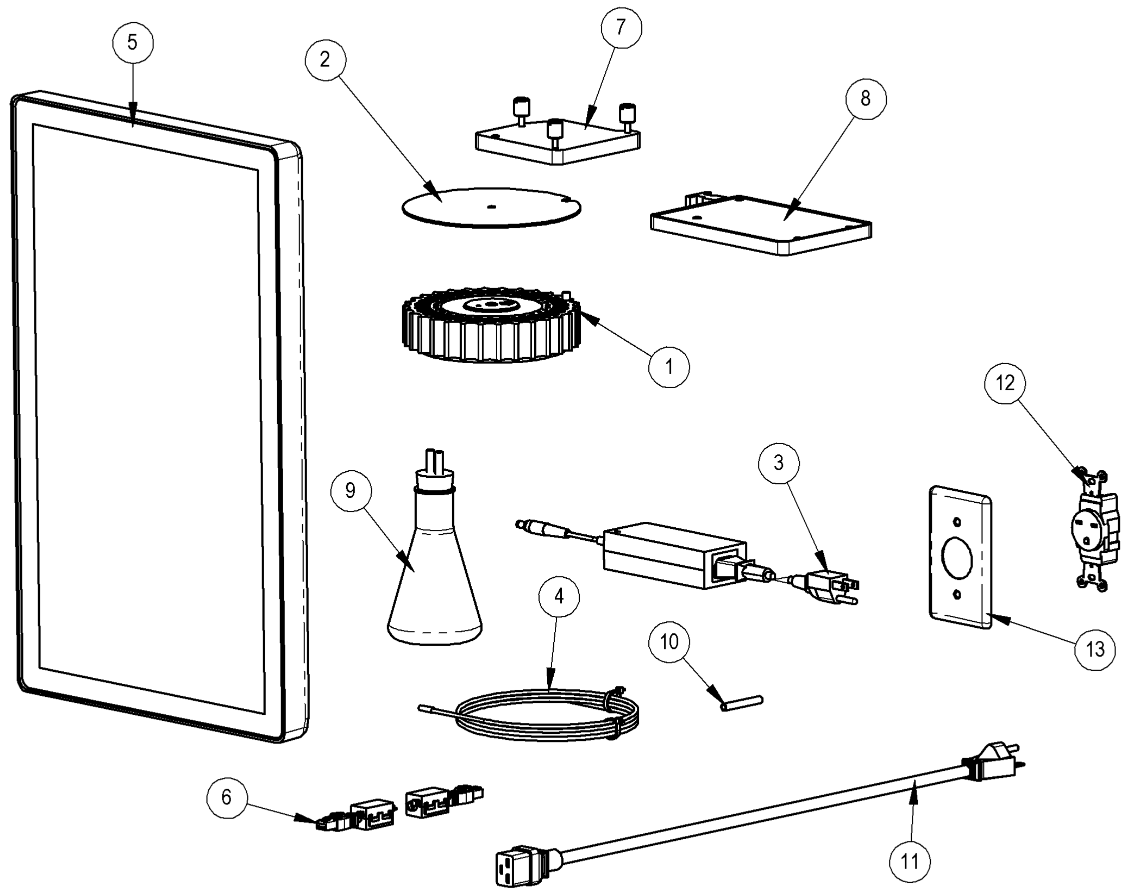


622-160-070 PACK COMPONENT CN/FP828/P			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	619-180	ASSY CAROUSEL STACKABLE 30 POS	1
2	619-304	ASSY COVER DUST CAROUSEL	1
3	619-592-395	ASSY CONNECTION CU .125 GAS CARRIER 6 FT	1
4	620-682	ASSY CABLE CAT 5 15' & FERRITE BEADS	1
5	622-002-516	ASSY PLATE BYPASS	1
6	622-002-531	ASSY MIRROR VIEWING FURNACE	1
7	625-603-197	ASSY FLASK EXHAUST	1
8	625-710-695	TUBING FLX POLYU ORANGE .166 ID X .042 W	1
9	709-806-720	POWER CORD ASSEMBLY	1
10	709-806-808	RECEPTACLE SINGLE	1
11	709-806-809	COVER WALL PLATE	1

622-160-070-ILS-C

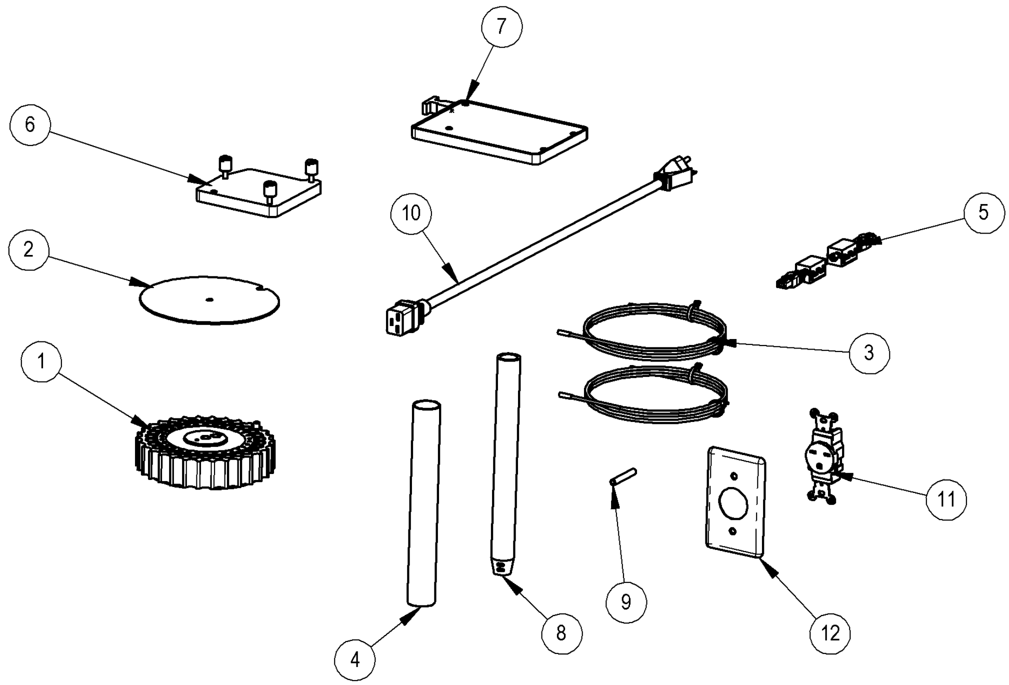
Figure 10-16
CN/FP828/P Component Pack Assembly



622-170-070 PACK COMPONENT CN/FP828/P W/TSCRN			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	619-180	ASSY CAROUSEL STACKABLE 30 POS	1
2	619-304	ASSY COVER DUST CAROUSEL	1
3	619-592-148	POWER SUPPLY/CABLE 12V MONITOR TOUCHSCREEN	1
4	619-592-395	ASSY CONNECTION CU .125 GAS CARRIER 6 FT	1
5	619-593-602	ASSY MONITOR TOUCH SCREEN 22 DISPLAY PORT	1
6	620-682	ASSY CABLE CAT 5 15' & FERRITE BEADS	1
7	622-002-516	ASSY PLATE BYPASS	1
8	622-002-531	ASSY MIRROR VIEWING FURNACE	1
9	625-603-197	ASSY FLASK EXHAUST	1
10	625-710-695	TUBING FLX POLYU ORANGE .166 ID X .042 W	1
11	709-806-720	POWER CORD ASSEMBLY	1
12	709-806-808	RECEPTACLE SINGLE	1
13	709-806-809	COVER WALL PLATE	1

622-170-070-ILS-C

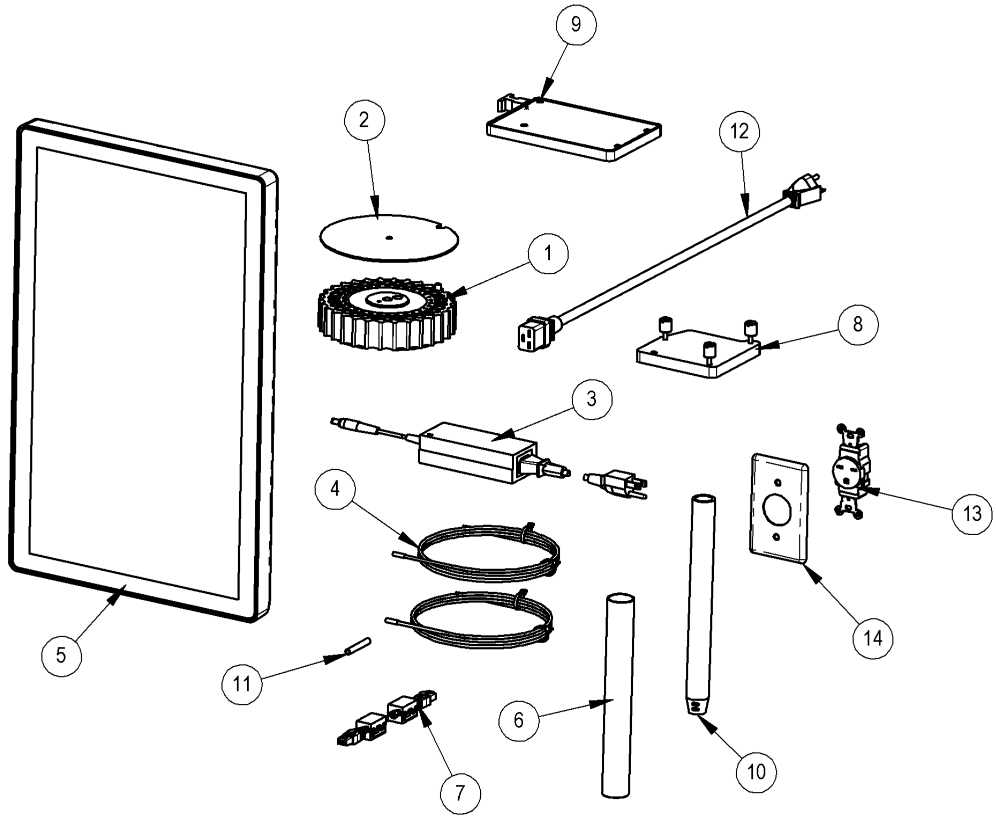
Figure 10-17
CN/FP828/P Touchscreen Component Pack Assembly



622-220-070 PACK COMPONENT CHN828			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	619-180	ASSY CAROUSEL STACKABLE 30 POS	1
2	619-304	ASSY COVER DUST CAROUSEL	1
3	619-592-395	ASSY CONNECTION CU .125 GAS CARRIER 6 FT	2
4	619-777	TUBE-MIDDLE DIRECTING	1
5	620-682	ASSY CABLE CAT 5 15' & FERRITE BEADS	1
6	622-002-516	ASSY PLATE BYPASS	1
7	622-002-531	ASSY MIRROR VIEWING FURNACE	1
8	622-002-748	TUBE REAGENT SEC LOADING STOP	1
9	625-710-695	TUBING FLX POLYU ORANGE .166 ID X .042 W	1
10	709-806-720	POWER CORD ASSEMBLY	1
11	709-806-808	RECEPTACLE SINGLE	1
12	709-806-809	COVER WALL PLATE	1

622-220-070-ILS-A

Figure 10-18
CHN828 Component Pack Assembly



622-230-070 PACK COMPONENT CHN828 W/TSCRN			
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	619-180	ASSY CAROUSEL STACKABLE 30 POS	1
2	619-304	ASSY COVER DUST CAROUSEL	1
3	619-592-148	POWER SUPPLY/CABLE 12V MONITOR TOUCHSCREEN	1
4	619-592-395	ASSY CONNECTION CU .125 GAS CARRIER 6 FT	2
5	619-593-602	ASSY MONITOR TOUCH SCREEN 22 DISPLAY PORT	1
6	619-777	TUBE-MIDDLE DIRECTING	1
7	620-682	ASSY CABLE CAT 5 15' & FERRITE BEADS	1
8	622-002-516	ASSY PLATE BYPASS	1
9	622-002-531	ASSY MIRROR VIEWING FURNACE	1
10	622-002-748	TUBE REAGENT SEC LOADING STOP	1
11	625-710-695	TUBING FLX POLYU ORANGE .166 ID X .042 W	1
12	709-806-720	POWER CORD ASSEMBLY	1
13	709-806-808	RECEPTACLE SINGLE	1
14	709-806-809	COVER WALL PLATE	1

622-230-070-ILS-A

Figure 10-19
CHN Touchscreen Component Pack Assembly

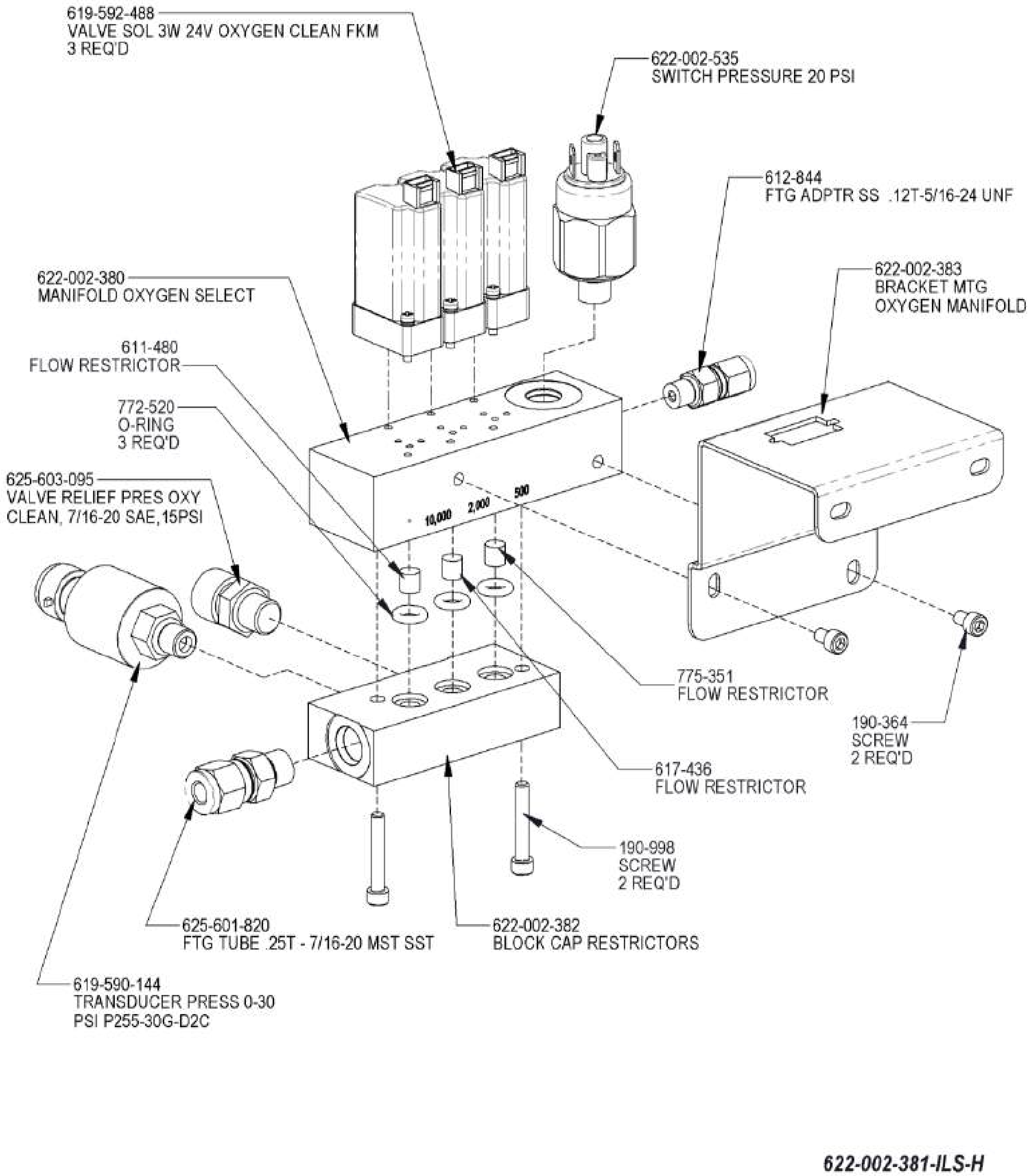


Figure 10-20
Oxygen Select Manifold Assembly
(FP828 model only)

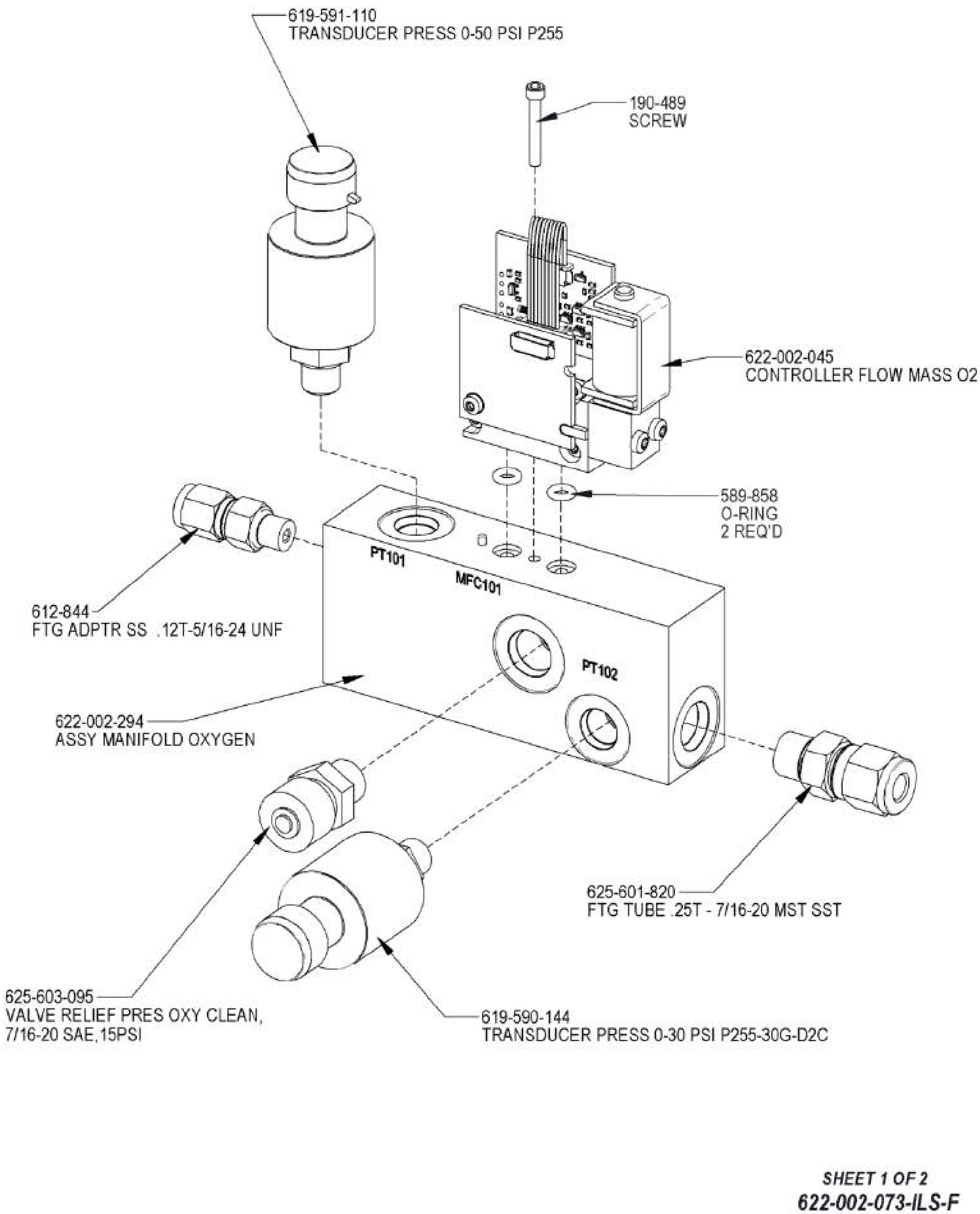


Figure 10-21
Oxygen Manifold Assembly 1 of 2
(CN828 and FP828P models only)

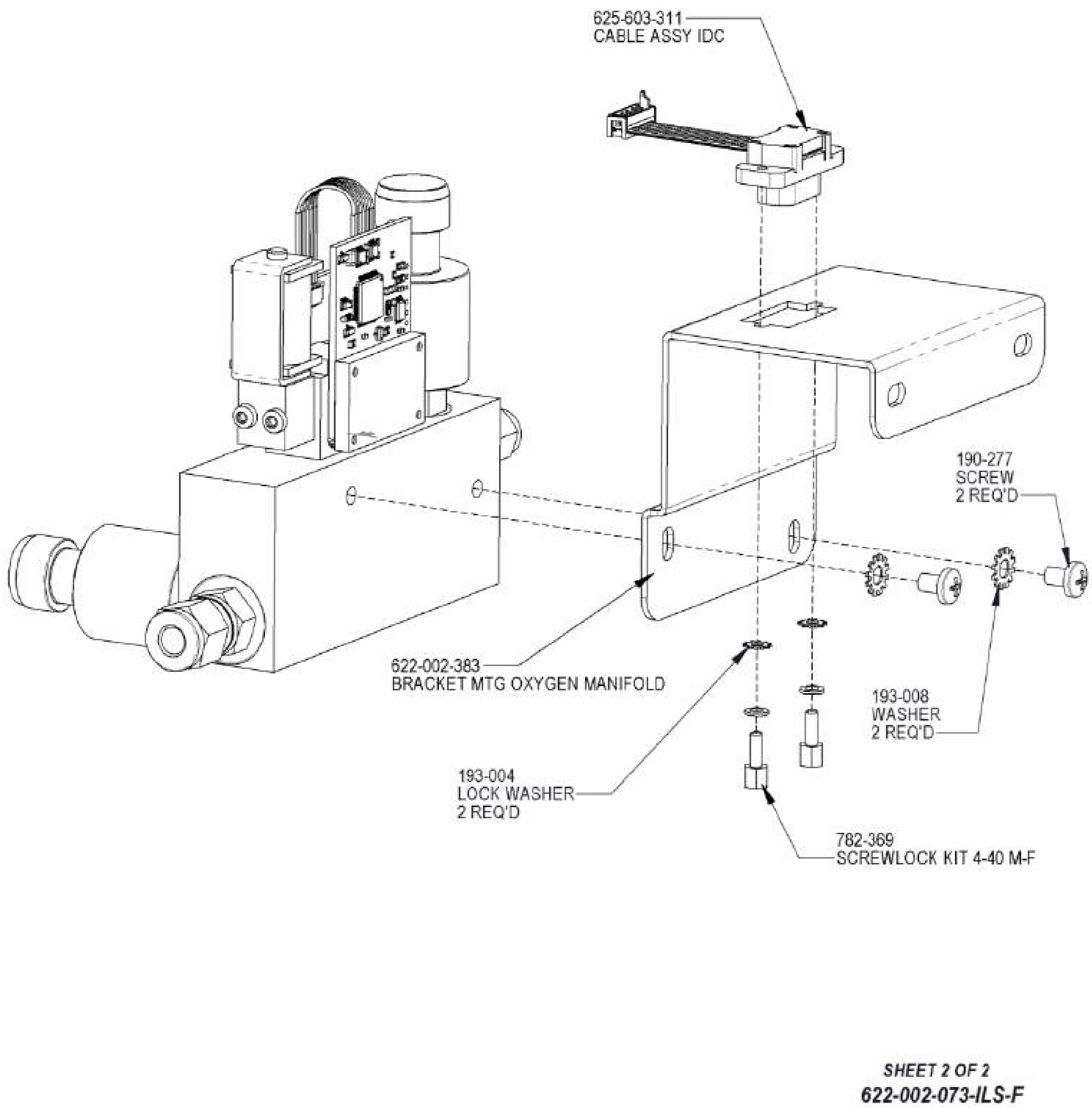


Figure 10-22
Oxygen Manifold Assembly 2 of 2
(CN828 and FP828P models only)

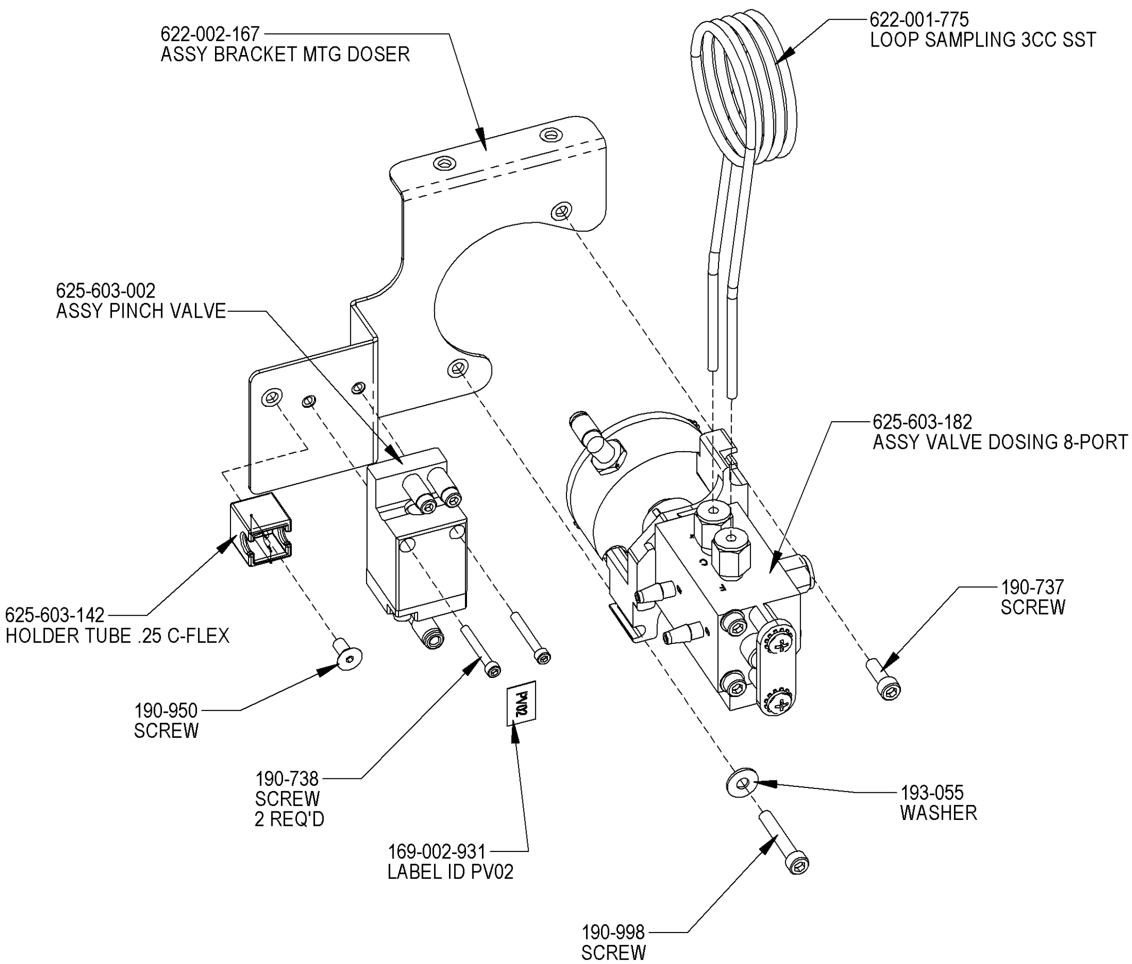


Figure 10-23
Doser with Bracket Assembly
(FP828 model only)

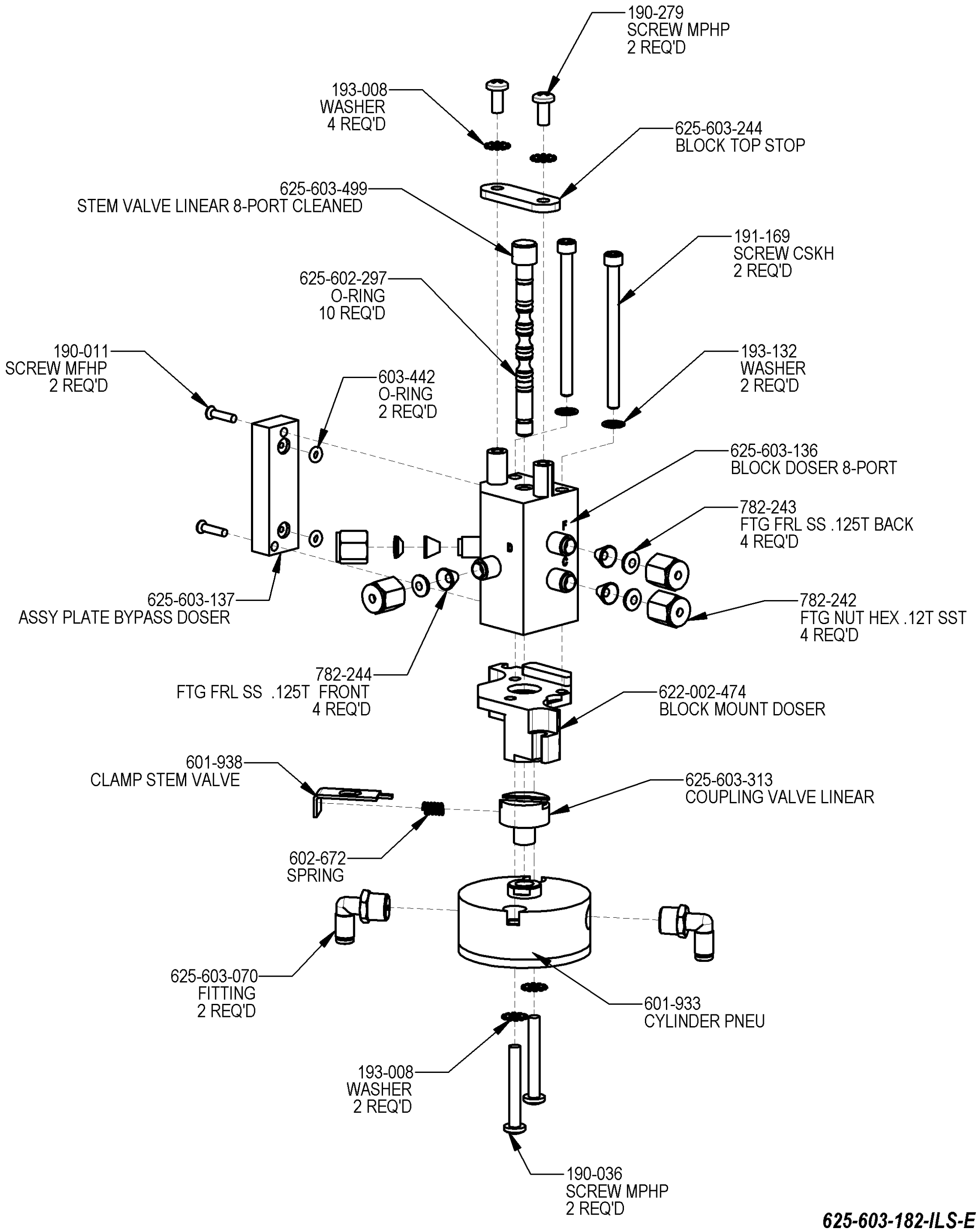


Figure 10-24
8-Port Dosing Valve
(FP828 model only)

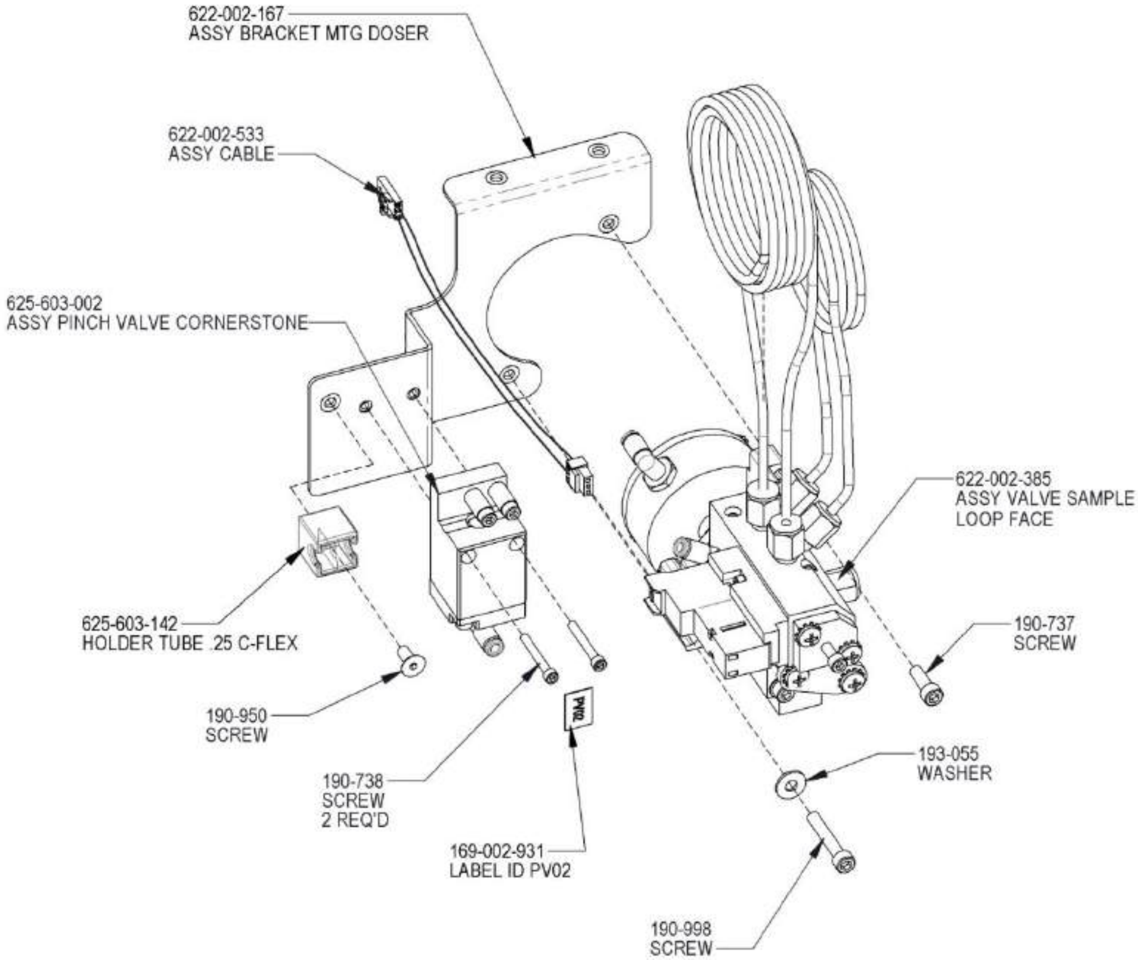


Figure 10-25
Dual Loop Doser w/Bracket Assembly
(CN828 and FP828P models only)

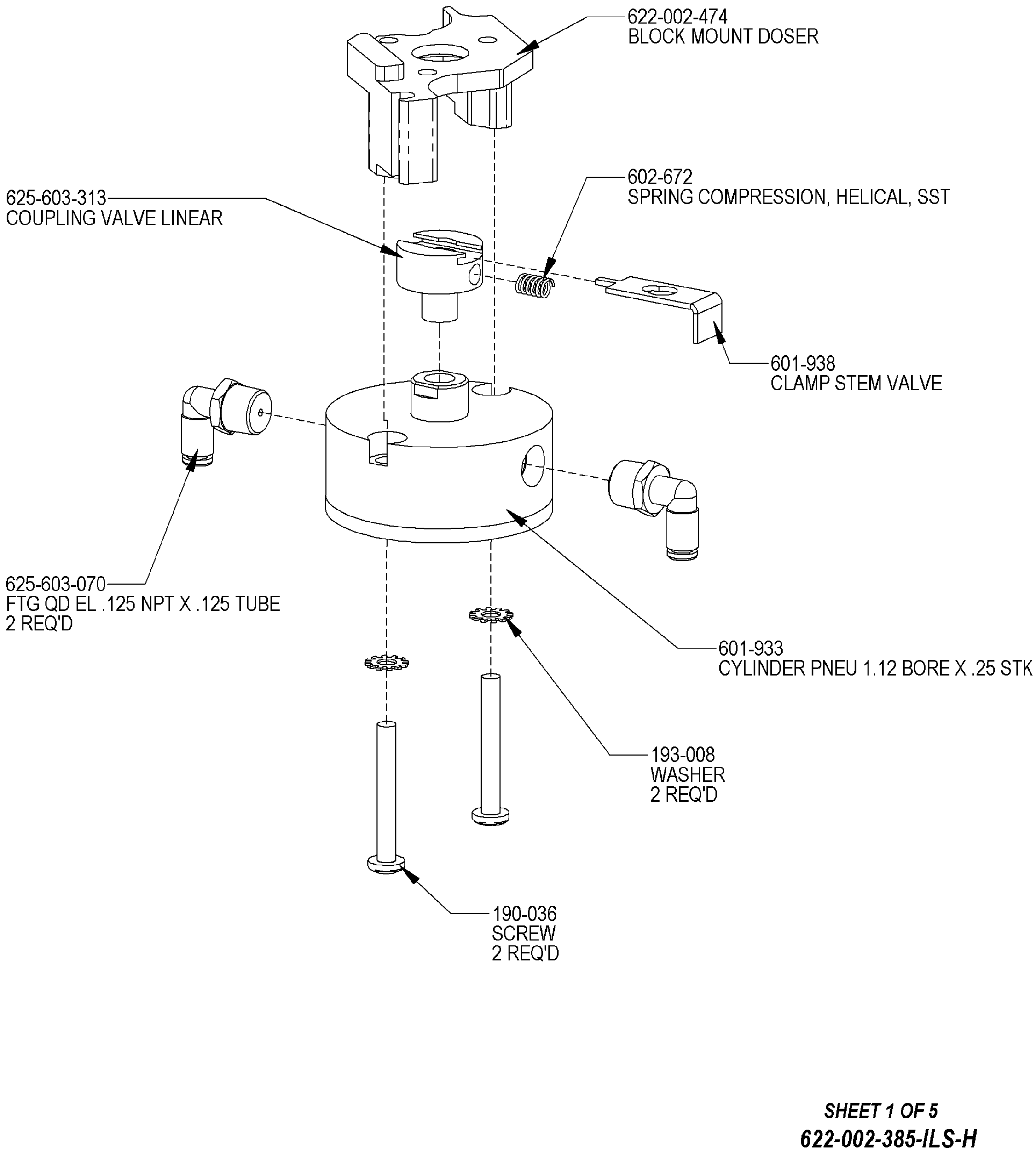


Figure 10-26
Dual Loop Doser Assembly 1 of 5
(CHN828 model only)

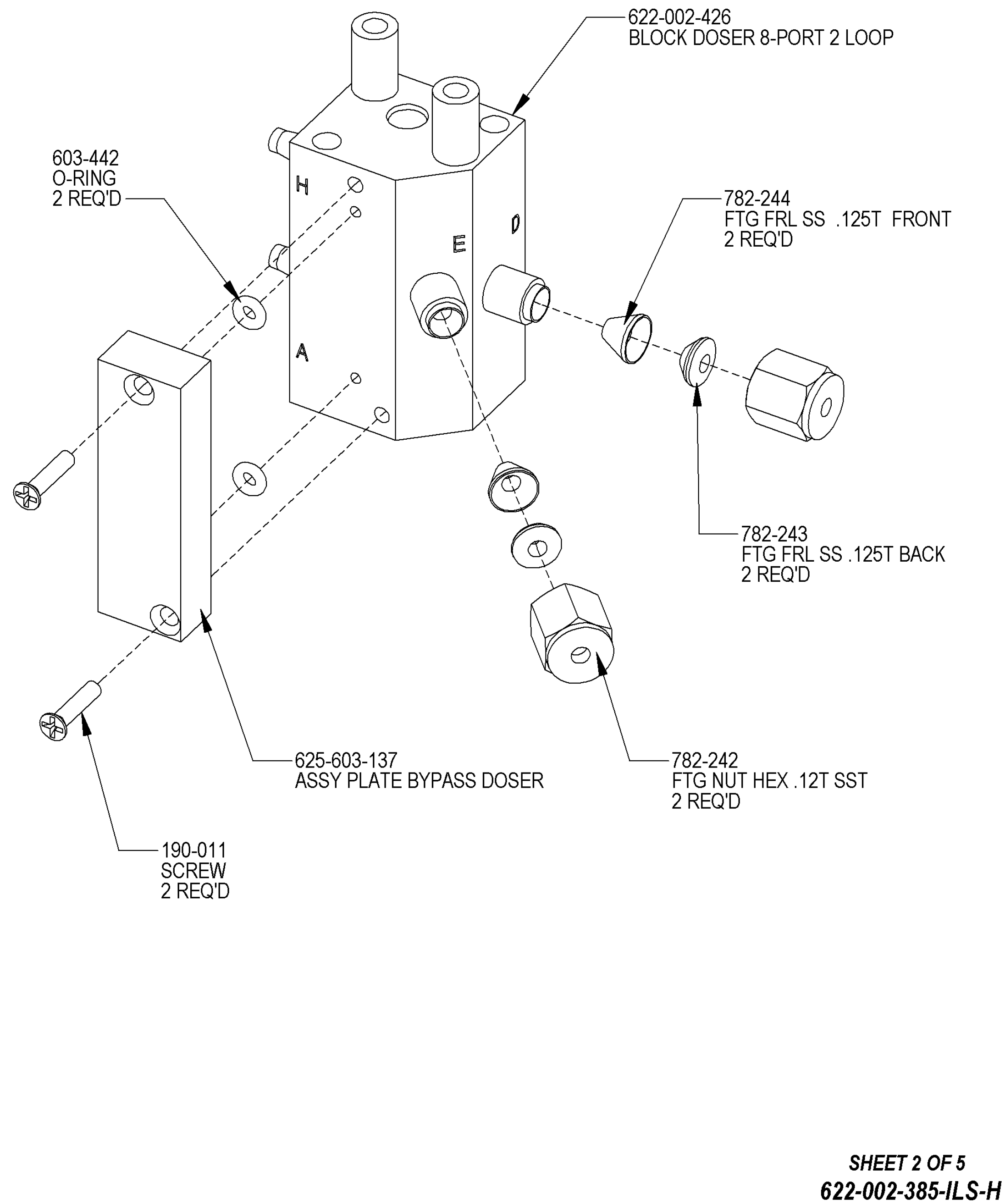


Figure 10-27
Dual Loop Doser Assembly 2 of 5
(CHN828 model only)

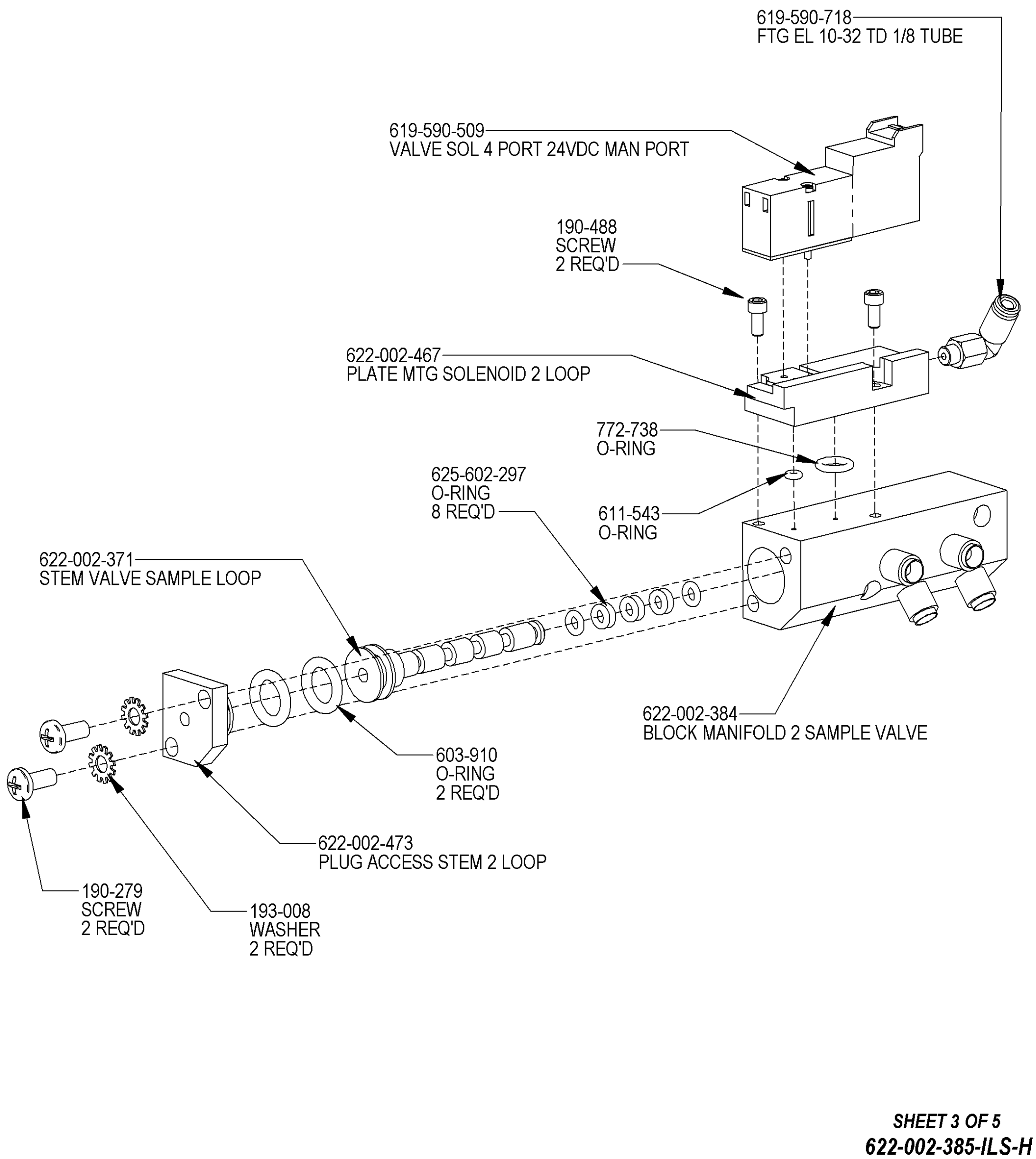


Figure 10-28
Dual Loop Doser Assembly 3 of 5
(CHN828 model only)

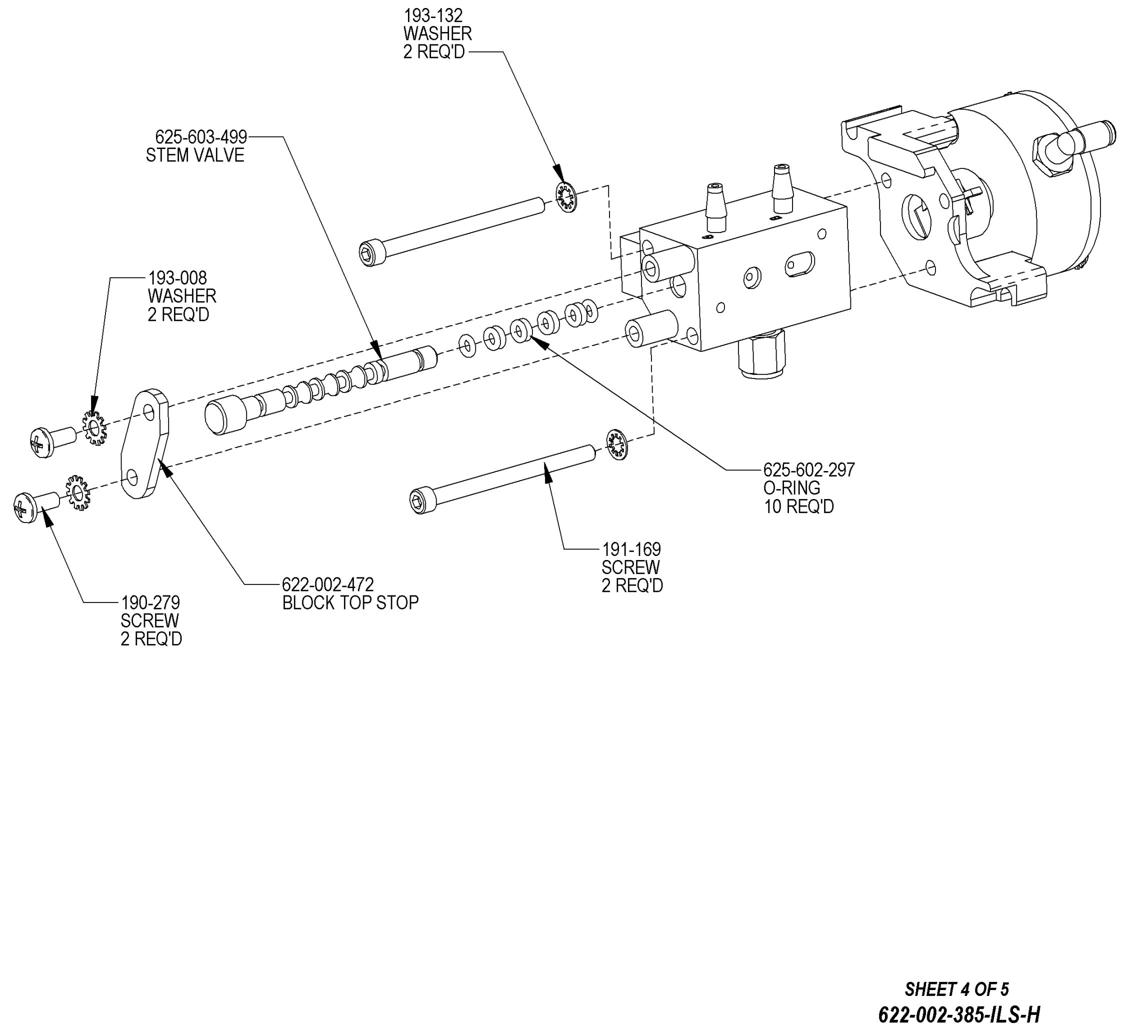
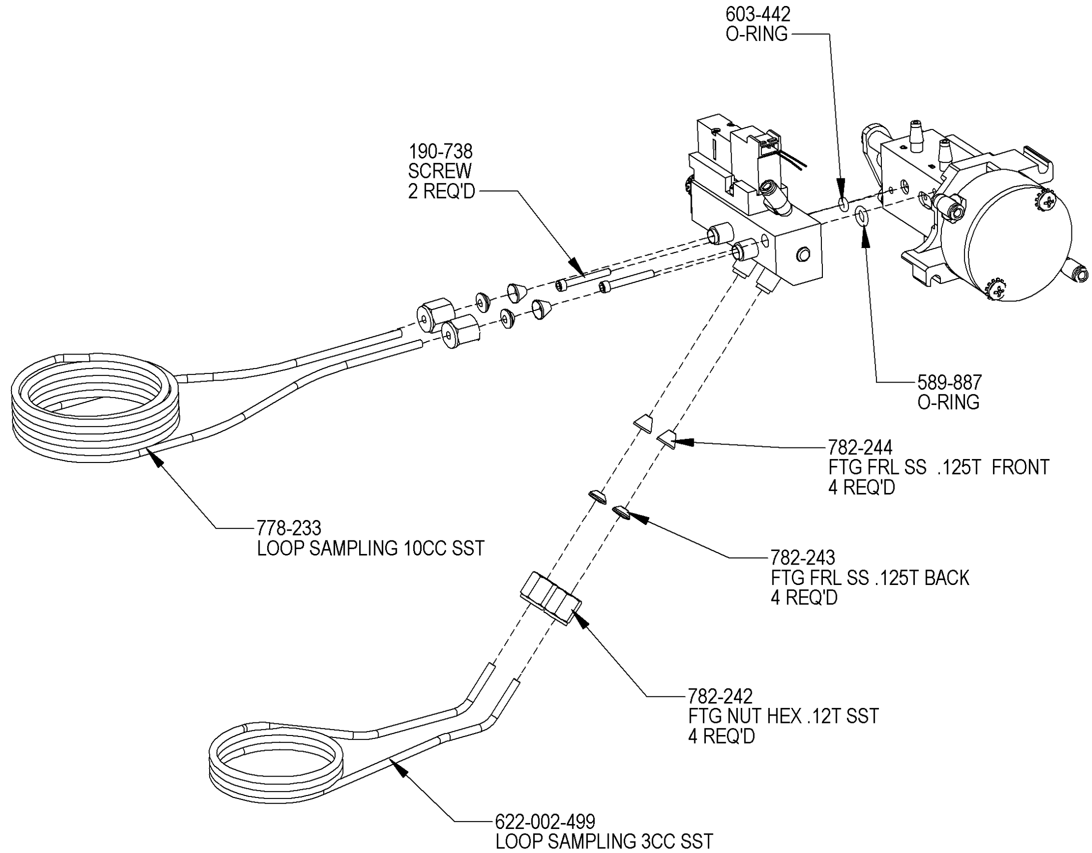


Figure 10-29
Dual Loop Doser Assembly 4 of 5
(CHN828 model only)



SHEET 5 OF 5
622-002-385-ILS-H

Figure 10-30
Dual Loop Doser Assembly 5 of 5
(CHN828 model only)

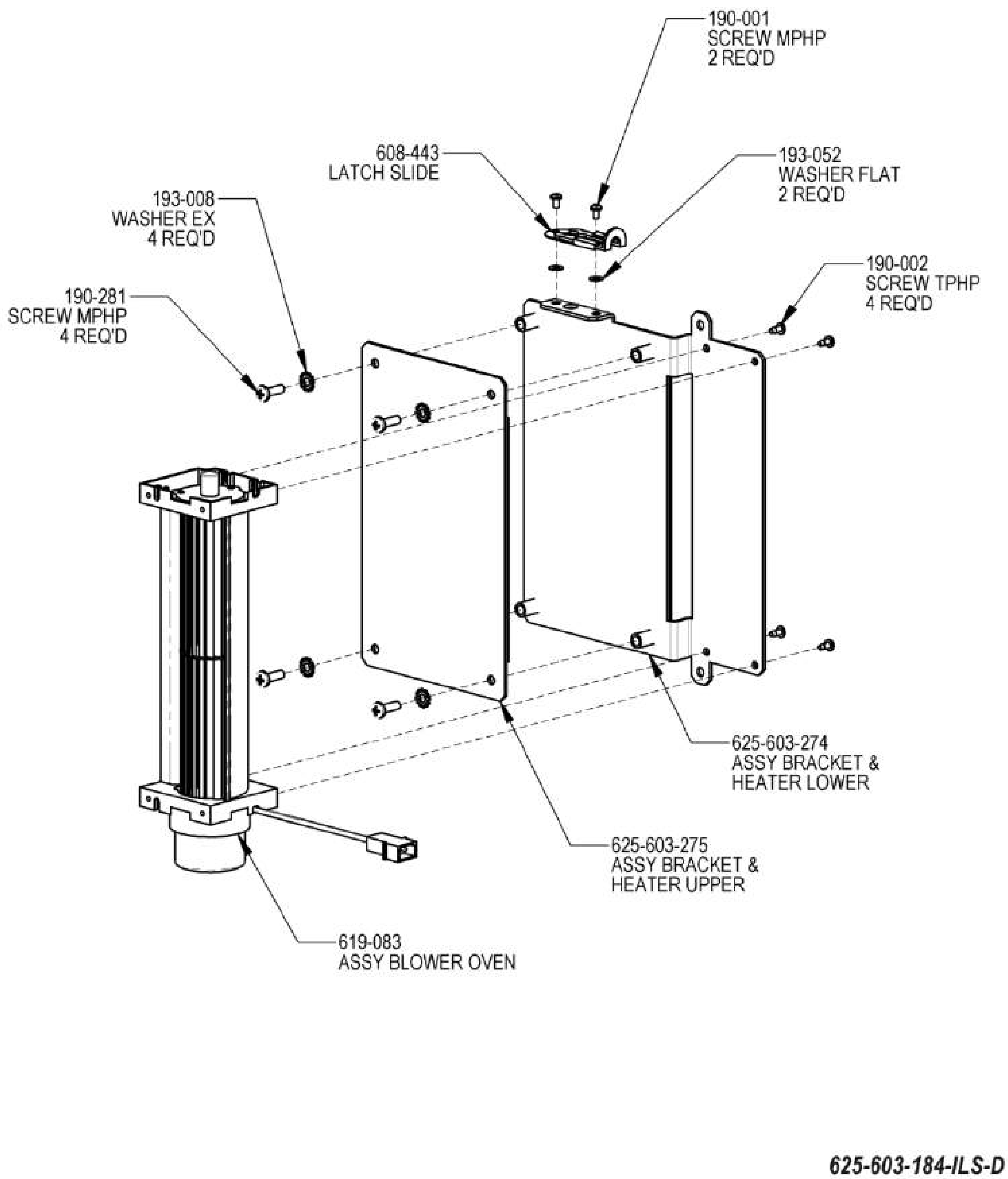


Figure 10-31
Ballast Heater Assembly

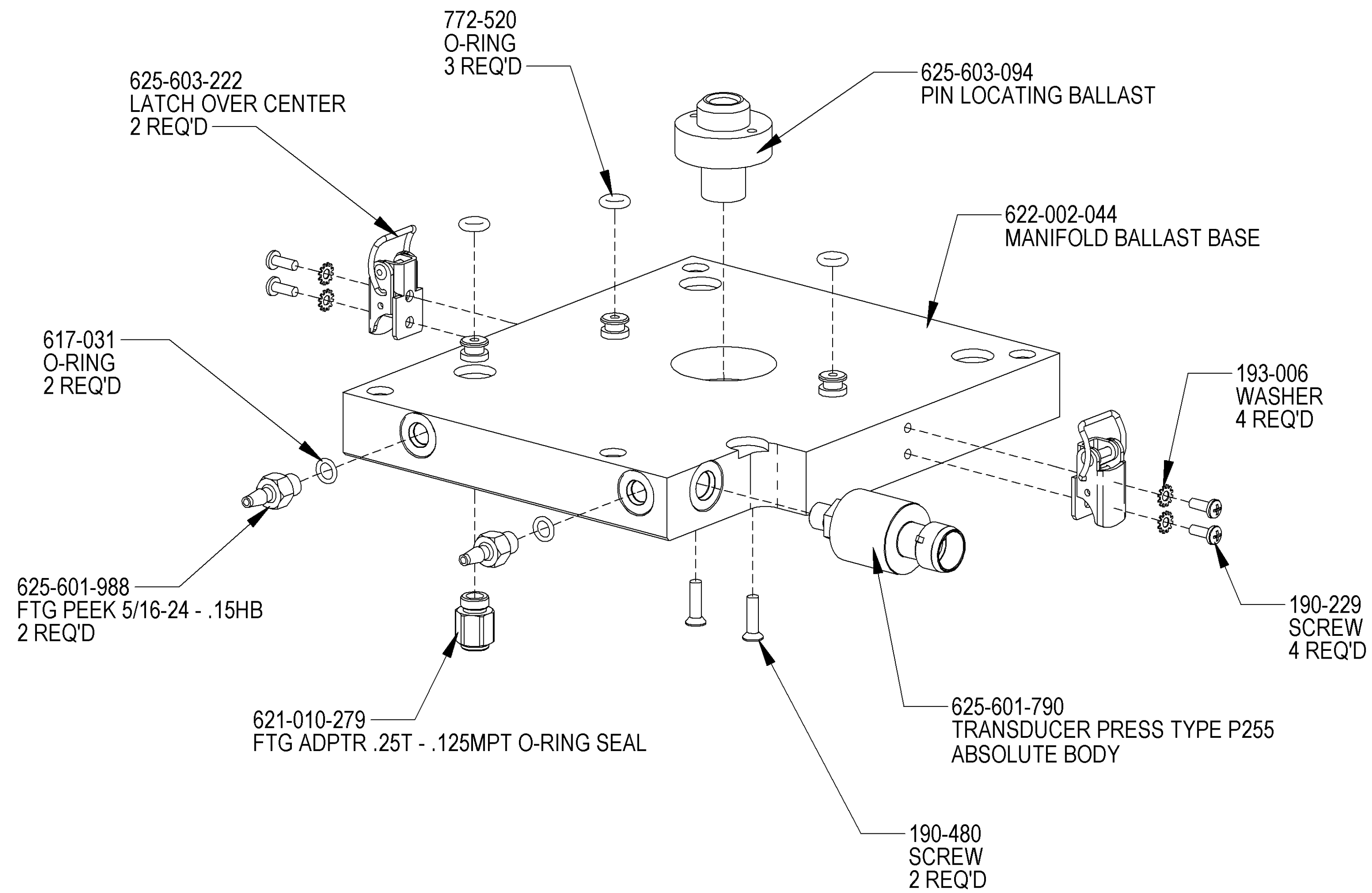


Figure 10-32
Ballast Base Assembly

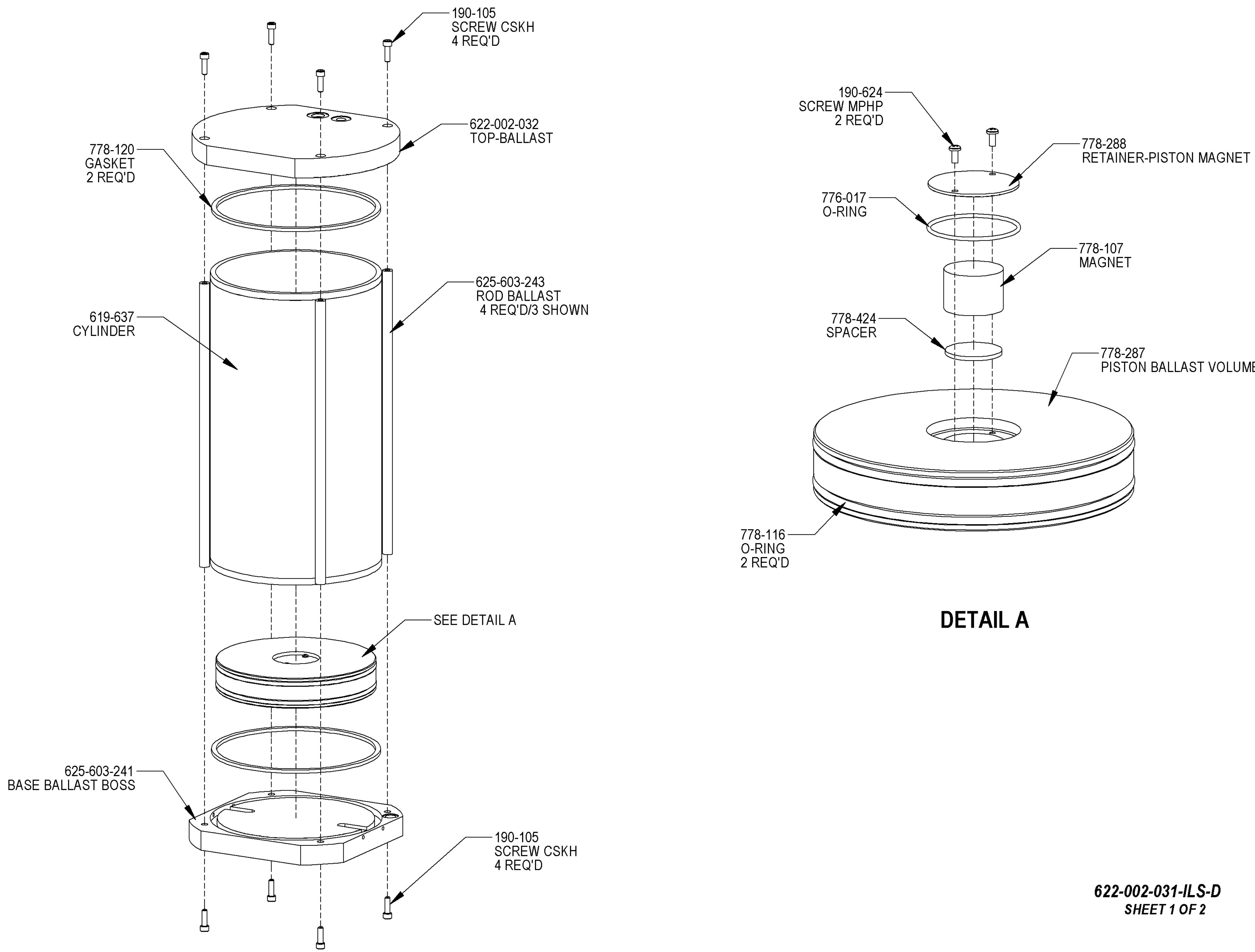
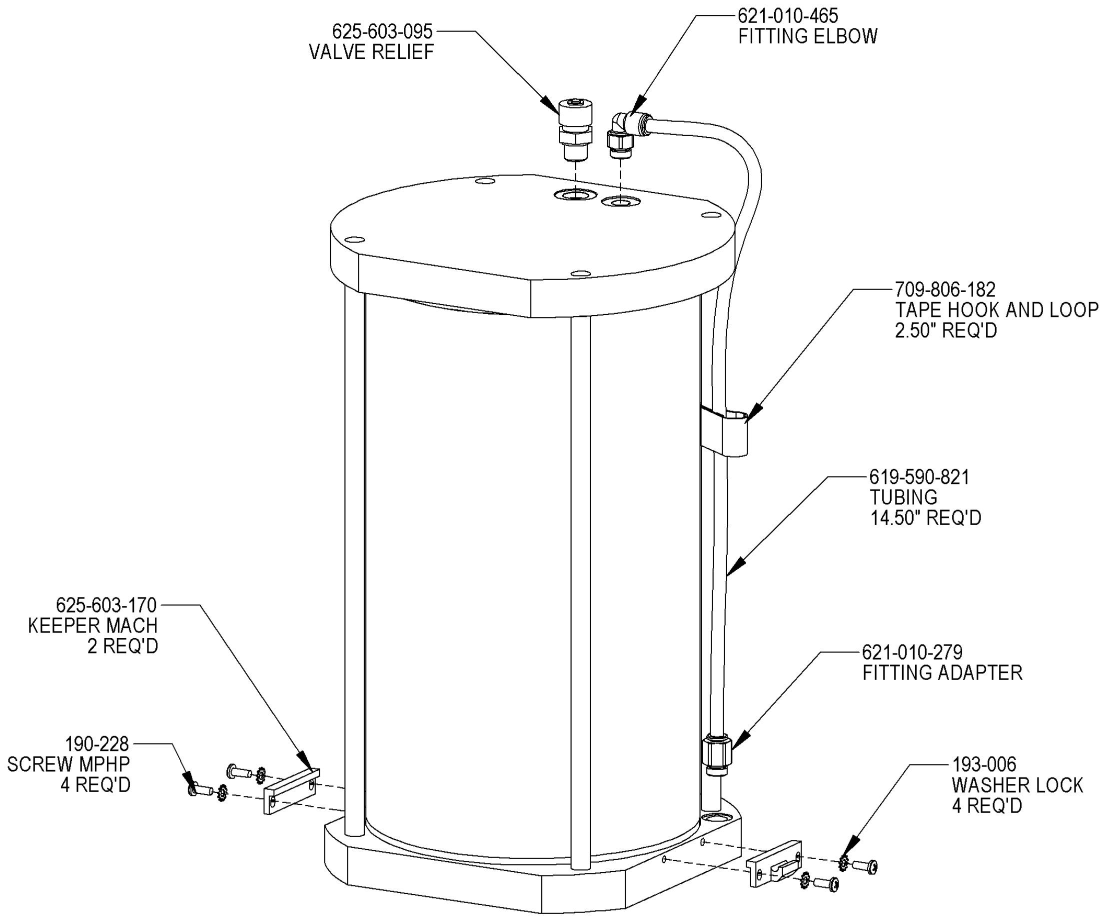


Figure 10-33
Ballast Assembly 1 of 2
(CN828, FP828, and FP828P models only)



622-002-031-ILS-D
SHEET 2 OF 2

Figure 10-34
Ballast Assembly 2 of 2
(CN828, FP828, and FP828P models only)

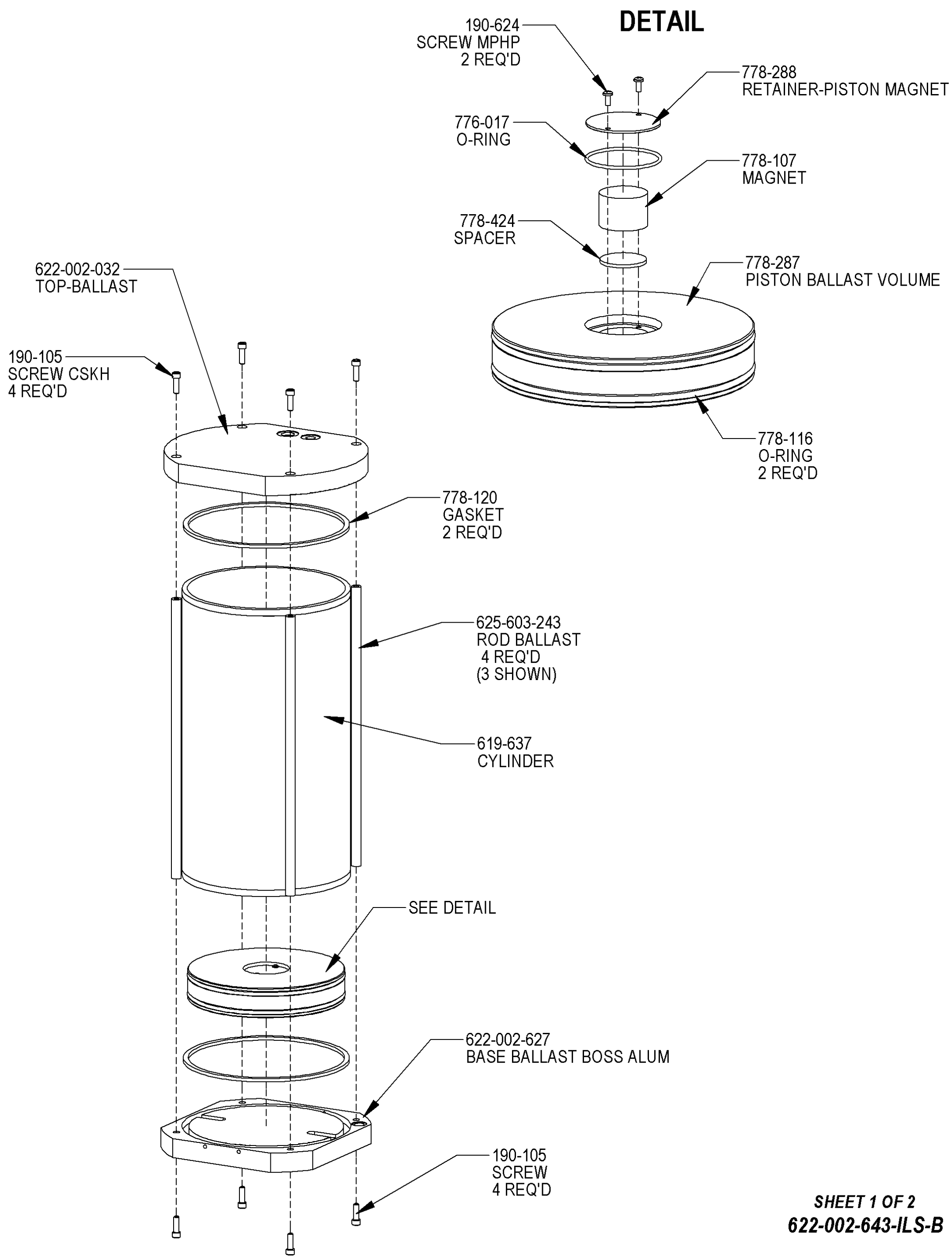


Figure 10-35
4.5L Ballast Cylinder Assembly 1 of 2
(CHN828 model only)

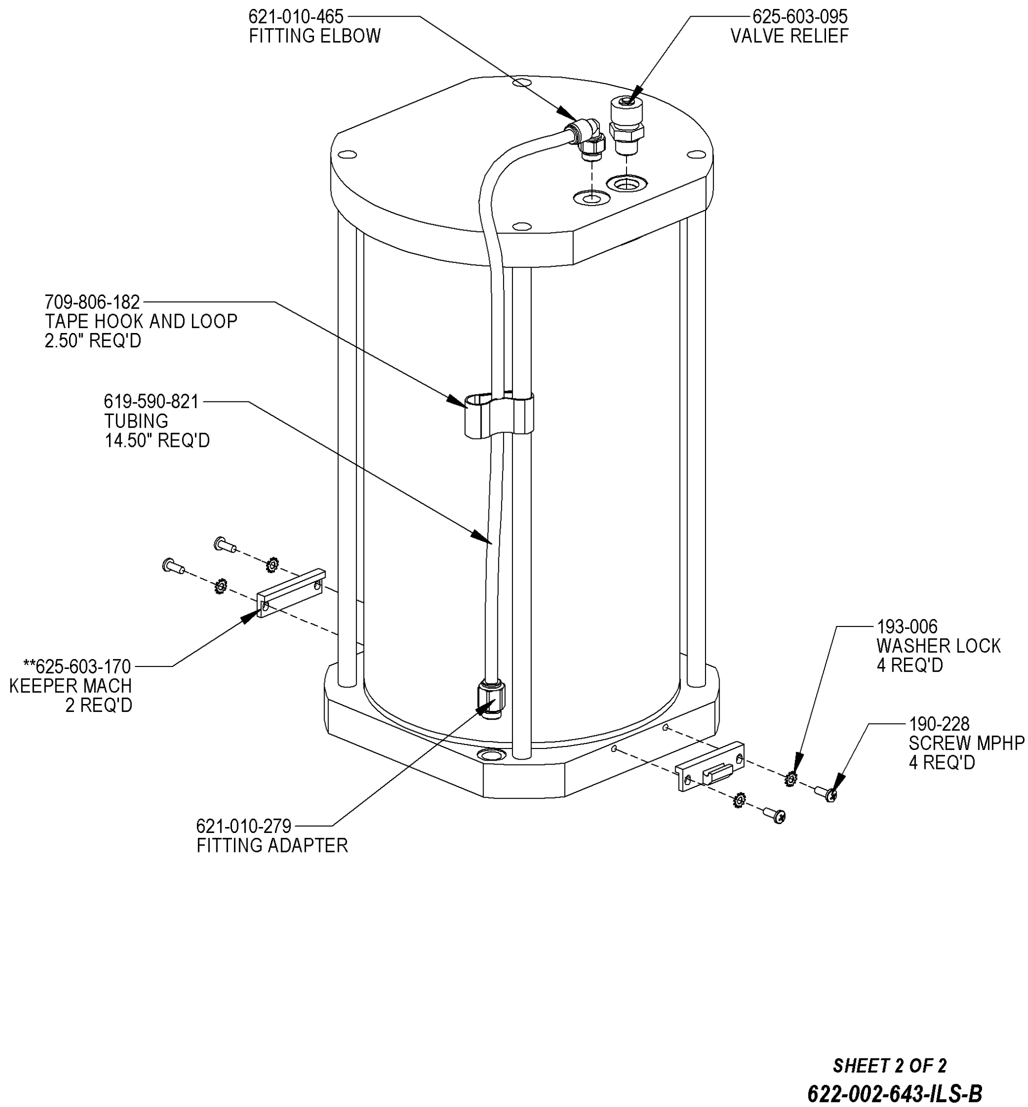


Figure 10-36
4.5L Ballast Cylinder Assembly 2 of 2
(CHN828 model only)

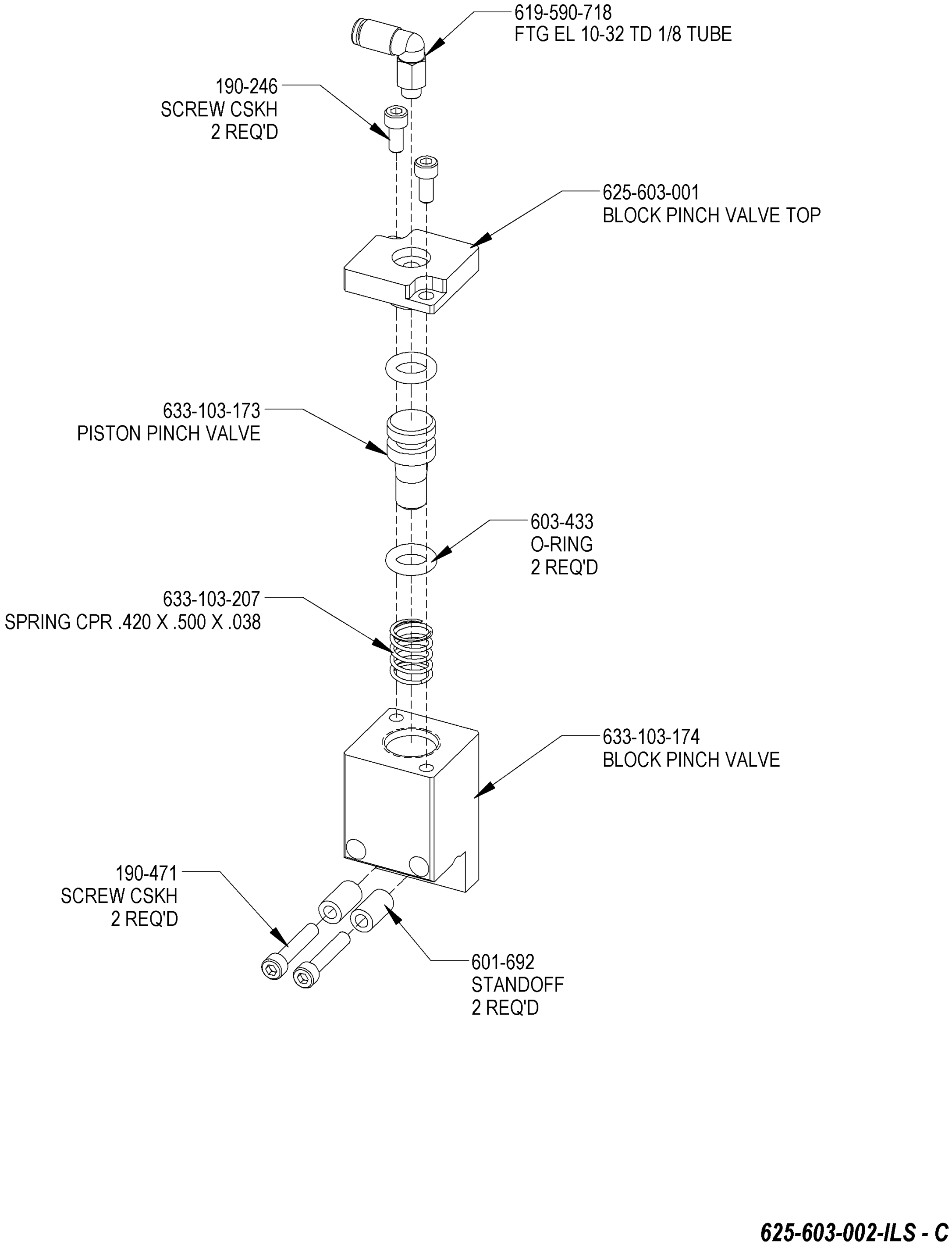


Figure 10-37
Cornerstone® Pinch Valve

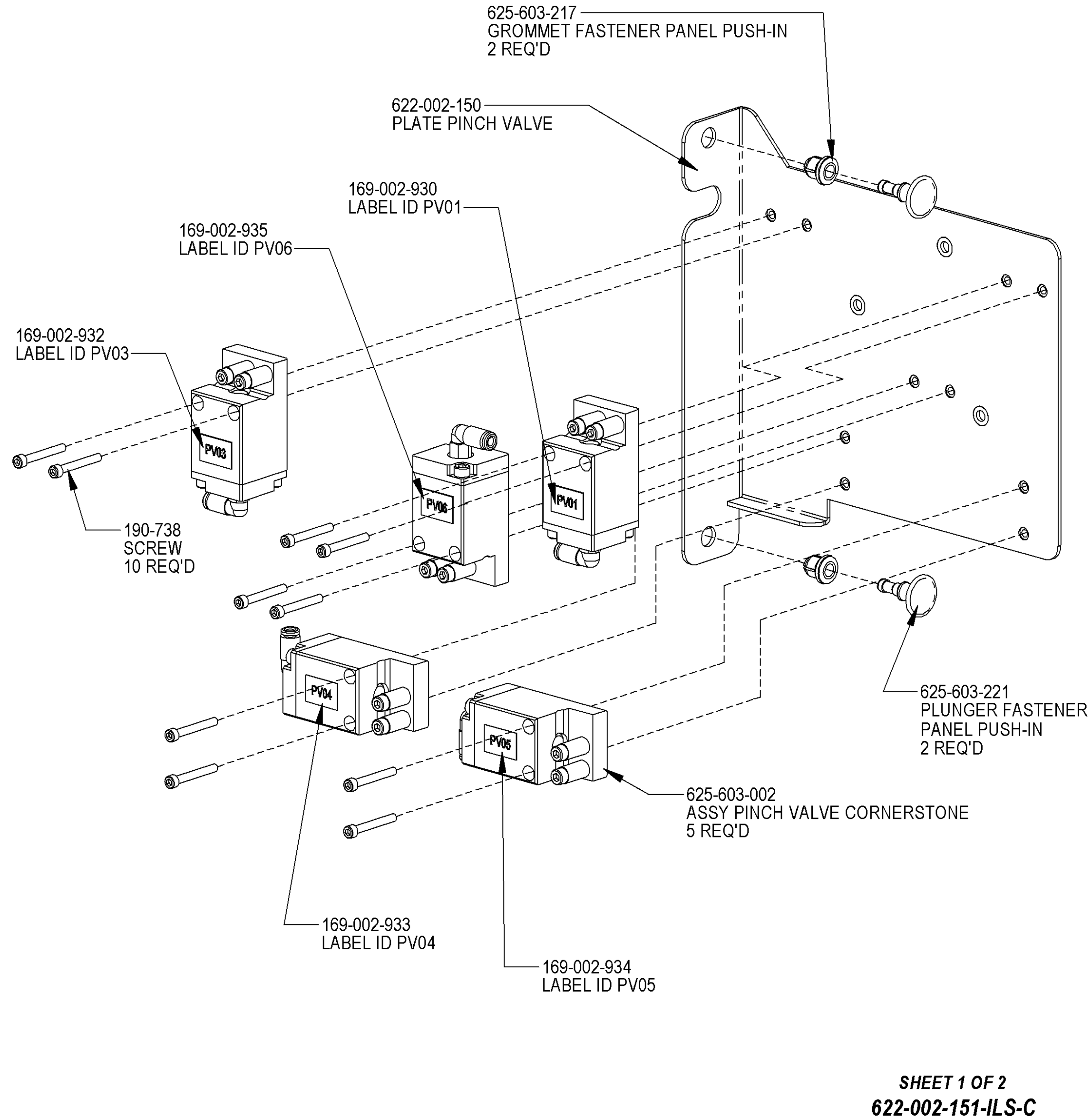
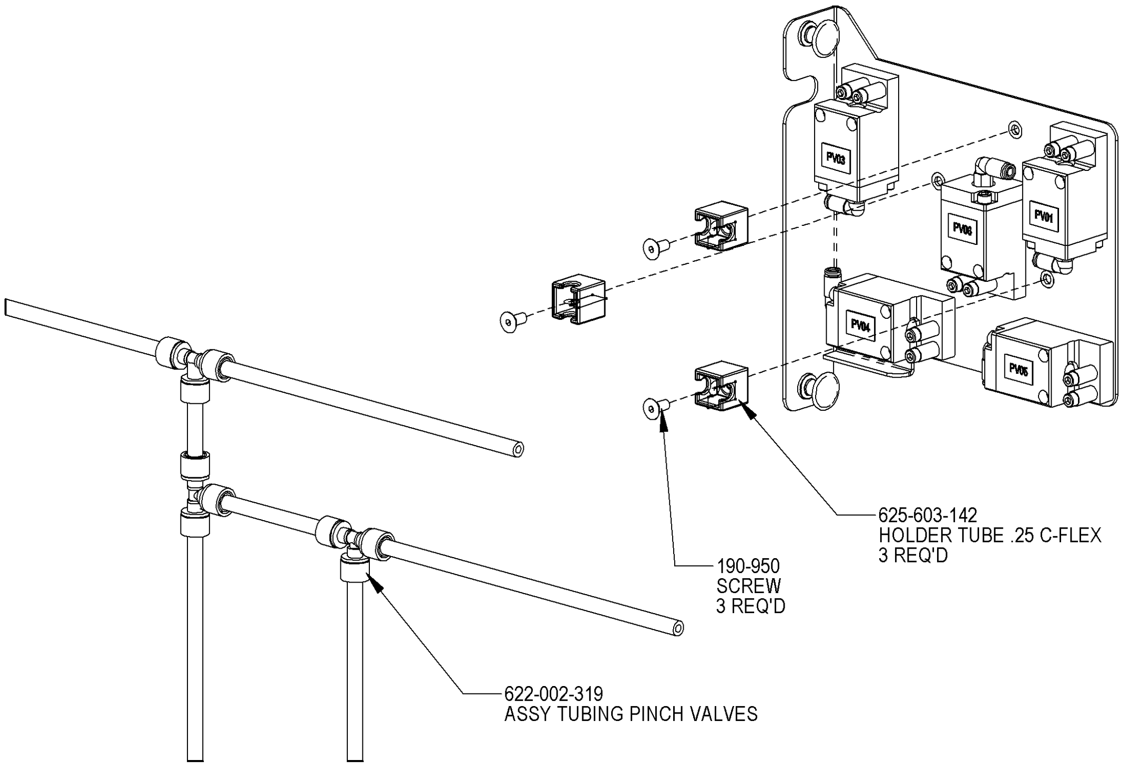


Figure 10-38
Pinch Valve Plate Assembly 1 of 2
(CN828, FP828, and FP828P models only)



SHEET 2 OF 2
622-002-151-ILS-C

Figure 10-39
Pinch Valve Plate Assembly 2 of 2
(CN828, FP828, and FP828P models only)

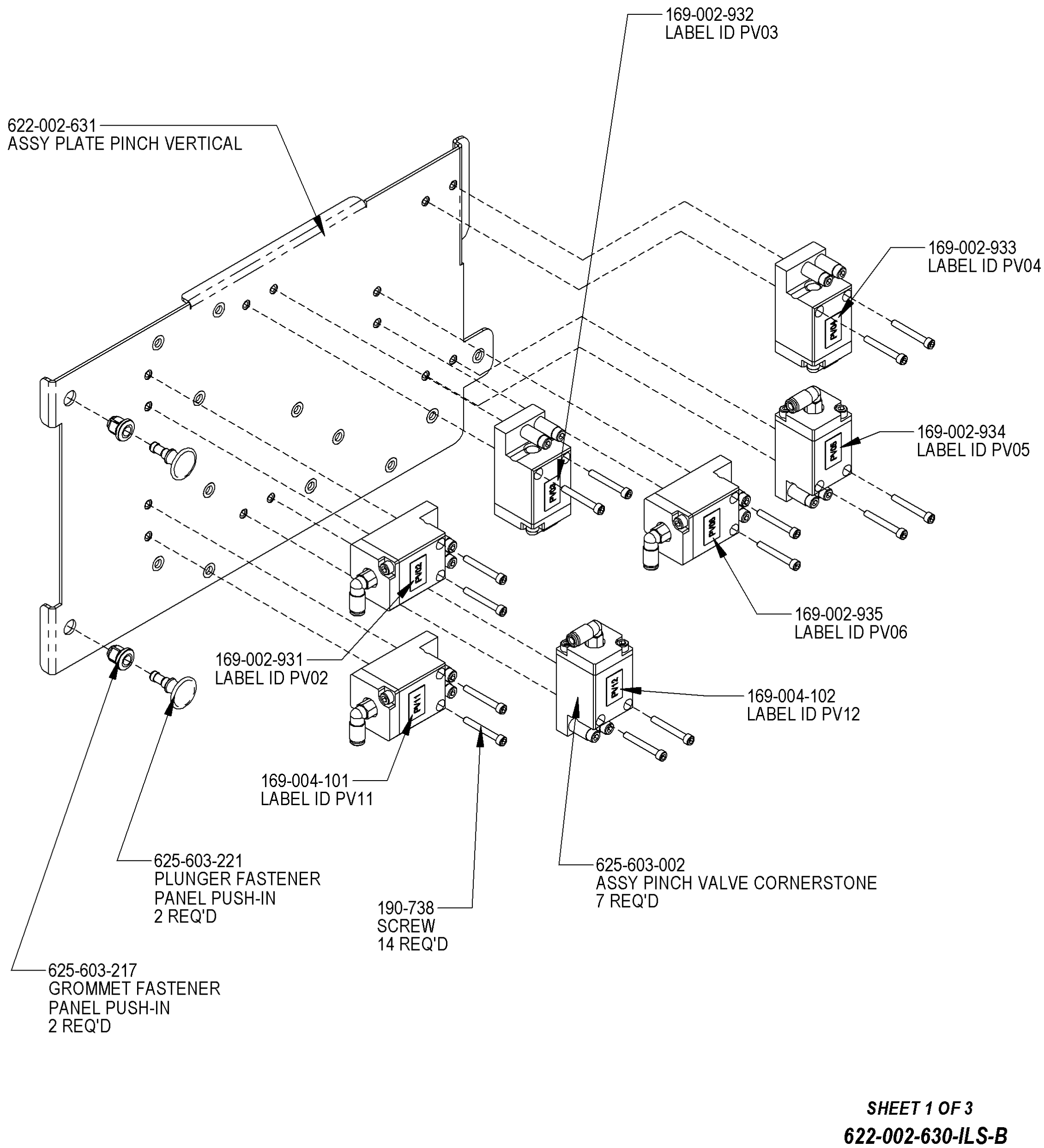


Figure 10-40
Vertical Pinch Valve Plate Assembly 1 of 3
(CHN828 model only)

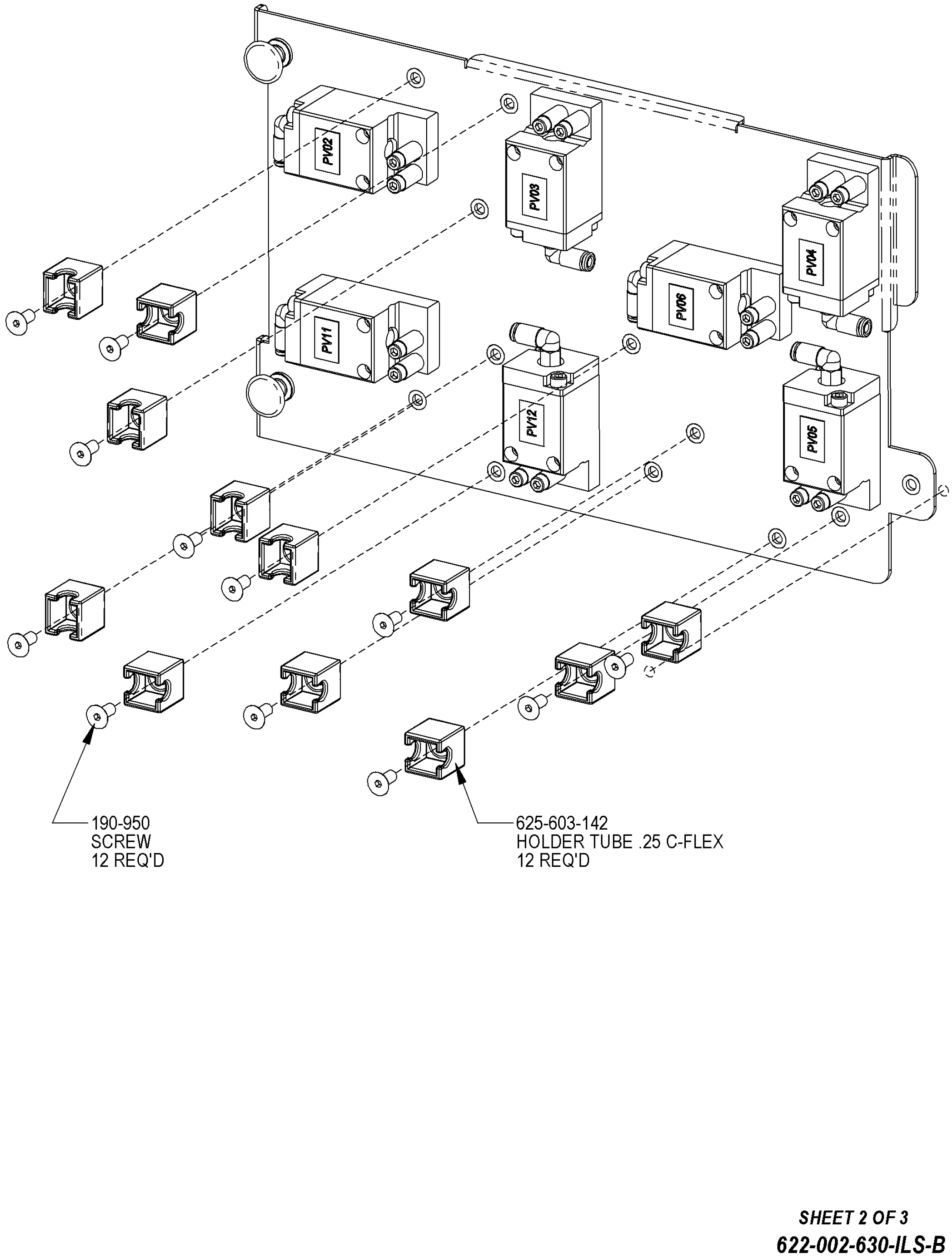


Figure 10-41
Vertical Pinch Valve Plate Assembly 2 of 3
(CHN828 model only)

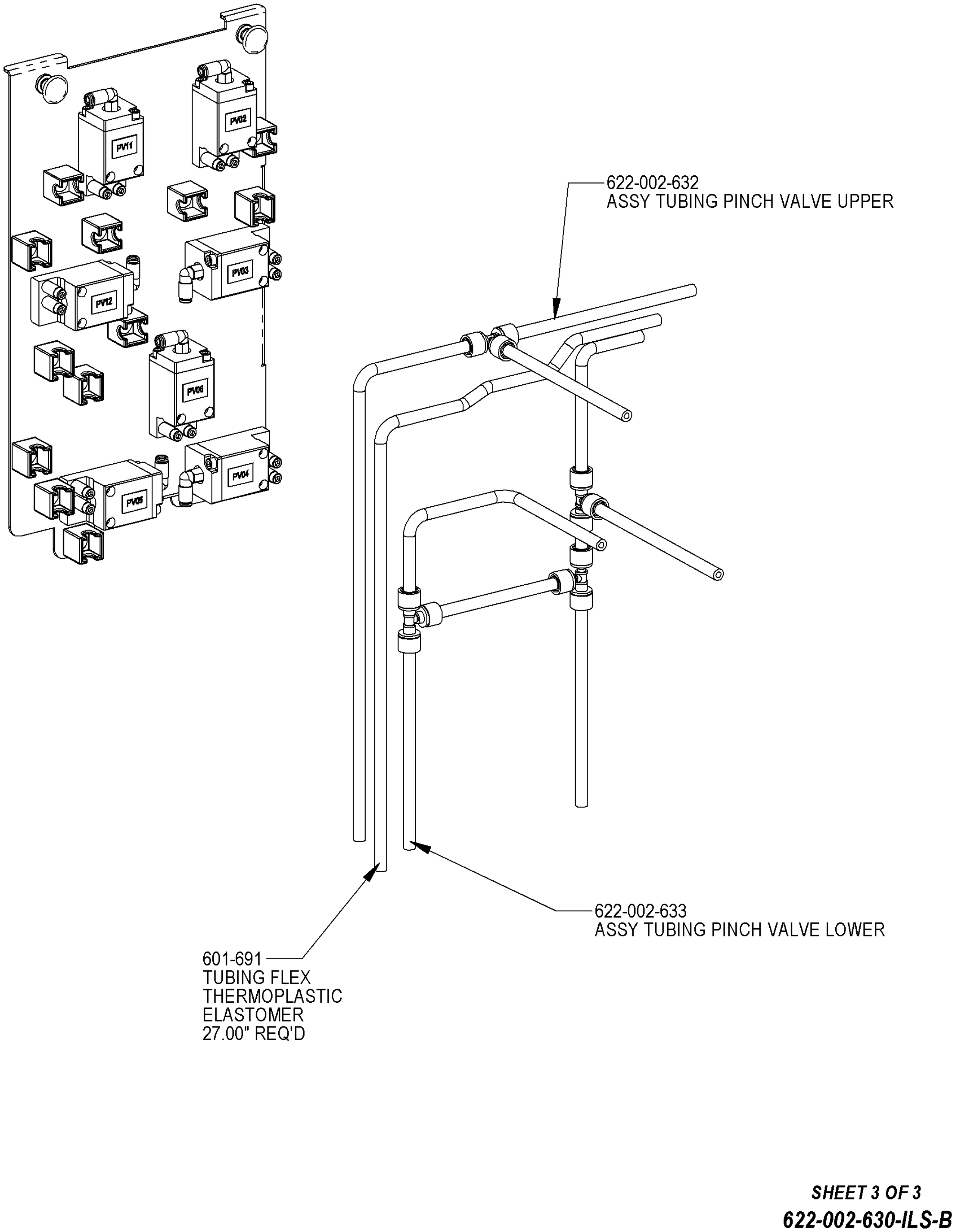


Figure 10-42
Vertical Pinch Valve Plate Assembly 3 of 3
(CHN828 model only)

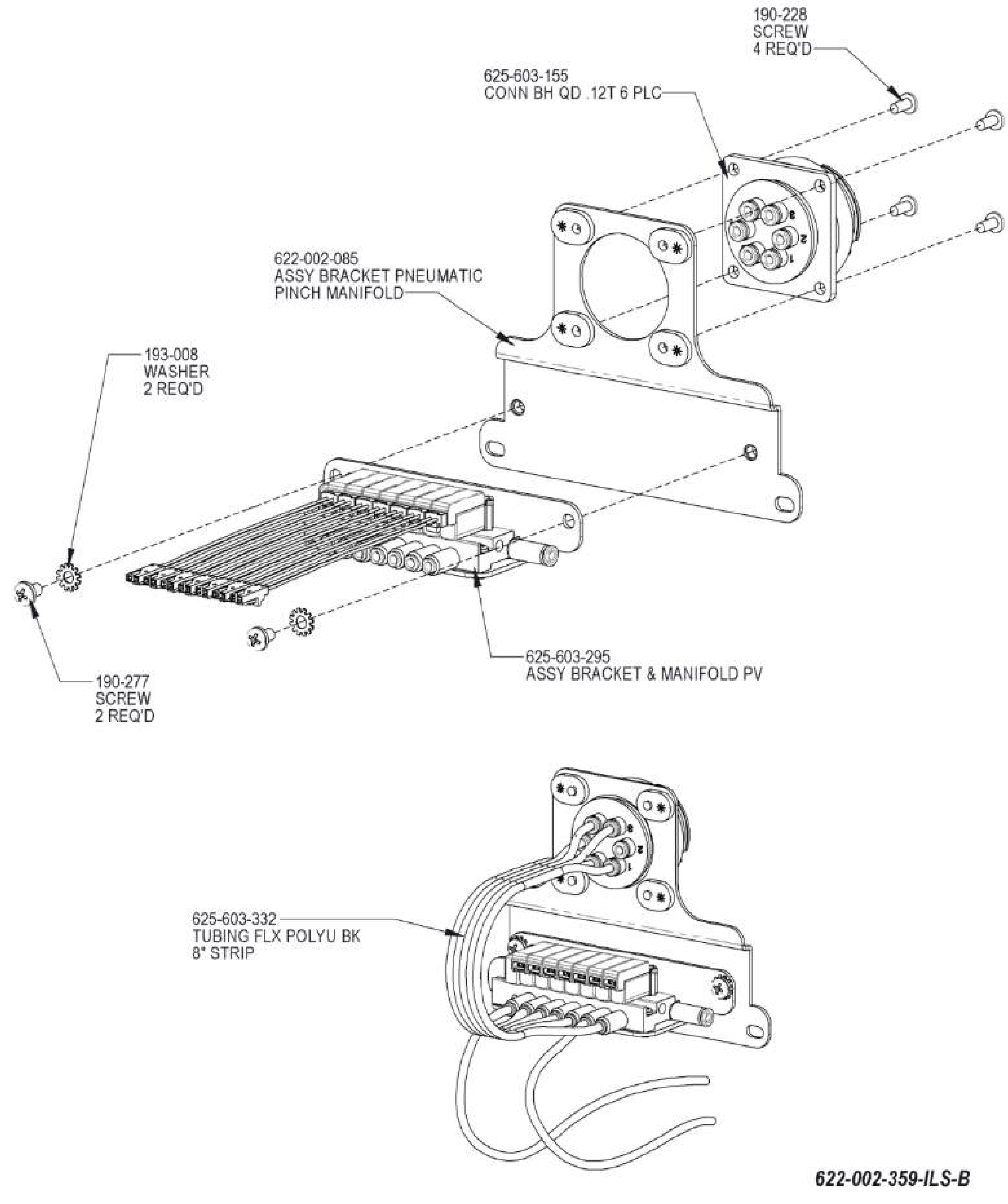


Figure 10-43
Pneumatic and Controller Manifold Assembly
(CN828, FP828, and FP828P models only)

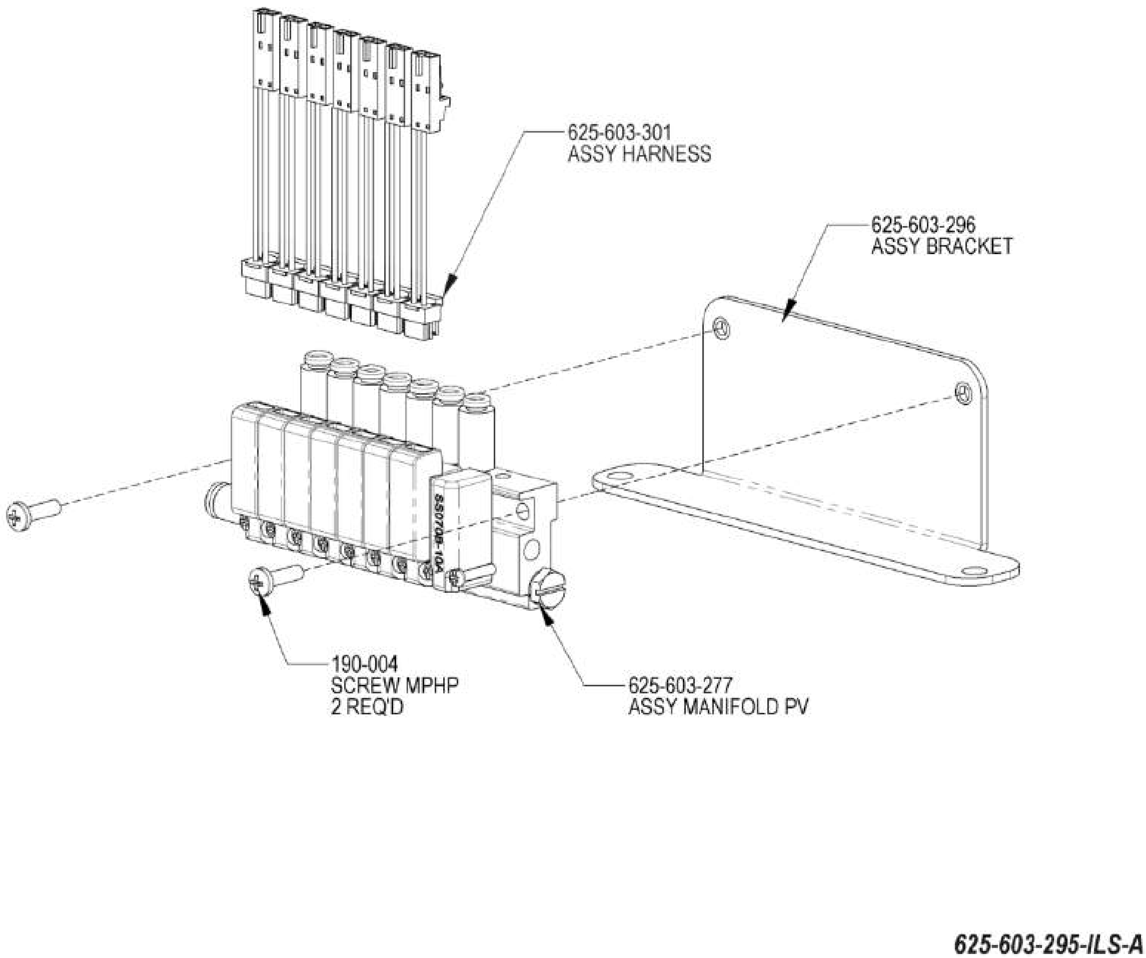


Figure 10-44
Manifold and Bracket Assembly

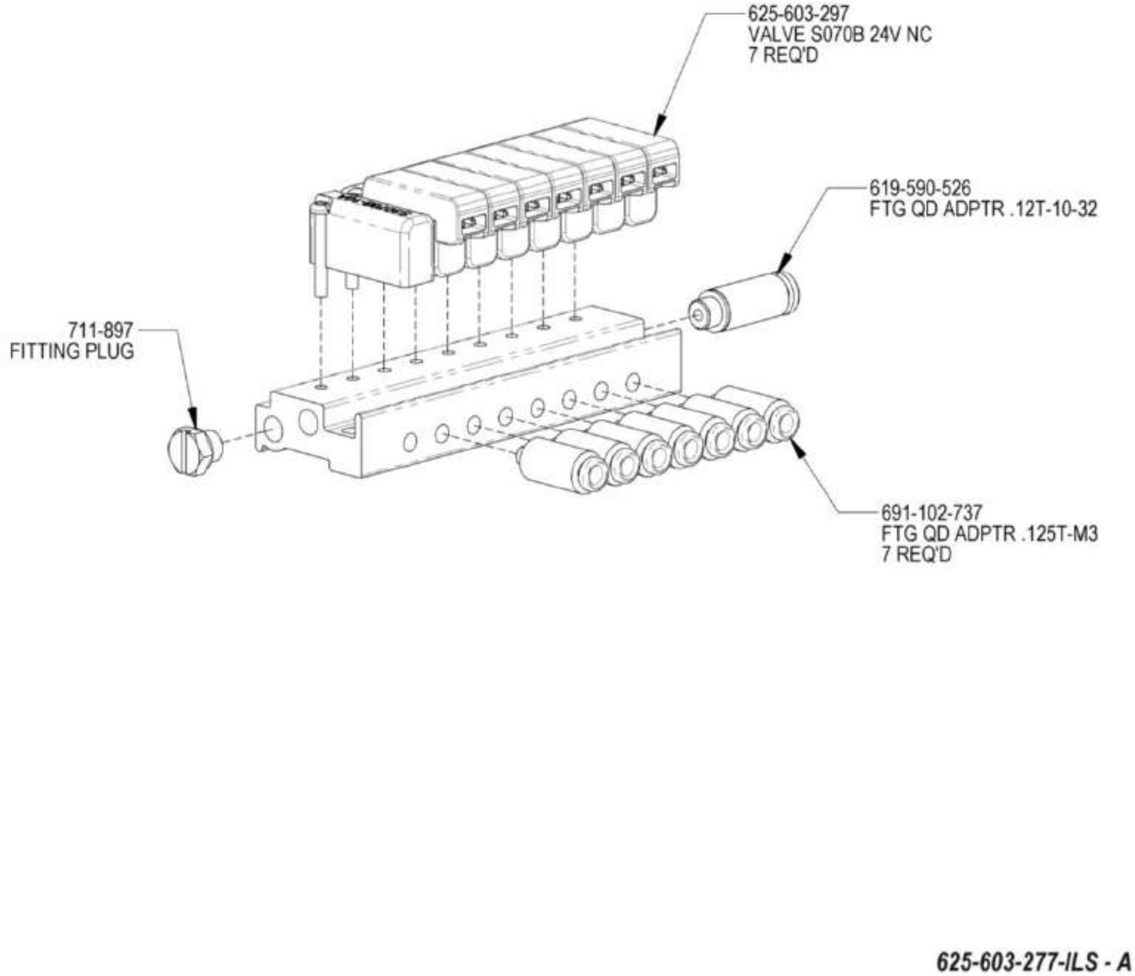


Figure 10-45
Pinch Valve Manifold Assembly

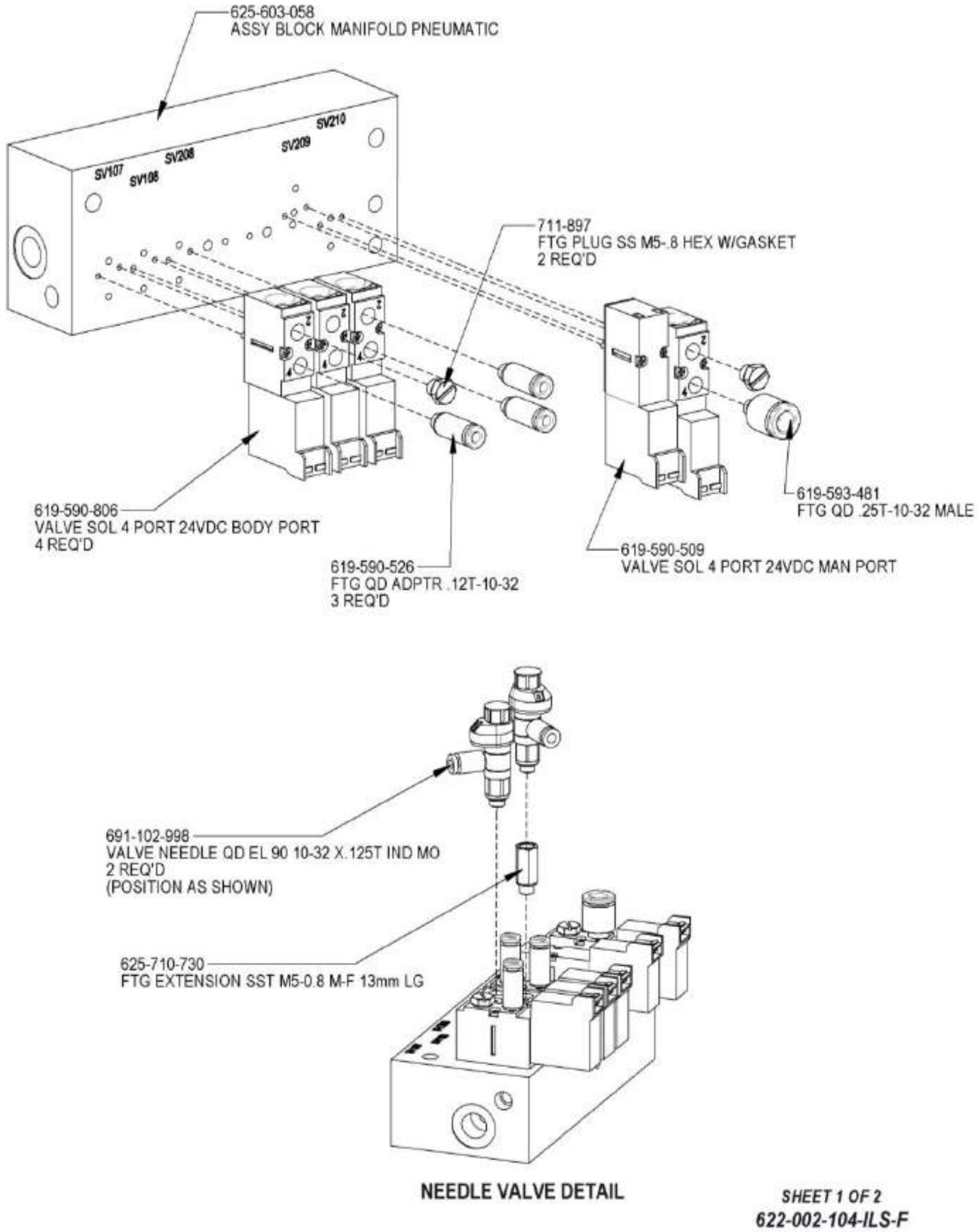


Figure 10-46
Pneumatic Manifold Assembly 1 of 2

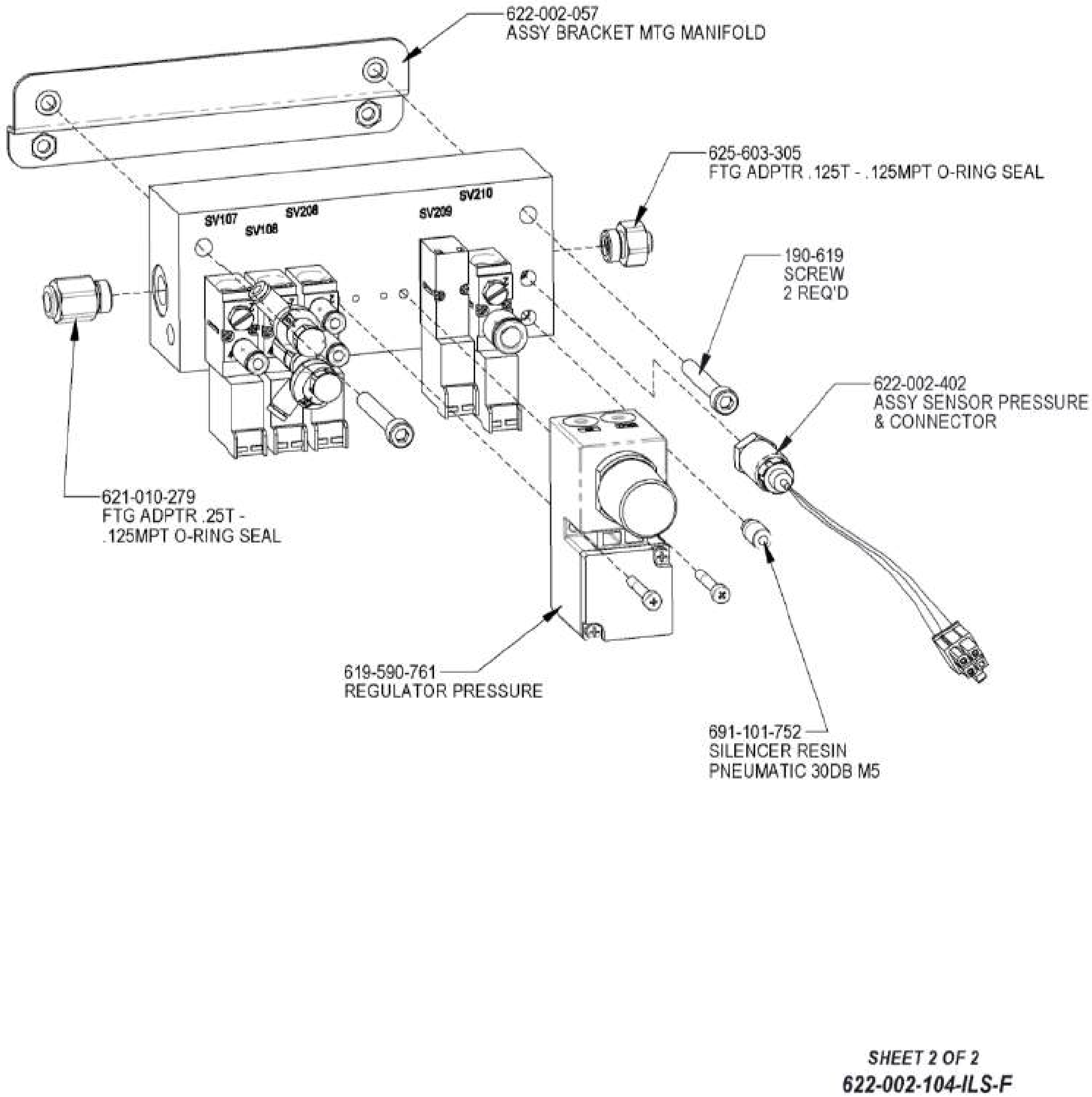


Figure 10-47
Pneumatic Manifold Assembly 2 of 2

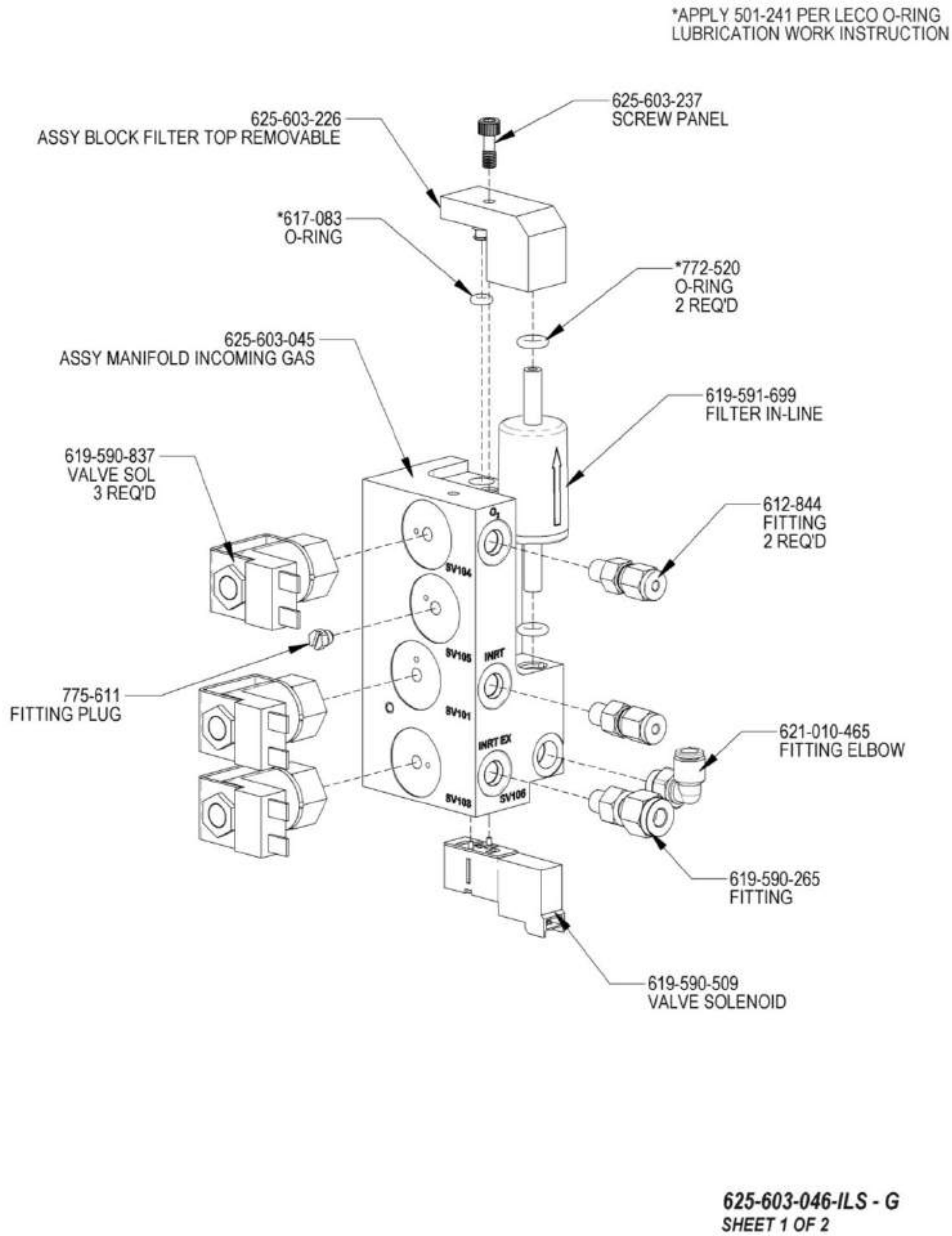
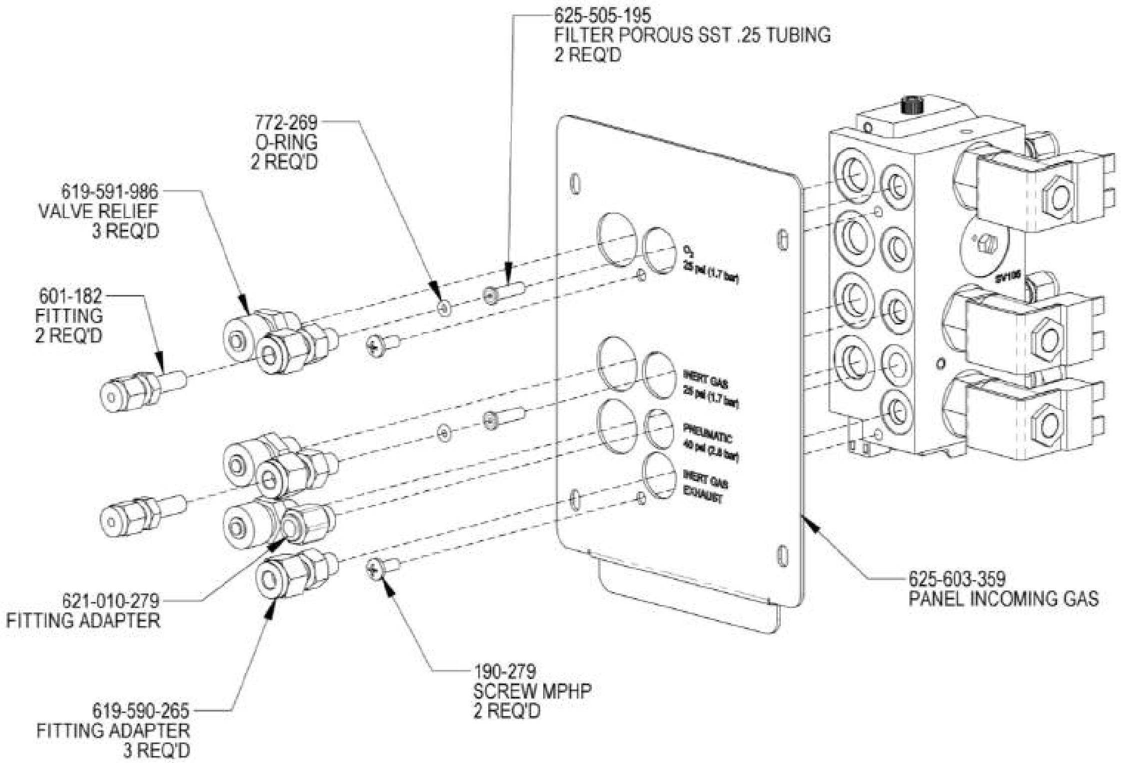


Figure 10-48
Incoming Gas Manifold Assembly 1 of 2



625-603-046-ILS - G
SHEET 2 OF 2

Figure 10-49
Incoming Gas Manifold Assembly 2 of 2

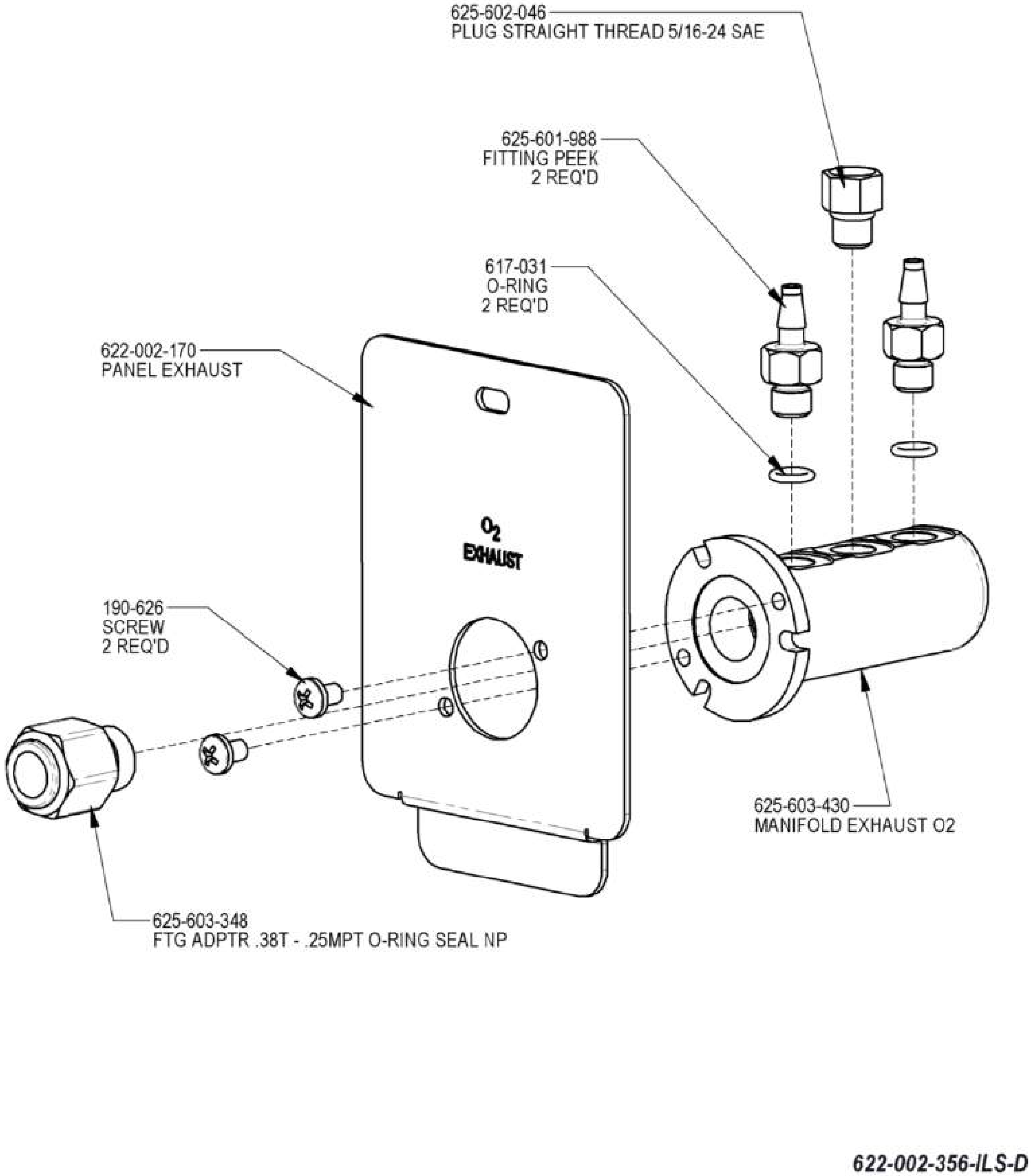


Figure 10-50
O_2 Exhaust Manifold Assembly
(CN828, FP828, and FP828P models only)

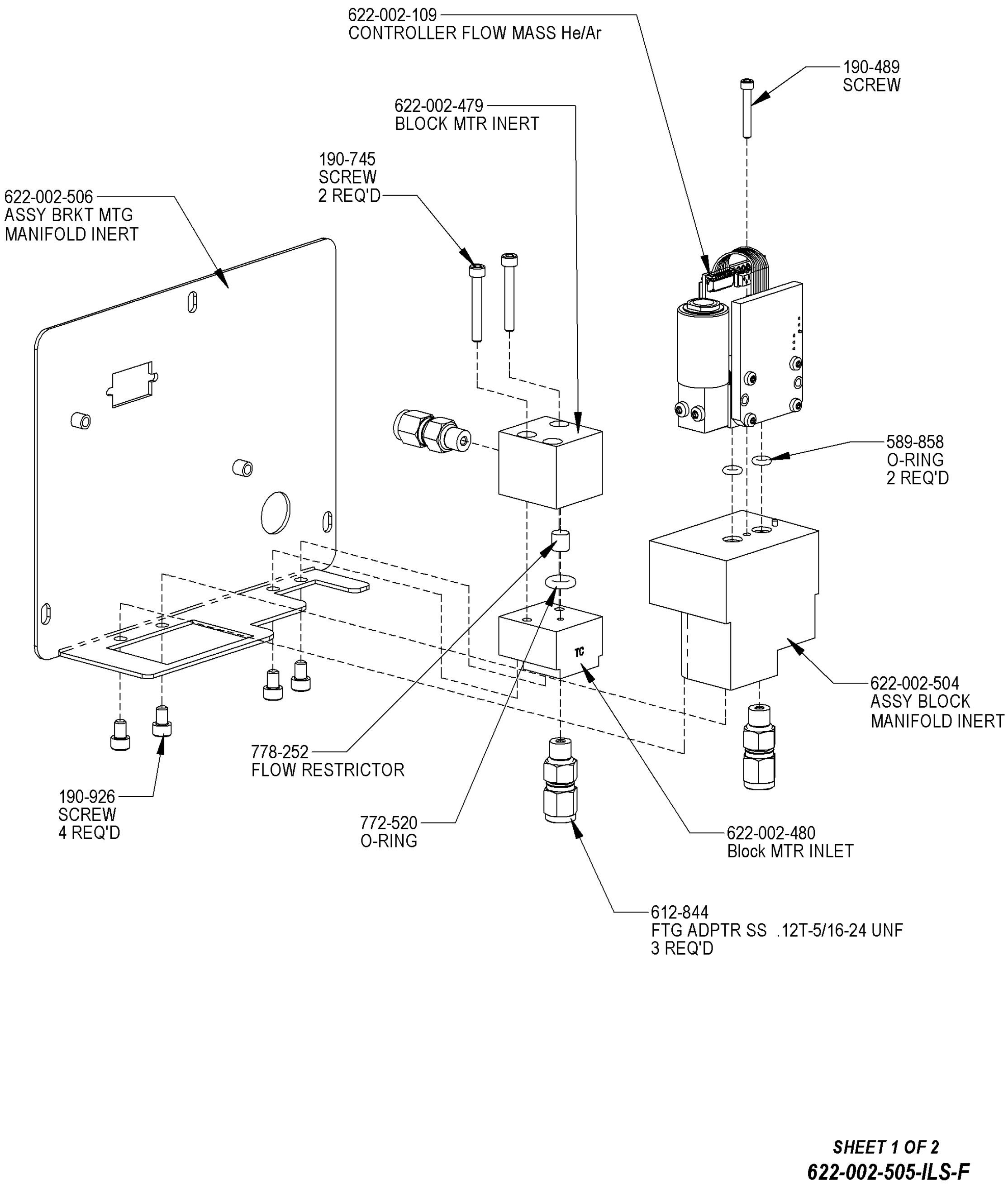


Figure 10-51
Inert Manifold Assembly 1 of 2

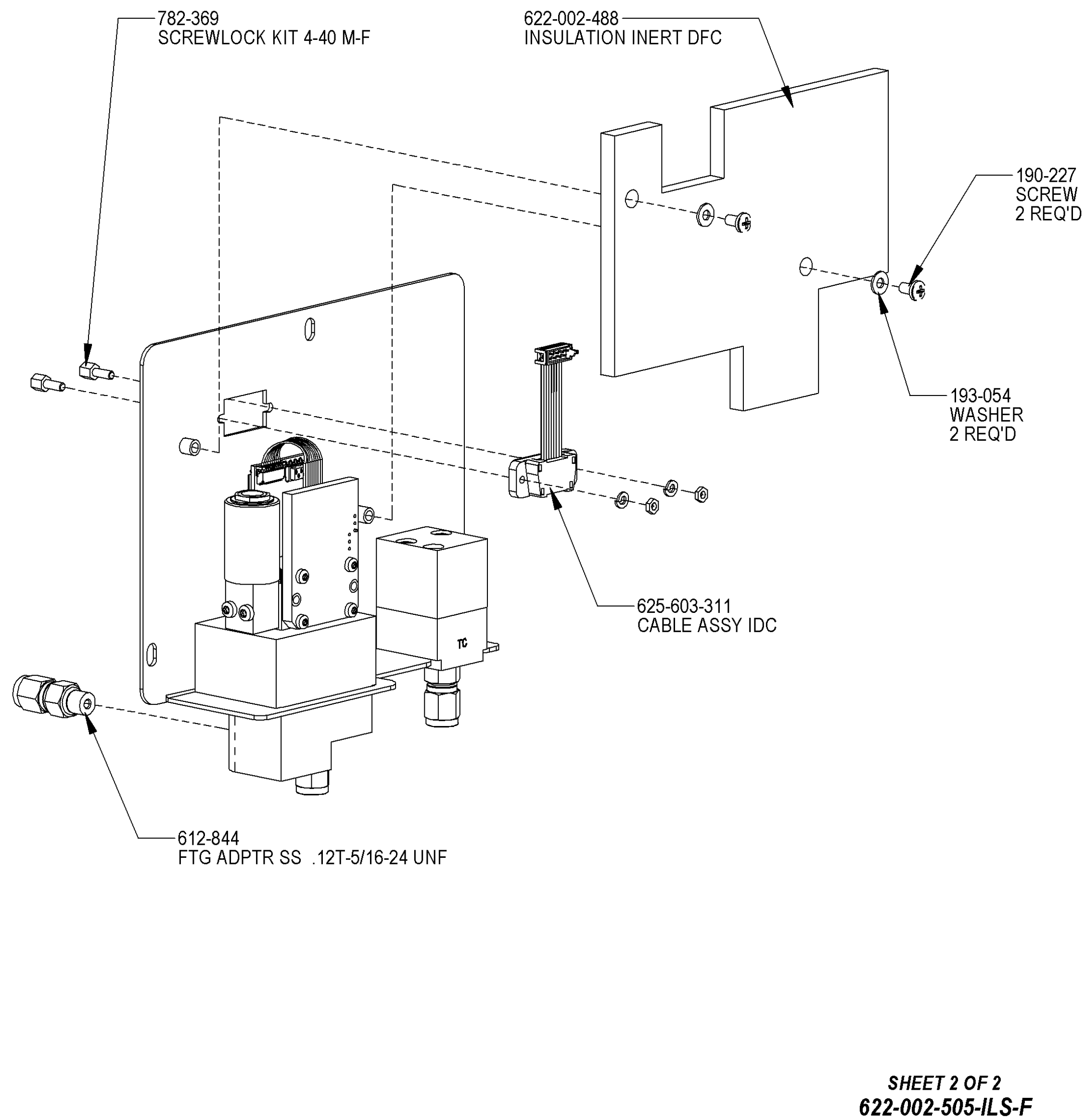


Figure 10-52
Inert Manifold Assembly 2 of 2

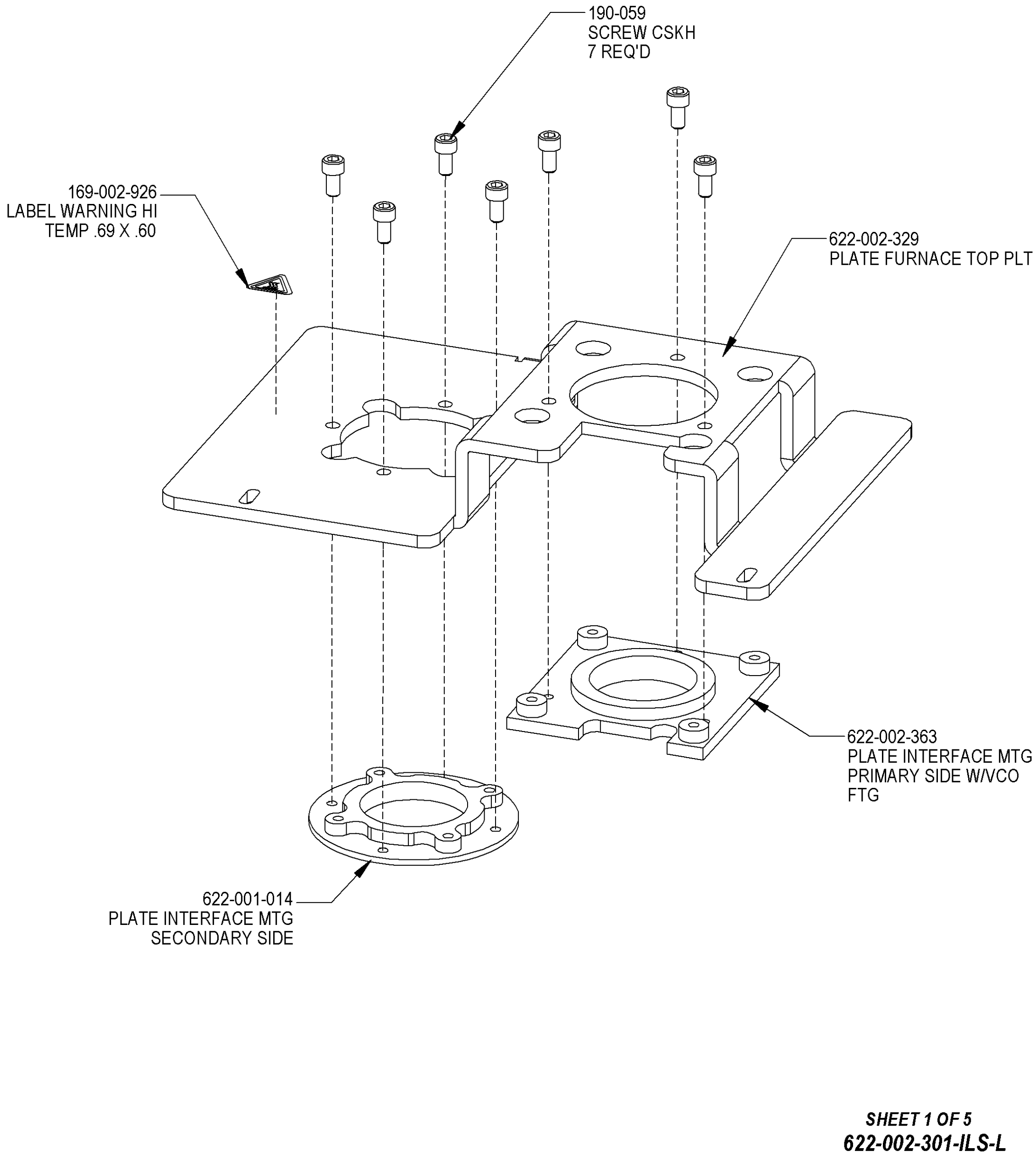


Figure 10-53
Dual Furnace Assembly 1 of 5

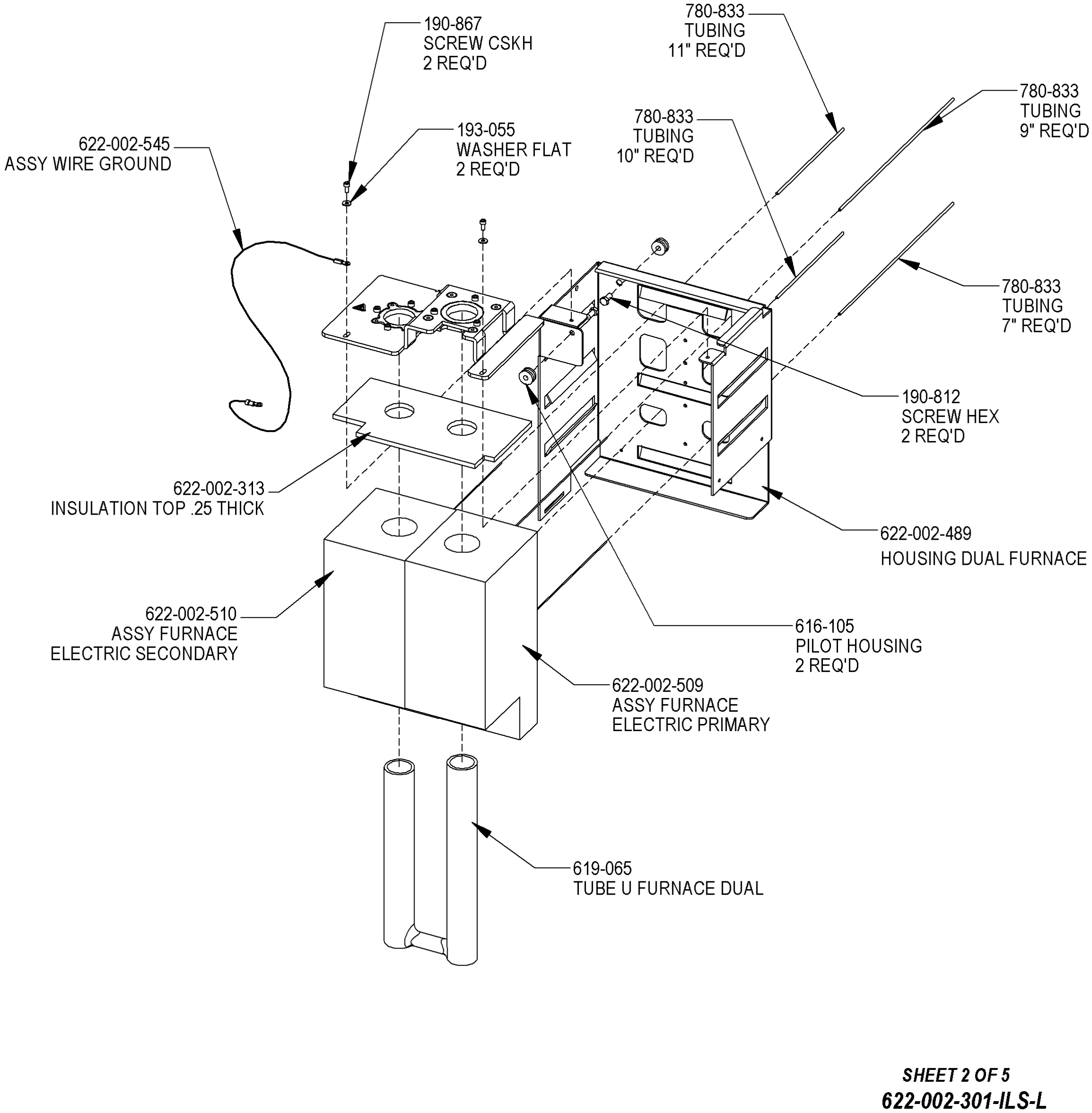


Figure 10-54
Dual Furnace Assembly 2 of 5

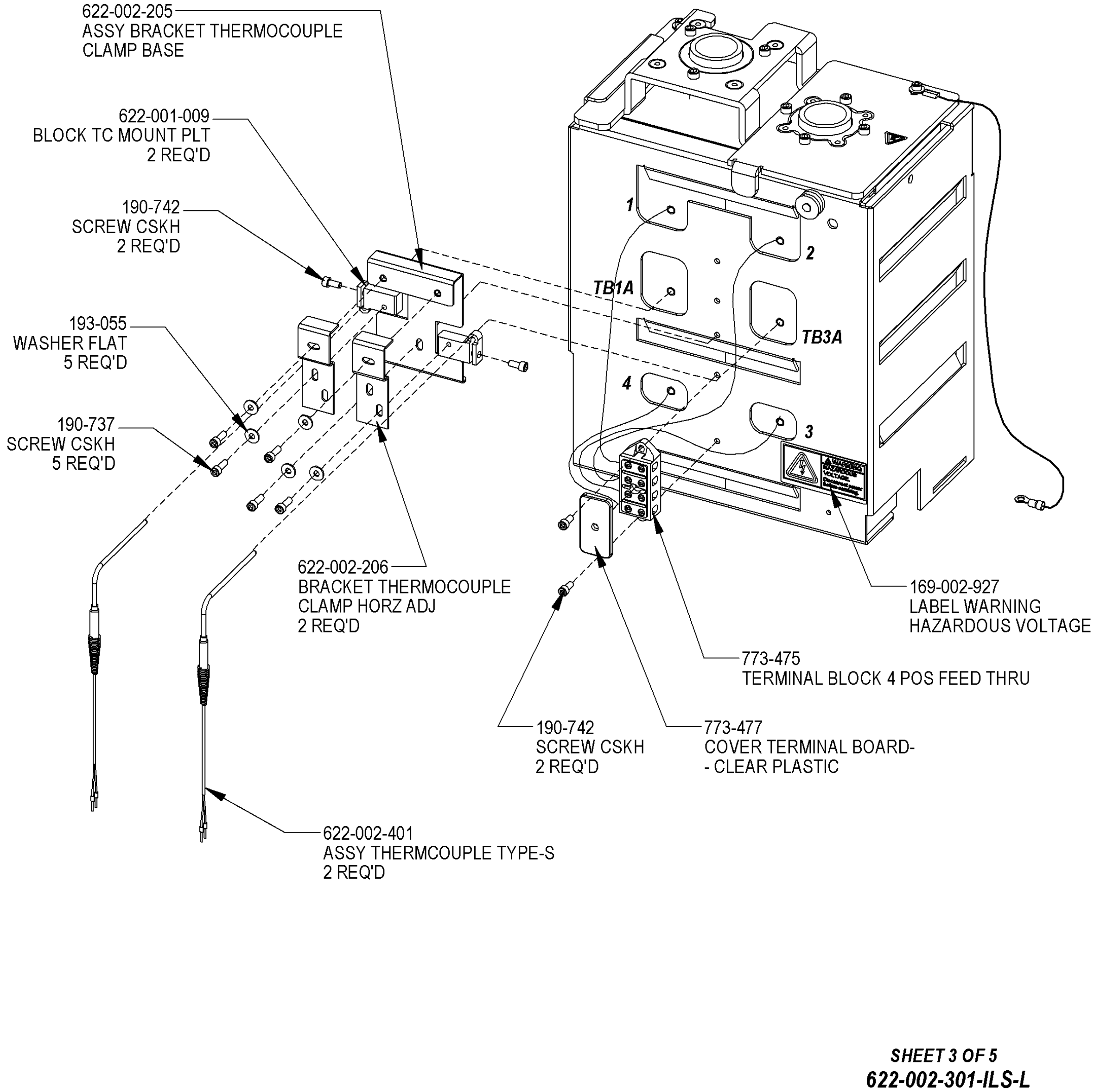


Figure 10-55
Dual Furnace Assembly 3 of 5

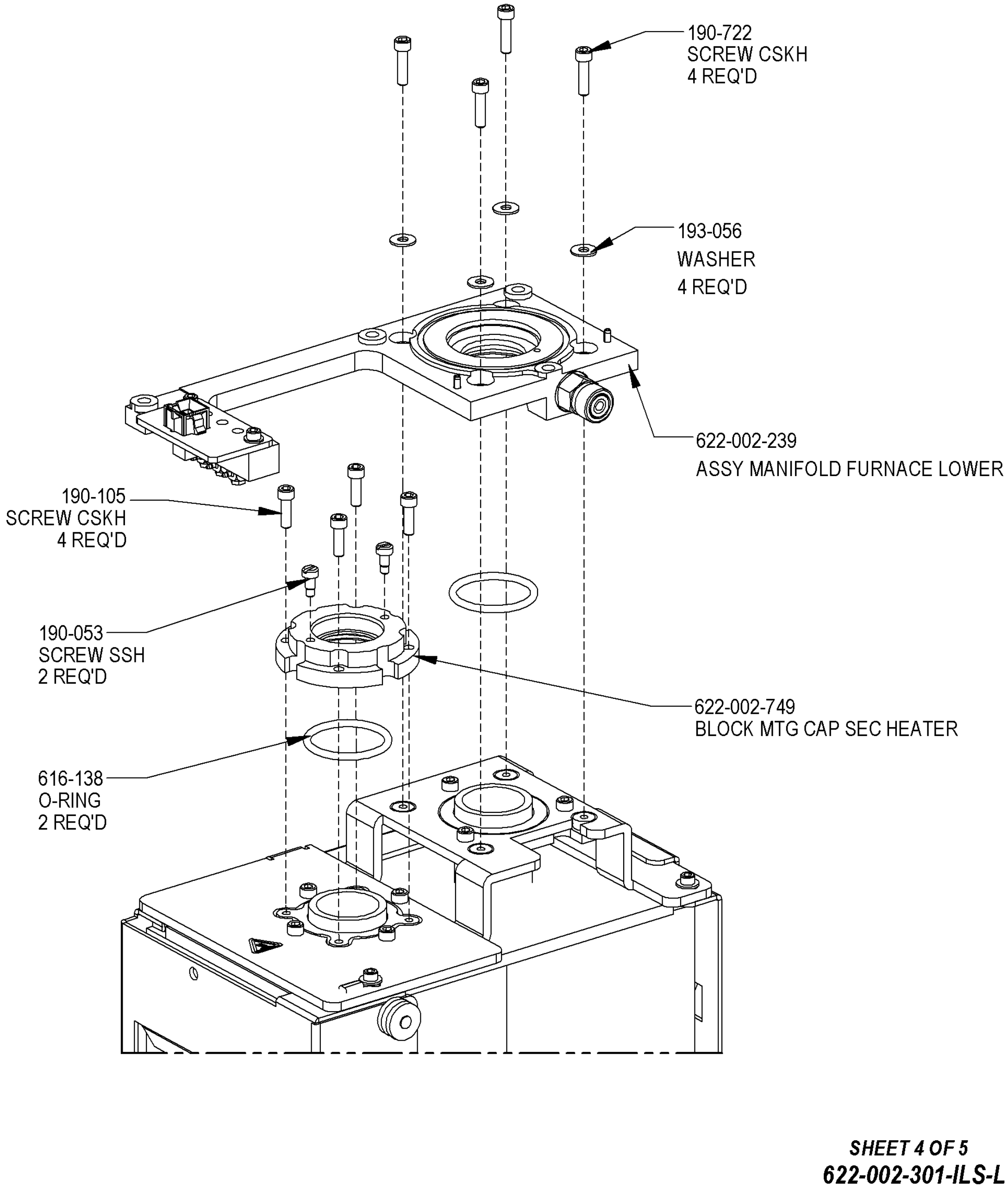


Figure 10-56
Dual Furnace Assembly 4 of 5

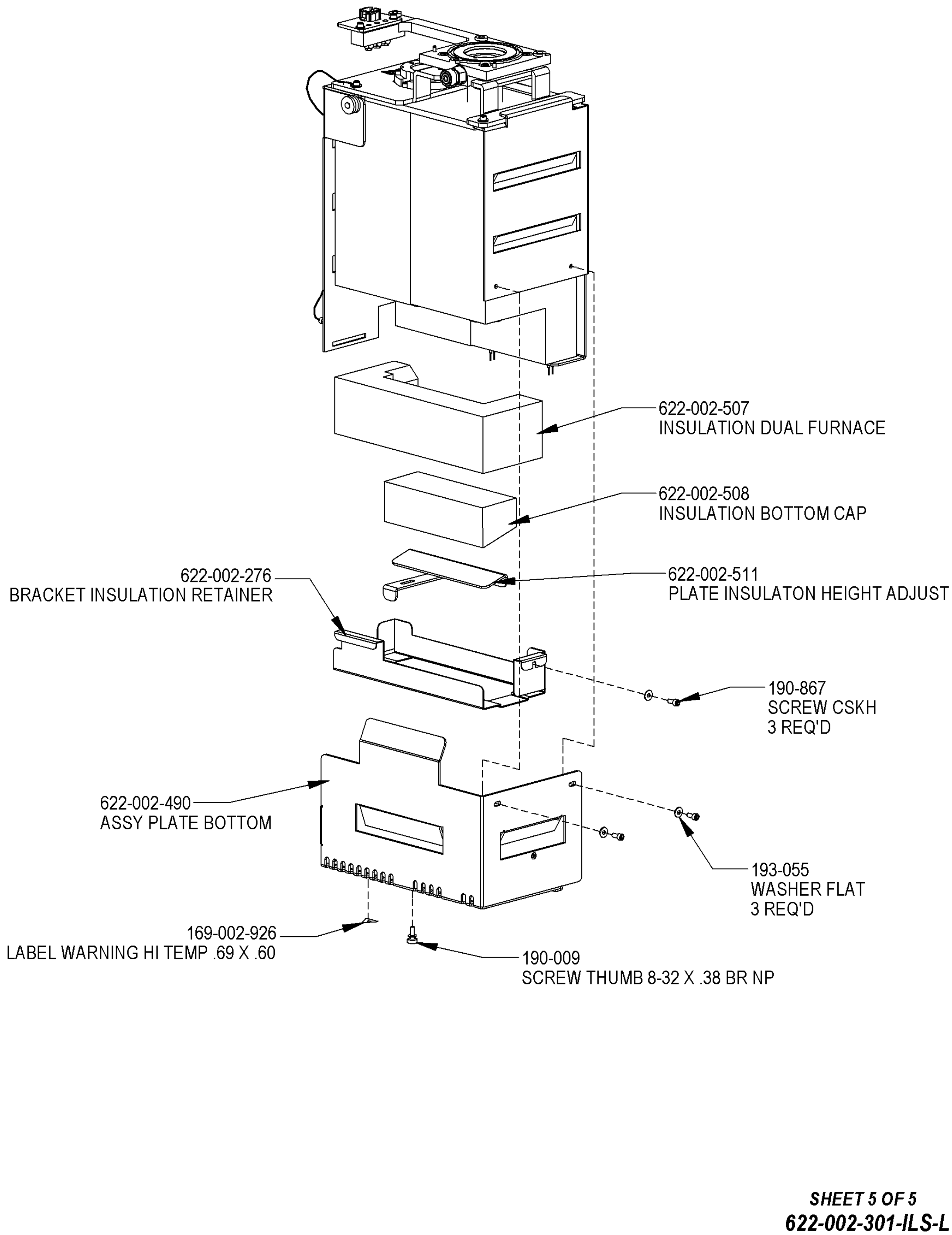


Figure 10-57
Dual Furnace Assembly 5 of 5

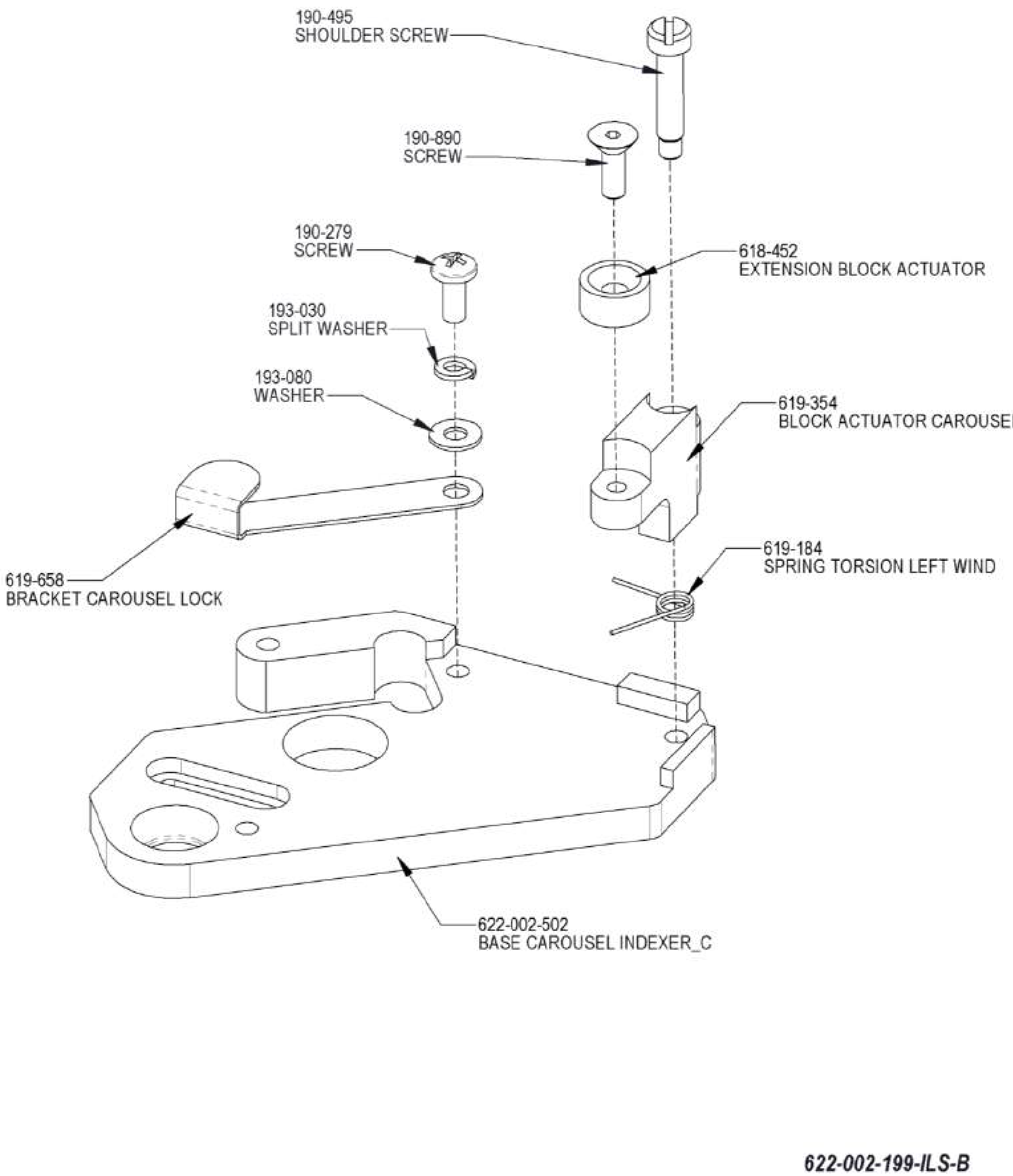


Figure 10-58
Slide Block Adapter Assembly

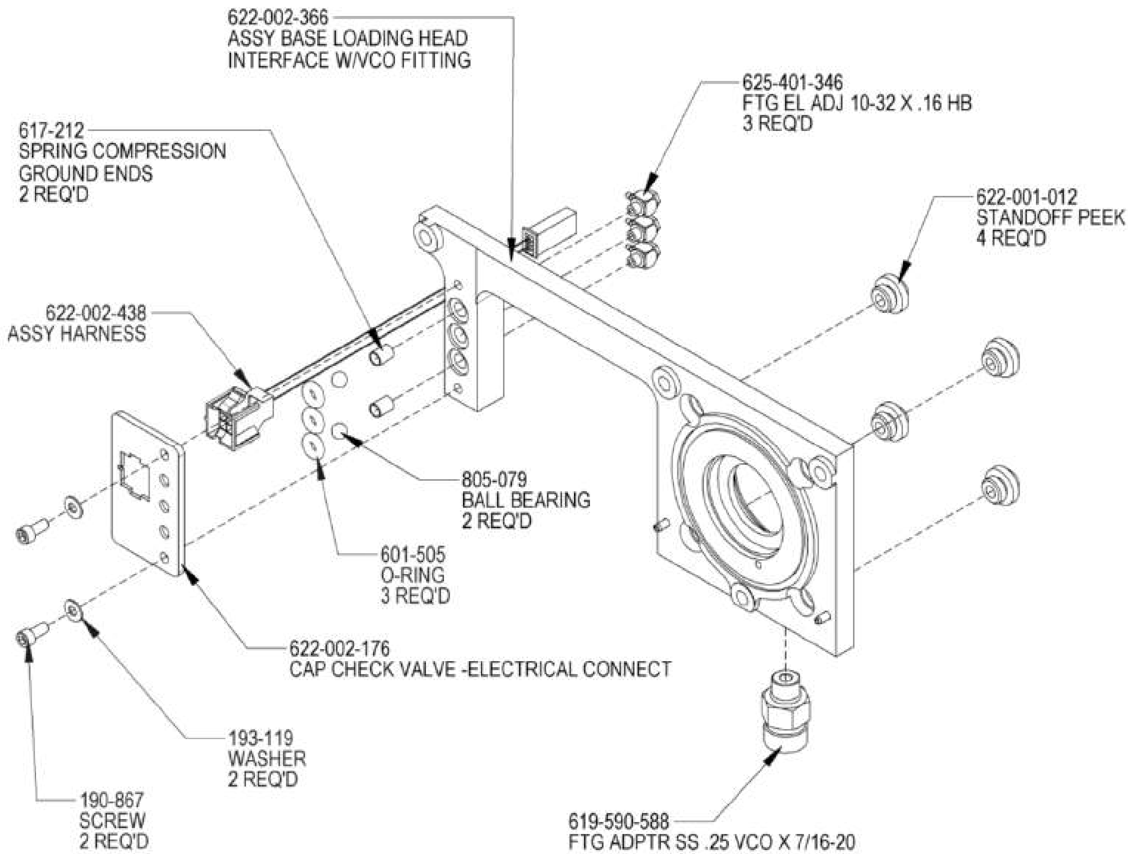


Figure 10-59
Lower Furnace Manifold Assembly

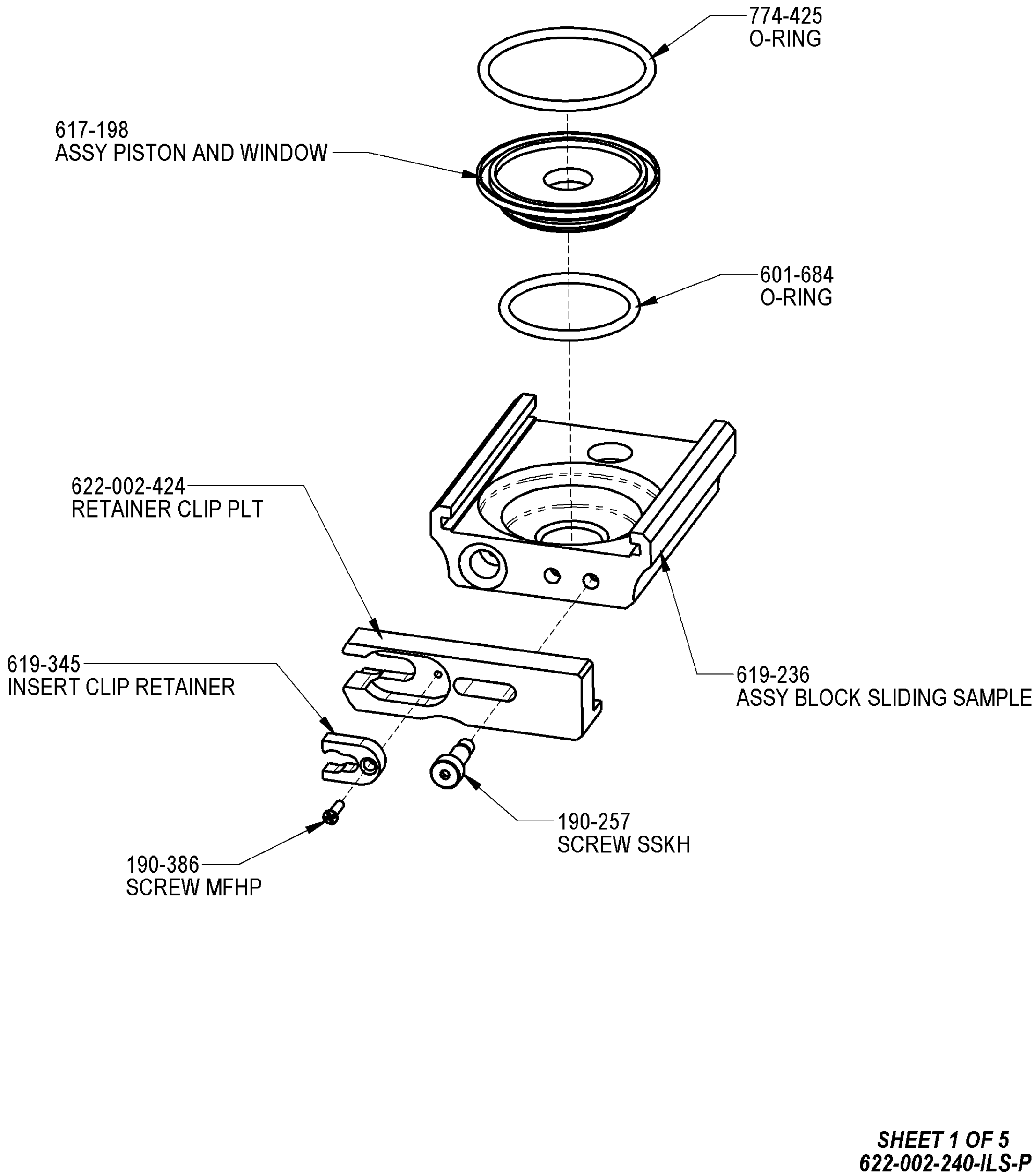


Figure 10-60
Loadhead Furnace Assembly 1 of 5

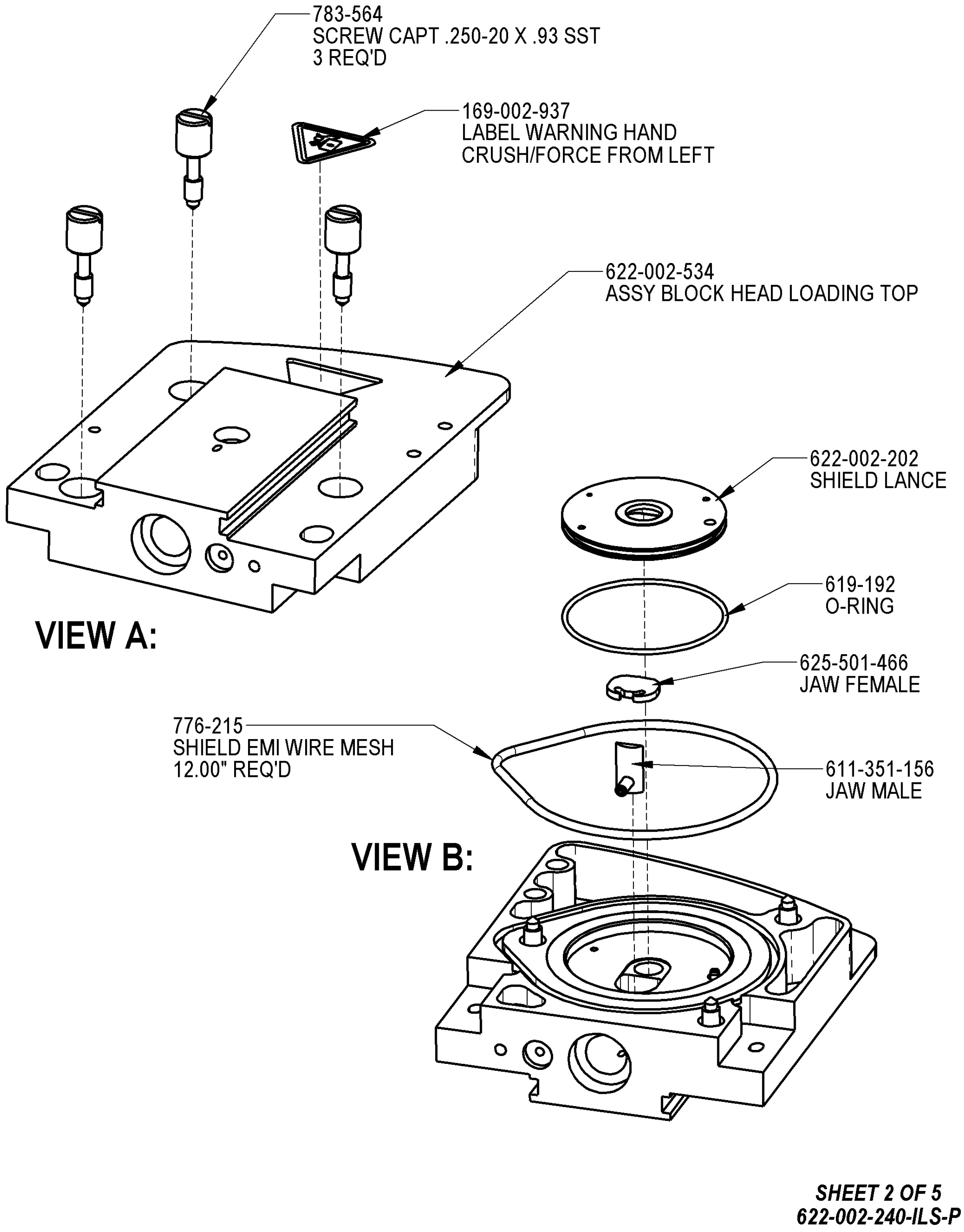


Figure 10-61
Loadhead Furnace Assembly 2 of 5

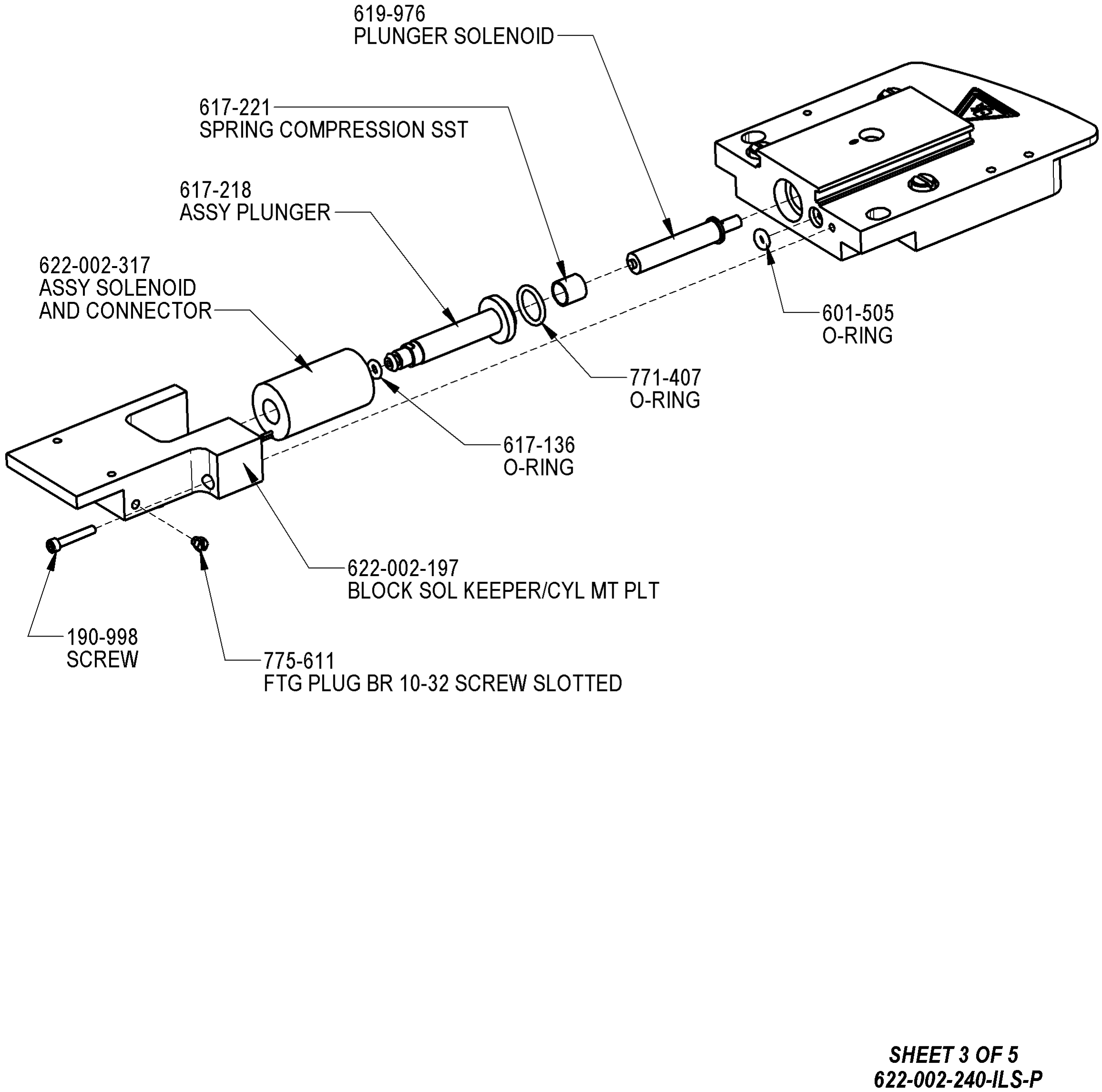


Figure 10-62
Loadhead Furnace Assembly 3 of 5

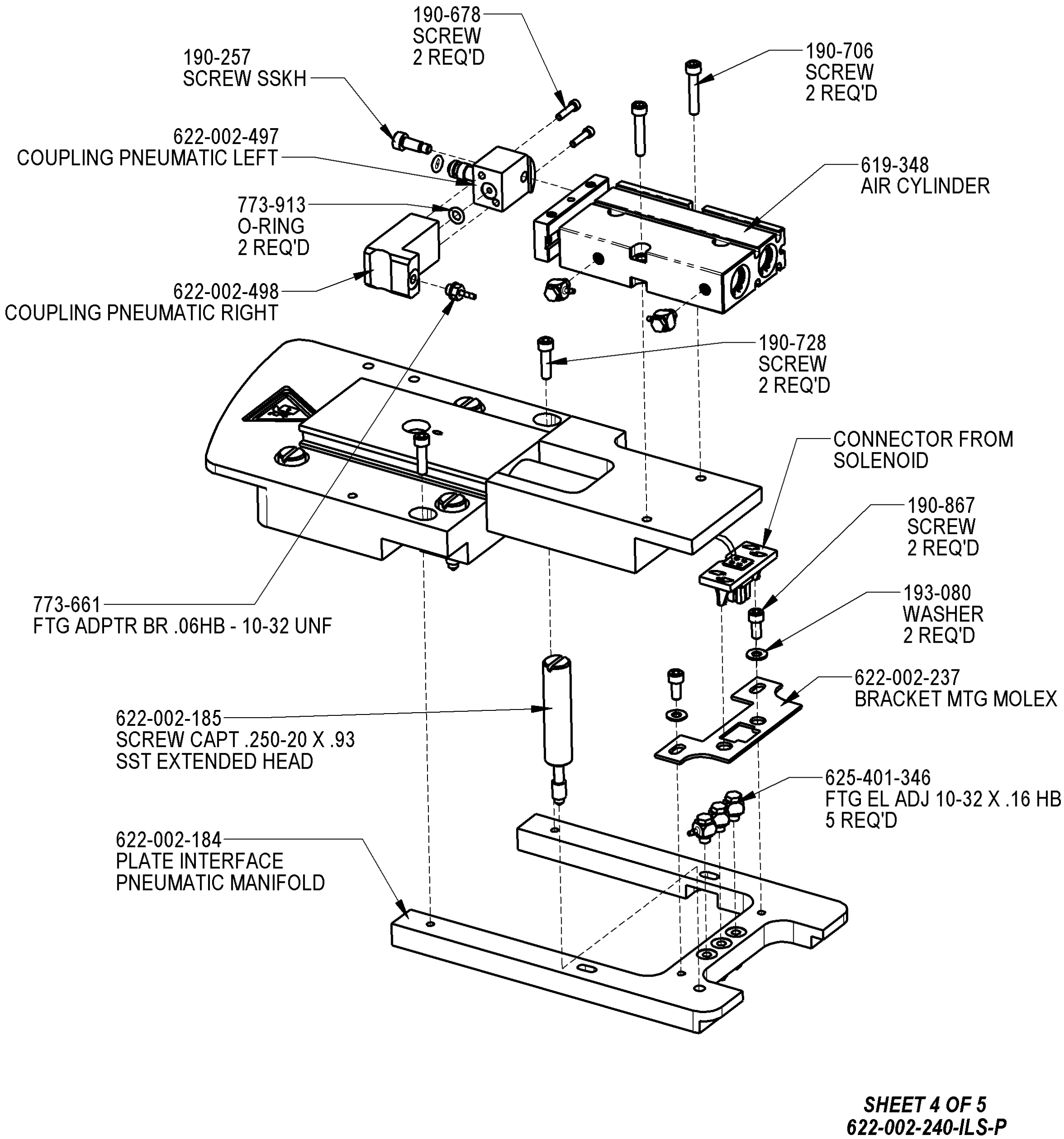


Figure 10-63
Loadhead Furnace Assembly 4 of 5

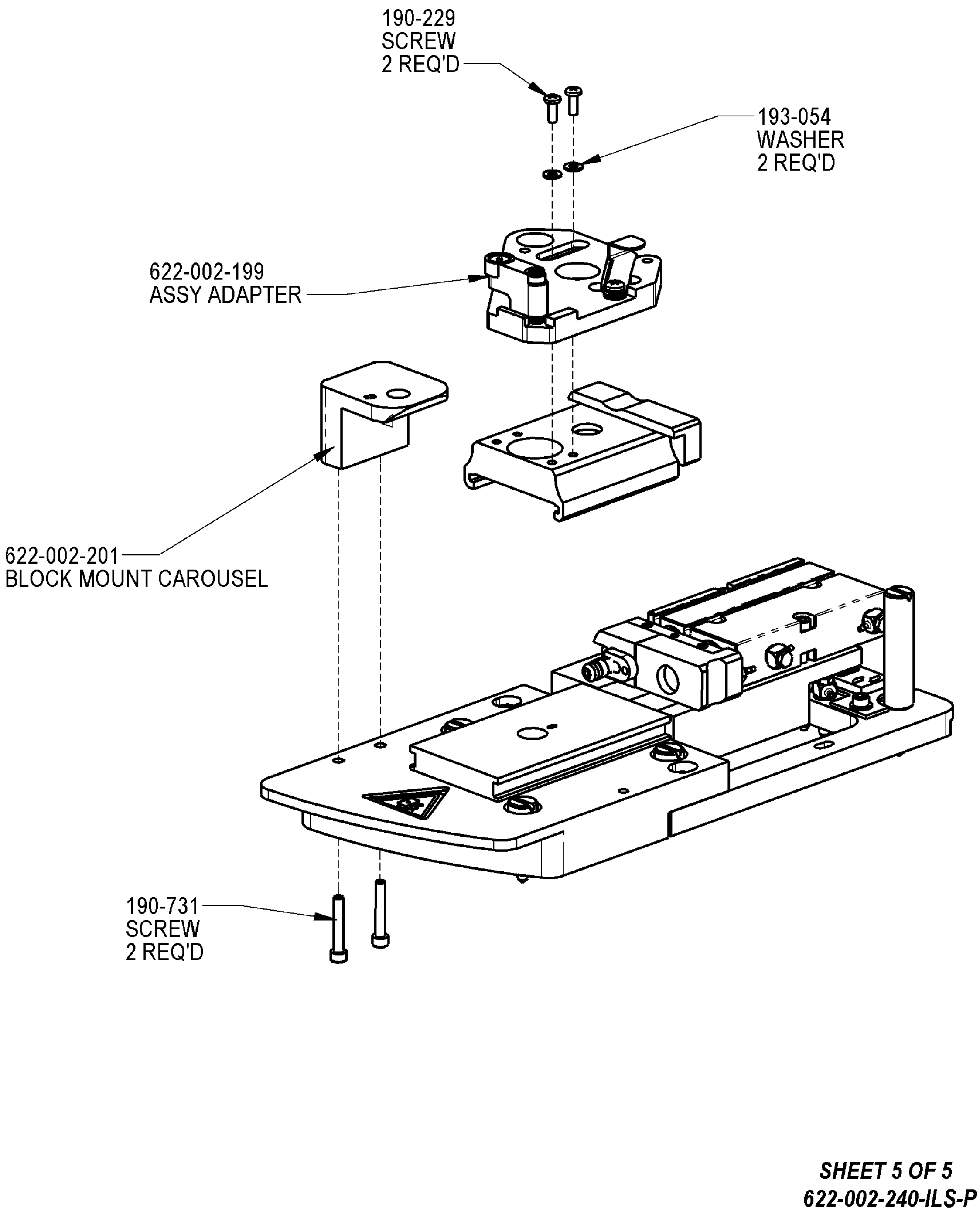


Figure 10-64
Loadhead Furnace Assembly 5 of 5

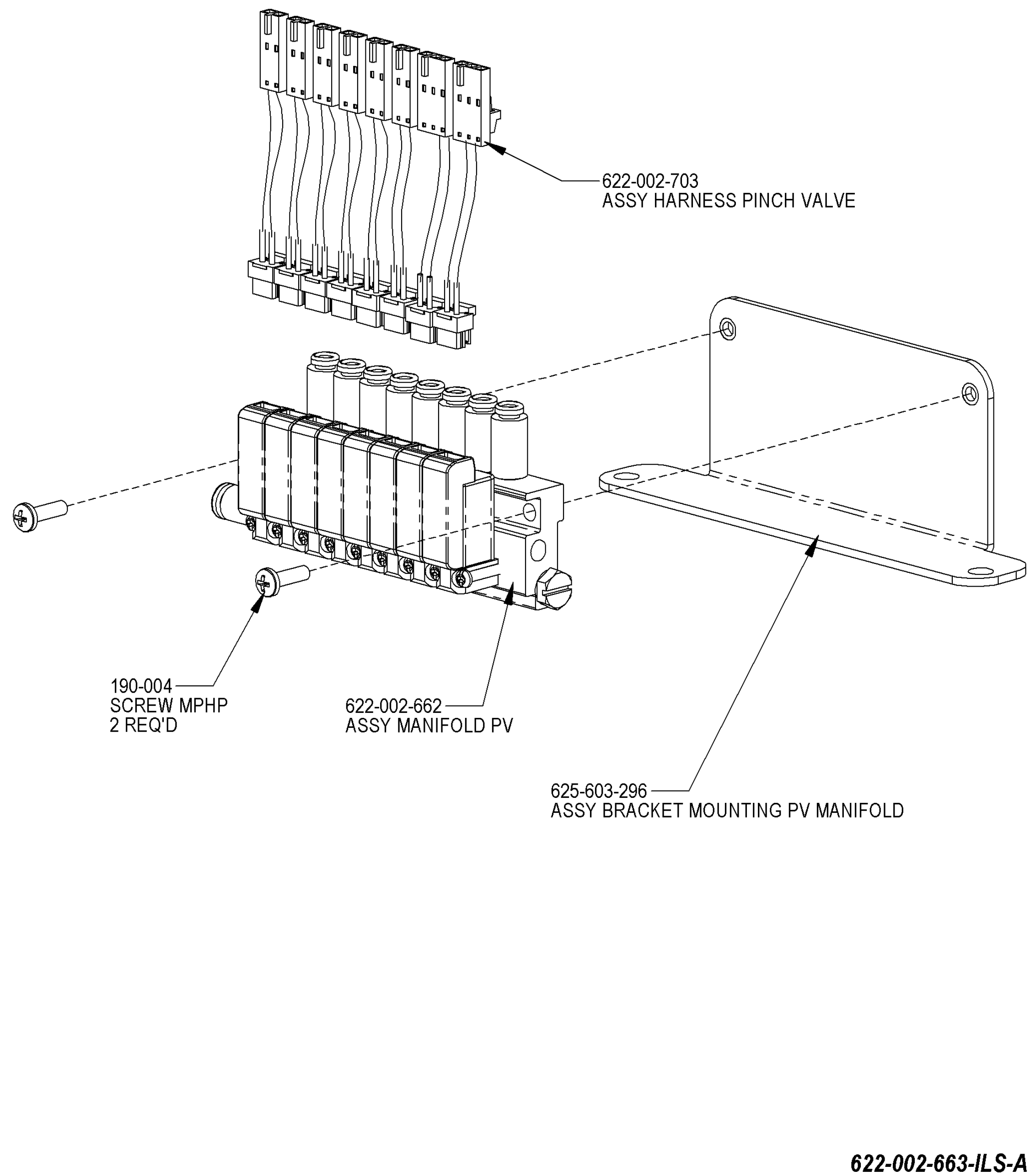


Figure 10-65
PV Manifold and Bracket
(CHN828 model only)

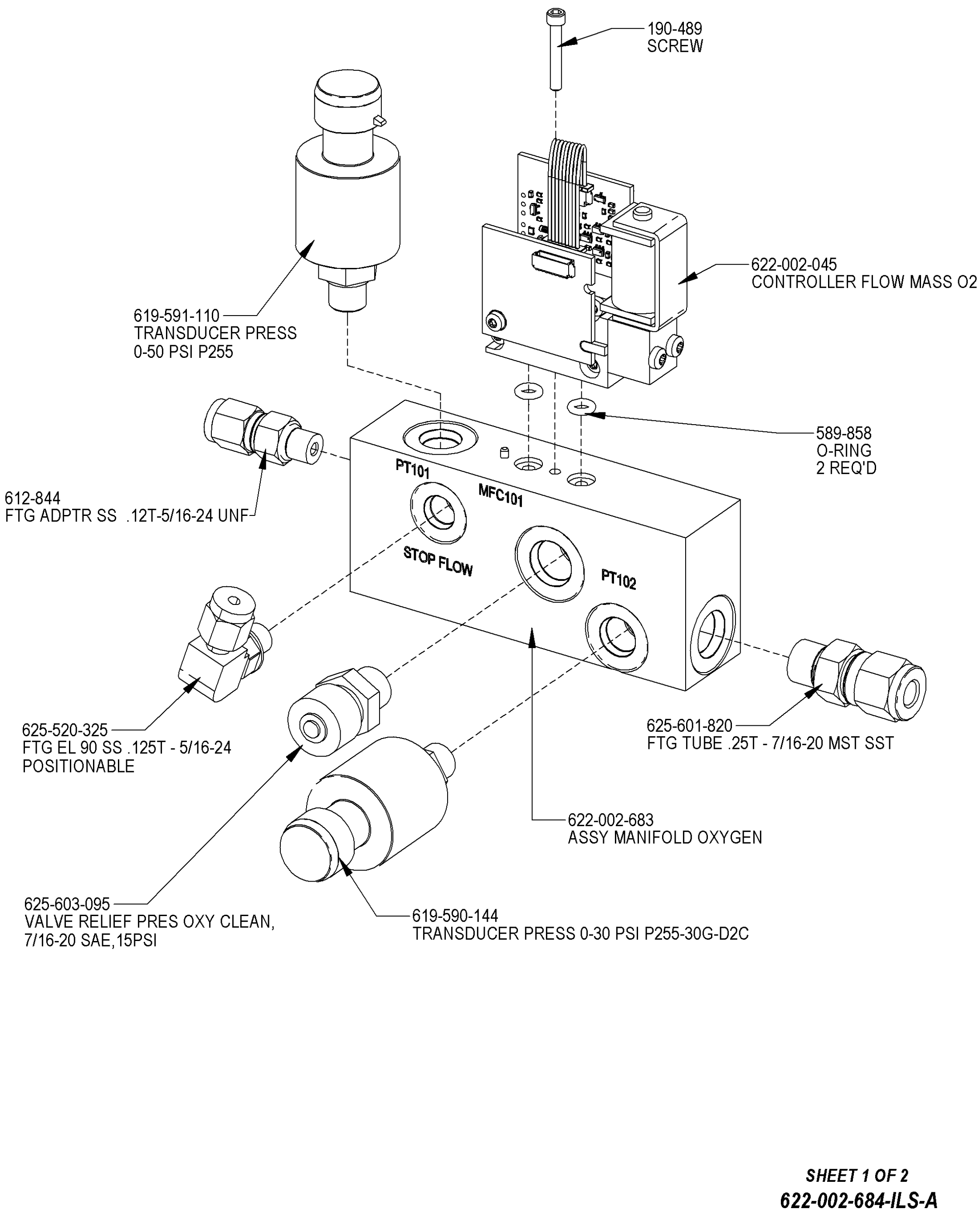


Figure 10-66
MFC Furnace Manifold Assembly 1 of 2
(CHN828 model only)

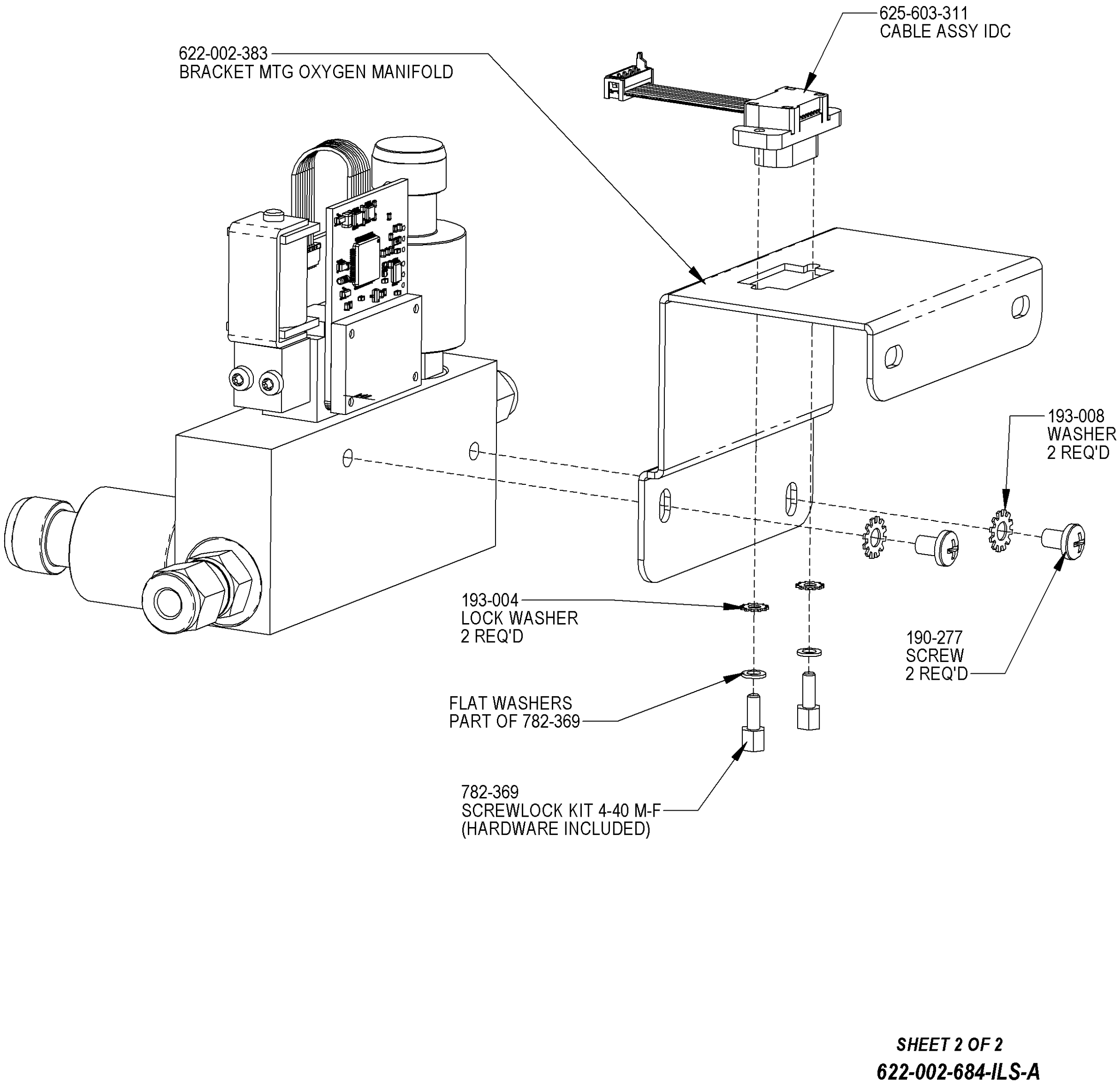


Figure 10-67
MFC Furnace Manifold Assembly 2 of 2
(CHN828 model only)

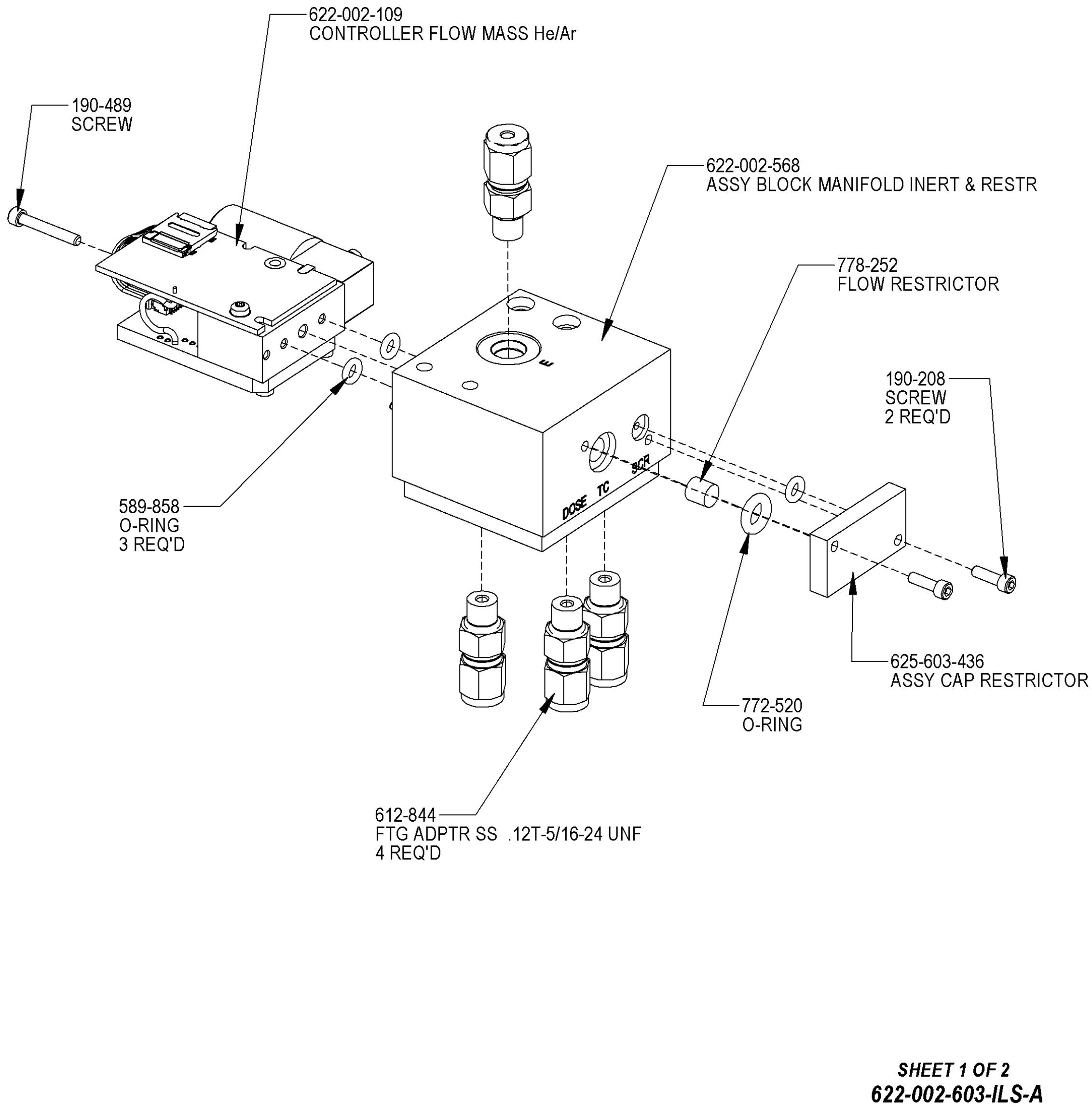
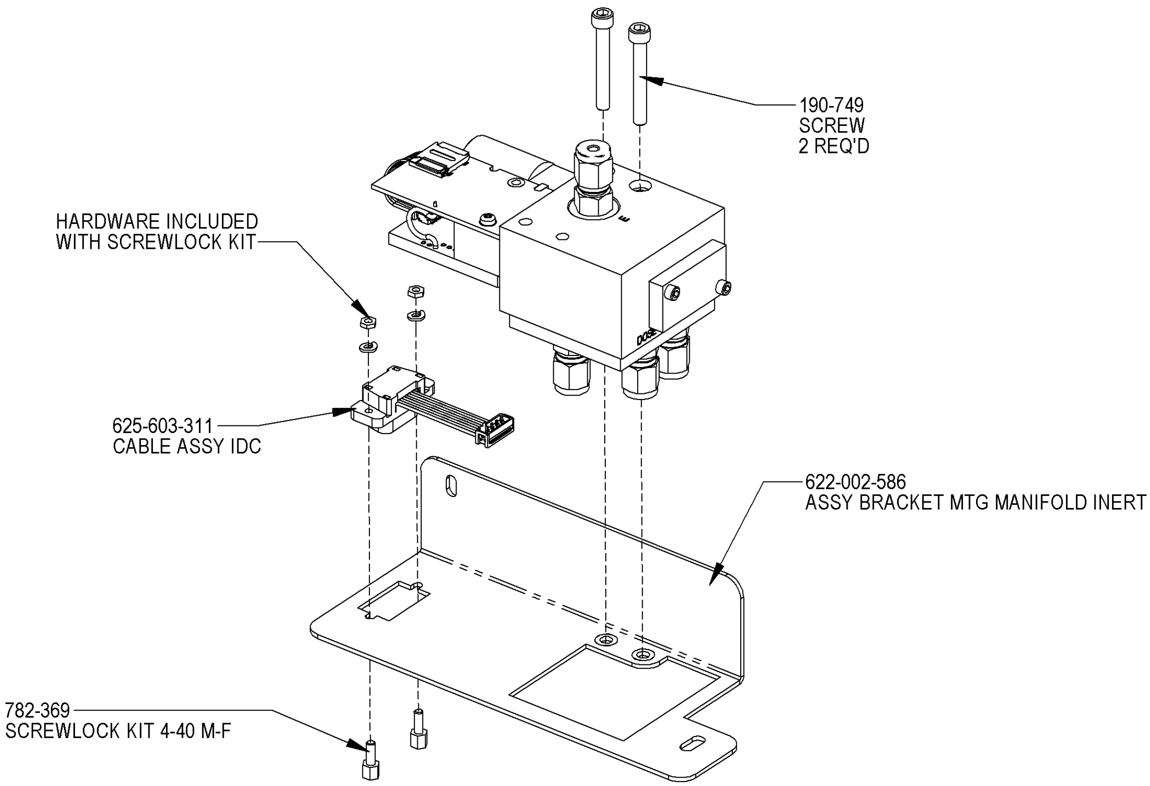


Figure 10-68
He MFC and Restrictor Assembly 1 of 2
(CHN828 model only)



SHEET 2 OF 2

622-002-603-ILS-A

Figure 10-69
He MFC and Restrictor Assembly 2 of 2
(CHN828 model only)

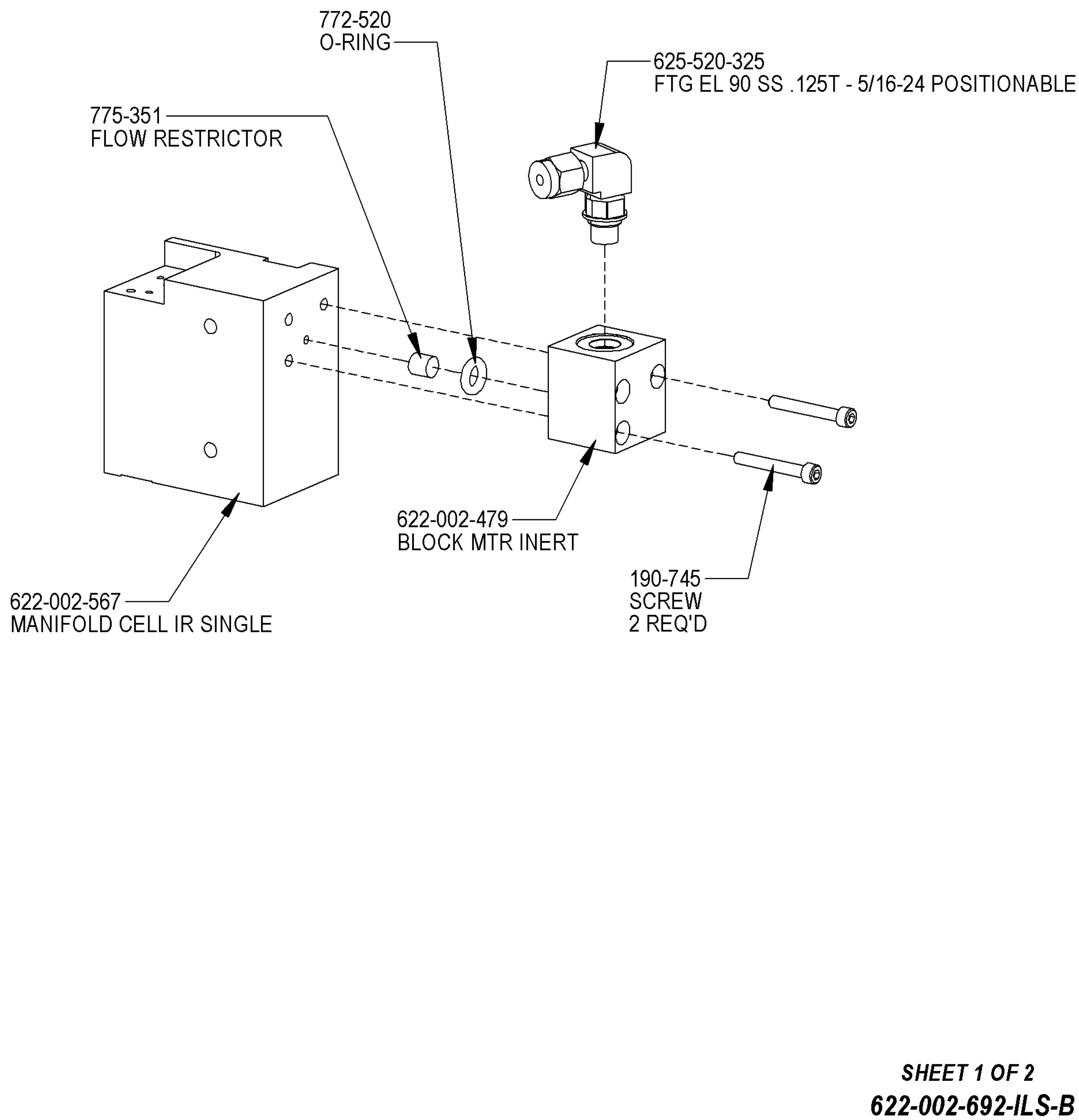


Figure 10-70
Single IR Cell Manifold Assembly 1 of 2
(CHN828 model only)

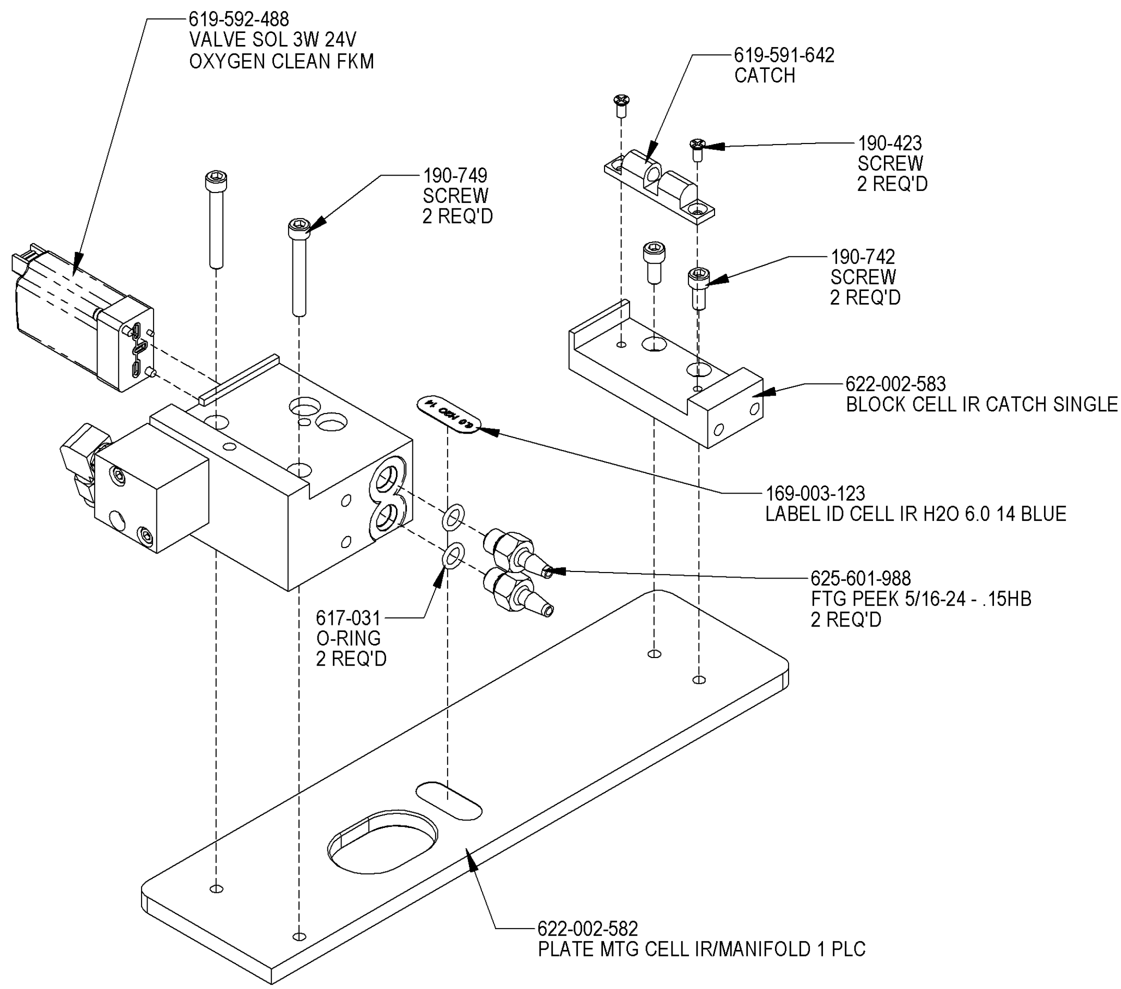


Figure 10-71
Single IR Cell Manifold Assembly 2 of 2
(CHN828 model only)

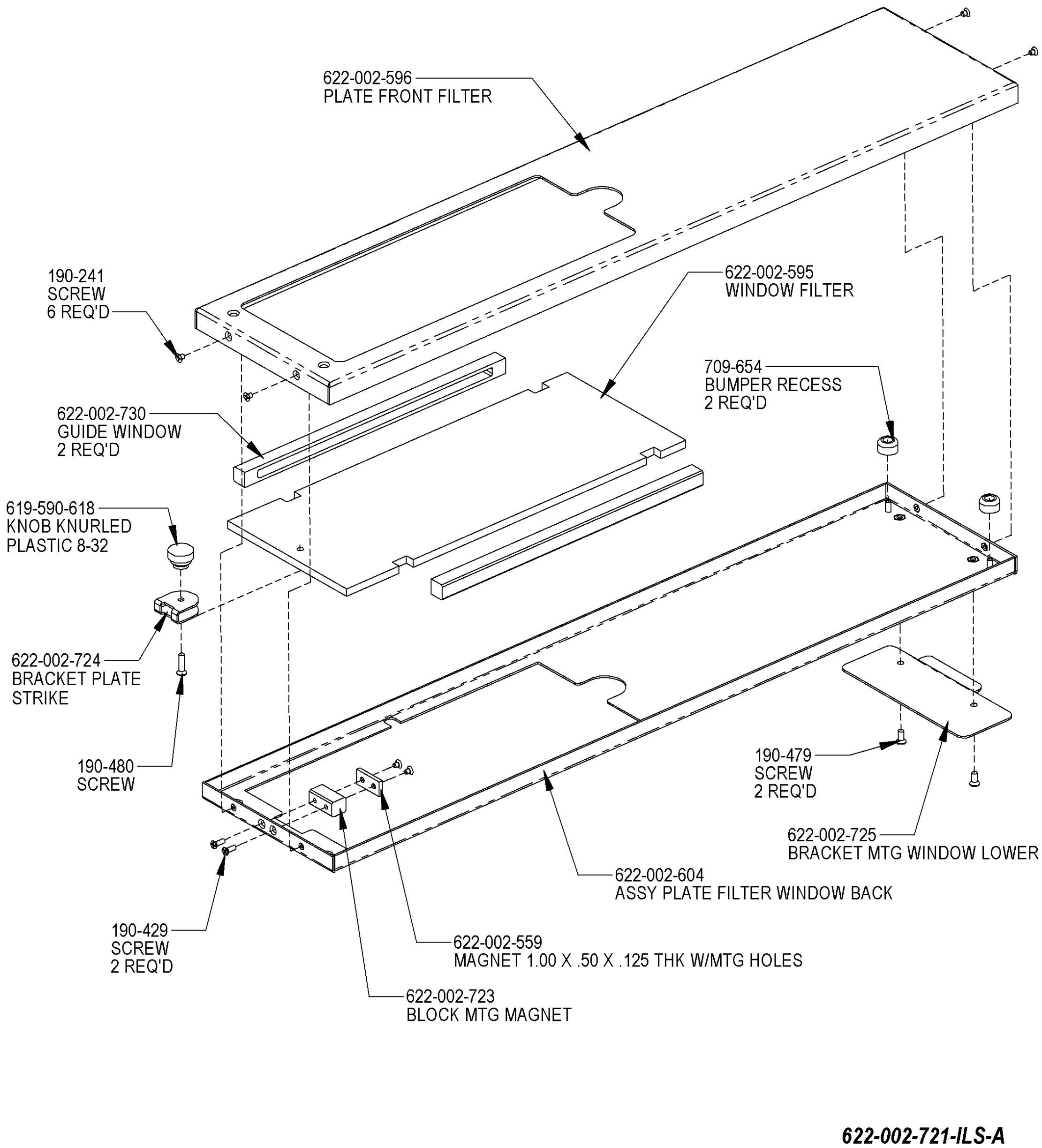


Figure 10-72
Sliding Window Door Assembly
(CHN828 model only)

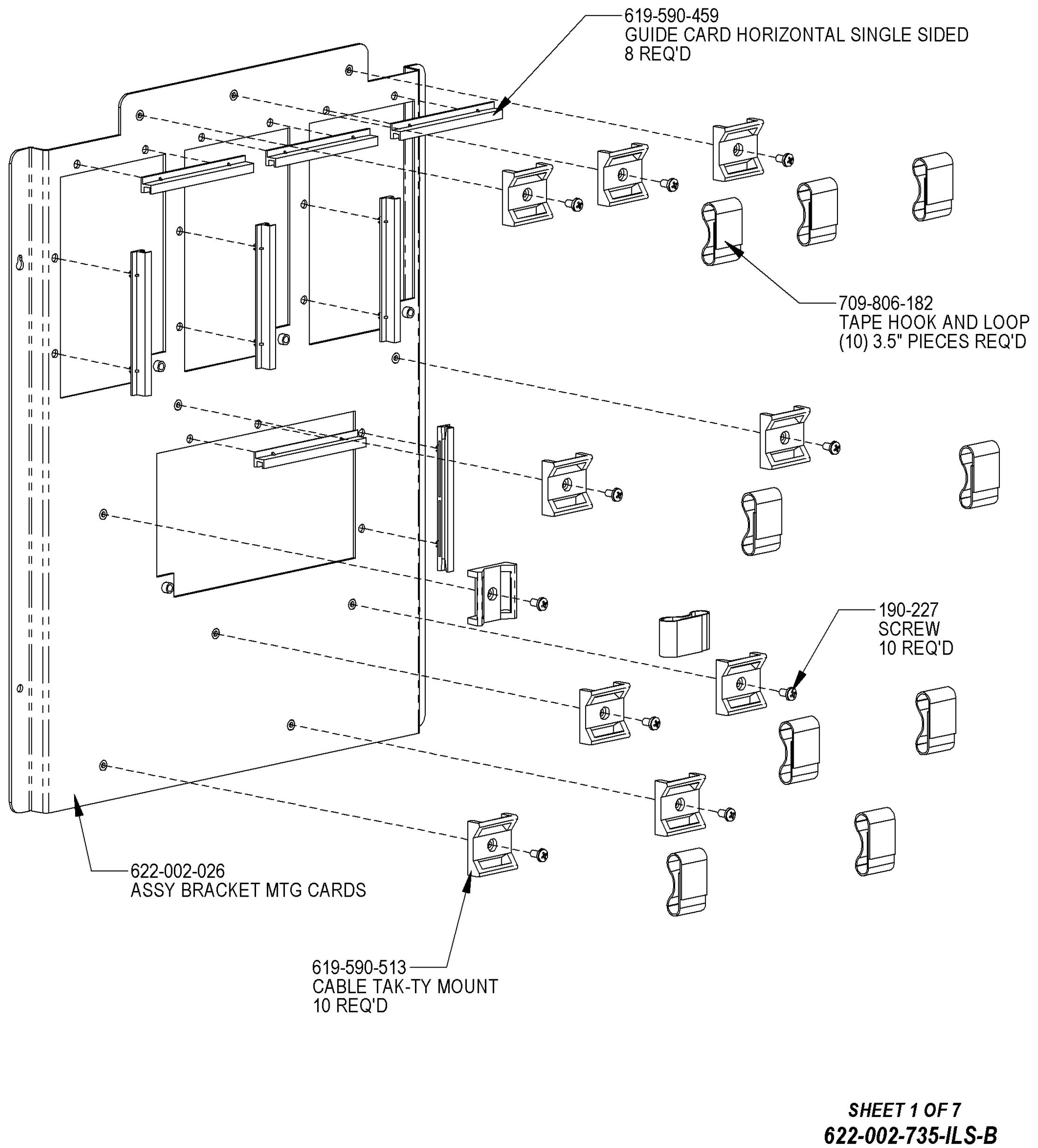


Figure 10-73
Oven Enclosure Assembly 1 of 7
(CHN828 model only)

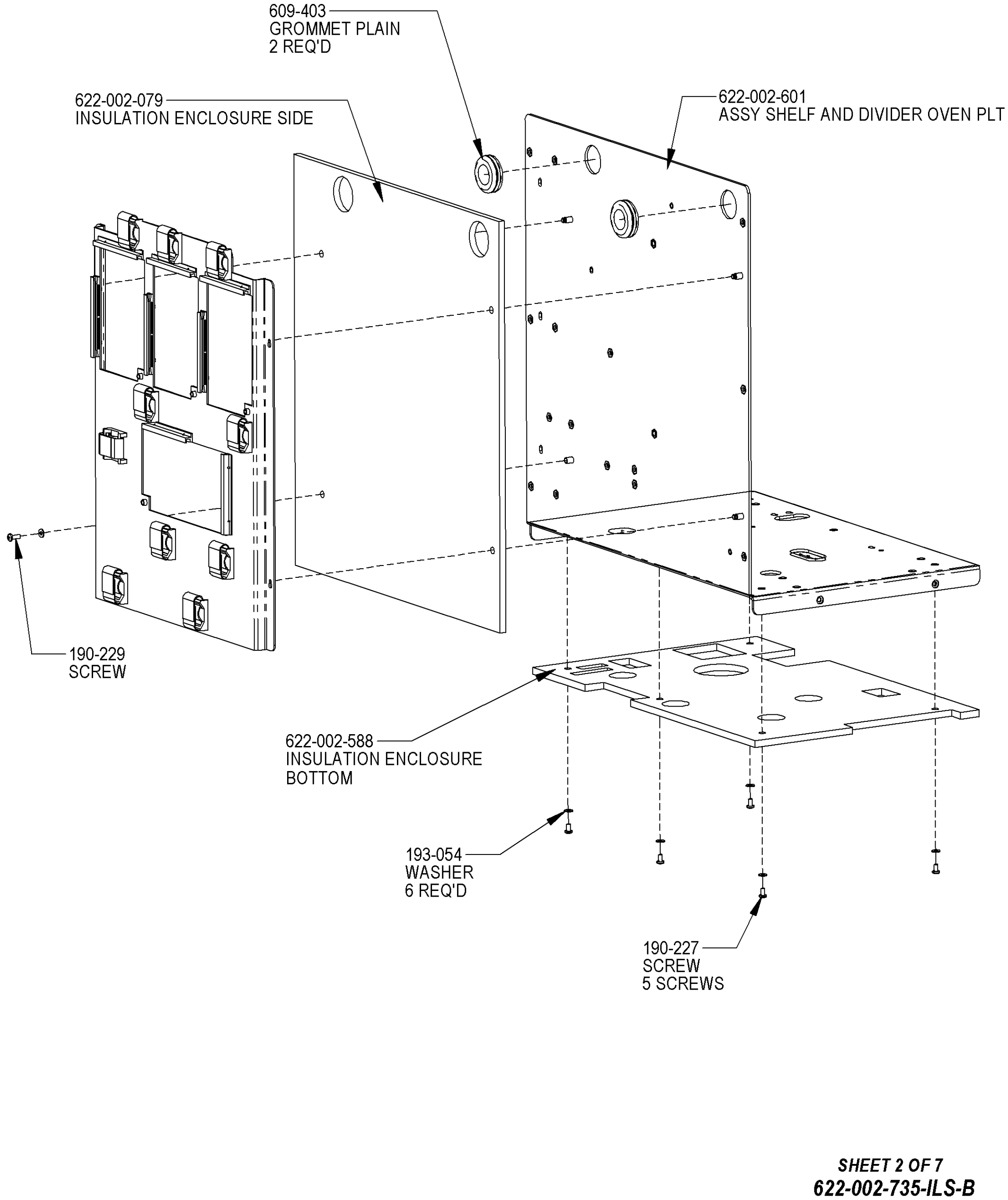


Figure 10-74
Oven Enclosure Assembly 2 of 7
(CHN828 model only)

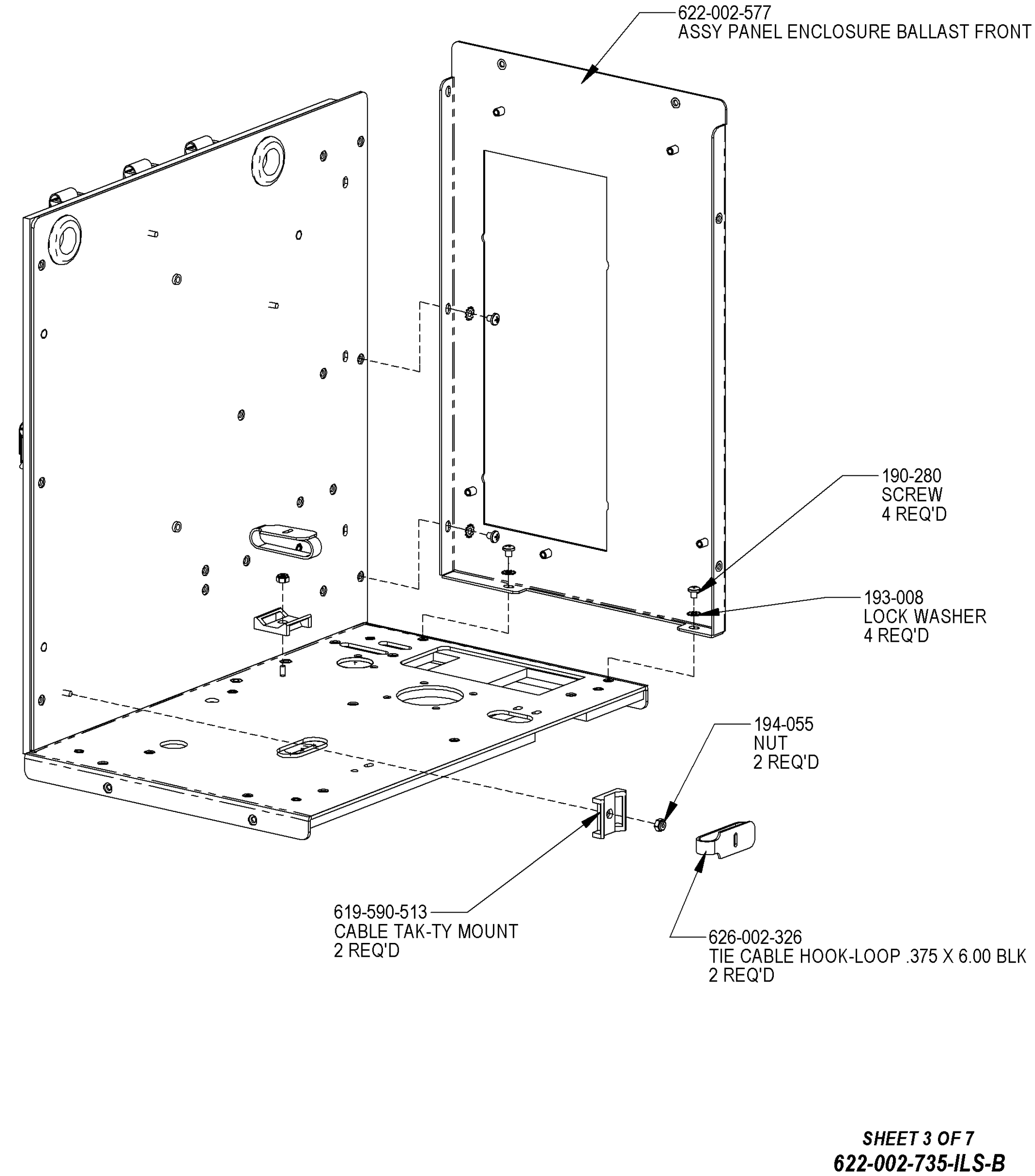


Figure 10-75
Oven Enclosure Assembly 3 of 7
(CHN828 model only)

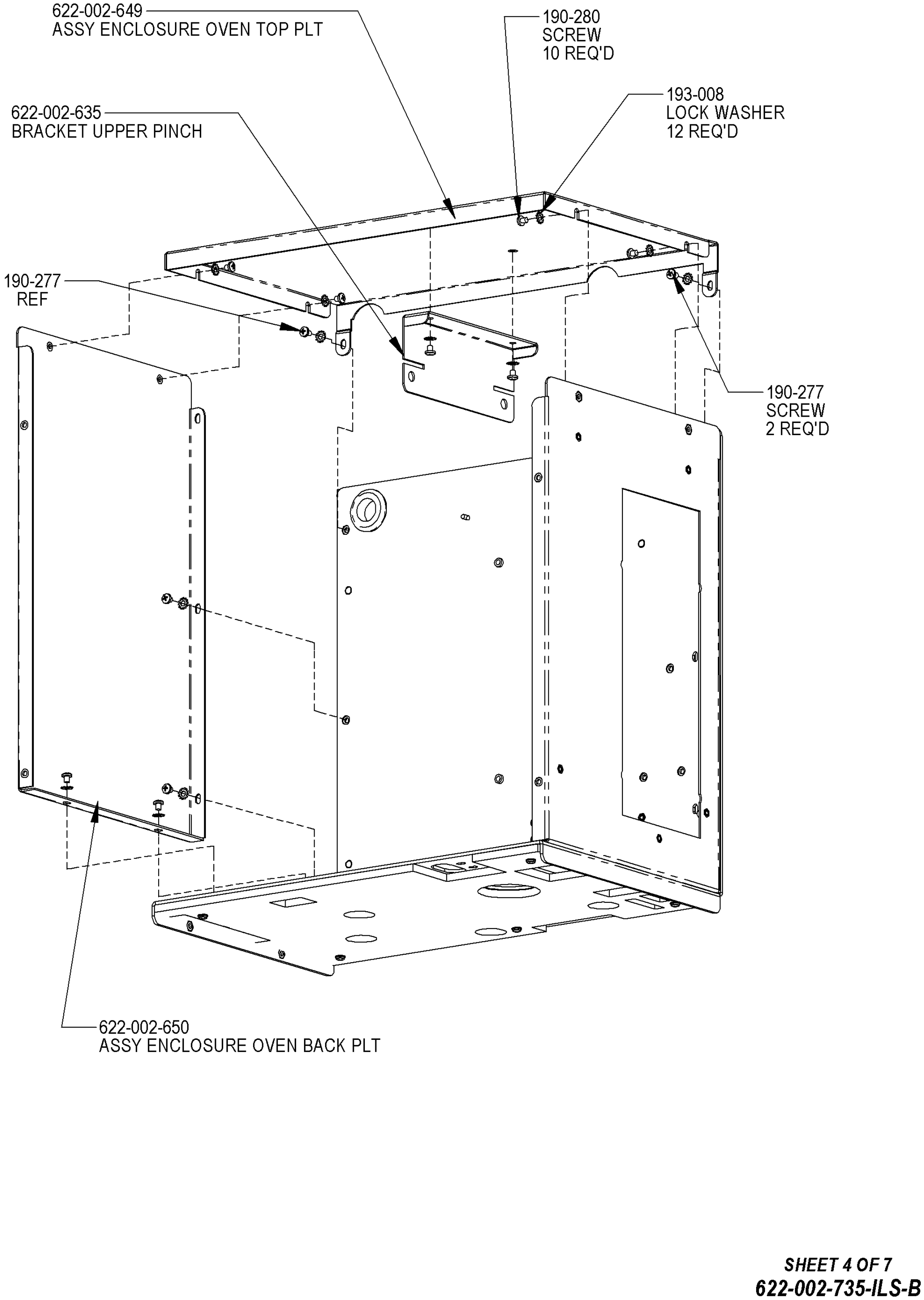


Figure 10-76
Oven Enclosure Assembly 4 of 7
(CHN828 model only)

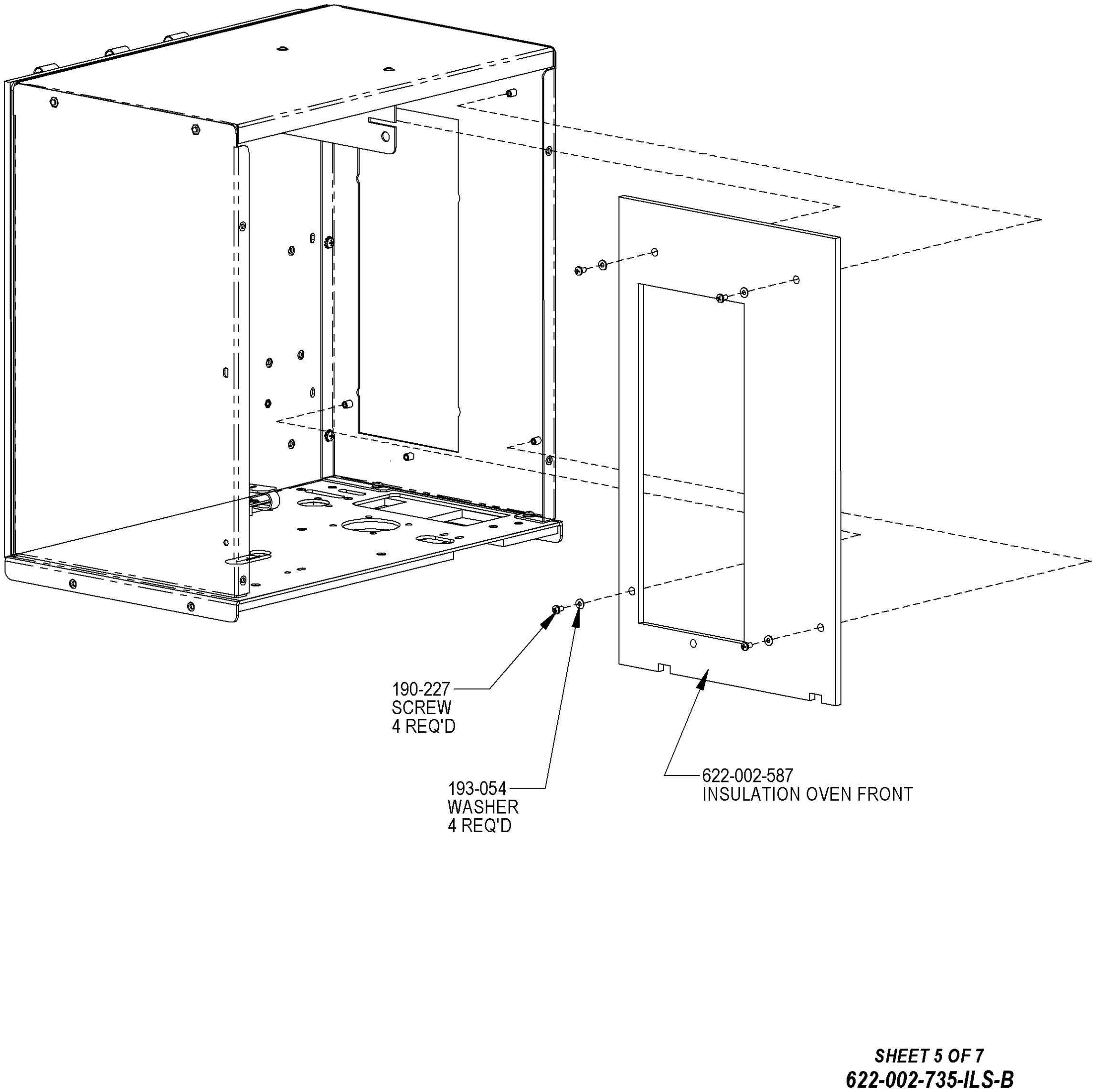


Figure 10-77
Oven Enclosure Assembly 5 of 7
(CHN828 model only)

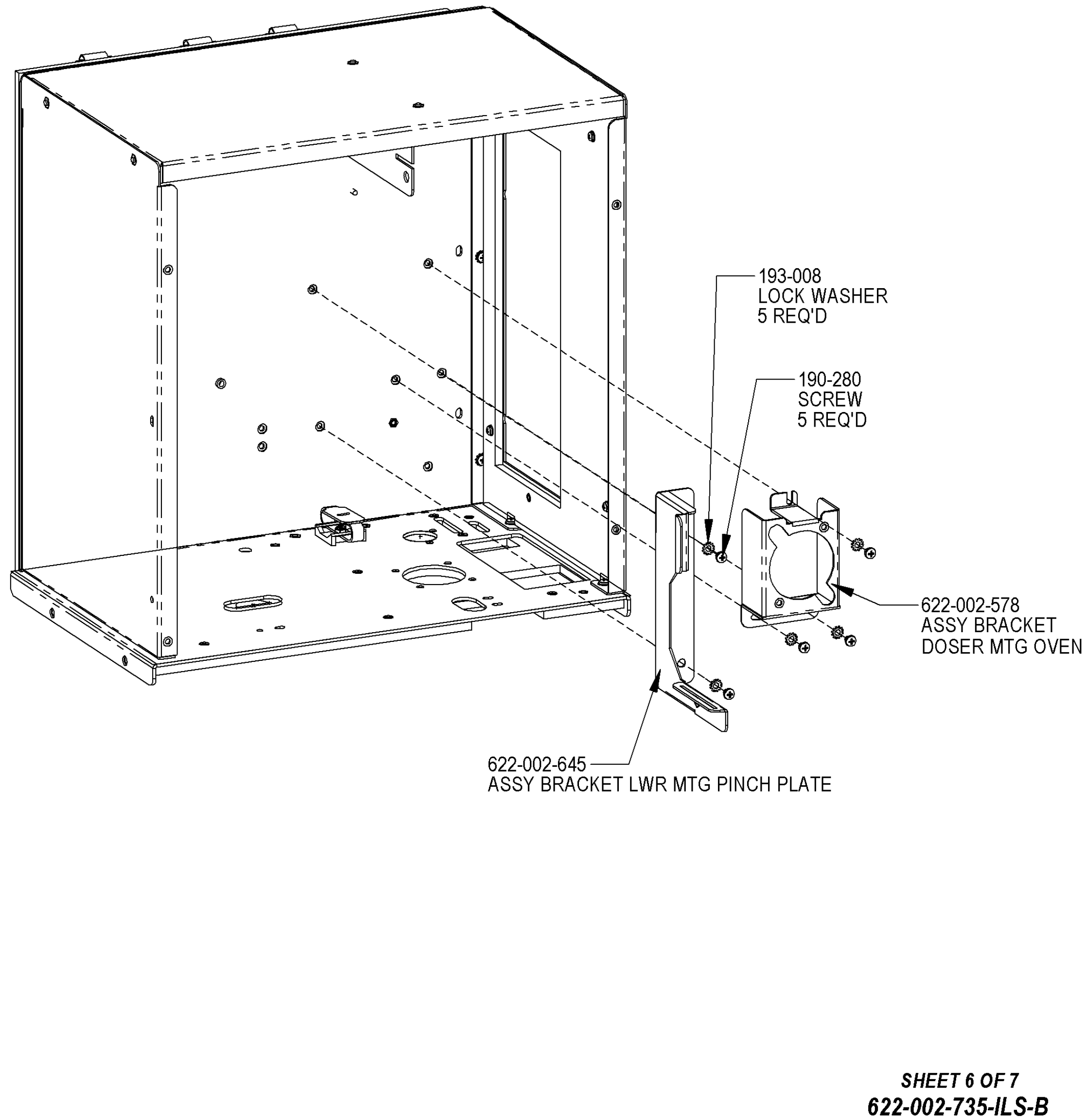


Figure 10-78
Oven Enclosure Assembly 6 of 7
(CHN828 model only)

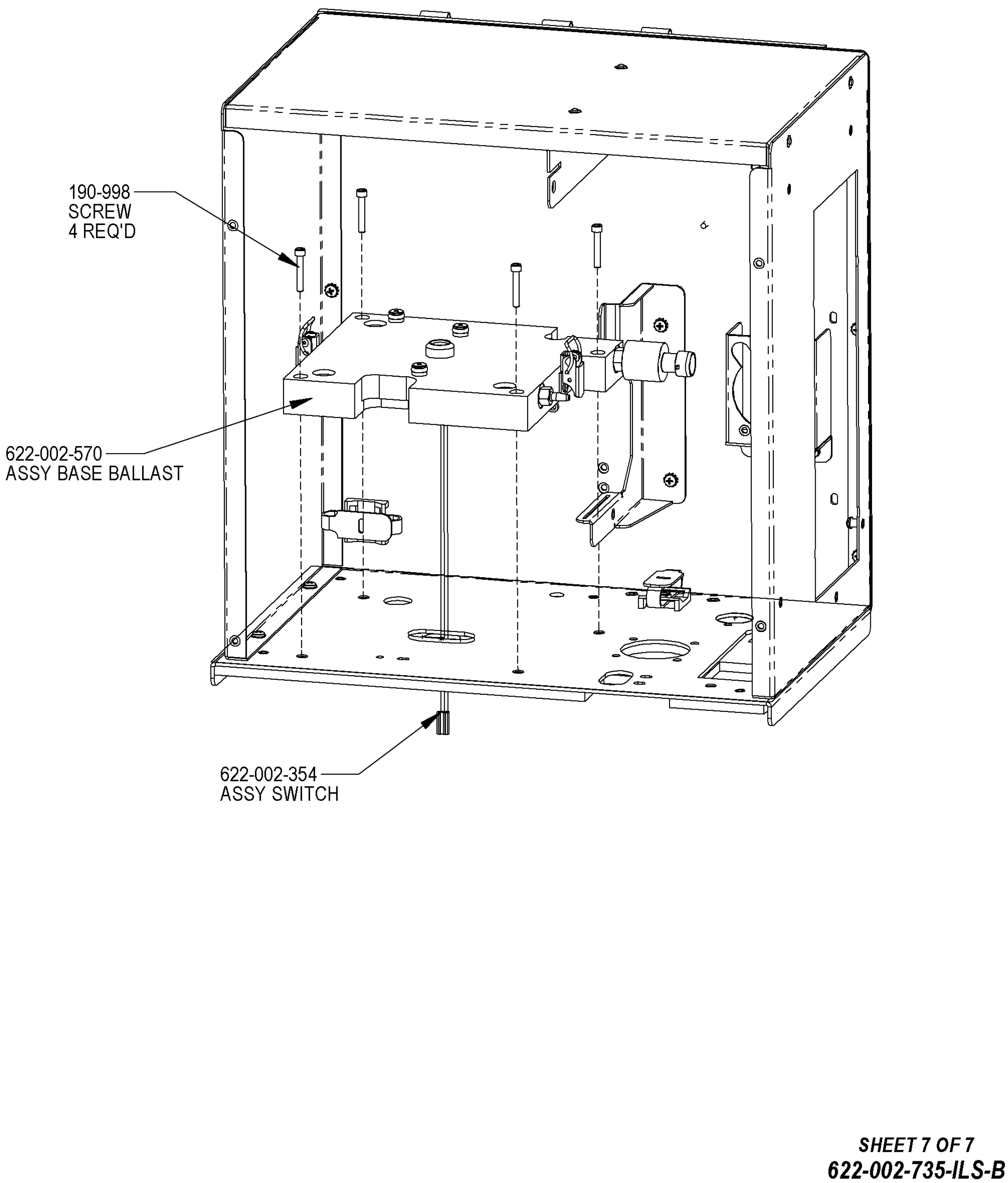


Figure 10-79
Oven Enclosure Assembly 7 of 7
(CHN828 model only)

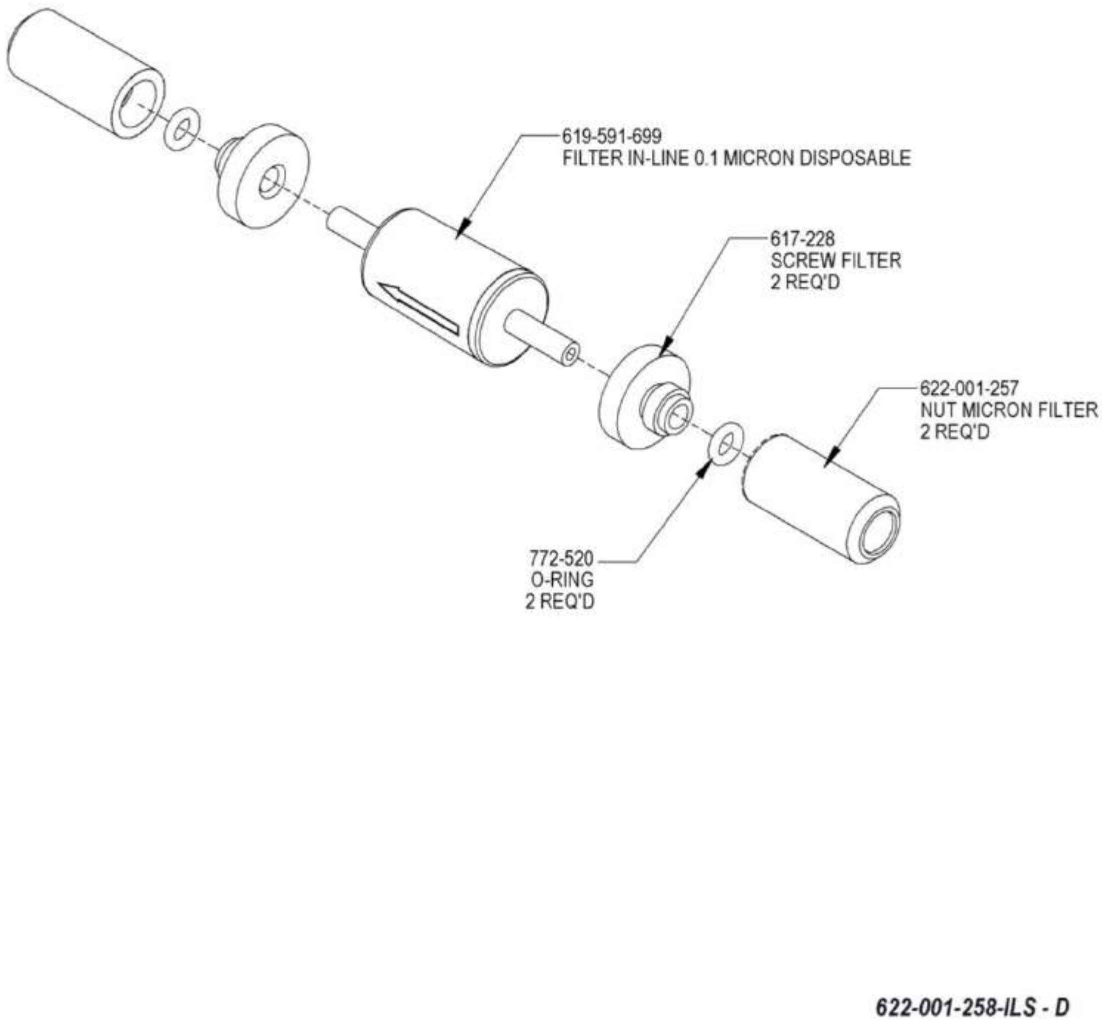


Figure 10-80
0.10 Micron Filter Assembly

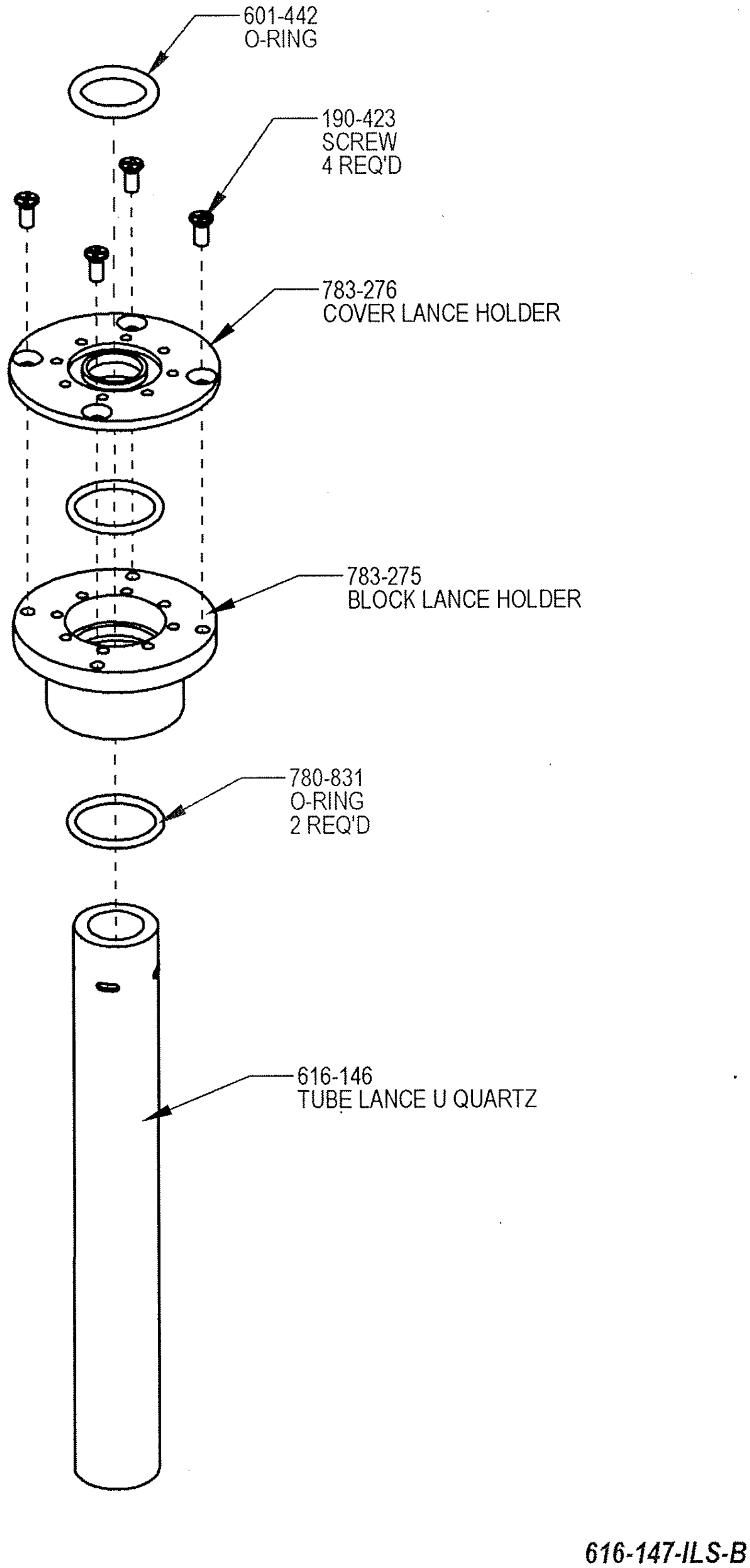


Figure 10-81
Lance Assembly

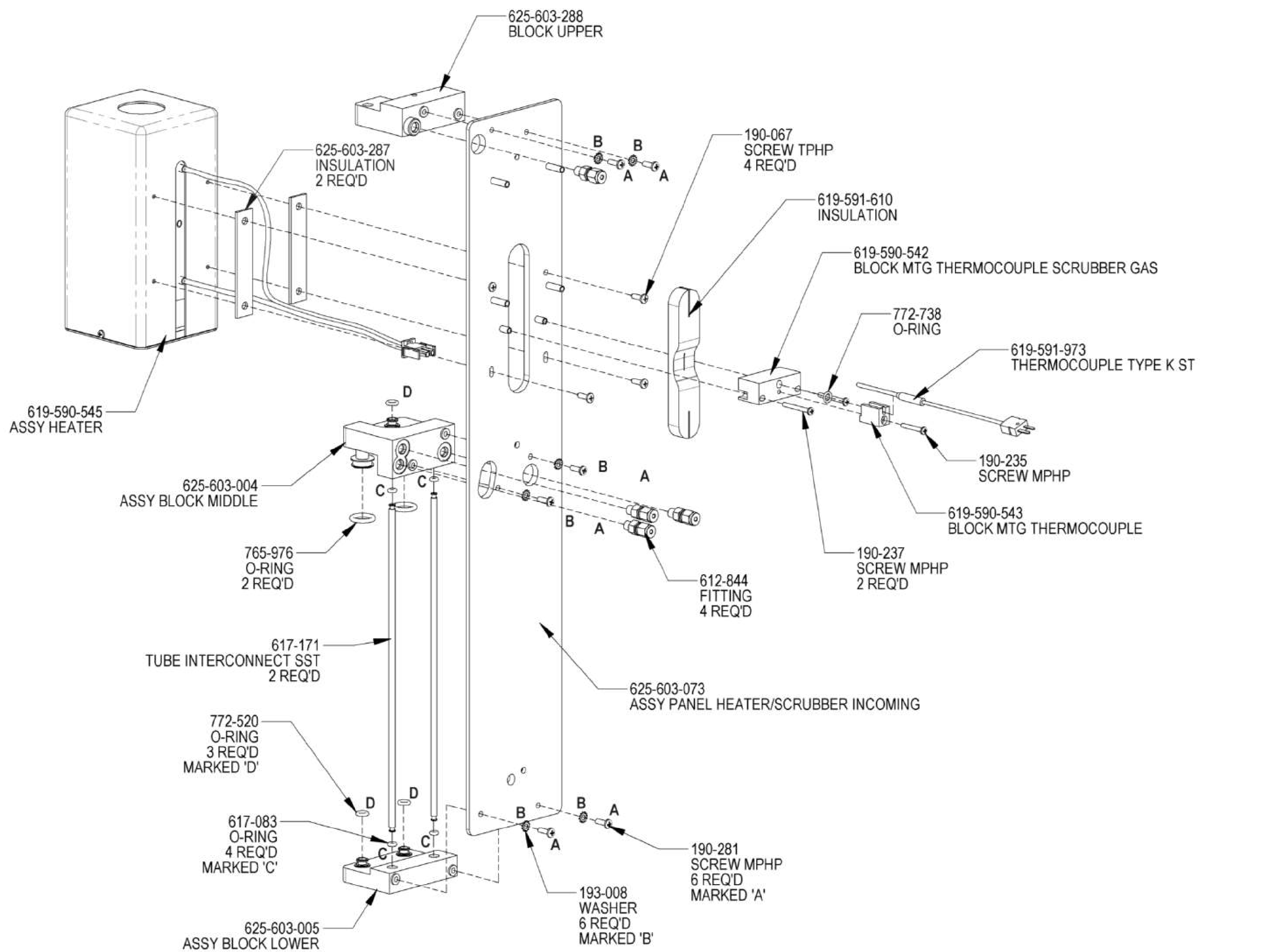


Figure 10-82
Reagent Heater Assembly

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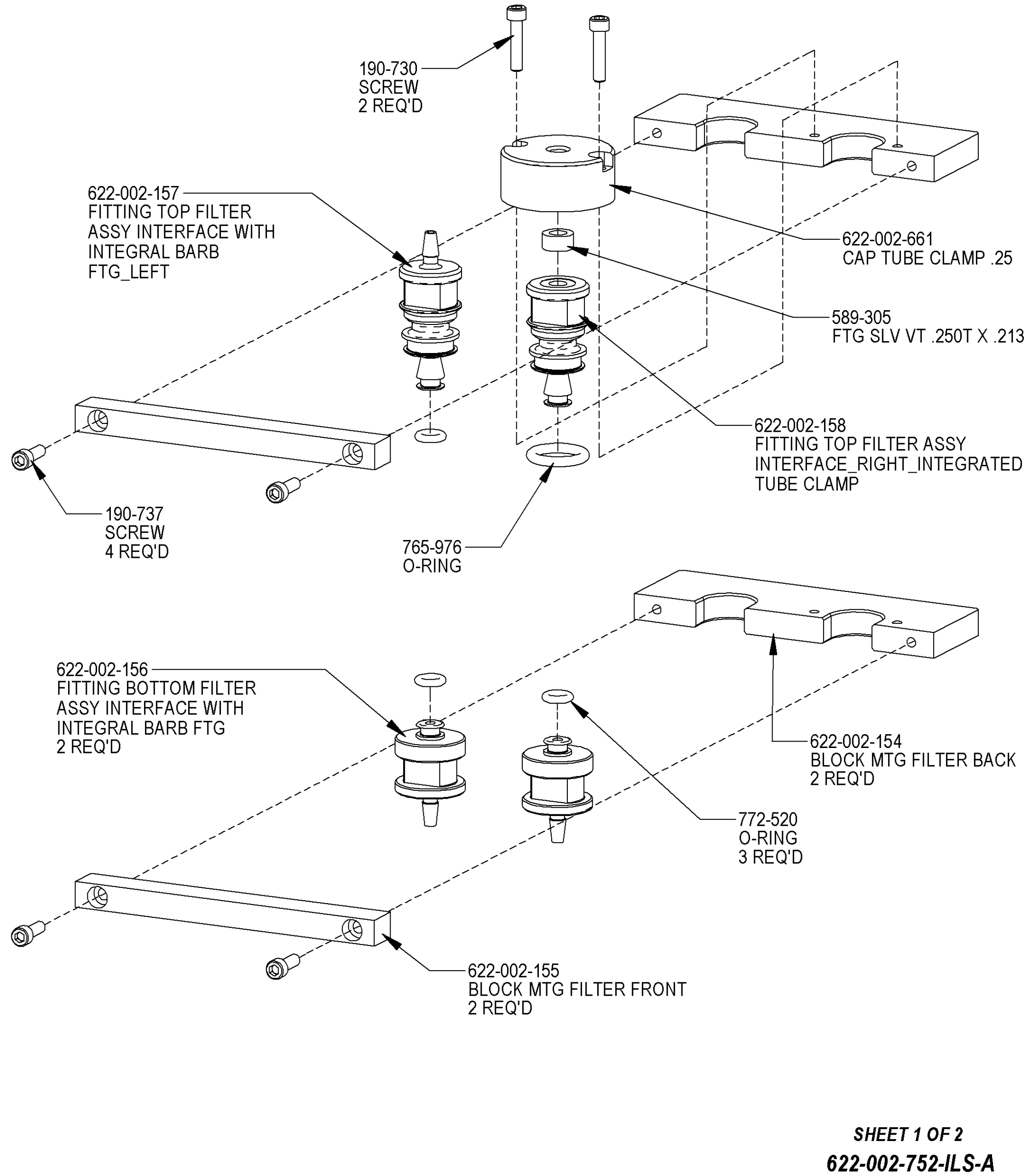


Figure 10-83
Filter Assembly 1 of 2
(CN828, FP828, and FP828P models only)

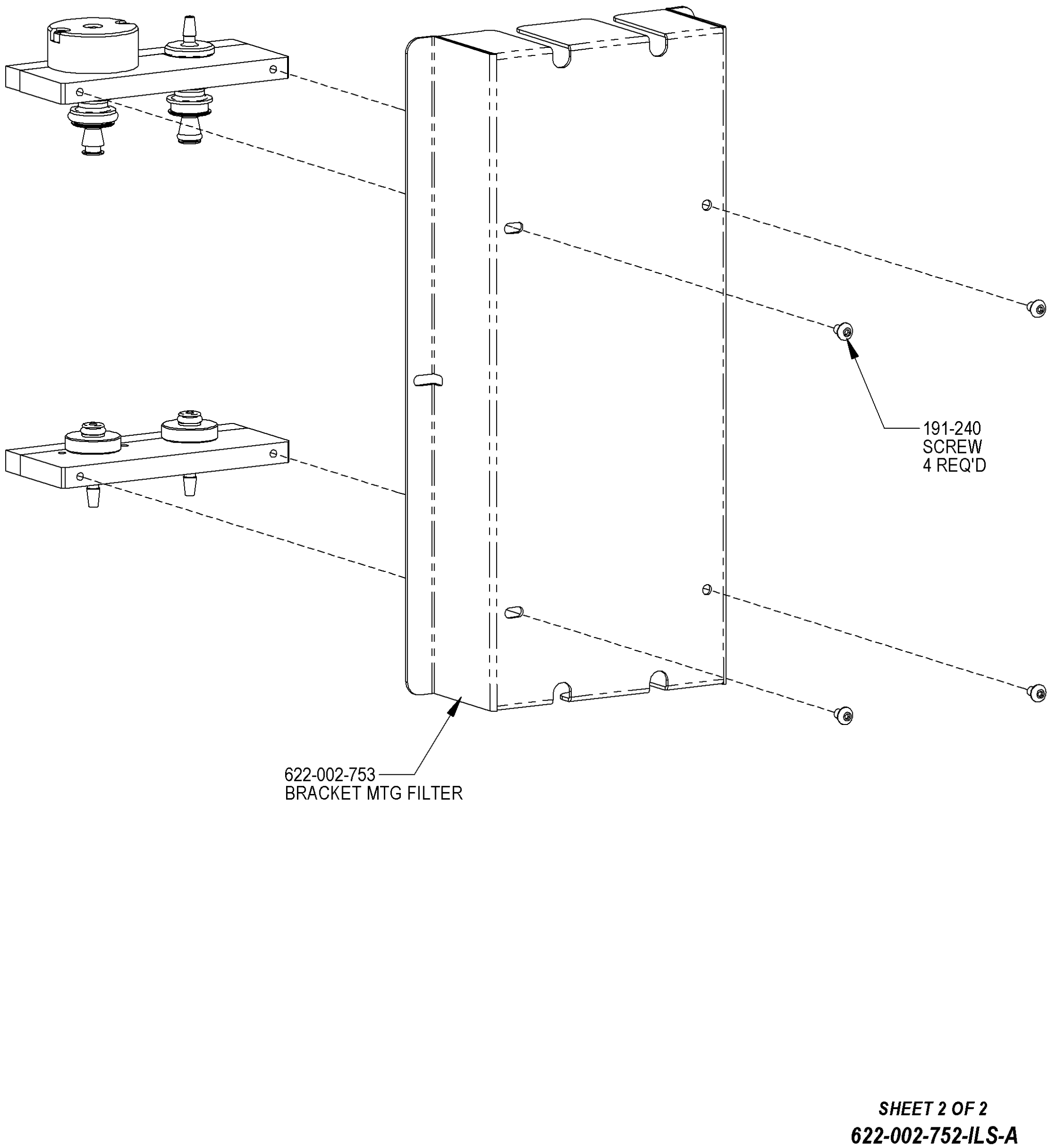


Figure 10-84
Filter Assembly 2 of 2
(CN828, FP828, and FP828P models only)

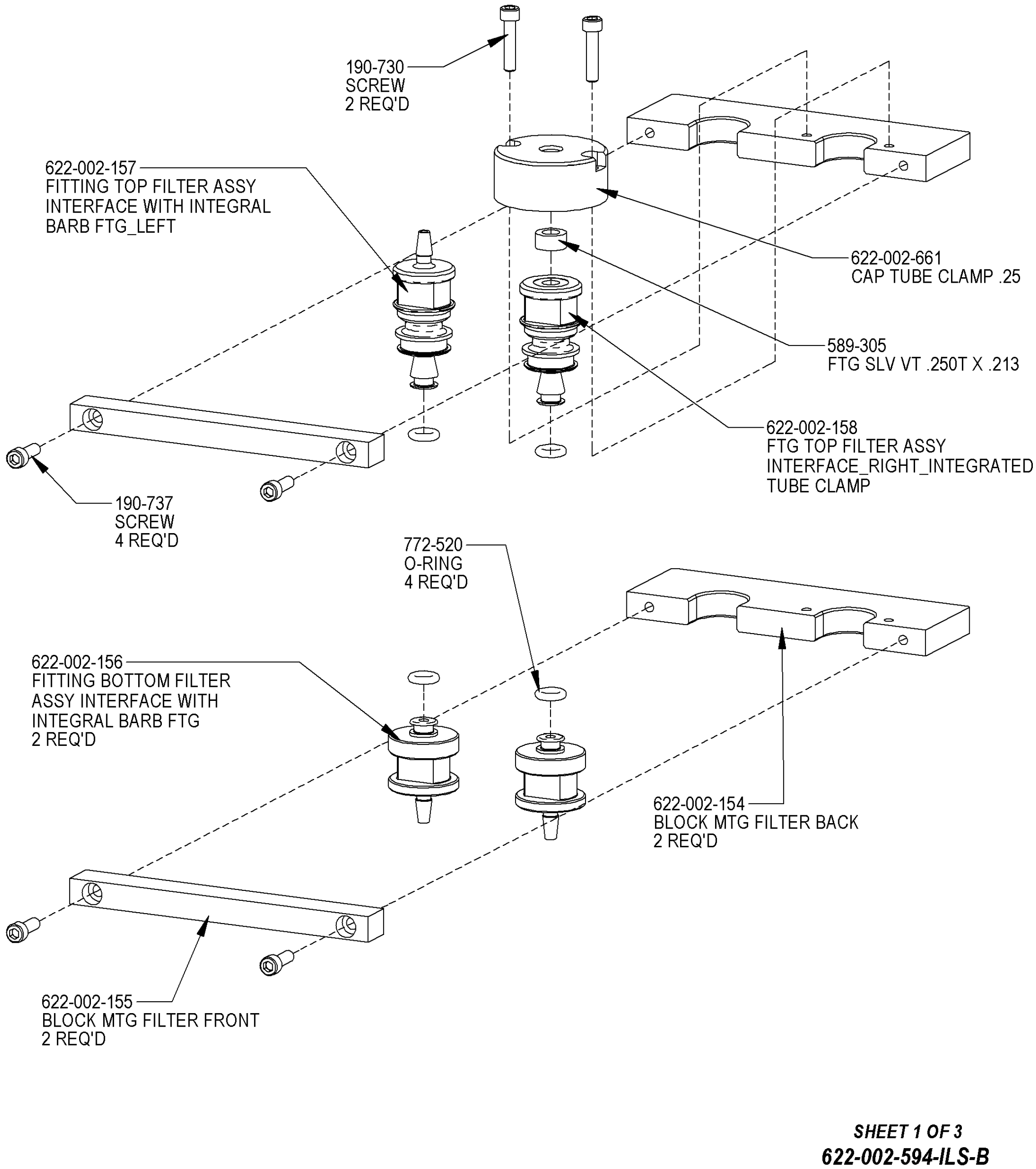


Figure 10-85
Filter Assembly 1 of 3
(CHN828 model only)

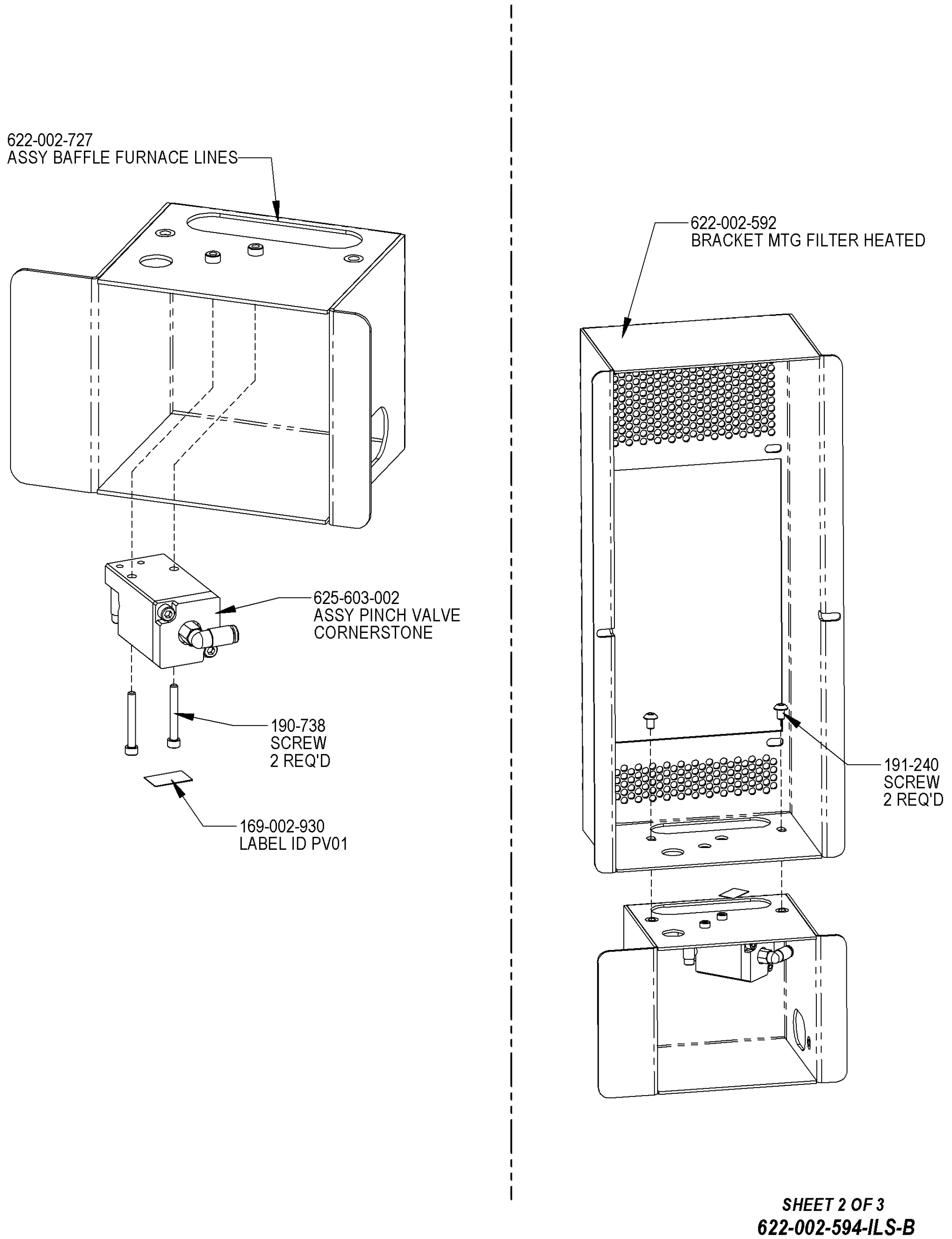
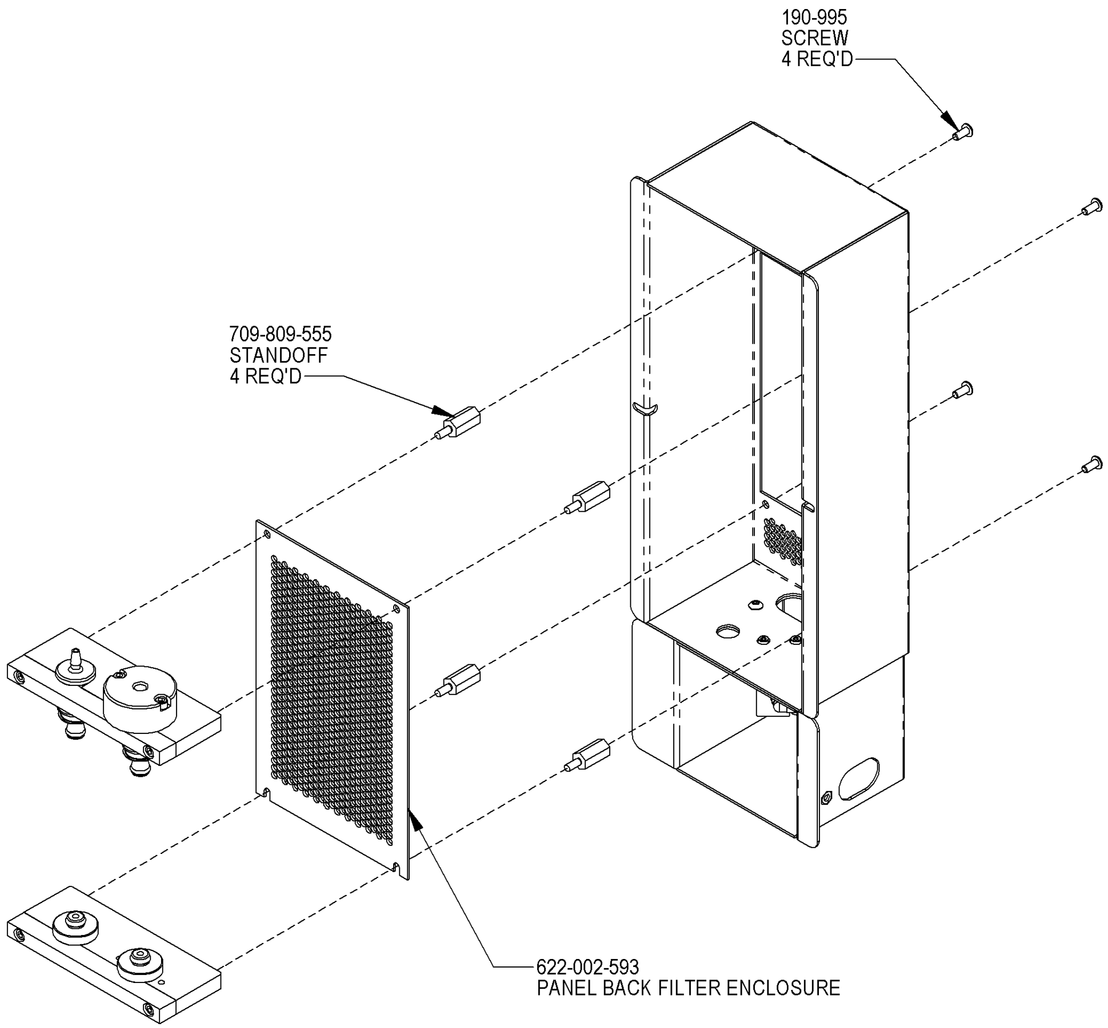


Figure 10-86
Filter Assembly 2 of 3
(CHN828 model only)



SHEET 3 OF 3
622-002-594-ILS-B

Figure 10-87
Filter Assembly 3 of 3
(CHN828 model only)

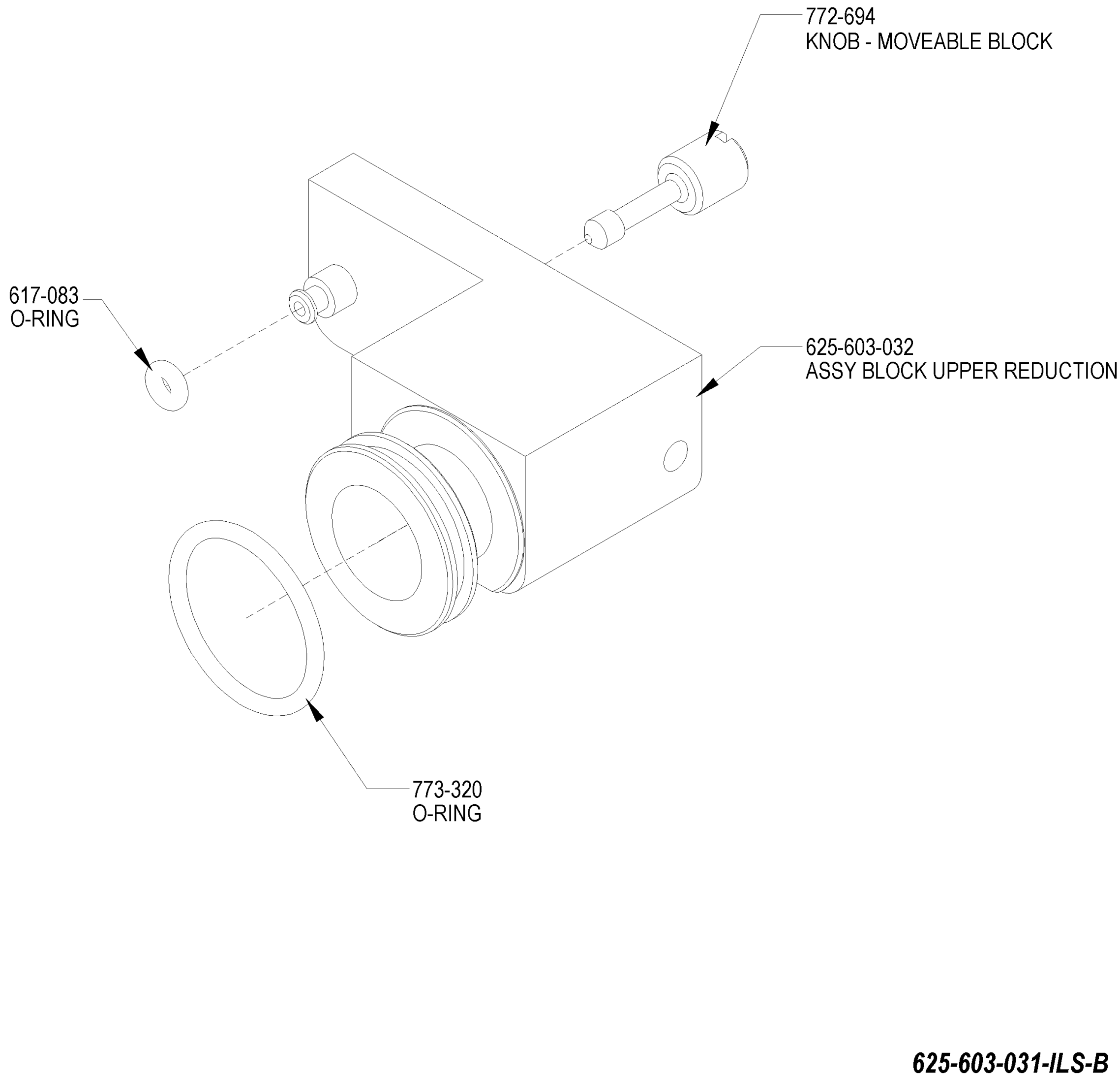


Figure 10-88
Upper Reduction Block Assembly

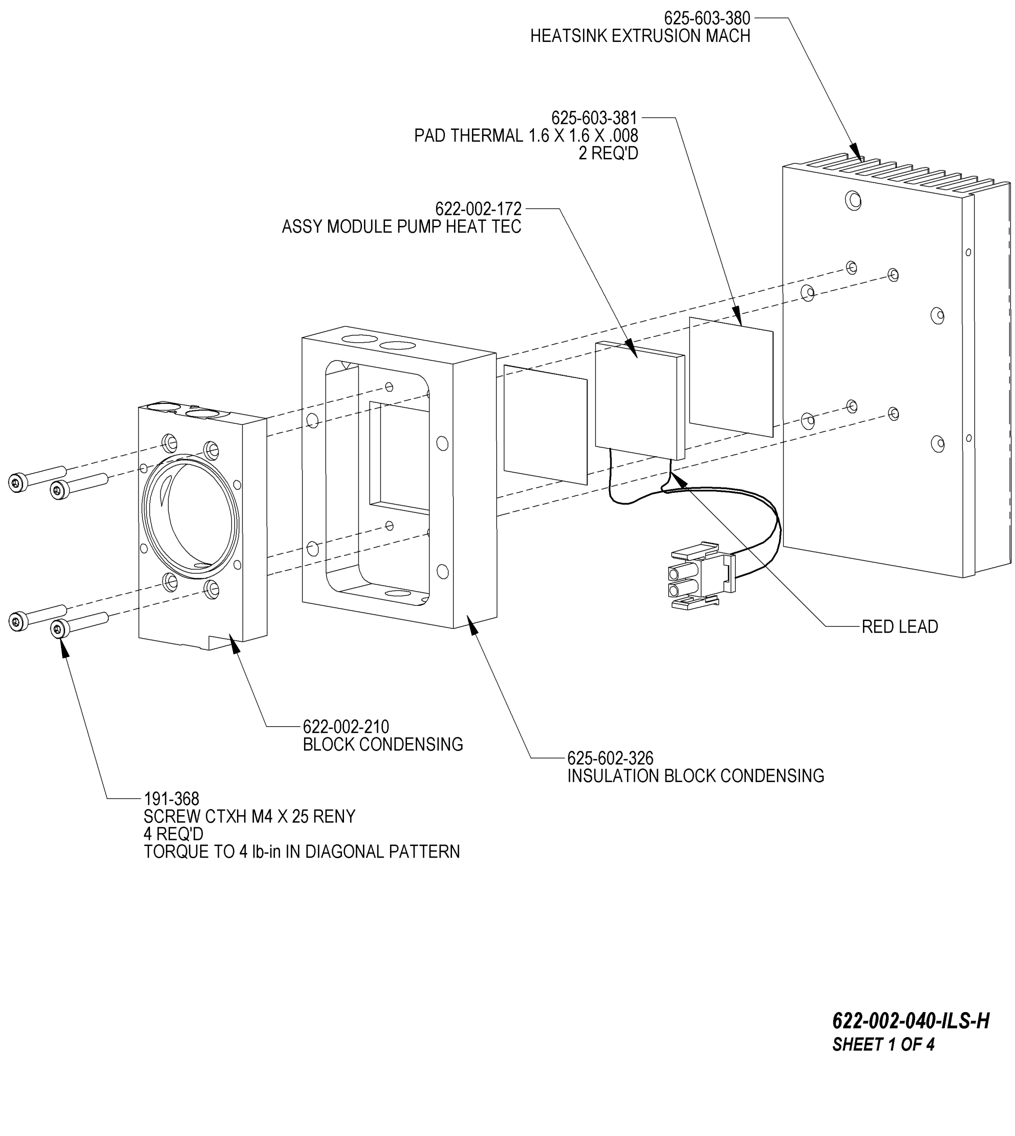


Figure 10-89
TE Cooler with Housing Assembly 1 of 4
(CN828, FP828, and FP828P models only)

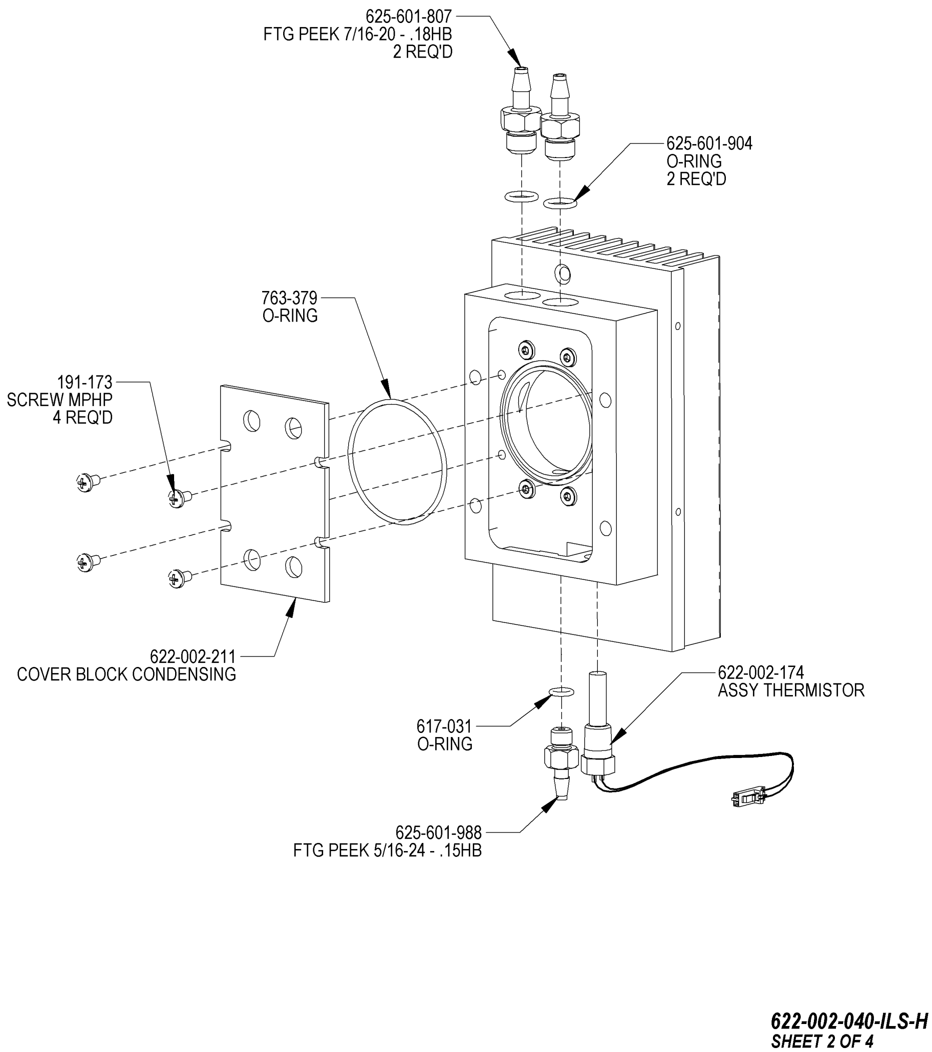


Figure 10-90
TE Cooler with Housing Assembly 2 of 4
(CN828, FP828, and FP828P models only)

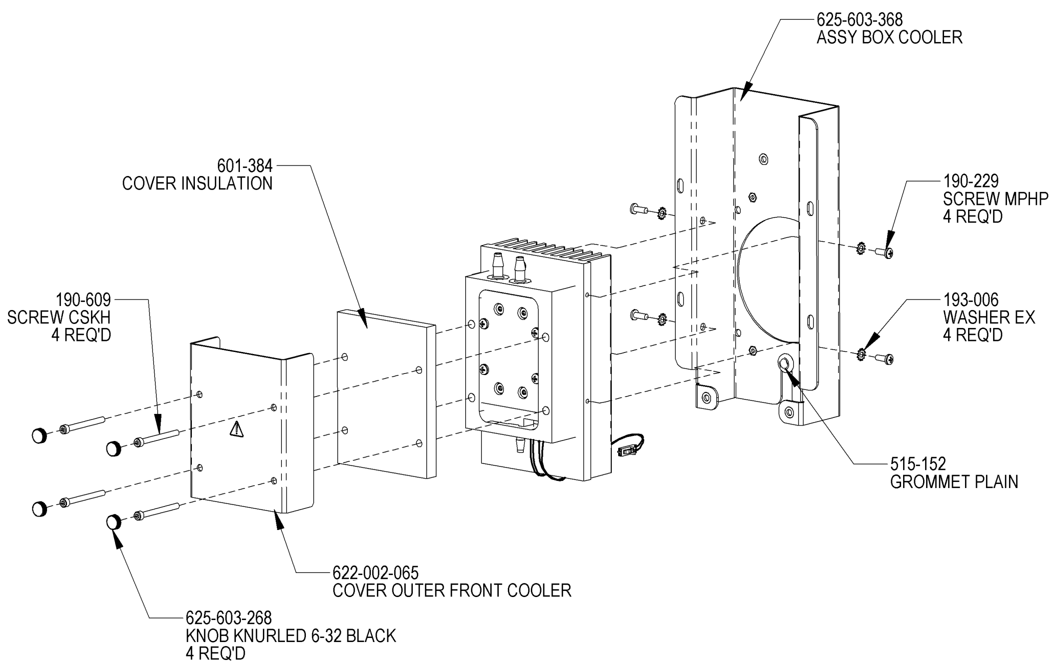
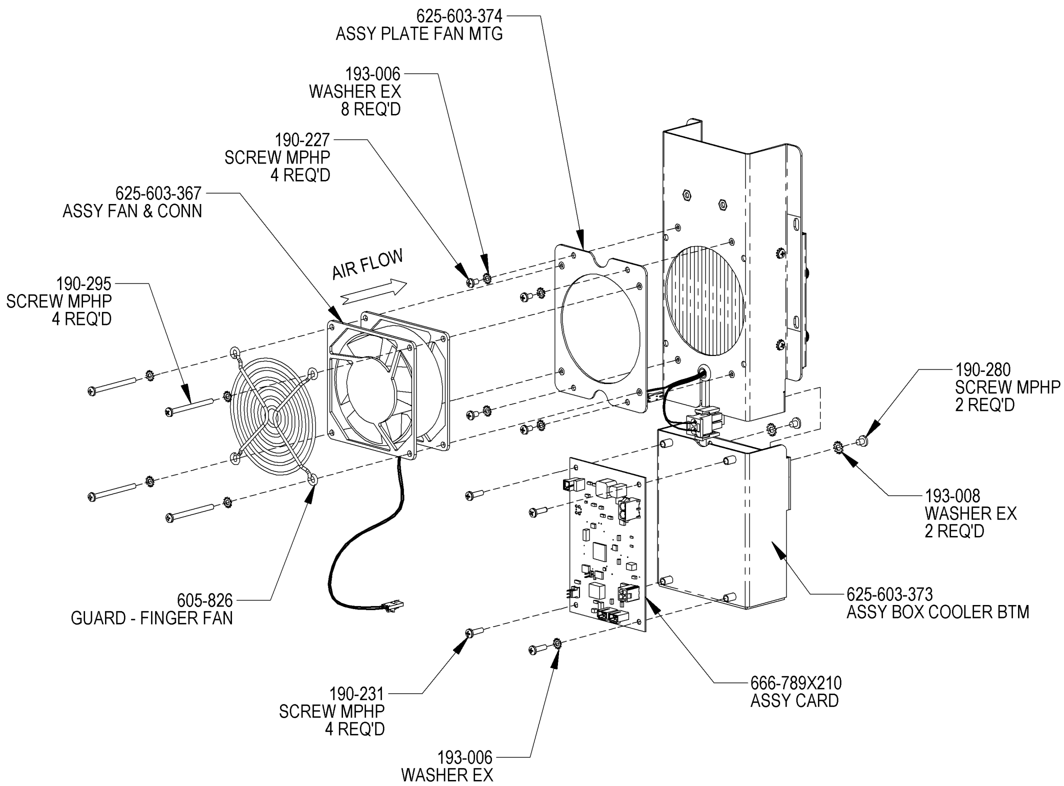


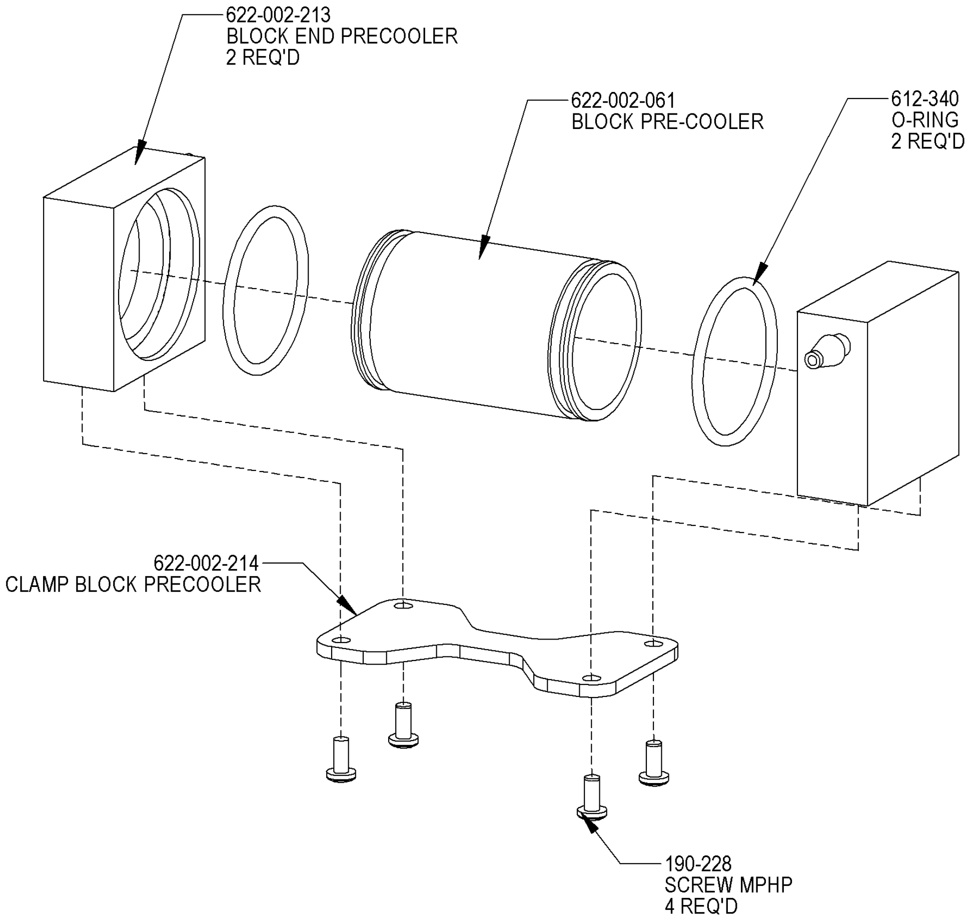
Figure 10-91
TE Cooler with Housing Assembly 3 of 4
(CN828, FP828, and FP828P models only)



X = ASSY CARD REVISION AS INDICATED BY WORK ORDER OR KIT COMPONENT

622-002-040-ILS-H
SHEET 4 OF 4

Figure 10-92
TE Cooler with Housing Assembly 4 of 4
(CN828, FP828, and FP828P models only)



622-002-062-ILS-C

Figure 10-93
Pre-Cooler Block Assembly
(CN828, FP828, and FP828P models only)

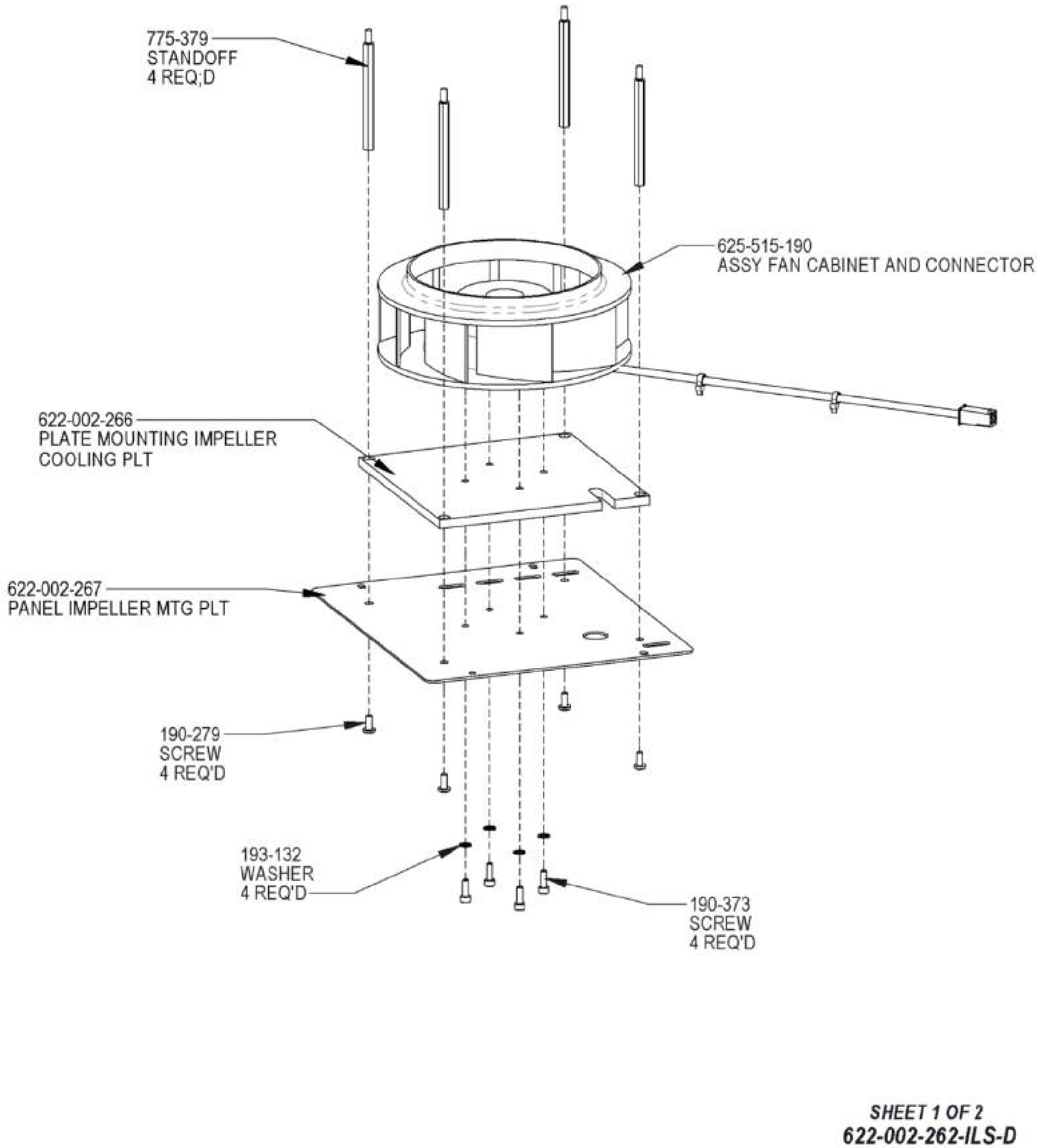


Figure 10-94
Impeller Assembly 1 of 2

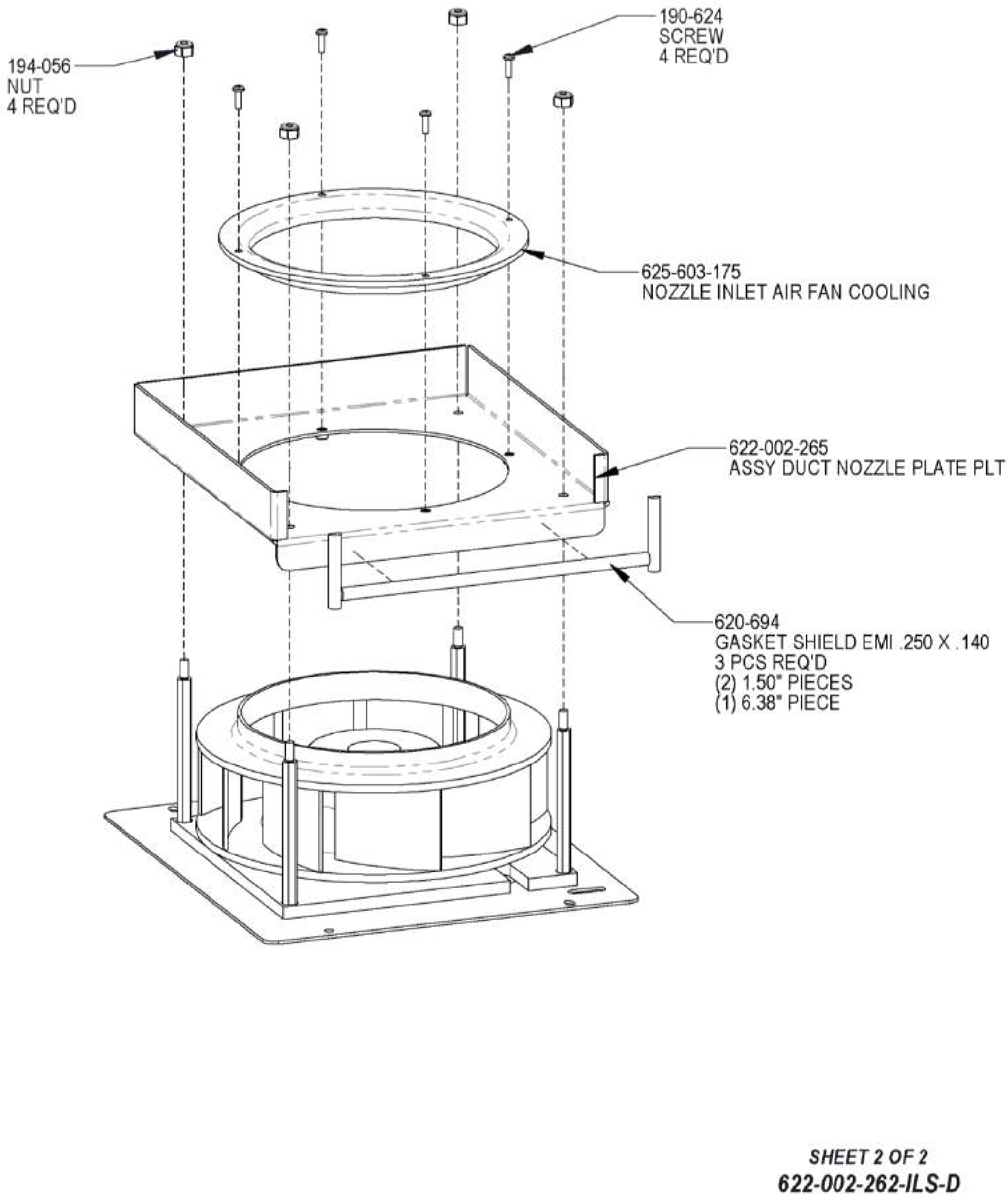


Figure 10-95
Impeller Assembly 2 of 2

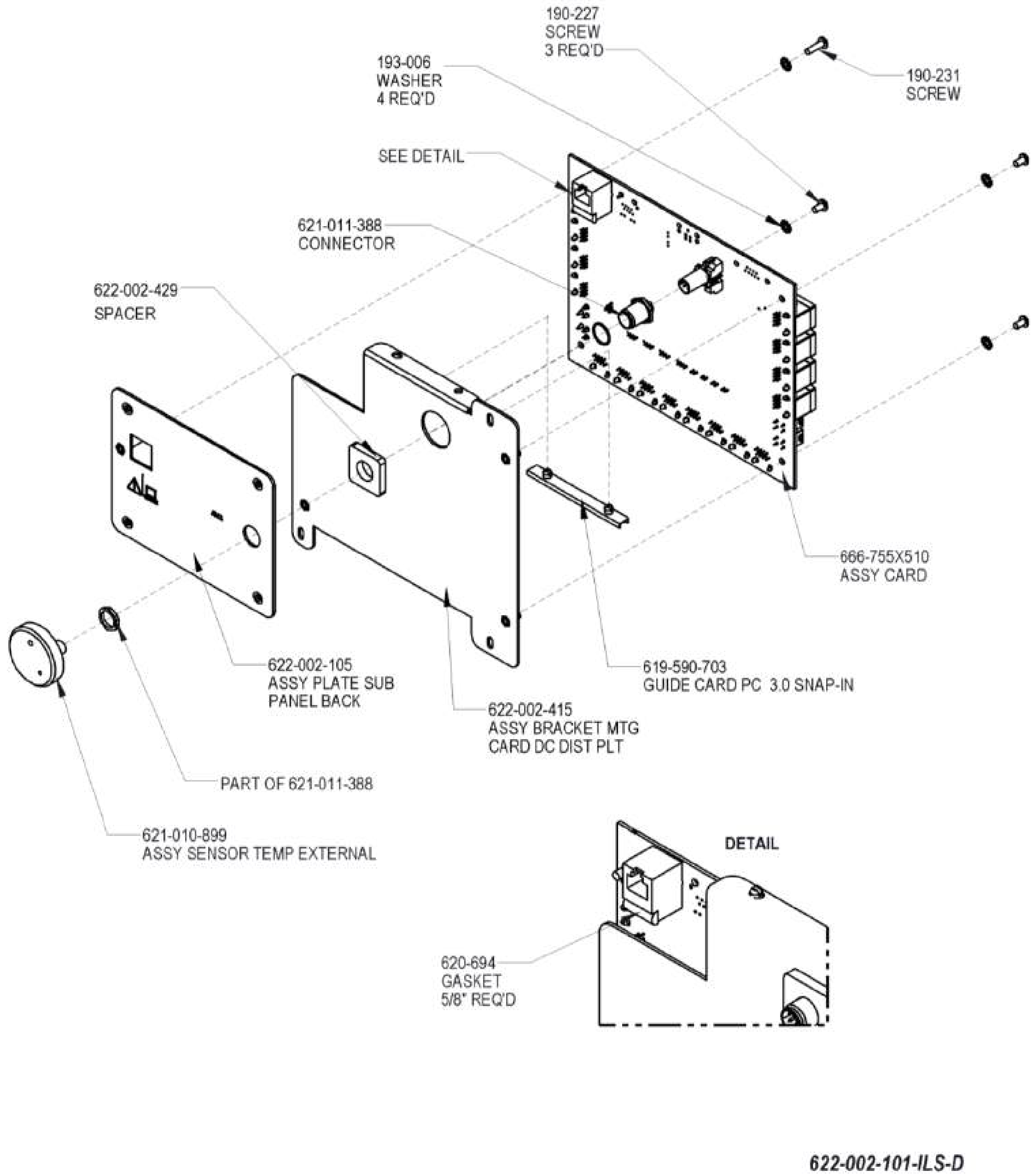
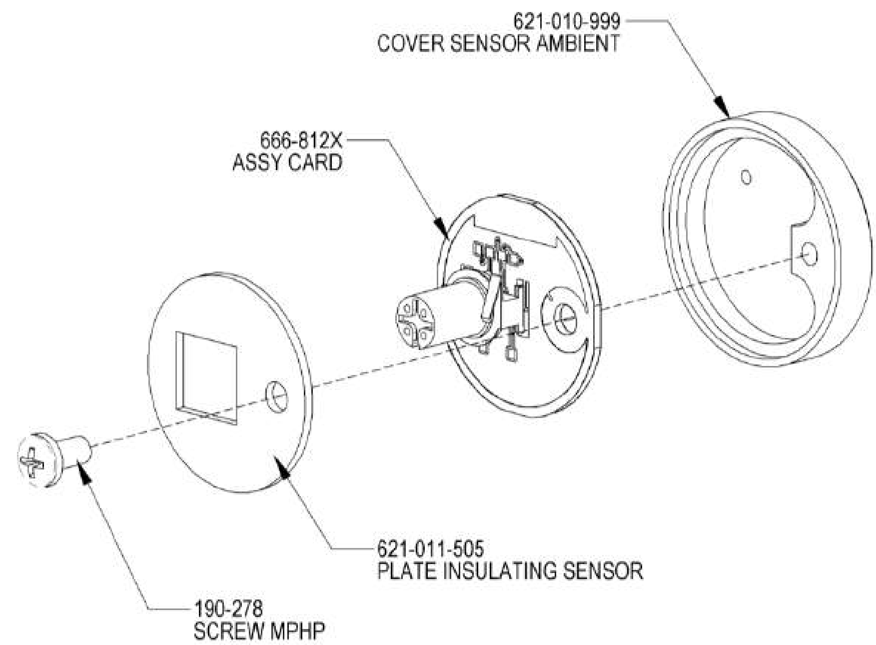


Figure 10-96
DC Distribution Bracket/Card



X = ASSY CARD REVISION AS INDICATED BY WORK ORDER OR KIT COMPONENT

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Figure 10-97
Ambient Monitor Assembly

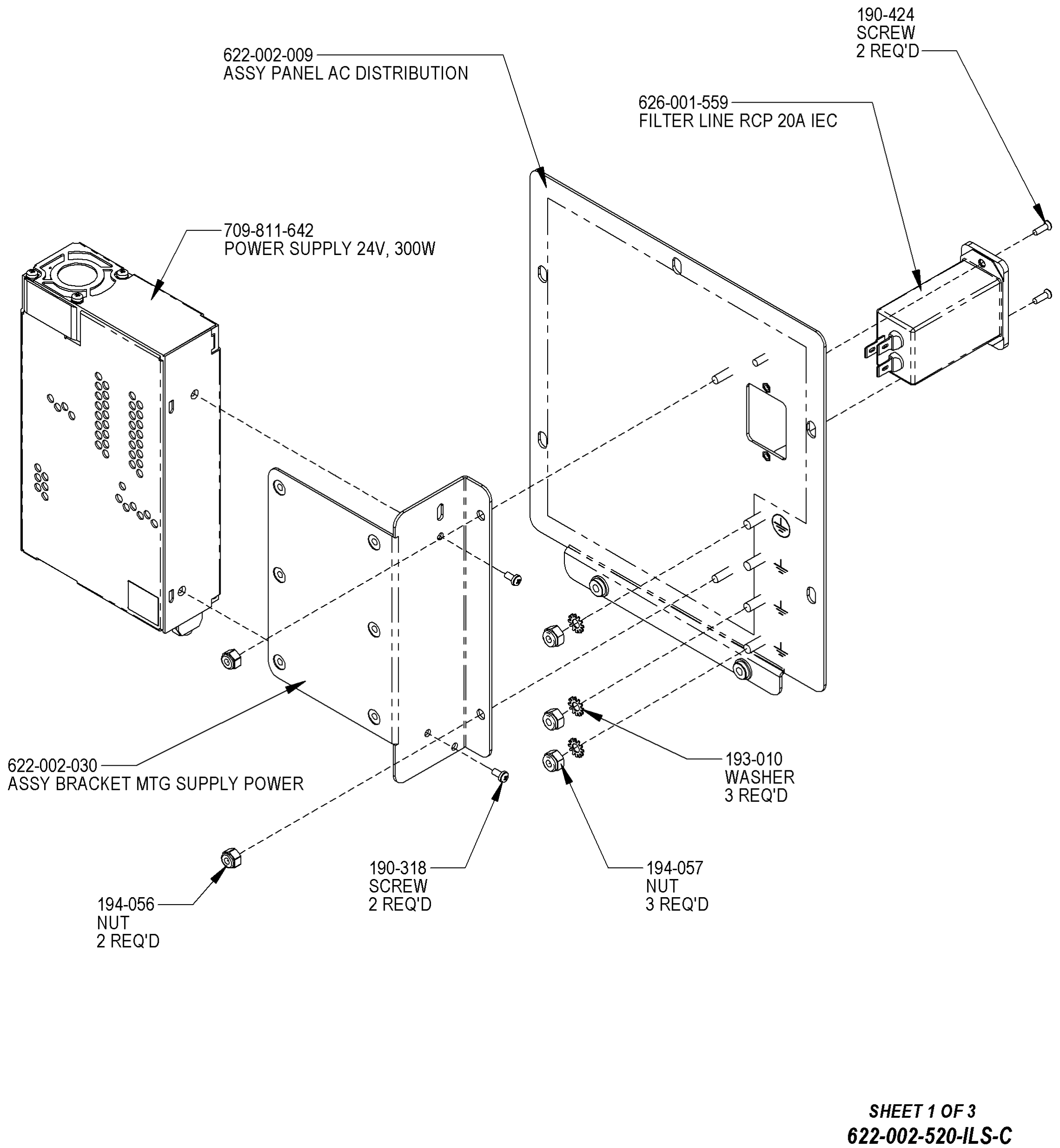


Figure 10-98
AC Distribution Panel Assembly 1 of 3

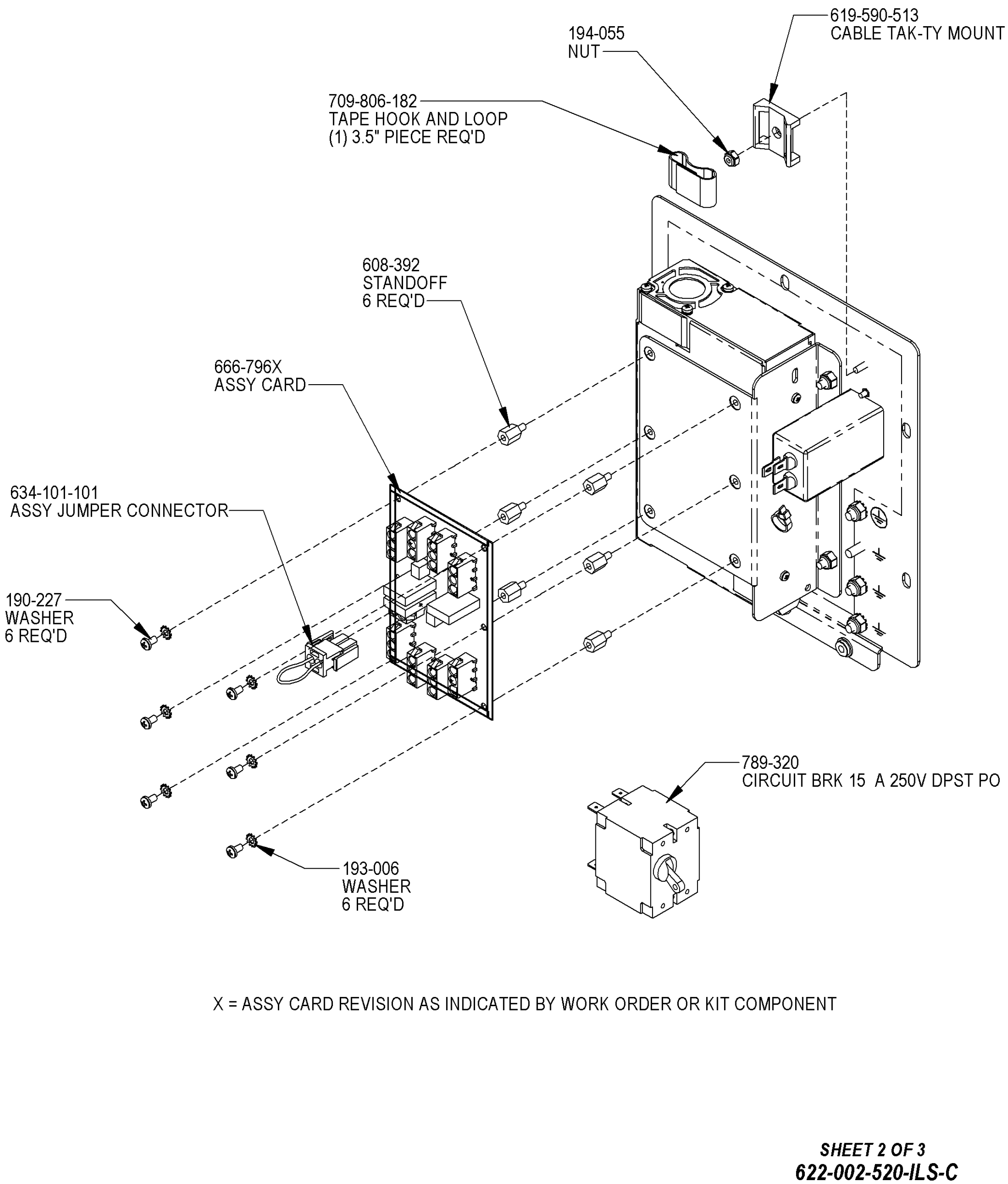


Figure 10-99
AC Distribution Panel Assembly 2 of 3

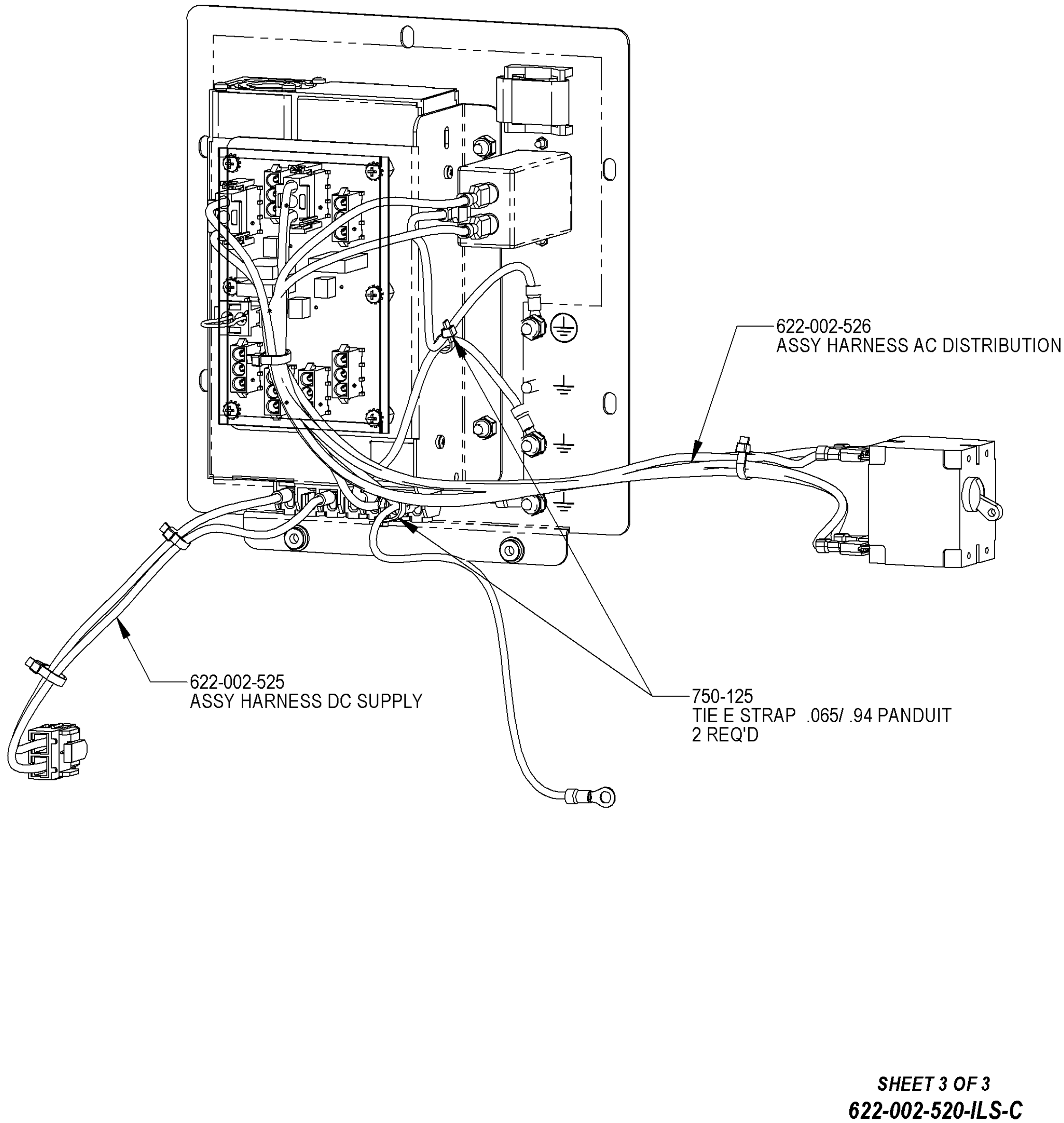


Figure 10-100
AC Distribution Panel Assembly 3 of 3

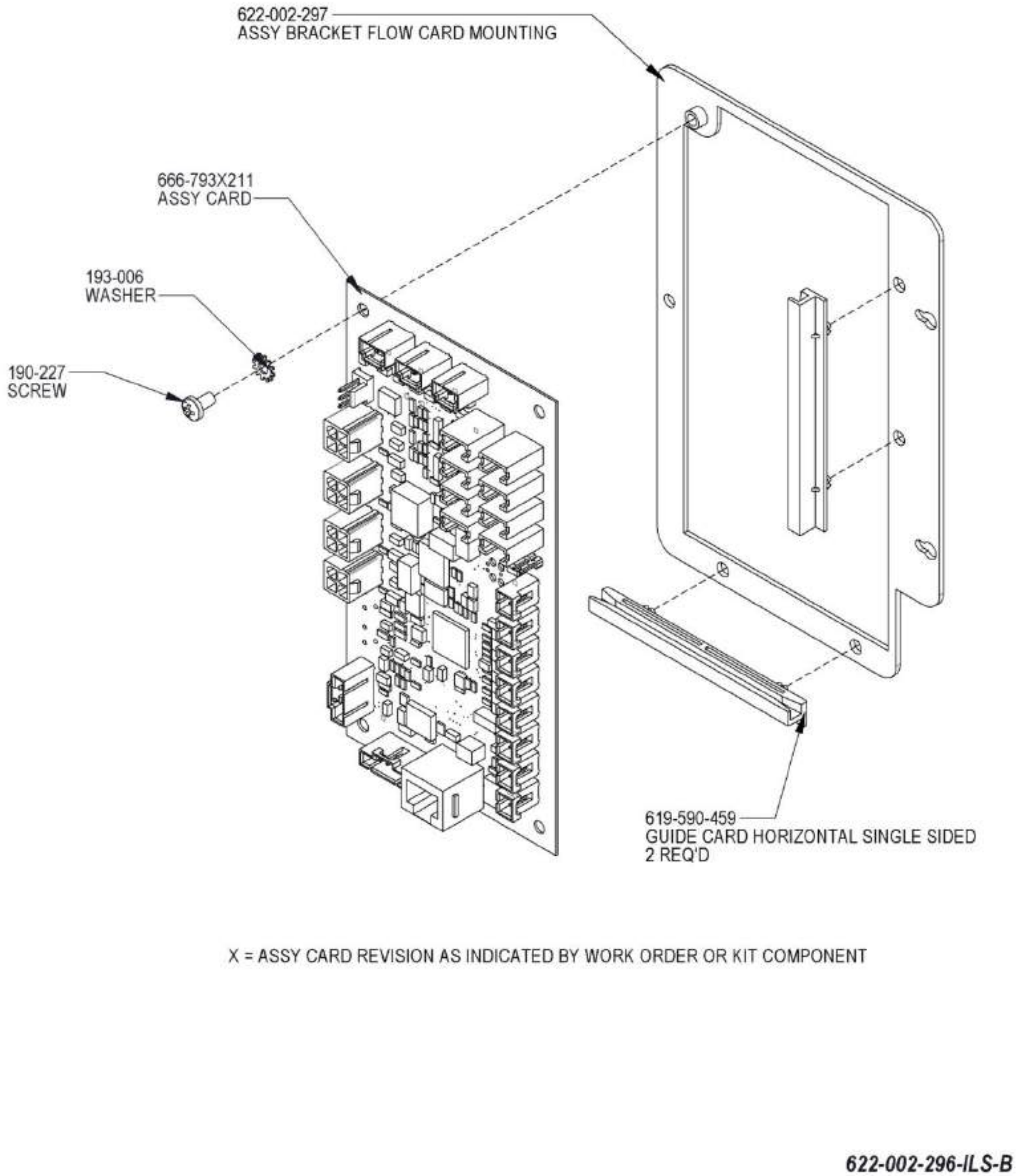
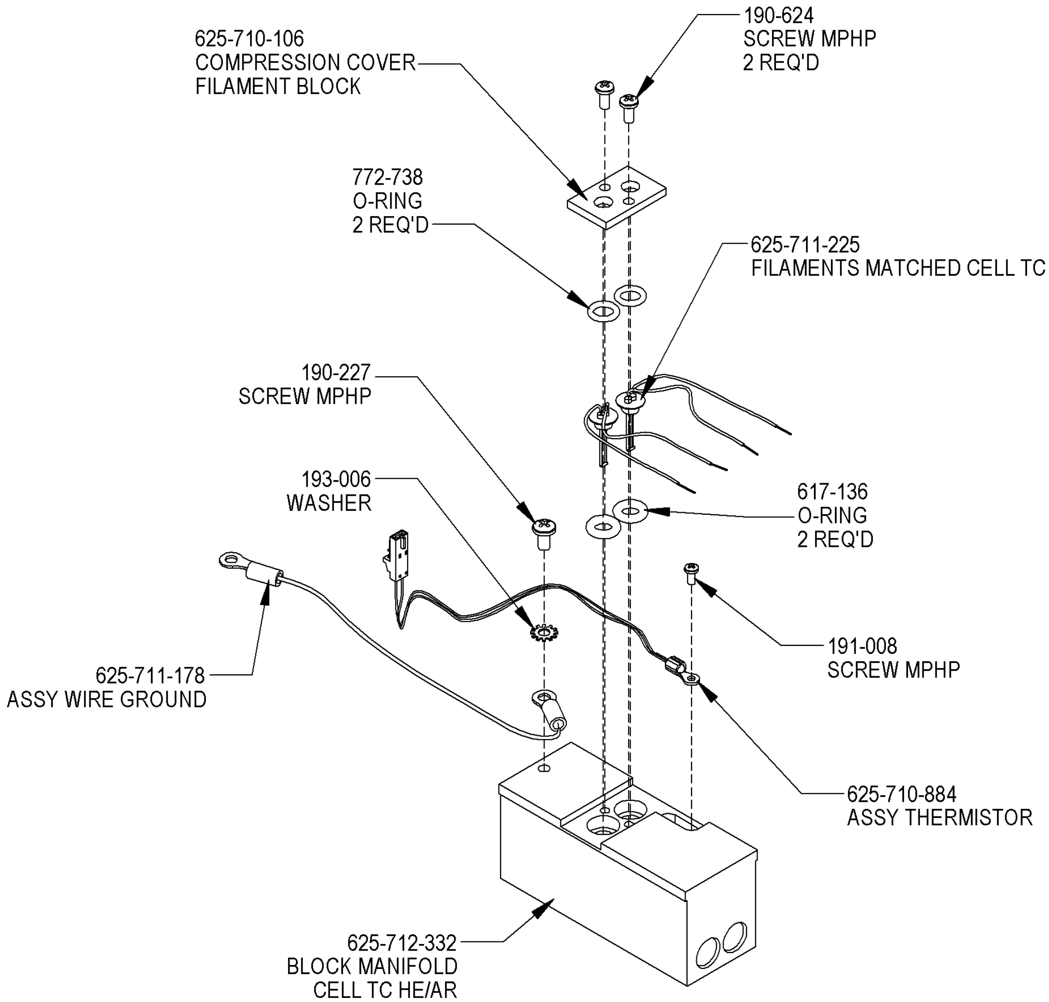


Figure 10-101
Flow Card and Bracket Assembly



SHEET 1:5
625-603-199-ILS-J

Figure 10-102
He/Ar TC Cell Assembly 1 of 5

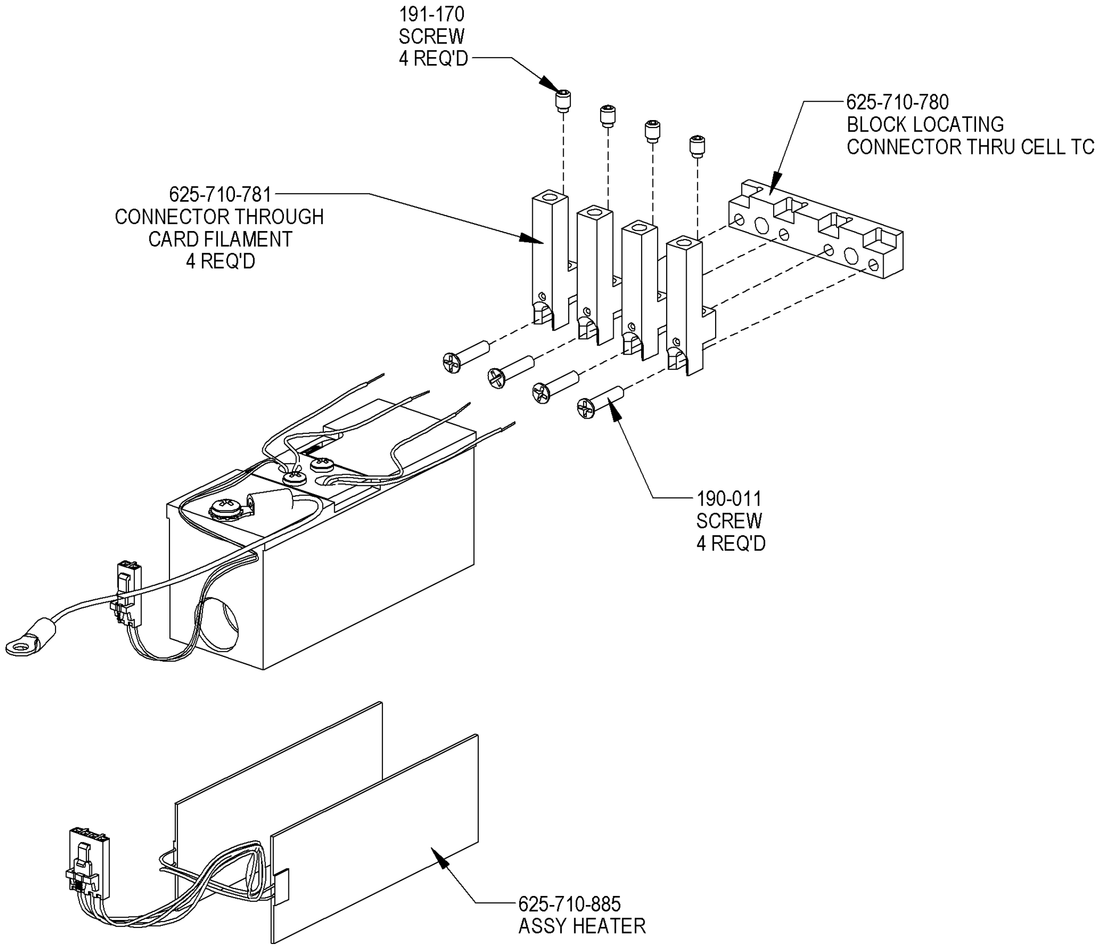
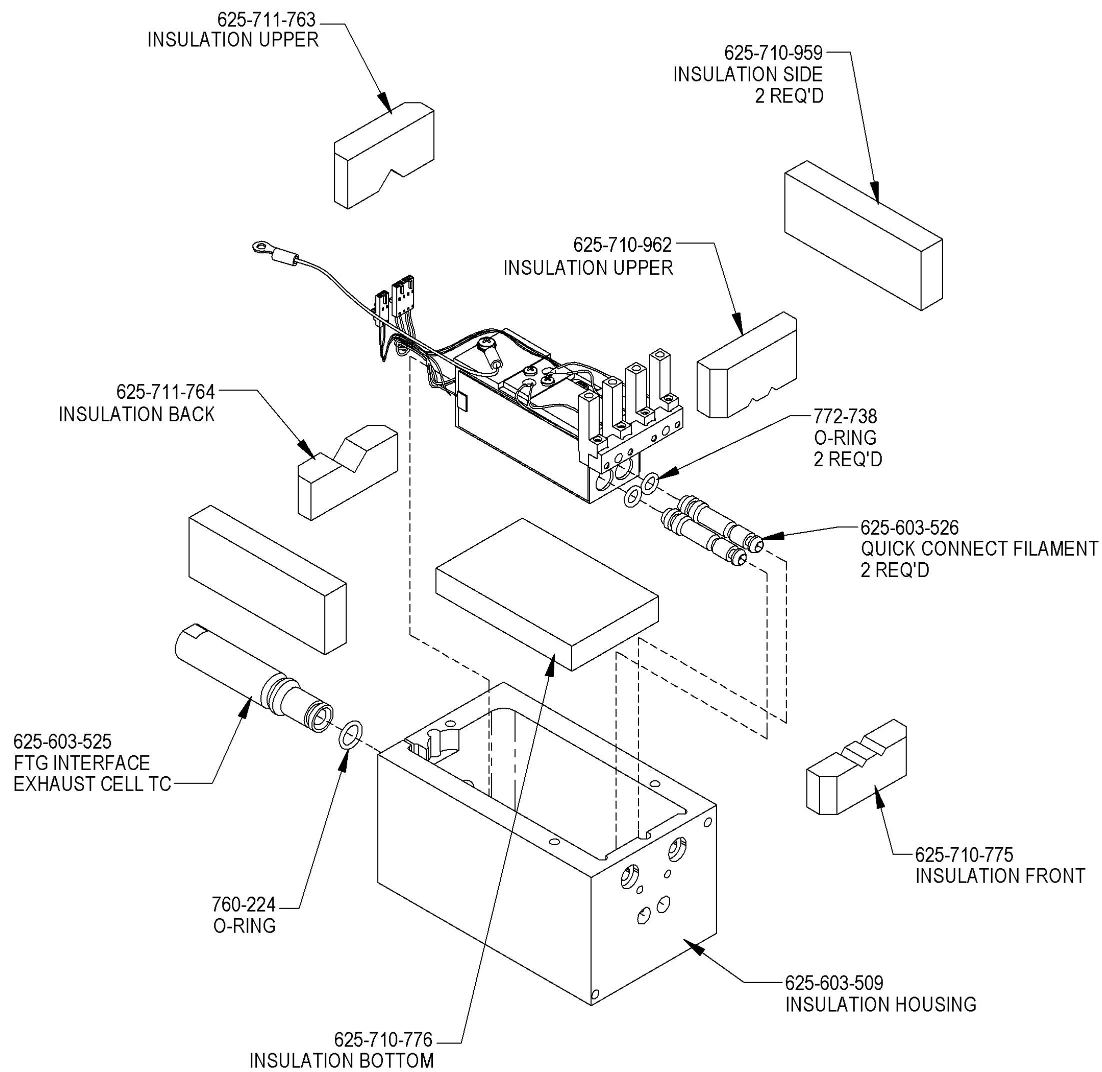
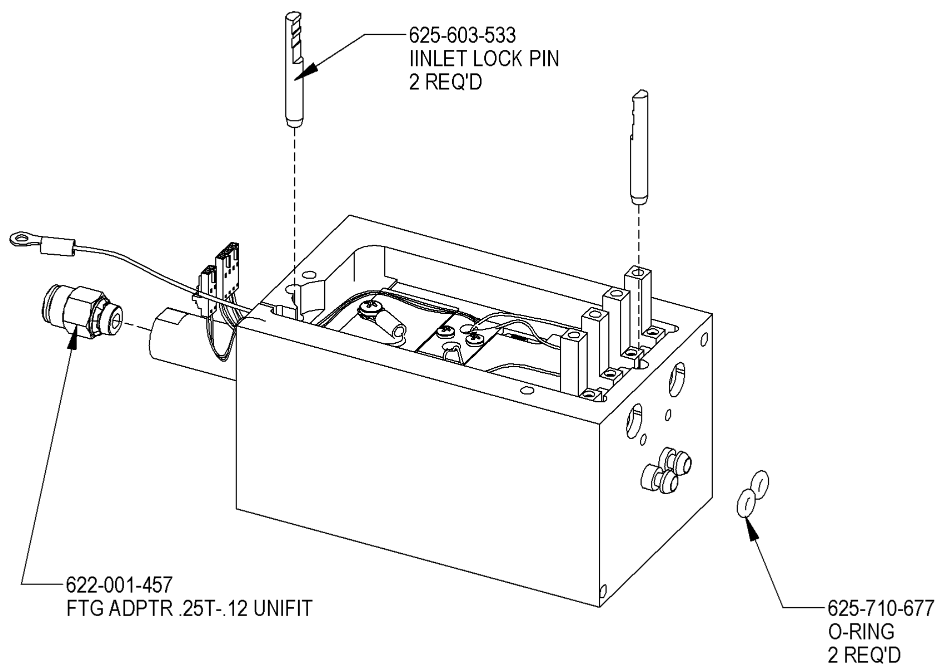


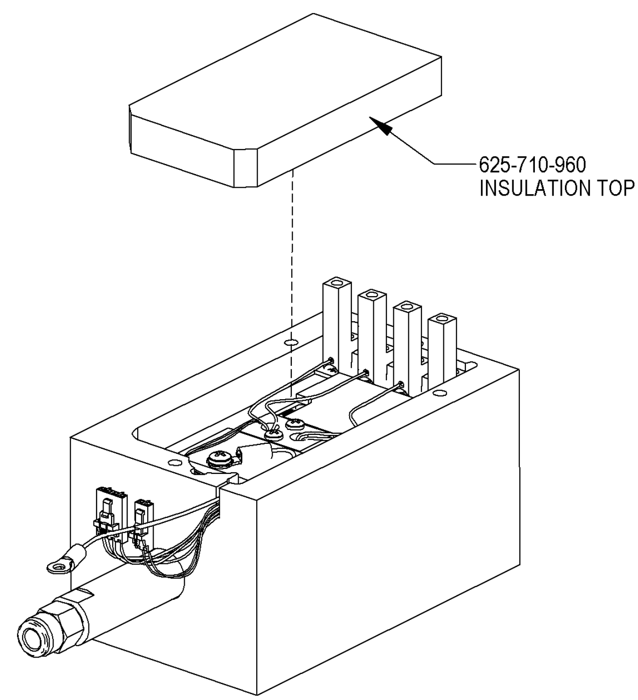
Figure 10-103
He/Ar TC Cell Assembly 2 of 5



SHEET 3:5
625-603-199-ILS-J

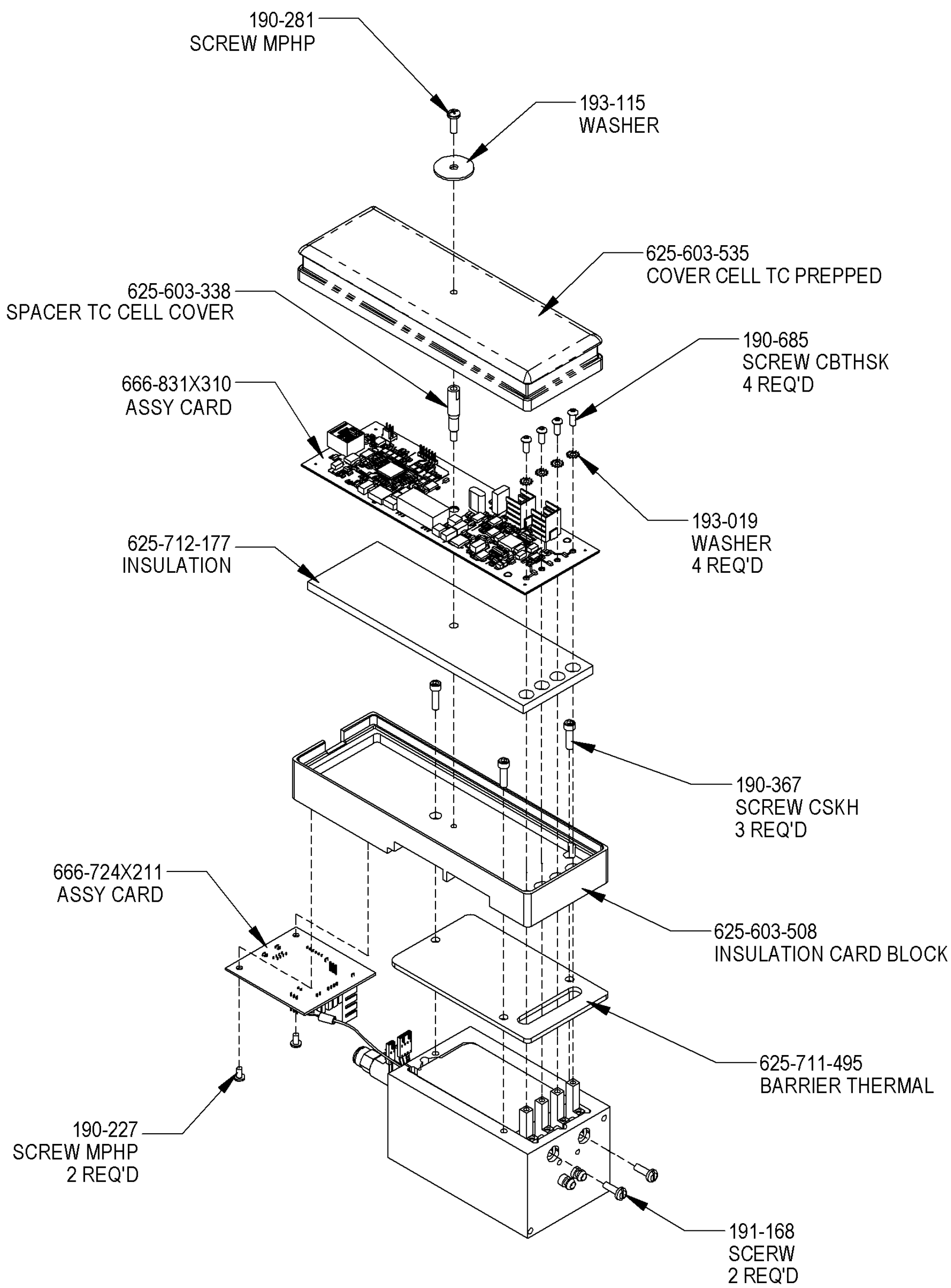
Figure 10-104
He/Ar TC Cell Assembly 3 of 5





SHEET 4:5
625-603-199-ILS-J

Figure 10-105
He/Ar TC Cell Assembly 4 of 5



X = ASSY CARD REVISION AS INDICATED BY WORK ORDER OR KIT COMPONENT

SHEET 5:5
625-603-199-ILS-J

Figure 10-106
He/Ar TC Cell Assembly 5 of 5

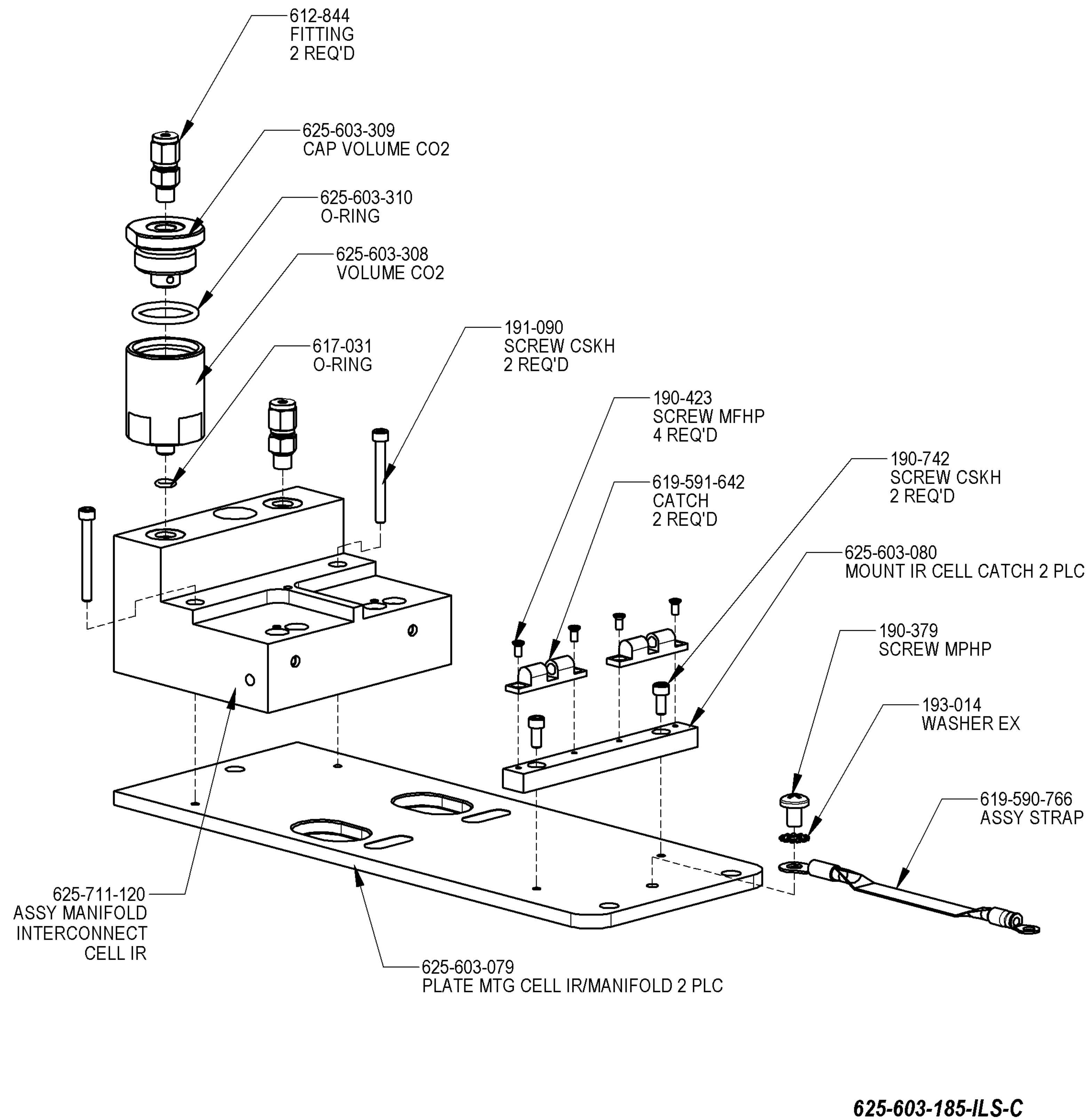


Figure 10-107
IR Cell Manifold Assembly
(CN828 model only)

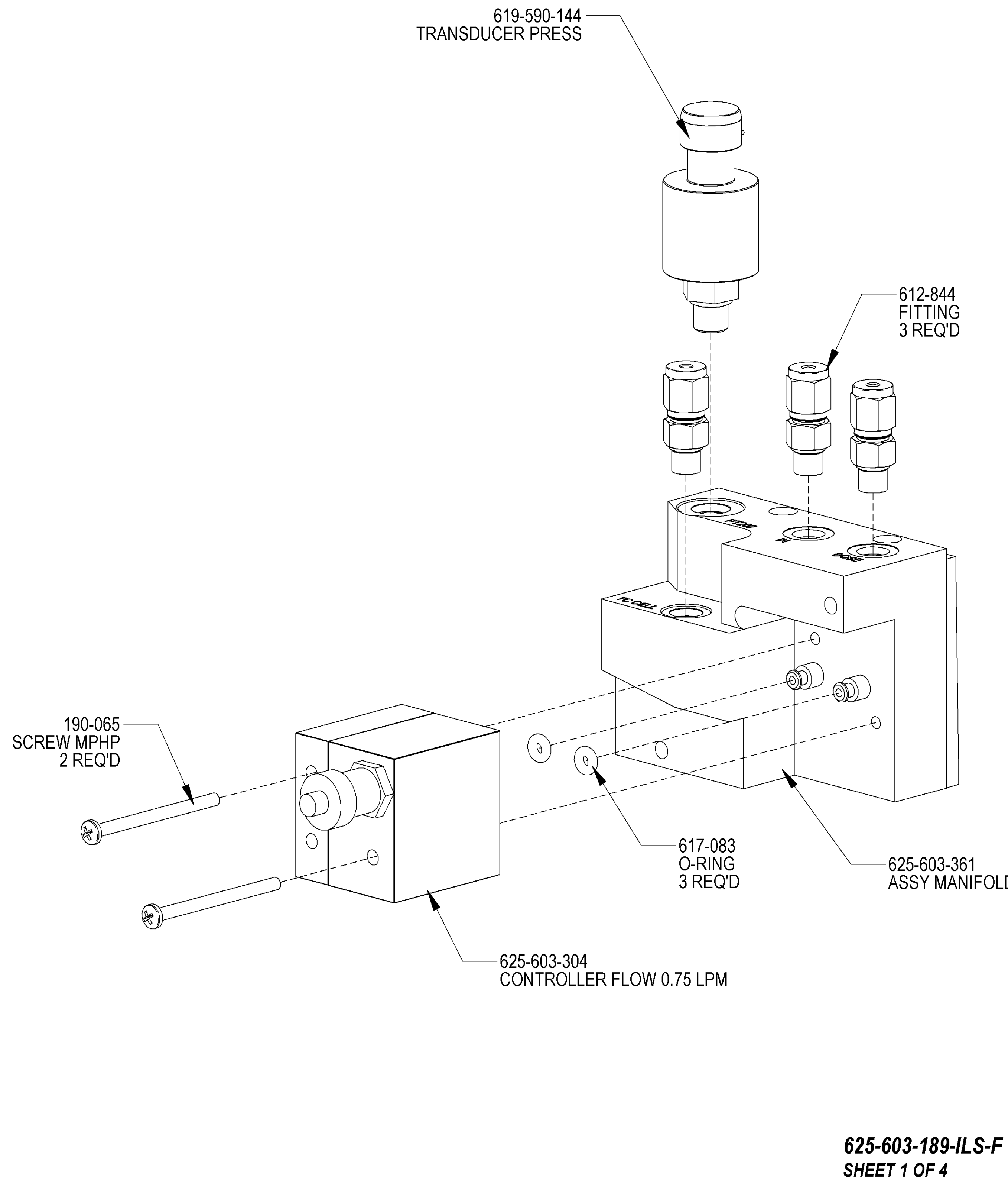


Figure 10-108
TC Cell Manifold Assembly 1 of 4

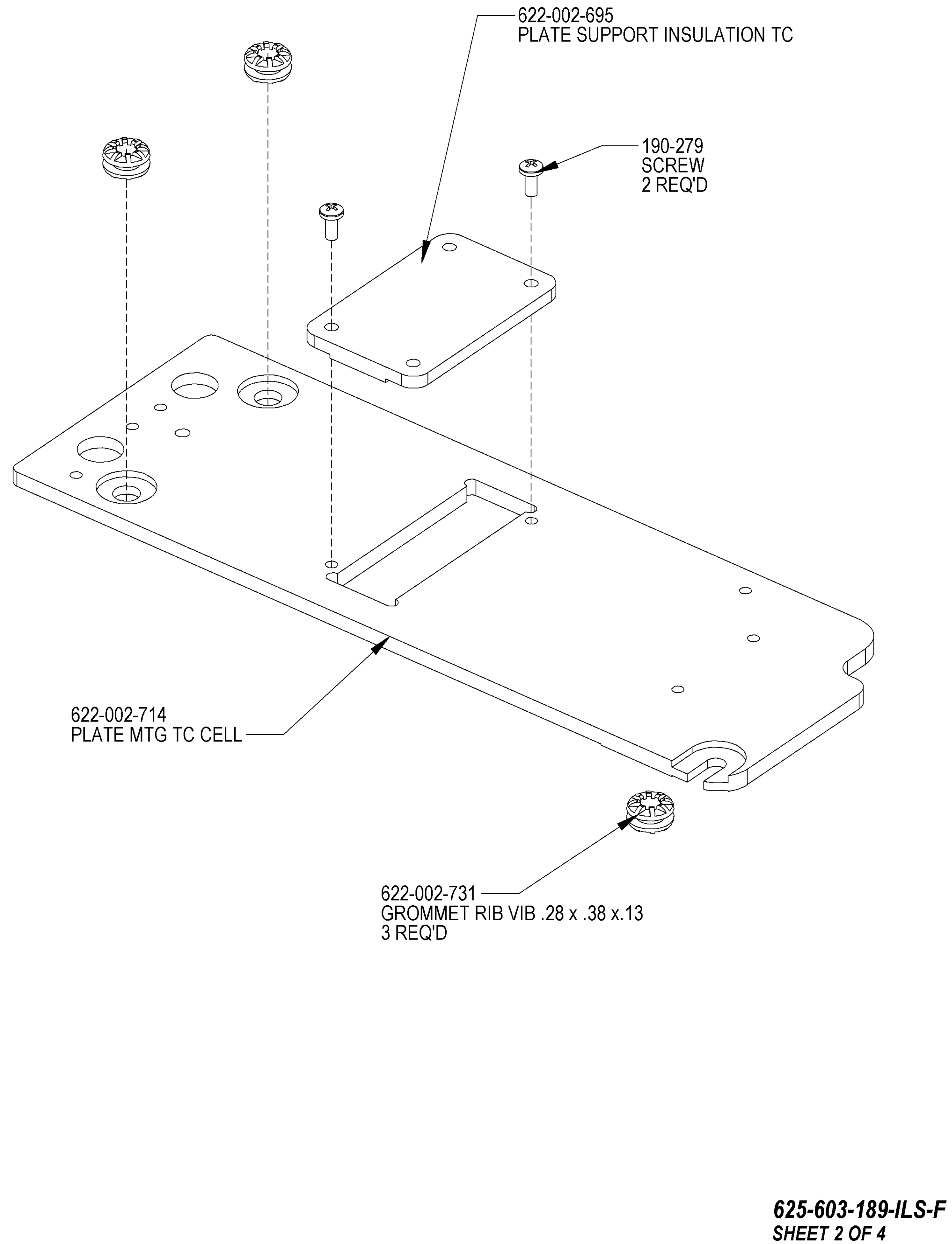


Figure 10-109
TC Cell Manifold Assembly 2 of 4

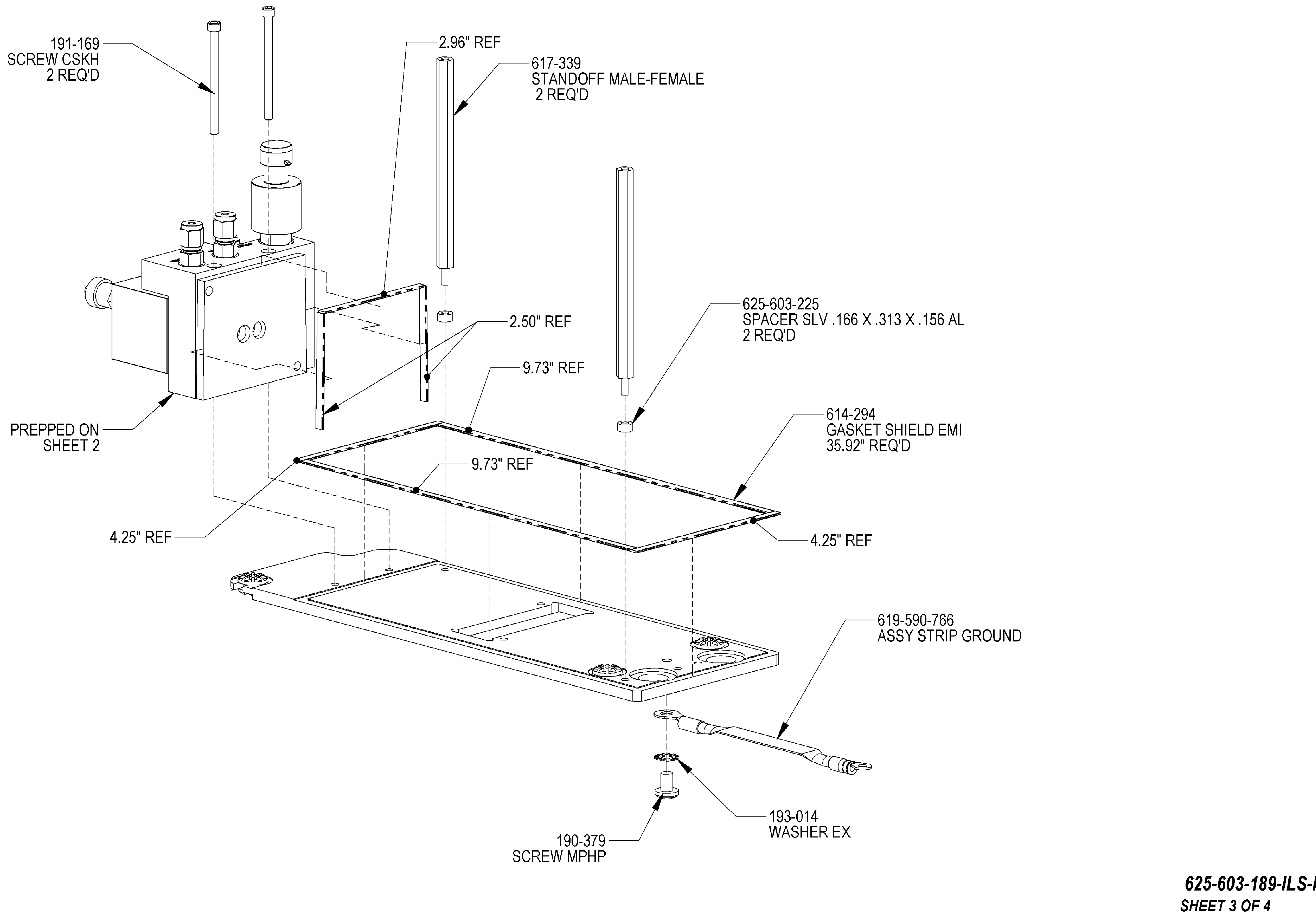


Figure 10-110
TC Cell Manifold Assembly 3 of 4

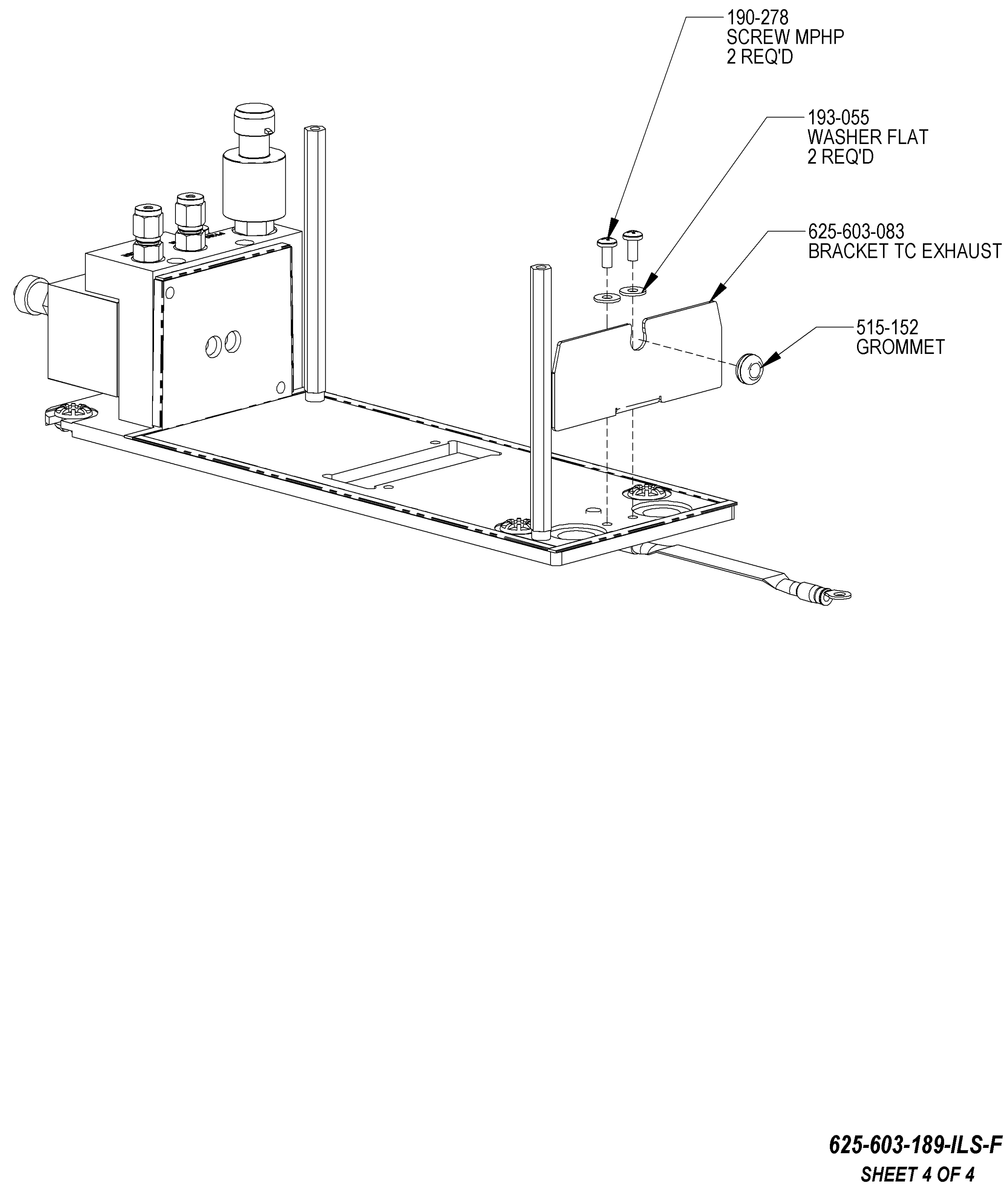


Figure 10-111
TC Cell Manifold Assembly 4 of 4

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11 Schematics

The Schematics chapter provides electronic information for service of the instrument. For part numbers of circuit boards, assemblies, and components, refer to the schematic diagrams.

NOTE This section includes only the pages of the schematic drawings that are applicable for service of the instrument.

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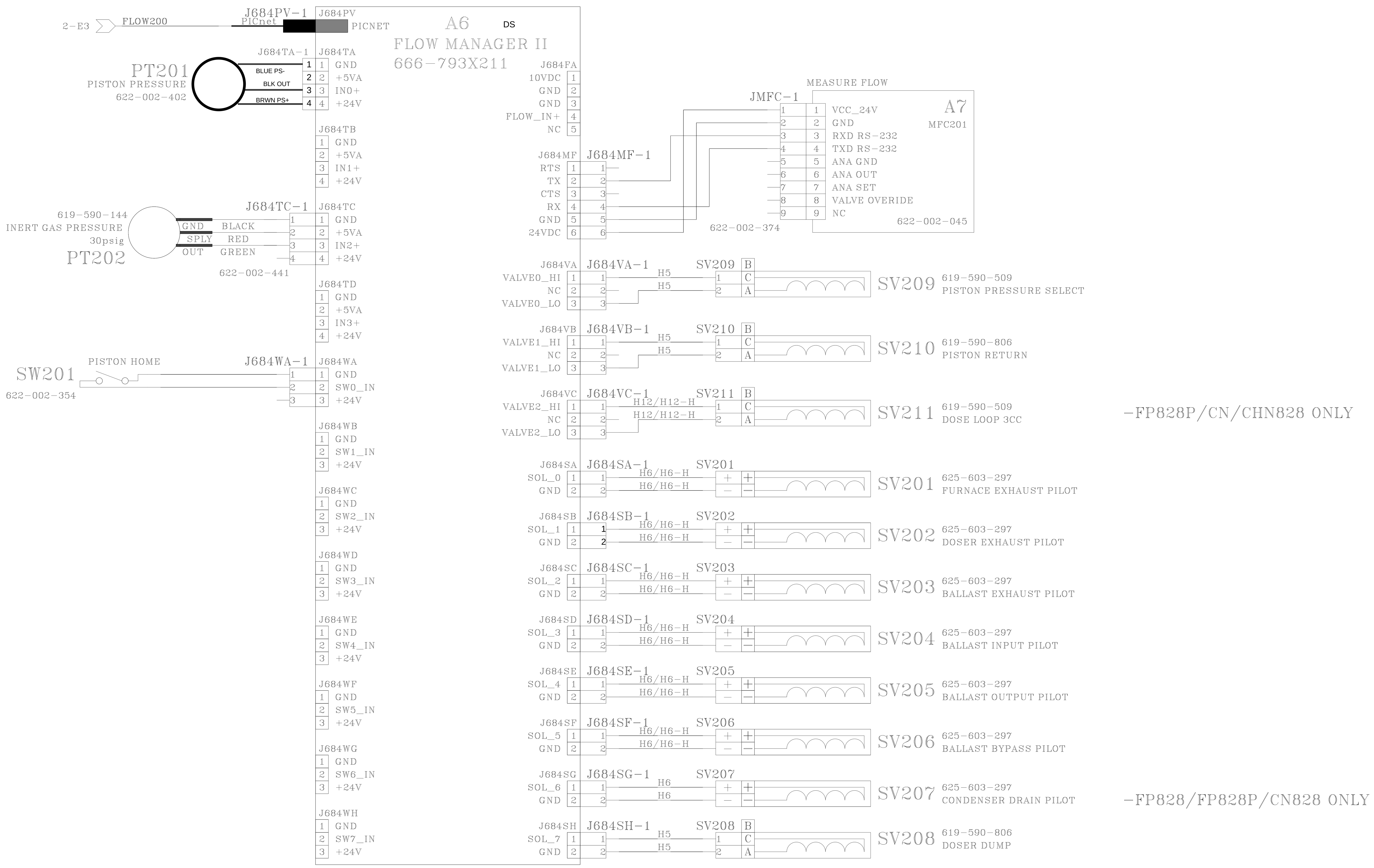
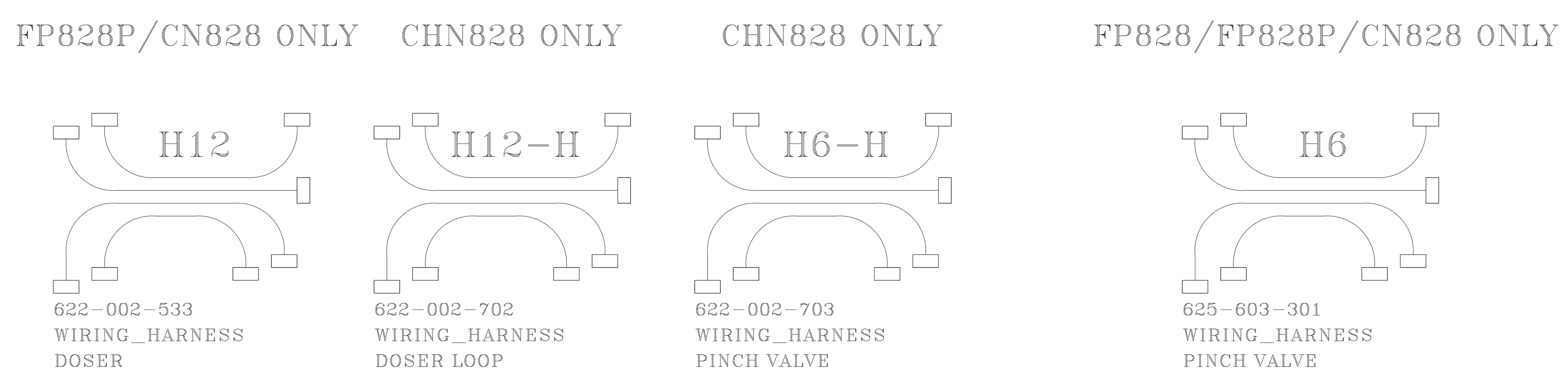
Name: 151-061
Location: TOP-TopTop
Module Sheet 2
2 OF 7
AC DISTRIBUTION
POWER ENTRY
LINE_CORD
709-806-720
LC1
230V
LINE_FILTER
LOAD
GND
20A
FL1
626-001-559
CB1
15A
LINE
MAIN_BREAKER
789-320
H1
PROTECTIVE EARTH GROUND.
THIS GRAPHIC IS TO BE
STAMPED NEXT TO
CONNECTION.
GND
AC-DISTRIBUTION
666-796X
J695F
J695E
J695D
J695C
HIGH VOLTAGE
WARNING
FOR CGND CONNECTION
USE METAL STANDOFF
A1
J695K
H2 PRIMARY_FURNACE_L1 6-E1
H2 PRIMARY_FURNACE_L2 6-E1
J695J
H2 AFTERBURNER_L1 6-E6
H2 AFTERBURNER_L2 6-E6
J695H
H2 BALLAST_OVEN_L1 6-C6
H2 BALLAST_OVEN_L2 6-C6
J695G
H2 REDUCTION_TUBE_L1 6-C1
H2 REDUCTION_TUBE_L2 6-C1
J695L
CGND
SURGE
634-101-101
POWER SUPPLY
PS1
24V
PWR_SUPPLY
709-811-642
DC DISTRIBUTION
PIC32_DISTRIBUTION_CARD
J670A 24GND NC +24VDC REMOTE SENSE
ETHERNET J670EA
620-682
TO PC
J670 +24V_BULK GND_BULK POWER INPUT
625-603-270
4-B4 FLOW200 1' PICnet 622-002-541 J670PD
5-B7 TC_CELL H9 2' PICnet 619-590-807 J670PE
5-D7 TC_CELL_HTR H9 2' PICnet 619-590-807 J670PF
666-755X510
A2
J670PK PICnet 2' 622-002-741 IR_CELL_6_H2O 5-D1
J670PL PICnet 1' 622-002-547 IR_CELL_0.725_CO2 5-B1
J670PM PICnet 3' H10/H11 619-590-808 FLOW100 3-B3
J670PN PICnet 5' H10/H11 625-710-787 REDUCTION_TUBE 6-B1
J670PP PICnet 2' H11 619-590-807 BALLAST_OVEN 6-B6
J670PR PICnet 3' H10/H11 619-590-808 AFTERBURNER 6-E6
J670PS PICnet 3' H10/H11 619-590-808 PRIMARY_FURNACE 6-E1
J670PY +24V_PWR/4A CAN_HI GND CAN_LO
J670PZ +24_TEC 7-B2 CANHI_TEC 7-B2 GND_TEC 7-B2 CANLO_TEC 7-B2
625-603-407
J670AE +24V_PWR/1.5A GND PWM_OPEN_COLLECTOR GND
J670AF +24V_PWR/1.5A PWM_PULLUP GND GND
J670AG +24V_PWR/1.5A PWM_PULLUP NC GND
J670AA J670AB J670AC J670AD +24V_PWR/1.5A GND
FAN1
COOLING FAN
625-515-190
+ RED
SENSOR YELLOW
CNTRL BROWN
− BLACK
J50 J50
622-002-416
J670AH +24V_PWR/1.5A PWM_PULLUP PWM_OPEN_COLLECTOR GND
J755D J812 +5V SDA SCL GND
A3
666-812X
AMBIENT_MONITOR_CARD
H9
622-002-542
WIRING_HARNESS
TC CELL 828
H10
622-002-514
WIRING_HARNESS
E-CAT FP
H11
622-002-347
WIRING_HARNESS
E-CAT CN/FPP
H1
622-002-526
WIRING_HARNESS
AC DISTRIBUTION
H2
622-002-413
WIRING_HARNESS
HARNESS AC
LECO®
St. Joseph, Michigan USA
Description
Schematic CABINET
CN/FP/CHN828
Part Number
151-061
Rev
D
Date: 14/05/2020:10:45
Type M
Schematic Sheet 2 OF 7

FLOW 100 CARD
A4
FLOW MANAGER II
666-793X210
2-E8
FLOW100
PICnet
J684PV-0
J684PV
PICNET
FP828P/CN/CHN828 ONLY-
PT101
619-591-110
INCOMING OXYGEN
50psig
PT102
619-590-144
FURANCE PRESSURE
30psig
PT103
625-601-790
BALLAST PRESSURE
30psia
GND BLACK
SPLY RED
OUT GREEN
J684TA-0
J684TB-0
J684TC-0
622-002-442
622-002-443
622-002-444
J684TA GND +5VA IN0+ +24V
J684TB GND +5VA IN1+ +24V
J684TC GND +5VA IN2+ +24V
J684TD GND +5VA IN3+ +24V
FP828 ONLY-
SW101
691-102-866
OXYGEN PRESSURE
SWITCH
C H4
NO H4
J684WA-0
J684WA GND SW0_IN +24V
J684WB GND SW1_IN +24V
J684WC GND SW2_IN +24V
J684WD GND SW3_IN +24V
J684WE GND SW4_IN +24V
J684WF GND SW5_IN +24V
J684WG GND SW6_IN +24V
J684WH GND SW7_IN +24V
J684PA 10VDC GND GND FLOW_IN+ NC
J684MF RTS TX CTS RX GND 24VDC
J684MF-0
622-002-376
FURNACE FLOW
JMFC-0
A5
MFC101
VCC_24V
GND
RXD RS-232
TXD RS-232
ANA GND
ANA OUT
ANA SET
VALVE OVERIDE
NC
622-002-045
-FP828P/CN/CHN828 ONLY
J684VA VALVE0_HI NC VALVE0_LO
J684VA-0
H4-FP/H4-H
SV110
SV110 619-592-488 OXYGEN FLOW LOW
-FP828 ONLY
J684VB VALVE1_HI NC VALVE1_LO
J684VB-0
H4-FP/H6-H
SV111
SV111 619-592-488 OXYGEN FLOW MED
-FP828 ONLY
J684VC VALVE2_HI NC VALVE2_LO
J684VC-0
H4-FP/H6-H
SV112
SV112 619-592-488 OXYGEN FLOW HIGH
-FP828 ONLY
J684SA SOL_0 GND
J684SA-0
H3
SV101
SV101 619-590-837 INERT GAS INLET
J684SB SOL_1 GND
J684SB-0
SV103
SV103 619-590-837 INERT GAS EXHAUST
J684SC SOL_2 GND
J684SC-0
SV104
SV104 619-590-837 OXYGEN INLET
J684SD SOL_3 GND
J684SD-0
J684SE SOL_4 GND
J684SE-0
SV106
SV106 619-590-509 PNEUMATIC INLET
J684SF SOL_5 GND
J684SF-0
H5
SV107
SV107 619-590-806 FURNACE SEAL
J684SG SOL_6 GND
J684SG-0
SV108
SV108 619-590-806 SLIDE BLOCK CLOSE
J684SH SOL_7 GND
J684SH-0 J49 J49
J51 J51
SV109 622-002-317 SAMPLE DROP
622-002-439
622-002-438
CHN828 ONLY
J684VA-0
H4
SV110
SV110 619-592-488 H2O CONSERVE
J684VB-0
SV111
SV111 625-603-297 H2O FILL
J684VC-0
SV112
SV112 625-603-297 H2O EXHAUST
CHN828 ONLY
FP828 ONLY
H4-H
622-002-701
WIRING_HARNESS
H2O CONSERVE
H3
622-002-355
WIRING_HARNESS
INCOMING GAS
H4-FP
622-002-468
WIRING_HARNESS
LOW O2 FLOW
H5
622-002-461
WIRING_HARNESS
PNEUMATIC
Name: 151-061
Location: TOP-TopTop
Module Sheet 3
3 OF 7
LECO®
St. Joseph, Michigan USA
Description
Schematic CABINET
CN/FP/CHN828
Part Number
151-061
Rev
D
Date: 14/05/2020:10:45
Type M
Schematic Sheet 3 OF 7

FLOW 200 CARD





LECO® St. Joseph, Michigan USA

Description
Schematic CABINET
CN/FP/CHN828

Part Number 151-061 | Rev D

Date: 14/05/2020:10:45 | Type M

TC CELL ASSY - 625-603-199

IR CELLS IN 828 DERIVATIVES

	0.725" CO2	6" H2O
MODEL	619-590-934	619-590-935
FP828		
FP828P		
CN828	PRESENT	
CHN828	PRESENT	PRESENT

LECO® St. Joseph, Michigan USA

Description
Schematic CABINET
CN/FP/CHN828

Part Number 151-061 | Rev D

Date: 14/05/2020:10:45 | Type M

Name: 151-061
Location: TOP-TopTop
Module Sheet 6 OF 7

LECO® St. Joseph, Michigan USA

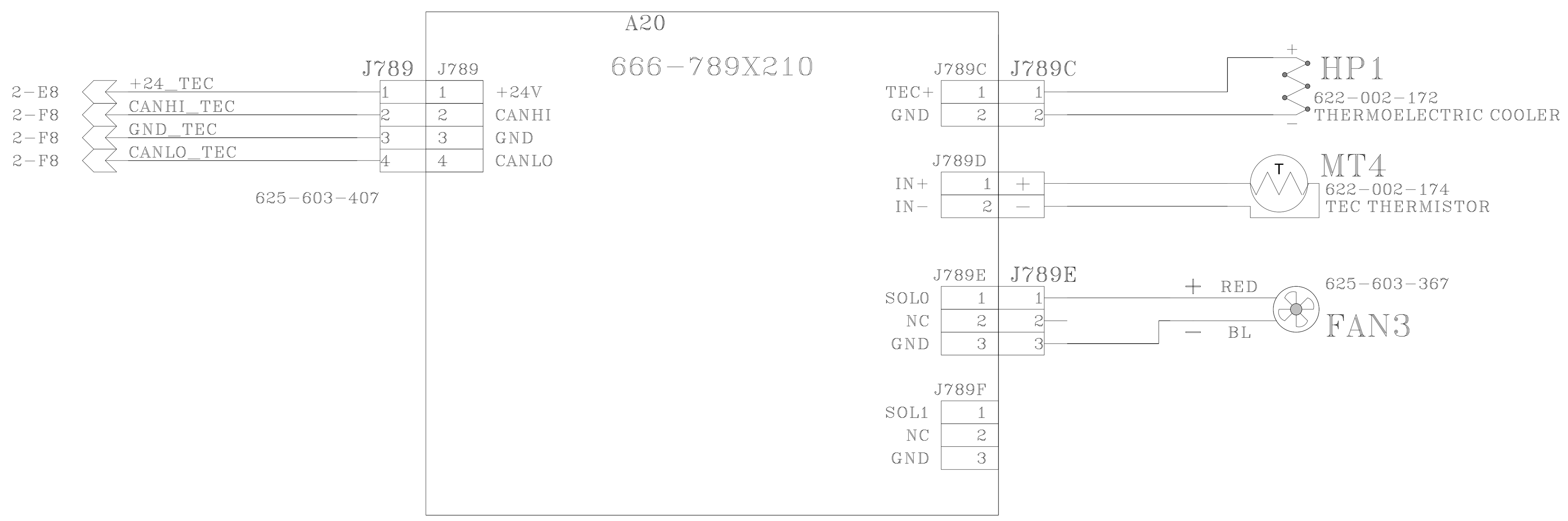
Description
Schematic CABINET
CN/FP/CHN828

Part Number 151-061 | Rev D

Date: 14/05/2020:10:45 | Type M

Schematic Sheet 6 OF 7

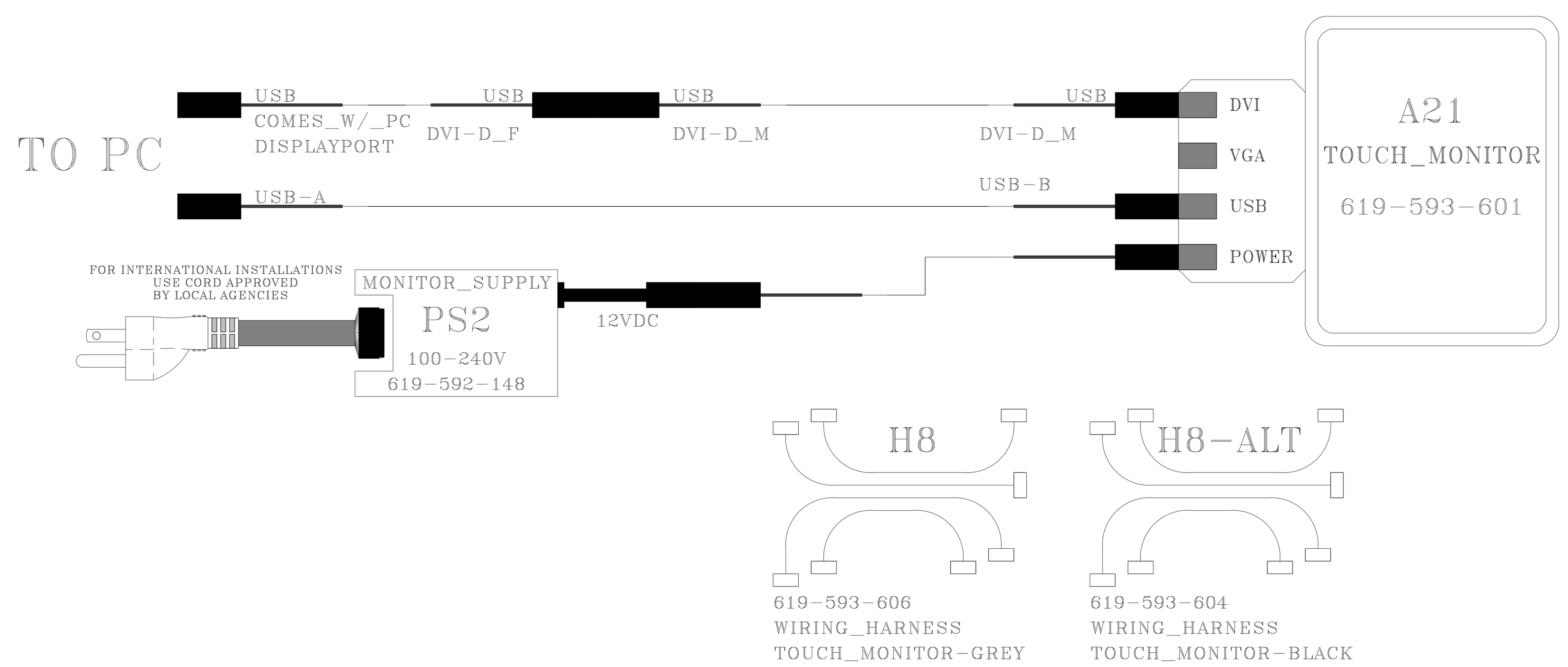
THERMOELECTRIC COOLER



CST THERMOELECTRIC COOLER CTRL

FP828/FP828P/CN828 ONLY

TOUCH MONITOR CONNECTIONS



12 Glossary

A

Absolute Error—Plots the absolute error versus the certified mass of the sample. Absolute Error = Calculated – Certified.

Accuracy—Closeness of a measured value to the true value.

Analysis Date—The date and time the analysis completed.

Analysis Time—The length of time the instrument is in the analysis state after the analytes are introduced and until the final result is displayed.

Analyte—The specific component measured in a chemical analysis.

B

Baseline—Electronic line determined as the zero or reference line that is used to differentiate the actual analyte composition.

Bias—Deviation of a measurement process from the true or accepted value.

C

Calibration Curve—A series of standard samples containing known compositions of the analyte are analyzed. These standards should cover the range of interest and have a matrix composition as similar to the samples as possible. A blank sample must be analyzed and subtracted from each of the standard samples. The certified mass, in grams, is plotted along the x-axis, while adjusted area (Aadj) is plotted along the y-axis for each of the analyzed standard samples. The curve that best fits the plotted points is the calibration curve.

Calibration Factor—The slope of the obtained calibration curve.

Calibration Plot—Displays the adjusted area versus the certified mass of the sample.

Cell—Refer to **Detector.**

Check Standard—A standard whose purpose is to assess the accuracy of a measurement.

D

Detector—A device that produces a voltage change in response to a change in the composition of the material in its flow cell.

F

Forced Through Origin—A calibration curve in which the y-intercept is forced to equal zero, and the polynomial coefficients are determined numerically to minimize the total error between the "best-fit" polynomial and the measured values.

Full Regression—A calibration curve in which the polynomial coefficients and the y-intercept are determined numerically to minimize the total error between the "best-fit" polynomial and the measured values.

M

Mass—The quantity of matter in an object. In the software, mass is the equivalent of weight in the keypad software. Default Unit—gram.

Mass Ratio—A measure of composition in which the analyte mass is computed as a ratio of the sample mass.

$$MassRatio = \frac{analyte(g)}{sample(g)}$$

O

Origin—The intersection of the X and Y axes. On the calibration curve, this is zero certified mass and zero adjusted area.

Orphan—The database keeps track of data objects such as samples, calibrations, standards, methods, etc., that are associated with each other. Orphan database objects are created when the connection between data objects is broken due to a rare occasion, such as when a sample is deleted and the software does not perform the save correctly.

P

Peak—When the analyte passes through the detector, there is a change in the voltage that is proportional to the amount of analyte in the detector. After the analyte is passed, the voltage returns to normal. The region of this voltage change is the peak.

ppm—parts per million

Precision—Variability of the individual results of replicate measurements.

R

Relative Error—Plots the percent relative error versus the certified mass of the sample. Percent Relative Error =100*[(xi-xt)/xt], when xi is Calculated Value and xt is Certified Value.

Rounding—Rounding a numerical value means replacing it with another value that is approximately equal to but easier to report and communicate than the original value, which would otherwise be misleadingly precise. Numerical values in Cornerstone® are rounded to the nearest digit; midpoint values are rounded to the next number away from zero. For example, 3.75 rounds to 3.8, 3.85 rounds to 3.9; -3.75 rounds to -3.8, and -3.85 rounds to -3.9.

S

Sample—A determined mass of a substance of unknown analyte composition. The analyte composition will be determined by performing the analysis.

T

Tare—Sets the balance display to zero.

W

Weighting Factor—A factor used to alter the significance of the measured values in a calibration curve.

13 Index

A

B

I

L

M

N

O

P

Q

R

S