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Varian, Inc.
2700 Mitchell Drive
Walnut Creek, CA 94598-1675/usa

Saturn® 2000 GC/MS

Hardware Manual

QUALITY SYSTEM ISO 9001 CERTIFIED

©Varian, Inc. 2002-2003
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CE

Declaration of Conformity

We hereby Declare that the equipment listed below complies with the requirements of:
The Low Voltage Directive 73/23/EEC (93/68/EEC)
The EMC Directive 89/336/EEC (92/31/EEC and 93/68/EEC)

Applicable Standards

LVD	EN 61010
EMC	EN 50082-1 EN 55011
TUV File Number(s):	E9672056 P9672055
Type of Equipment:	Mass Spectrometer **Model:** Saturn 2000 Series

Authorized Representative in the EU

Print Name: G. A. Wassink

Signed: _____

Position: Quality Manager

Date: October 16, 2001

Company Name: Varian B.V.
Address: Herculesweg 8
P.O. Box 8033
4330 EA Middelburg
The Netherlands
Telephone: +31(0) 118 671 000
Fax: +31(0) 118 633 118

Manufacturer

Print Name: Martin O'Donoghue

Signed: _____

Position: General Manager

Date: October 16, 2001

Company Name: Varian, Inc.
Address: 2700 Mitchell Drive
Walnut Creek, California 94598
USA
Telephone: 925-939-2400
Fax: 925-945-2168

03-914535-12:7
SPEC. 03-914411-00 1:2:3:4n

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Quality Systems At Varian, Inc.

The ISO 9000 series standards were created in Geneva in 1987 to cut through a morass of conflicting quality definitions. These standards define a model for quality assurance systems in product design, development, manufacturing, installation, service, and customer support. They are now the worldwide quality assurance benchmark used to gauge the strength of a company's commitment to quality, and the value of its quality systems.

Various organizations around the world, such as the British Standards Institution (BSI), provide certified, objective auditors to scrutinize quality procedures, product development, manufacturing processes, and customer satisfaction programs. No company can claim ISO 9000 series registration unless it receives a stamp of approval from the demanding quality assessors of BSI or similar accredited examining body. ISO 9000 series registration constitutes an objective third-party report to determine the level of a supplier's commitment to quality.

In 1992, Varian, Inc., Analytical Instruments became registered to the most comprehensive of the ISO 9000 series standards — ISO 9001. ISO 9001 registration means that every stage of our quality system, including product development, manufacturing, final test, shipping, and parts and supplies has been rigorously examined against the most exacting set of internationally recognized standards. It means we live up to a standard of quality that you can count on today, and into the future. Our Quality System has received ISO 9001 certification number FM21797.

The quality systems that earned us ISO 9001 registration have direct benefits for our customers:

- We can speed instruments to you faster than ever before. Emergency orders can be processed even faster.
- We fill your orders promptly and completely.
- We have implemented a system of continuous feedback from our customers — we are aware of your needs today and tomorrow.
- We have improved your productivity by cutting systems failure rates in half and speeding service response time.
- We have embedded continuous improvement into the fabric of our organization so that we can achieve even higher levels of quality in the future.
- We are embedding GLP requirements into our products and services to help you meet your regulatory compliance requirements.

ISO 9001 registration is not enough. For us, quality is defined by our customers. We are not satisfied unless you are satisfied. We are striving to understand customer needs, using independent surveys, user groups, customer advisory boards, and our “Hallmark of Quality” response program, in addition to individual face-to-face customer contact. Our products and our processes are configured to meet those needs.

We know that you are seeking more than the most advanced processes and top-notch applications expertise. You want to join forces with a partner committed to delivering world-class quality, reliability, and value — on time, every time.

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Our overriding aim is to be that partner.

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Qualitätssysteme bei Varian, Inc.

Die Standards der ISO 9000 Serien wurden 1987 in Genf mit dem Ziel geschaffen, das Durcheinander gegensätzlicher Qualitätsbestimmungen zu entwirren. Diese Standards legen ein Modell für Qualitätssicherungssysteme hinsichtlich Produktdesign, Entwicklung, Herstellung, Installation, Service und Kundenbetreuung fest. Sie sind nun die weltweiten Maßstäbe der Qualitätssicherung, die die Anstrengungen eines Unternehmens bezüglich der Qualität und der Bedeutung seiner Qualitätssysteme messen.

Verschiedene Organisationen in der ganzen Welt, wie die British Standards Institution (BSI), stellen ausgebildete, objektive Prüfer zur Begutachtung von Qualitätsmaßnahmen, Produktentwicklung, Herstellungsprozessen und von Programmen zur Erforschung der Kundenzufriedenheit zur Verfügung. Kein Unternehmen kann die ISO 9000 Registrierung beantragen, ohne die Genehmigung von den beauftragten Qualitätsgutachtern der BSI oder einer ähnlichen akkreditierten Stelle erhalten zu haben. Die ISO 9000 Registrierung bildet einen objektiven Bericht von dritter Seite, um den Grad der Qualitätsanstrengung eines Lieferanten zu bestimmen.

1992 wurden die Varian, Inc., Analytical Instruments nach den umfassendsten Standards der ISO 9000 Serie registriert — ISO 9001. Die ISO 9001 Registrierung bedeutet, daß jedes Stadium unseres Qualitätssystems, einschließlich Produktentwicklung, Herstellung, Endkontrolle, Versand, sowie Teile und Zubehör rigoros gegen die anspruchsvollste Serie international anerkannter Standards geprüft worden ist. Das bedeutet, daß wir einen Qualitätsstandard bieten, auf den Sie heute und in Zukunft rechnen können. Unser Qualitätssystem hat die ISO 9001 Zertifikatnummer FM21797 erhalten.

Die Qualitätssysteme der ISO 9001 Registrierung haben für unsere Kunden direkte Vorteile:

- Wir können Instrumente schneller denn je zu Ihnen schicken. Eilbestellungen werden noch schneller durchgeführt.
- Wir erfüllen Ihre Bestellungen pünktlich und vollständig.
- Wir haben ein System kontinuierlichen Informationsrückflusses von unseren Kunden aufgebaut—wir kennen Ihre Anforderungen von heute und von morgen.
- Wir haben Ihre Produktivität durch Halbierung der Systemfehlerraten und durch Verkürzung unserer Reaktionszeit im Service verbessert.
- Wir haben kontinuierliche Verbesserungen in unserer Organisationsstruktur verankert, so daß wir künftig eine noch höhere Qualität erreichen können.
- Wir haben die GLP Anforderungen in unsere Produkte und Dienstleistungen eingeführt, um Ihnen bei der Erfüllung Ihres behördlichen Abnahmeprotokolls zu helfen.

Die ISO 9001 Registrierung ist nicht genug. Für uns wird Qualität durch unsere Kunden definiert. Wir sind nicht zufrieden, wenn Sie es nicht auch sind. Wir bemühen uns, die Anforderungen unserer Kunden durch unabhängige Untersuchungen, Anwendergruppen, Kundenberatungsgremien und unser Antwortprogramm “Gütesiegel der Qualität” zu verstehen, zusätzlich zu persönlichen Kundenkontakten. Unsere Produkte und unsere Prozesse sind so gestaltet, daß sie diese Anforderungen erfüllen.

Wir wissen, daß Sie mehr als fortschrittliche Prozesse und ausgezeichnetes Anwendungswissen suchen. Sie suchen einen Partner, der Qualität von Weltklasse, Verläßlichkeit und Nutzen für Sie liefert— pünktlich und jederzeit.

Unser oberstes Ziel ist, für Sie dieser Partner zu sein.

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Systèmes de qualité chez Varian, Inc.

Les normes ISO série 9000 ont été créées à Genève, en 1987, pour remédier à la confusion dans la définition des normes de qualité. Ces normes définissent un modèle de contrôle de qualité dans le domaine de la conception produit, du développement, de la production, des installations, des services et du support client. Elles constituent à présent la référence mondiale en matière de contrôle de qualité utilisée aux fins d'évaluation du niveau d'engagement d'une entreprise dans ce domaine et la valeur de ses systèmes de qualité.

Plusieurs organisations de par le monde, telle la British Standards Institution (BSI) offrent les services d'auditeurs qualifiés et objectifs, chargés d'examiner les procédures de qualité, le développement de produit, les procédés de fabrication et les programmes de satisfaction du client.

Aucune société ne peut se prévaloir de l'homologation ISO 9000, sans avoir reçu l'approbation des évaluateurs rigoureux de la BSI ou d'un organisme accréditif similaire. L'homologation ISO 9000 constitue une évaluation objective d'un tiers afin de déterminer le niveau d'engagement d'un fournisseur dans le domaine de la qualité.

En 1992, Varian, Analytical Instruments a reçu l'homologation ISO 9001, normes des plus complètes de la série IS0 9000. En d'autres termes, chaque étape du processus de qualité, notamment le développement produit, la fabrication, le test final, l'expédition et les fournitures de pièces a étés oumis à un contrôle rigoureux par rapport à des normes extrêmement strictes, reconnues au niveau international. Nous sommes donc à même de vous garantir et de maintenir un niveau de qualité. Lesdites procédures ont reçu l'homologation ISO 9001 numéro FM21797.

Les systèmes de qualité qui ont reçu l'homologation ISO 9001 présentent des avantages directs pour nos clients :

- Nous sommes en mesure de vous livrer les instruments et de traiter les commandes en urgence dans des délais record.
- Nous répondons pleinement et de manière rapide à vos commandes.
- Nous avons mis en place un système de feedback continu de la part de nos clients et sommes conscients de vos attentes présentes et futures.
- Nous avons amélioré votre productivité en réduisant de moitié les Temps de panne et en accélérant les temps de réponse.
- Nous avons apporté des améliorations constantes au sein de notre structure, afin d'atteindre des niveaux de qualité optima, à l'avenir.
- Nos produits et services reflètent les exigences BPL pour vous permettre de répondre aux impératifs de respect de la règlementation.

Toutefois, nous ne nous contentons pas de l'homologation ISO 9001. Pour nous, la qualité est définie par nos clients. Nous ne sommes satisfaits que lorsque nos clients le sont. Nous nous efforçons de comprendre vos besoins, à l'aide d'évaluations externes, de groupes d'utilisateurs, de comités de conseil clients, et de notre programme “Hallmark of Quality”, outre les contacts directs que nous établissons avec chacun de nos clients. Nos produits et nos procédés sont conçus pour répondre à vos attentes.

Nous n'ignorons pas que vous recherchez plus que des processus évolués et un savoir-faire d'exception dans le domaine des applications. Vous souhaitez conjuguer vos forces avec un partenaire s'étant engagé à offrir une qualité, une fiabilité et une valeur optimales, au moment où il faut et quand il faut.

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Notre principal objectif : devenir votre partenaire !

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I sistemi di qualità della Varian, Inc.

La serie degli standard ISO 9000 è stata presentata nel 1987 a Ginevra con lo scopo di mettere ordine in un groviglio di definizioni contrastanti sulla qualità. Tali standard definiscono un modello che assicura la qualità nella progettazione, nello sviluppo, nella fabbricazione, nell'installazione e nella manutenzione dei prodotti nonché nel servizio assistenza clienti. Oggi come oggi essi costituiscono il punto di riferimento, a livello mondiale, ai fini della valutazione dell'impegno delle diverse aziende sul fronte della qualità e della validità dei sistemi di qualità da esse adottati.

Diverse organizzazioni internazionali, come la British Standard Institution (BSI), dispongono d'ispettori certificati e imparziali per la valutazione delle procedure di qualità, dello sviluppo dei prodotti, dei processi di fabbricazione e dei programmi di soddisfazione del cliente. Nessuna azienda può asserire d'essere in possesso della certificazione ISO 9000 finché non dispone del marchio d'approvazione concesso dai rigorosi ispettori di qualità della BSI o di altri enti di controllo riconosciuti. La certificazione di conformità agli standard ISO 9000 costituisce un'attestazione imparziale di terzi del grado d'impegno di una determinata azienda nei confronti della qualità.

Nel 1992 la Varian, Inc., Analytical Instruments ha ottenuto l'omologazione allo standard più completo della serie ISO 9000, l'ISO 9001. L'omologazione ISO 9001 significa che ogni singola fase del nostro sistema di qualità - compresi lo sviluppo del prodotto, la fabbricazione, le prove finali, la spedizione, i componenti e le forniture - è stata rigorosamente esaminata a fronte della serie più esigente di standard riconosciuti a livello mondiale, il che significa che rispondiamo pienamente ad uno standard qualitativo sul quale il cliente può contare oggi come nel futuro. Il nostro Sistema di Qualità ha ottenuto la certificazione ISO 9001 col numero FM21797.

I sistemi di qualità per i quali abbiamo ottenuto l'omologazione ISO 9001 comportano dei vantaggi diretti per i nostri clienti, ovvero:

- Siamo in grado di consegnare gli strumenti più rapidamente rispetto al passato, con la possibilità di evadere le richieste d'emergenza con una rapidità ancora maggiore.
- Gli ordini vengono evasi tempestivamente ed in modo completo.
- Abbiamo messo a punto un sistema di riscontro costante con la clientela, in modo da poter essere sempre perfettamente informati sulle esigenze attuali e future del cliente.
- Abbiamo migliorato la produttività del cliente riducendo della metà il tasso di guasti dei sistemi e velocizzando i tempi d'intervento della manutenzione.
- Abbiamo introdotto un costante miglioramento nella nostra struttura organizzativa in modo da poter conseguire in futuro livelli qualitativi ancor più elevati.
- Stiamo adeguando i nostri prodotti e servizi agli standard GLP per poter aiutare i clienti a soddisfare i requisiti di conformità posti loro dagli enti normativi.

Ma l'omologazione ISO 9001 non è tutto. Per quanto ci riguarda, la qualità viene definita dai nostri clienti: noi siamo soddisfatti solo se lo è il cliente. Ci adoperiamo al massimo per comprendere le esigenze del cliente, ricorrendo ad indagini di società private, gruppi di utenti, associazioni di consumatori e con il nostro programma di risposta Hallmark of Quality - il marchio di garanzia di qualità - oltre che col contatto diretto coi singoli clienti. I nostri prodotti ed i nostri processi sono configurati per rispondere a tali esigenze.

Sappiamo che a Voi i processi più avanzati e l'esperienza delle applicazioni di prim'ordine non bastano. Sappiamo che intendete unire le vostre forze con quelle d'un partner impegnato a fornire livelli qualitativi internazionali, affidabilità e valore, in modo tempestivo e costante.

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Quel partner vogliamo essere noi.

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Sistemas de calidad en Varian, Inc.

Las normas ISO 9000 fueron creadas en Ginebra en 1987 para acabar con una multitud de definiciones de calidad contradictorias. Estas normas constituyen un modelo de sistemas de garantía de calidad en el diseño, desarrollo, fabricación, instalación, mantenimiento y asistencia técnica de productos. Se han convertido en el banco de pruebas de garantía de calidad a nivel mundial y miden el grado de compromiso de una empresa con la calidad, así como el alcance de sus sistemas de calidad.

Diversas organizaciones mundiales, como la British Standards Institution (BSI), proporcionan expertos titulados de probada objetividad para investigar procedimientos de calidad, desarrollo de productos, procesos de fabricación y programas de servicio al cliente.

Varian, Inc., Analytical Instruments fue registrada en 1992 con la norma más exhaustiva de la serie ISO 9000: la ISO 9001. La certificación por la norma ISO 9001 significa que todas las etapas de nuestro sistema de calidad, como el desarrollo del producto, la fabricación, las pruebas finales, la expedición, así como los suministros y recambios, han sido examinados rigurosamente respecto a las normas más exigentes reconocidas internacionalmente. Significa que nos comprometemos a mantener un nivel de calidad con el que podrá siempre contar, hoy y en el futuro. Il nostro Sistema di Qualità ha ottenuto la certificazione ISO 9001 col numero FM21797.

Los sistemas de calidad que nos valieron la certificación ISO 9001 representan beneficios directos para nuestros clientes:

- haremos llegar nuestros aparatos más rápidamente que nunca. Podemos cumplir con pedidos urgentes aún más deprisa.
- Atenderemos sus pedidos de forma rápida y completa.
- Aplicamos un sistema de retorno de información permanente con nuestros clientes: siempre somos conscientes de sus necesidades, actuales o futuras.
- Hemos mejorado la productividad de nuestros clientes, disminuyendo el índice de defectos a la mitad y acortando el tiempo de respuesta del servicio de mantenimiento.
- Hemos integrado sistemas de mejora continuada en nuestra organización, de forma que podremos obtener niveles de calidad aún superiores en un futuro.
- Estamos integrando los requerimientos GLP en nuestros productos y servicios para ayudarle a cumplir con requerimientos de conformidad obligatorios.

La conformidad con ISO 9001 no nos basta. Para nosotros, los criterios de calidad los definen nuestros clientes. No estaremos satisfechos hasta que usted lo esté. Intentamos comprender las necesidades de nuestros clientes, a través de entidades independientes, grupos de usuarios, oficinas de asesoramiento a usuarios y nuestro programa de respuesta “Hallmark of Quality”, además de los contactos directos con nuestros clientes. Nuestros productos y procedimientos están diseñados para poder corresponder a sus necesidades.

Sabemos que nuestros clientes buscan más que experiencia en procesos avanzados y aplicaciones punteras. Se trata de unir fuerzas con un socio que se compromete a entregar calidad reconocida a nivel mundial, fiabilidad y valor, a tiempo, siempre.

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Nuestra meta principal es ser ese socio.

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Varian, Inc. Analytical Instrument Warranty

Hardware Products

All analytical instruments sold by Varian, Inc. are warranted to be free from defects in material and workmanship for the periods specified and in accordance with the terms on the face of Varian's quotation or as otherwise agreed upon in writing between Varian and the Customer. The warranty period begins on the date of **shipment** from Varian to the original Customer. However, where installation is paid for by the Customer or included in the purchase price, the warranty period begins upon completion of installation. If the Customer schedules **installation** to start later than 30 days after delivery or if such delay is caused through the Customer's inability to provide adequate facilities or utilities or through failure to comply with Varian's reasonable pre-installation instructions or through other omissions by Customer, then the warranty period starts on the 31st day from date of shipment. Moreover Varian will charge the Customer for labor and other expenses involved in making multiple or follow-up installation service calls.

Software Products

Where software is provided within the frame of a license agreement concluded between the Customer and Varian, any warranty shall be strictly in accordance with the terms of such agreement.

In the absence of a license agreement and unless an alternate warranty period is agreed upon in writing between Varian and the Customer, the warranty period is as specified on the face of Varian's quotation. Varian warrants such software products, if used with and properly installed on Varian hardware or other hardware as specified by Varian to perform as described in the accompanying Operator's Manual and to be substantially free of those defects which cause failure to execute respective programming instructions; however, Varian does not warrant uninterrupted or error-free operation.

Remedies

The sole and exclusive remedy under hardware warranty shall be **repair** of instrument malfunctions which in Varian's opinion are due or traceable to defects in original materials or workmanship or, at Varian's option, **replacement** of the respective defective parts, provided that Varian may as an alternative elect to **refund** an equitable portion of the purchase price of the instrument or accessory.

Repair or replacement under warranty does not extend the original warranty period.

Repair or replacement under warranty claims shall be made in Varian's sole discretion either by sending a Customer Support Representative to the site or by authorizing the Customer to return the defective accessory or instrument to Varian or to send it to a designated service facility. The Customer shall be responsible for loss or damage in transit and shall prepay shipping cost. Varian will return the accessory or instrument to the Customer prepaid and insured. Claims for loss or damage in transit shall be filed by the Customer. To correct software operation anomalies, Varian will issue software revisions where such revisions exist and where, in Varian's opinion, this is the most efficient remedy.

Limitation of Warranty

This **warranty does not cover** software supplied by the Customer, equipment and software warranted by another manufacturer or replacement of expendable items and those of limited life, such as but not limited to: Filters, glassware, instrument status lamps, source lamps, septa, columns, fuses, chart paper and ink, nebulizers, flow cells, pistons, seals, fittings, valves, burners, sample tubes, probe inserts, print heads, glass lined tubing, pipe and tube fittings, variable temperature dewars, transfer lines, flexible discs, magnetic tape cassettes, electron multipliers, filaments, vacuum gaskets, seats and all parts exposed to samples and mobile phases.

This **warranty shall be void** in the event of accident, abuse, alteration, misuse, neglect, breakage, improper operation or maintenance, unauthorized or improper modifications or tampering, use in an unsuitable physical environment, use with a marginal power supply or use with other inadequate facilities or utilities. Reasonable care must be used to avoid hazards.

This warranty is expressly in lieu of and excludes all other express or implied warranties, including but not limited to warranties of merchantability and of fitness for particular purpose, use or application, and all other obligations or liabilities on the part of Varian, unless such other warranties, obligations or liabilities are expressly agreed to in writing by Varian.

Limitation of Remedies and Liability

The remedies provided herein are the sole and exclusive remedies of the Customer. In no case will Varian be liable for incidental or consequential damages, loss of use, loss of production or any other loss incurred.

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Varian, Inc. Analytical Instrument Garantie

Hardwareprodukte

Es wird garantiert, daß alle von Varian, Inc. verkauften analytischen Instrumente für die angegebene Zeitdauer und in Übereinstimmung mit den „Allgemeinen Lieferbedingungen“ oder anderen schriftlichen Zusagen zwischen Varian und dem Kunden frei von Material- und Herstellungsfehlern sind. Die Garantiezeit beginnt mit dem **Versanddatum** von Varian zum Originalkunden. Wenn die Installation vom Kunden bezahlt oder im Verkaufspreis eingeschlossen ist, beginnt die Garantiezeit nach der abgeschlossenen Installation. Wenn der Kunde den **Installationsbeginn** später als 30 Tage nach erfolgter Lieferung ansetzt, oder wenn die Verzögerung dadurch verursacht wird, daß der Kunde nicht den ausreichenden Platz oder die Versorgungseinrichtungen beschafft oder Varian's berechtigte Anweisungen zur Installationsvorbereitung nicht einhält oder andere Versäumnisse des Kunden vorliegen, dann beginnt die Garantiezeit am 31. Tag nach dem Versanddatum. Darüber hinaus wird Varian dem Kunden den Arbeitsaufwand und andere Unkosten durch mehrfache oder fortgesetzte Installationsanforderungen berechnen.

Softwareprodukte

Wo Software innerhalb des Rahmens eines Lizenzabkommens zwischen dem Kunden und Varian geliefert wird, wird die Garantie genau entsprechend der zeitlichen Abmachung eingehalten.

Besteht kein Lizenzabkommen und ist keine alternative Garantiezeit schriftlich zwischen Varian und dem Kunden festgelegt, gilt die Garantiezeit der „Allgemei-nen Lieferbedingungen“. Varian garantiert für solche Softwareprodukte, die mit Varian’s Hardware benutzt und richtig installiert sind oder zur Ausführung mit anderer von Varian angegebener Hardware, wie sie in der beigefügten Bedienungsanleitung beschrieben ist, daß sie im wesentlichen frei von solchen Defekten sind, die Fehler bei der Ausführung der jeweiligen Programmieranweisungen verursachen; Varian garantiert jedoch keine ununterbrochene oder fehlerfreie Arbeitsweise.

Abhilfen

Die einzige und ausschließliche Abhilfe in der Hardwaregarantie wird die **Reparatur** der Instrumentstörungen sein, die sich nach Varian's Ansicht auf Defekte in den Originalteilen oder bei der Herstellung zurückführen läßt oder, nach Varian's Wahl, der **Austausch** der entsprechenden defekten Teile oder die **Erstattung** eines fairen Teils des Kaufpreises des Instruments oder Zubehörs, vorausgesetzt, daß sich Varian alternativ dafür entscheidet.

Reparatur oder Austausch unter Garantie verlängert nicht die ursprüngliche Garantiezeit.

Reparatur oder Austausch unter Garantieansprüchen soll in Varian's ausschließlichem Ermessen entweder durch einen Serviceingenieur beim Kunden oder durch Ermächtigung des Kunden zum Einschicken des defekten Zubehörs oder Instruments an Varian oder einen Servicestützpunkt erfolgen. Der Kunde übernimmt die Verantwortung für Verlust oder Beschädigung im Transit und hat die Versandkosten im voraus zu bezahlen. Varian wird das Zubehör oder Instrument vorausbezahlt und versichert zum Kunden zurückschicken. Ansprüche für Verlust oder Beschädigung im Transit hat der Kunde zu erheben. Zur Korrektur von Anomalien des Softwarebetriebs wird Varian Software-Neuausgaben ausgeben, sofern Revisionen existieren und dies die beste Abhilfe ist.

Garantieeinschränkungen

Diese **Garantie erfaßt nicht** vom Kunden bereitgestellte Software, Ausrüstungen und Software, die von anderen Herstellern garantiert werden oder den Austausch entbehrlicher Teile und solcher von begrenzter Lebensdauer wie diese, aber nicht darauf beschränkt: Filter, Glaswaren, Instrument Statuslampen, Lampenquellen, Septen, Säulen, Sicherungen, Schreiberpapier und Tinte, Zerstäuber, Flußzellen, Kolben, Dichtungen, Fittings, Ventile, Brenner, Probenröhrchen, Sondeneinsätze, Druckköpfe, glasausgekleidetes Rohr, Leitungs- und Rohrfittings, Dewars für variable Temperaturen, Transferleitungen, flexible Disketten, Magnetbandkassetten, elektronische Vervielfacher, Hitzdrähte, Vakuum Gaskets, Sitzflächen und alle Teile, die den Proben und mobilen Phasen ausgesetzt sind.

Diese **Garantie erlischt** bei eingetretenem Unfall, falscher Benutzung, Umbau, Mißbrauch, Vernachlässigung, Bruch, falscher Benutzung oder falscher Wartung, unbefugten oder falschen Modifikationen oder Basteleien, Benutzung in ungeeigneter physikalischer Umgebung, Benutzung mit marginaler Stromversorgung oder Benutzung mit anderen ungenügenden Einrichtungen oder Versorgungen. Mit vernünftiger Sorgfalt müssen Gefahren vermieden werden.

Diese Garantie steht ausdrücklich anstelle von allen anderen angedeuteten Garantien und schließt sie aus, einschließlich, aber nicht beschränkt auf Garantien der Verkäuflichkeit und Eignung für einen besonderen Zweck, Gebrauch oder Anwendung und allen anderen Verpflichtungen oder Haftungen von Varian’s Seite, wenn nicht solche Garantien, Verpflichtungen oder Haftungen ausdrücklich schriftlich mit Varian vereinbart wurden.

Beschränkung der Hilfen und Haftung

Die hier gegebenen Hilfen sind einzig und allein Sache des Kunden. In keinem Fall wird Varian für versehentliche oder sich ergebende Schäden wie Nutzungsverlust, Produktionsverlust oder jeden anderen Verlust haften.

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Garantie des instruments d'analyse Varian, Inc.

Matériel

Les instruments d'analyse vendus par Varian, Inc. sont garantis exempts de défauts de matière et de fabrication, pour les périodes spécifiées et conformément aux conditions mentionnées sur le recto du devis ou aux termes de tout autre accord écrit intervenu entre Varian et le client. La période de garantie commence à compter de la date de **livraison** de Varian au client d'origine. Cependant, lorsque le client a acquitté les frais d'installation ou que celle-ci est inclue dans le prix d'achat, la période de garantie commence à compter de l'achèvement de l'installation. Si le client prévoit le début de **l'installation** au-delà de 30 jours après la livraison ou si ledit retard est dû à l'inaptitude du client à mettre à disposition les installations ou services ou au non respect des instructions de pré-installation de Varian ou à la suite desdites négligences du client, la période de garantie commence le 31ème jour à compter de la date de livraison. De plus, Varian fera supporter au client tout frais de main d'oeuvre et autres coûts résultant de multiples appels téléphoniques aux fins de suivi de l'installation.

Logiciel

Pour tout logiciel faisant l'objet d'un accord de licence conclu entre le client et Varian, la garantie sera strictement limitée aux termes dudit accord.

En l'absence d'accord de licence et sauf accord écrit sur tout autre période de garantie entre Varian et le client, la période de garantie est telle que spécifiée sur le recto du devis de Varian. Sous réserve de leur installation et de leur utilisation correcte sur le matériel Varian ou tout autre matériel, tel que spécifié, Varian garantie le fonctionnement tel que décrit dans le manuel d'utilisation fourni avec le matériel et l'absence de défauts entraînant l'impossibilité d'exécuter des instructions de programmation respectives. Toutefois, Varian ne garantit pas un fonctionnement sans interruption et sans erreurs.

Recours

Le seul et unique recours relatif à la garantie du matériel se limite à la **réparation** suite à un mauvais fonctionnement de l'instrument, qui, de l'avis de Varian, est dû à des défauts des pièces d'origine ou de la fabrication, ou, à la discrétion de Varian, au **remplacement** des pièces défectueuses en question, sous réserve du choix de Varian de **rembourser** une part raisonnable du prix d'achat de l'instrument ou de l'accessoire.

La répaation ou le remplacement sous garantie n'étend pas la période de garantie originale.

La réparation ou le remplacement, aux termes d'un recours, est laissé à l'entière discrétion de Varian, soit par l'envoi d'un technicien de maintenance sur le site du client, soit en autorisant le client à retourner l'accessoire ou l'instrument défectueux à Varian, voire à l'envoyer à un service de maintenance désigné.

Le client assumera la responsabilité de toute perte ou sinistre lors du transport et règlera à l'avance les frais de transport. Varian renverra l'accessoire ou l'instrument au client en port payé et assuré. Toute réclamation résultant d'une perte ou d'un sinistre intervenu lors du transport devra être faite par le client. Aux fins de correction des anomalies de fonctionnement du logiciel, Varian diffusera des mises à jour des logiciels, le cas échéant, et si de l'avis de Varian, elles constituent la mesure corrective la plus appropriée en la matière.

Limitation de garantie

Cette **garantie ne couvre pas** le logiciel fourni par le Client, les équipements ou logiciels garantis par un autre fabricant ni le remplacement des pièces consommables ou présentant une durée de vie limitée, notamment : filtres, verres, indicateurs d'état de l'instrument, lampes source, septa, colonnes, fusibles, papier graphique et encre, nébuliseurs cellules, pistons, joints, raccords, vannes, brûleurs, tubes d'échantillonnage, inserts de sonde, têtes d'impression, tubes à garniture de verre, dewars, lignes de transfert, disquettes, cassettes magnétiques, multiplicateurs d'électron, filaments, joints hermétiques, isolant et toutes les pièces en contact avec des échantillons et des phases mobiles.

Ladite garantie est nulle en cas d'accident, de mauvaise utilisation,d'altération, de négligence, de bris, d'utilisation, maintenance voire de modifications inappropriées, d'utilisation dans un environnement inadapté, d'utilisation avec une alimentation marginale ou d'autres installations ou services inappropriés. Un certain nombre de précautions doivent être prises pour éviter tout accident.

Ladite garantie se substitue et exclue expressément toute garantie expresse ou tacite, y compris mais ne se limitant pas aux garanties relatives à la qualité marchande du programme et la garantie de son aptitude à une utilisation ou une application particulière, ainsi que toutes les autres obligations ou engagements de la part de Varian, à moins que lesdites garanties,obligations ou engagements aient fait expressément l'objet d'un accord écrit deVarian.

Limitations de garantie et de la responsabilité :

Les recours exclusifs du client sont expressément énoncés aux présentes. En aucun cas, Varian ne sera tenu pour responsable de tout dommage provenant de l'utilisation ou en découlant, de toute impossibilité d'utilisation ou de déficit de production ou de tout autre perte y afférent.

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Garanzia sugli strumenti analitici Varian, Inc.

Prodotti hardware

Tutti gli strumenti analitici commercializzati dalla Varian, Inc. sono garantiti da eventuali difetti di materiali e di costruzione per i periodi ed alle condizioni indicati sull'offerta Varian o comunque concordati per iscritto tra la Varian ed il Cliente. Il periodo di garanzia decorre dalla data di spedizione dalla Varian al Cliente. Se l'installazione è a carico del Cliente o compresa nel prezzo d'acquisto, il periodo di garanzia decorre dalla fine dell'installazione. Se il Cliente prevede di procedere all'installazione oltre i 30 giorni dalla consegna o se tale ritardo è imputabile alla mancata messa a disposizione, da parte del Cliente, di locali o strumenti idonei o al mancato rispetto delle ragionevoli istruzioni di preinstallazione della Varian o comunque a fatti imputabili al Cliente, il periodo di garanzia decorre dal 31° giorno dalla data di spedizione. Inoltre, la Varian addebiterà al Cliente le spese di manodopera e d'altro tipo sostenute per interventi d'installazione multipli o di verifica.

Prodotti software

Se il software viene fornito nell'ambito d'un contratto di licenza stipulato tra la Varian e il Cliente, trovano applicazione in via esclusiva le garanzie previste dal contratto.

In assenza d'un contratto di licenza e salvo diverso accordo scritto tra la Varian e il Cliente, vale il periodo di garanzia indicato nell'offerta della Varian. La Varian garantisce che i prodotti software, purché regolarmente utilizzati ed installati su hardware Varian o d'altre marche da essa indicate, hanno le prestazioni descritte nel Manuale d'uso fornito a corredo del software e che sono sostanzialmente esenti da difetti che impediscano l'esecuzione delle rispettive istruzioni di programma. La Varian non garantisce alcun funzionamento ininterrotto o senza errori.

Interventi Tecnici

Gli unici interventi previsti dalla garanzia sull'hardware sono o la riparazione dei malfunzionamenti dello strumento che, a giudizio della Varian, siano dovuti o riconducibili a difetti di costruzione dei materiali originali o, a discrezione della Varian, la sostituzione dei componenti difettosi, fermo restando che la Varian potrà, in alternativa, optare per il rimborso di una congrua parte del prezzo d'acquisto dello strumento o dell'accessorio difettosi.

La riparazione o la sostituzione in garanzia non valgono a prorogare in alcun modo il periodo di garanzia originariamente previsto.

Le riparazioni o le sostituzioni in garanzia verranno effettuate, ad esclusiva discrezione della Varian, inviando sul posto un tecnico o autorizzando la resa dello strumento o dell'accessorio difettoso alla Varian o al centro d'assistenza indicato dalla Varian. Il Cliente sarà responsabile di eventuali danni o perdite subiti durante il trasporto dallo strumento o dall'accessorio reso e dovrà pagare le spese di spedizione in via anticipata. La Varian restituirà al Cliente lo strumento o l'accessorio in porto franco con assicurazione a proprio carico. Sono a cura del Cliente gli eventuali reclami per perdite o danni di trasporto. Per eliminare eventuali anomalie di funzionamento del software, la Varian fornirà le eventuali revisioni del software disponibili qualora a suo giudizio siano il rimedio migliore.

Limitazioni della garanzia

La presente garanzia non copre il software fornito dal Cliente, le attrezzature e il software garantiti da altre case né la sostituzione del materiale di consumo o di durata limitata, quali, senza intento limitativo, filtri, provette, spie di stato dello strumento, voltmetri, setti, colonne, fusibili, carta ed inchiosto , nebulizzatori, celle a flusso, pistoni, guarnizioni, pezzi speciali, valvole, bruciatori, tubi di campionamento, inserti per sonde, testine di stampa, tubazioni rivestite in vetro, raccordi per tubi, dewars a temperatura variabile, linee di trasferimento, dischi flessibili, cassette a nastro magnetico, fotomoltiplicatori, filamenti, guarnizioni per vuoto, e tutte le parti esposte all'azione dei campioni o delle fasi mobili.

La presente garanzia decade in caso d'incidente, abuso, modifica, uso improprio, incuria, rottura, funzionamento o manutenzione impropri, modifiche non autorizzate od improprie o manomissioni, impiego in ambiente fisico non idoneo, impiego con alimentazione ai limiti o con altri mezzi o dispositivi inadeguati. Devono inoltre essere adottate tutte le misure ragionevoli atte ad evitare ogni e qualsiasi rischio.

La presente garanzia sostituisce ed esclude espressamente ogni altra garanzia espressa o implicita, comprese - senz'intento limitativo - le garanzie di commerciabilità ed idoneità a scopi, impieghi od applicazioni specifici nonché tutti gli altri obblighi o responsabilità della Varian, a meno che le altre garanzie, obblighi o responsabilità in parola non siano stati accettati per iscritto dalla Varian.

Limitazione degli interventi e delle responsabilità

Quelli qui contemplati sono gli unici ed esclusivi interventi cui ha diritto il Cliente. In nessun caso la Varian sarà responsabile per danni indiretti o consequenziali, mancata disponibilità, perdita di produzione o altre perdite subite.

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Instrumentos analíticos Varian, Inc. Garantía

Productos hardware

Todos los instrumentos analíticos vendidos por Varian, Inc. están garantizados contra defectos de materiales y de fabricación por la duración especificada y de acuerdo con los términos establecidos en las ofertas de Varian, o según lo especificado en el acuerdo escrito entre Varian y el cliente. El plazo de garantía comienza a partir de la fecha de **envío** del material de Varian al cliente original. Sin embargo, si la instalación ha sido pagada por el cliente o incluida en el precio de compra, el plazo de garantía comenzará a partir de la fecha de conclusión de la instalación. Si el cliente especifica que la **instalación** comenzará 30 días después de la entrega, o si este plazo se genera por la imposibilidad por parte del cliente de proveer los medios necesarios o la falta de cumplimiento de las directrices de preinstalación de Varian, o cualquier otra omisión por parte del cliente, el plazo de garantía comenzará el trigésimoprimer día a partir del envío. Además, Varian cobrará al cliente por trabajos y otros gastos relacionados con intervenciones de servicio de instalación múltiples o tardías.

Productos de software

Cuando el software se suministra dentro del marco de una licencia de utilización acordada entre Varian y el cliente, cualquier garantía estará estrictamente limitada a los términos del citado acuerdo. En ausencia de una licencia de utilización y a no ser que exista un acuerdo de período de garantía por escrito entre Varian y el cliente, el período de garantía será el fijado de acuerdo con los términos de Varian que se citan. Varian garantiza estos productos de software si se instalan y usan con hardware Varian, u otro tipo de hardware en el que Varian certifique que funcionan según lo descrito en Manual de instrucciones, y que esté libre de defectos que impidan la ejecución de instrucciones de programación. Sin embargo, Varian no garantiza la utilización ininterrumpida o libre de errores.

Recursos

El único y exclusivo recurso en cuanto a hardware bajo garantía será **reparar** los defectos del aparato, que, en opinión de Varian, sean claramente imputables a defectos de los materiales originales o de fabricación, o **sustituir** los componentes defectuosos, pudiendo Varian optar por **reembolsar** una parte equitativa del precio de compra del aparato o componente.

Las reparaciones o sustituciones en período de garantía no prolongan el período de garantía original.

Las reparaciones o sustituciones en período de garantía se efectuarán, a criterio exclusivo de Varian, enviando un representante de servicio posventa a la instalación, o autorizando al cliente a reexpedir el componente o aparato defectuoso a Varian o a un servicio de reparación designado. El cliente será responsable sobre pérdidas o daños de transporte, y pagará los costes de dicho transporte. Varian reexpedirá el componente o aparato a portes pagados y con seguro de transporte. Las demandas por daños o pérdidas deberán ser gestionadas por el cliente. Para corregir anomalías de funcionamiento de software, Varian editará revisiones de software, siempre y cuando éstas estén disponibles, y cuando, en opinión de Varian, este sea el remedio mas eficaz.

Limitación de garantía

Esta garantía no cubre software provisto por el cliente, equipos y software garantizados por otros fabricantes, consumibles o artículos de duración de vida limitada, como son, entre otros: filtros, elementos de vidrio, pilotos, lámparas, diafragmas, columnas, fusibles, papel y tinta de gráficos, nebulizadores, células de flujo, pistones, cierres, juntas, válvulas, quemadores, tubos de muestras, inserciones de sondas, cabezales de impresión, tubos de vidrio, juntas de tubo, dispositivos de temperatura variable, líneas de transferencia, disquetes, cintas magnéticas, multiplicadores de electrones, filamentos, juntas de vacío, soportes y todos los componentes en contacto con muestras y partes móviles.

Esta garantía no tendrá efecto en los casos de accidente, abuso, alteración, utilización incorrecta, negligencia, rotura, mantenimiento o uso inadecuados, modificaciones inadecuadas o no autorizadas, uso de la fuerza, uso en un entorno inadecuado, funcionamiento con una alimentación defectuosa o el uso con medios inadecuados. Es necesario tomar las precauciones adecuadas para evitar riesgos.

Las garantías de los productos de software de Varian sustituyen y excluyen cualquier otra garantía, implícita o explícita, incluidas pero sin limitación, las garantías de comerciabilidad, adecuación a un fin, uso o aplicación en particular, y todas las demás obligaciones y responsabilidades por parte de Varian, a no ser que estas garantías, obligaciones y responsabilidades sean otorgadas expresamente y por escrito por Varian.

Limitaciones de recursos y responsabilidades

Los recursos provistos en lo citado son única y exclusivamente los del cliente. Varian no podrá ser responsable en ningún caso por daños imprevistos o consecuencias, pérdida de uso, pérdida de producción o cualquier otra pérdida incurrida.

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Safety Information

Operating Instructions

This instruction manual is provided to help you establish operating conditions which will permit safe and efficient use of your equipment. Special considerations and precautions are also described in the manual, which appear in the form of **NOTES**, **CAUTIONS**, and **WARNINGS** as described below. It is important that you operate your equipment in accordance with this instruction manual and any additional information which may be provided by Varian. Address any questions regarding the safe and proper use of your equipment to your local Varian office.

NOTE

Information to aid you in obtaining optimal performance from your instrument.

CAUTION

Alerts you to situations that may cause moderate injury and/or equipment damage, and how to avoid these situations.

WARNING

Alerts you to potentially hazardous situations that could result in serious injury, and how to avoid these situations.

Warning Symbol	Warning Description
 WARNING: SHOCK HAZARD	Hazardous voltages are present inside instrument. Disconnect from main power before removing screw-attached panels.
 WARNING: CHEMICAL HAZARD	Hazardous chemicals may be present. Avoid contact, especially when replenishing reservoirs. Use proper eye and skin protection.
 WARNING: BURN HAZARD	Very hot or cryogenically cold surfaces may be exposed. Use proper skin protection.
 WARNING: EYE HAZARD	Eye damage could occur either from flying particles, chemicals or UV radiation. Use proper eye and face protection.
 WARNING: FIRE HAZARD	The potential for fire may be present. Follow manual instructions for safe operation.
 WARNING: EXPLOSION HAZARD	The potential for explosion may exist because of type of gas or liquid used.
 WARNING: RADIATION SOURCE	Ionizing radiation source is present. Follow manual instructions for safe operation.
 WARNING: MOVING PARTS	Keep hands and fingers away.

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General Safety Precautions

Follow these safety practices to ensure safe equipment operation.

- Perform periodic leak checks on all supply lines and pneumatic plumbing.
- Do not allow gas lines to become kinked or punctured. Place lines away from foot traffic and extreme heat or cold.
- Store organic solvents in fireproof, vented and clearly labeled cabinets so they are easily identified as toxic and/or flammable materials.
- Do not accumulate waste solvents. Dispose of such materials through a regulated disposal program and not through municipal sewage lines.

NOTICE: This instrument has been tested per applicable requirements of EMC Directive as required to carry the European Union CE Mark. As such, this equipment may be susceptible to radiation/interference levels or frequencies which are not within the tested limits.



This instrument is designed for chromatographic analysis of appropriately prepared samples. It must be operated using appropriate gases and/or solvents and within specified maximum ranges for pressure, flows, and temperatures as described in this manual. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



It is the responsibility of the Customer to inform Varian Customer Support Representatives if the instrument has been used for the analysis of hazardous biological, radioactive, or toxic samples, prior to any instrument service being performed or when an instrument is being returned to the Service Center for repair.

Electrical Hazards

- Disconnect the instrument from all power sources before removing protective panels to avoid exposure to potentially dangerous voltages.
- When it is necessary to use a non-original power cord plug, make sure the replacement cord adheres to the color coding and polarity described in the manual and all local building safety codes.
- Replace blown fuses with fuses of the size and rating stipulated on the fuse panel or in the manual.
- Replace faulty or frayed power cords immediately with the same type and rating.
- Make sure that voltage sources and line voltage match the value for which the instrument is wired.

Compressed Gas Cylinders

- Store and handle compressed gases carefully and in strict adherence to safety codes.
- Secure cylinders to an immovable structure or wall.
- Store and move cylinders in an upright, vertical position. Before transport, remove regulators and install cylinder cap.
- Store cylinders in a well-ventilated area away from heat, direct sunshine, freezing temperatures, and ignition sources.
- Mark cylinders clearly so there is no doubt as to their contents.
- Use only approved regulators and connections.
- Use only connector tubing that is chromatographically clean (Varian Part Number 03-918326-00) and has a pressure rating significantly greater than the highest outlet pressure from the regulator.

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GC Safety Practices

Exhaust System

No special exhaust ducting is necessary for GC detectors installed in a well-ventilated room except when the detectors are used to test hazardous chemicals. If you do install ducting:

- Use only fireproof ducting.
- Install a blower at the duct outlet.
- Locate duct intakes such that their vibration or air movement does not effect detector operation.
- Check periodically for proper operation of the duct.
- Ensure proper ventilation in lab area.

Radioactive Source Detectors

- Read carefully and comply with all NOTES, CAUTIONS, and WARNINGS in the Ni^{63} ECD manual.
- Perform the tests for removable radioactive contamination described in the Ni^{63} ECD manual.
- Comply with leak test schedules and procedures.

Burn Hazard

Heated or cryogenically cooled zones of gas chromatographs can remain hot or cold for a considerable time after instrument power is turned off. To prevent painful burns, ensure that all heated or cooled areas have returned to room temperature or wear adequate hand protection before you touch potentially hot or cold surfaces.

LC Safety Practices

High Pressure Hazard

If a line ruptures, a relief device opens, or a valve opens accidentally under pressure, potentially hazardous high liquid pressures can be generated by the pump causing a high velocity stream of volatile and/or toxic liquids.

- Wear face protection when you inject samples or perform routine maintenance.
- Never open a solvent line or valve under pressure. Stop the pump first and let the pressure drop to zero.
- Use shatter-proof reservoirs capable of operating at 50-60 psi.
- Keep the reservoir enclosure closed when the reservoir is under pressure.
- Read and adhere to all NOTES, CAUTIONS, and WARNINGS in the manual.

Flash Chromatography

The operator should be familiar with the physico-chemical properties of the components of the mobile phase.

Keep solvents from direct contact with the polyurethane supply tubing as certain solvents will cause weakening and leaks with possible bursting.

All components of the system should be connected to a common power supply and common ground. This ground must be a true ground rather than a floating ground.

Non-polar solvents can develop a static charge when pumped through the system. All vessels that contain mobile phase (including tubing and collection vessels) must be grounded to dissipate static electricity.

Employ static measuring and static discharge devices (e.g., air ionizers) to safeguard against the buildup of static electricity.

Ultraviolet Radiation

Liquid chromatograph detectors that use an ultraviolet light source have shielding to prevent radiation exposure to personnel.

For continued protection:

- Ensure that protective lamp covers of variable and fixed wavelength detectors are in place during operation.
- Do not look directly into detector fluid cells or at the UV light source. When inspecting the light source or fluid cell, always use protective eye covering such as borosilicate glass or polystyrene.

The following is a Federal Communications Commission advisory: This equipment has been tested and found to comply with the limits of a Class A computing device, pursuant to part 15 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.

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Spare Parts Availability

It is the policy of Varian to provide operational spare parts for any instrument and major accessory for a period of five (5) years after shipment of the final production run of that instrument. Spare parts will be available after this five (5) year period but on an *as available* basis. Operational spare parts are defined as those individual electrical or mechanical parts that are susceptible to failure during their normal operation. Examples include relays, lamps, temperature probes, detector elements, motors, etc. Sheet metal parts, structural members or assemblies and castings, printed circuit boards, and functional modules are normally capable of being rebuilt to like-new condition throughout their useful life and therefore will be supplied only on an *as available* basis after the final production run of the instrument.

Service Availability

Varian provides a variety of services to support its customers after warranty expiration. Repair service can be provided by attractively priced service contracts or on a time and material basis. Technical support and training can be provided by qualified personnel on both a contractual or as-needed basis.

Varian Analytical Instruments Sales Offices

For Sales or Service assistance and to order Parts and Supplies, contact your local Varian office.

Argentina
Buenos Aires
Tel. +54.11.4.783.5306

Australia
Mulgrave, Victoria
Tel. +61.3.9566.1134

Austria
Vösendorf bei Wien
Tel. +43.1.699.9669

Benelux
Bergen Op Zoom
Tel. +31.164.282.800

Brazil and Latin America (S)
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Mississauga, Ontario
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China
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Europe
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Mexico and Latin America (N)
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Russian Federation
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Taiwan
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Tel. +886.2.698.9555

United Kingdom and Ireland
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Tel. +44.1932.898000

Venezuela
Valencia
Tel. +58.41.257.608

United States
Walnut Creek, California, USA
Tel. +1.800.926.3000 (GC and GC/MS)

Tel. +1.800.367.4752 (LC)

VARIAN

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Sicherheitsinformationen

Arbeitsanleitungen

Diese Arbeitsanleitung will Ihnen bei der Aufstellung solcher Arbeitsbedingungen helfen, die einen sicheren und wirkungsvollen Gebrauch Ihrer Geräte ermöglichen. Besondere Überlegungen und Vorsichtsmaßnahmen erscheinen in diesem Handbuch in Form von **HINWEIS**, **ACHTUNG** und **WARNUNG,** wie unten beschrieben. Es ist wichtig, daß Sie Ihr Gerät in Übereinstimmung mit dieser Arbeitsanleitung und allen möglichen zusätzlichen Informationen von Varian betreiben. Alle Fragen bezüglich Sicherheit und Handhabung Ihres Gerätes richten Sie an Ihr Varian Büro.

HINWEIS

Eine Information, um einen optimalen Wirkungsgrad Ihres Instruments zu erzielen.

ACHTUNG

Weist auf Situationen, die zu mäßiger Beeinträchtigung und/oder zu Geräteschäden führen und auf die Vermeidung dieser Situationen hin.

WARNUNG

Weist auf mögliche Gefahrensituationen, die zu ernsthaften Verletzungen führen können und auf die Vermeidung dieser Situationen hin.

Warnungssymbol	Warnungsbeschreibung
WARNUNG ELEKTRISCHER SCHLAG	Gefährliche Spannungen bestehen innerhalb des Instruments. Trennen Sie das Gerät vom Netz, bevor Sie abschraubbare Paneele entfernen.
WARNUNG CHEMISCHE GEFAHR	Gefährliche Chemikalien können vorhanden sein. Vermeiden Sie jeden Kontakt, besonders beim Auffüllen der Reservoirs. Benutzen Sie wirksamen Augen und Hautschutz.
WARNUNG VERBRENNUNGSGEFAHR	Sehr heiße oder tiefstgekühlte Oberflächen können freigelegt sein. Benutzen Sie einen wirksamen Hautschutz.
WARNUNG AUGENVERLETZUNG	Herumfliegende Partikel, Chemikalien oder UV-Strahlung können Augenschäden verursachen. Tragen Sie deshalb einen geeigneten Schutz für Augen und Gesicht.
WARNUNG FEUERGEFAHR	Es besteht eine mögliche Feuergefahr. Beachten Sie die Vorschriften im Handbuch für eine gefahrlose Benutzung.
WARNUNG EXPLOSIONSGEFAHR	Eine mögliche Explosionsgefahr besteht infolge der benutzten Gas- oder Flüssigkeitsart.
WARNUNG STRAHLUNGSQUELLE	Es besteht eine ionisierende Strahlungsquelle. Beachten Sie die Vorschriften im Handbuch für eine gefahrlose Benutzung.
WARNUNG BEWEGTE TEILE	Bleiben Sie mit Ihren Händen und Fingern weg.

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Allgemeine Sicherheitsmaßnahmen

Befolgen Sie diese Sicherheitspraktiken für eine gefahrlose Gerätebenutzung.

- Prüfen Sie regelmäßig alle Versorgungs und Pneumatikleitungen auf Lecks.
- Gasleitungen dürfen nicht geknickt oder angestochen werden. Verlegen Sie die Leitungen außerhalb von Laufwegen und abseits von extremer Hitze oder Kälte.
- Lagern Sie organische Lösungsmittel in feuerfesten, belüfteten und eindeutig bezeichneten Schränken, damit sie leicht als toxische und/oder brennbare Materialien erkannt werden.
- Sammeln Sie keine Lösungsmittelabfälle. Entsorgen Sie solche Materialien über ein geregeltes Entsorgungsprogramm und nicht über die öffentlichen Abwasserleitungen.

HINWEIS: Dies Instrument wurde nach den zutreffenden Vorschriften der EMC Direktive getestet, die zum Führen des CE Zeichens der Europäischen Union berechtigen. Dieses Gerät kann an sich auf Strahlungs-/Störpegel oder Frequenzen außerhalb der getesteten Grenzen reagieren.



WARNUNG Dies Instrument ist für chromatographische Analysen entsprechend präparierter Proben gedacht. Es muß mit geeigneten Gasen und/oder Lösungsmitteln und innerhalb der im Handbuch spezifizierten maximalen Werte für Druck, Flüsse und Temperaturen betrieben werden.



WARNUNG Der Kunde ist vor der Durchführung irgendeines Geräteservices verpflichtet den Varian Kundendienstvertreter zu informieren, wenn das Instrument für Analysen gefährlicher biologischer, radioaktiver oder toxischer Proben benutzt worden ist.

Elektrische Gefahren

- Lösen Sie das Instrument von allen Stromquellen, bevor Sie Schutzpaneele entfernen, damit Sie nicht mit potentiell gefährlichen Spannungen in Berührung kommen.
- Wenn ein Nicht-Original Netzkabelstecker benutzt werden muß, muß das Austauschkabel die im Handbuch beschriebene Farbcodierung und Polarität beibehalten und alle örtlichen Sicherheitsvorschriften erfüllen.
- Ersetzen Sie durchgebrannte Sicherungen nur mit Sicherungen der Werte, die am Sicherungspaneel oder im Handbuch angegeben sind.
- Ersetzen Sie fehlerhafte oder durchgescheuerte Netzkabel sofort durch Kabel gleicher Art.
- Sorgen Sie dafür, daß Spannungsquellen und die Netzspannung den gleichen Wert haben, für den das Instrument verdrahtet ist.

Gasdruckflaschen

- Lagern und handhaben Sie komprimierte Gase vorsichtig und in strikter Einhaltung der Sicherheitsvorschriften.
- Befestigen Sie die Gasflaschen an feststehenden Aufbauten oder an Wänden.
- Lagern und transportieren Sie Gasflaschen in aufrechter Stellung. Druckregler zuvor abnehmen.
- Lagern Sie Gasflaschen in gut durchlüfteten Räumen, weit genug weg von Heizungen, direktem Sonnenschein, Frosttemperaturen und Entzündungszonen.
- Kennzeichnen Sie die Flaschen so eindeutig, daß kein Zweifel über deren Inhalt bestehen kann.
- Benutzen Sie nur geprüfte Druckminderer und Verbindungsstücke.
- Benutzen Sie nur chromatographisch reines Verbindungsrohr (Varian Part Number 03-918326-00), das wesentlich höheren Druck als den höchsten Ausgangsdruck des Druckminderers aushält.

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GC Sicherheitspraktiken

Abgassystem

Für GC Detektoren, die in einem gut durchlüfteten Raum installiert sind, ist keine spezielle Abgasführung erforderlich, außer wenn die Detektoren zum Testen gefährlicher Chemikalien benutzt werden. Wenn Sie eine Abgasführung installieren:

- Benutzen Sie nur feuerfeste Führungen.
- Installieren Sie ein Gebläse am Ausgang.
- Ordnen Sie die Ansaugöffnung so an, daß ihre Erschütterungen oder Luftströmungen nicht die Detektorfunktion beeinträchtigen.
- Prüfen Sie regelmäßig die einwandfreie Arbeitsweise der Abgasführung.
- Sorgen Sie für gute Entlüftung im Laborbereich.

Radioaktive Detektoren

- Lesen Sie sorgfältig und befolgen Sie alle **HINWEISE**, **ACHTUNGEN** und **WARNUNGEN** im Ni^{63} ECD Handbuch.
- Führen Sie die Tests für zu beseitigende radioaktive Kontamination durch, die im Ni^{63} ECD Handbuch beschrieben sind.
- Erfüllen Sie die Zeitpläne und Verfahren zur Dichtigkeitsprüfung.

Verbrennungsgefahr

Beheizte oder tieftemperaturgekühlte Zonen des Gaschromatographen können beträchtlich lange heiß oder kalt bleiben, nachdem das Instrument bereits abgeschaltet ist. Zur Vermeidung schmerzhafter Verbrennungen müssen Sie darauf achten, daß alle beheizten oder gekühlten Zonen auf Raumtemperatur zurückgegangen sind oder Sie müssen ausreichenden Handschutz benutzen, bevor Sie möglicherweise heiße oder kalte Oberflächen berühren.

LC Sicherheitspraktiken

Gefahr durch hohen Druck

Wenn eine Leitung bricht, eine Entlüftungseinheit sich öffnet oder ein Ventil sich unbeabsichtigt unter Druck öffnet, kann durch die Pumpe möglicherweise ein gefährlich hoher Flüssigkeitsdruck entstehen, der einen Strahl flüchtiger und/oder toxischer Flüssigkeiten von hoher Stömungsgeschwindigkeit verursacht.

- Tragen Sie einen Gesichtsschutz, wenn Sie Proben injizieren oder Routinewartungen durchführen.
- Öffnen Sie niemals eine unter Druck stehende Lösungsmittelleitung oder ein Ventil. Halten Sie zuerst die Pumpe an und lassen Sie den Druck auf Null abfallen.
- Benutzen Sie splittersichere Reservoirs, die für einen Druck von 3,4 bis 4,1 bar ausgelegt sind.
- Halten Sie die Reservoirverkleidung geschlossen, wenn die Reservoirs unter Druck stehen.
- Lesen Sie und befolgen Sie alle **HINWEISE**, **ACHTUNGEN** und **WARNUNGEN** im Handbuch.

Blitzlicht-Chromatographie

Der Bediener sollte mit den physikalisch-chemischen Eigenschaften der Komponenten vertraut sein, aus denen sich die mobile Phase zusammensetzt.

Vermeiden Sie direkten Kontakt der Lösungsmittel mit den Zuführungsleitungen aus Polyurethan, da einige Lösungsmittel das Material der Leitungen schwächen und damit Undichtigkeiten oder Brüche hervorrufen können.

Alle Systemkomponenten sollten an der gleichen Netzstromquelle und einer gemeinsamen Erdung angeschlossen sein. Dabei muss es sich um eine echte, nicht um eine schwebende Erdung handeln.

Nicht-polare Lösungsmittel können sich beim Pumpen durch das System statisch aufladen. Alle Gefäße, die mobile Phase enthalten (einschließlich Leitungen und Sammelgefäße), müssen zur Ableitung elektrostatischer Aufladungen geerdet sein.

Setzen Sie Geräte zur Messung und Ableitung elektrostatischer Aufladungen (z.B. Geräte zur Luftionisierung) als Maßnahmen gegen den Aufbau statischer Elektrizität ein.

Ultraviolette Strahlung

Detektoren in Liquidchromatographen, die eine ultraviolette Lichtquelle benutzen, besitzen eine Abschirmung, die das Bedienungspersonal gegen Abstrahlungen schützt. Zum ständigen Schutz:

- Achten Sie darauf, daß die schützende Lampenabdeckung der Detektoren mit variablen und festen Wellenlängen während des Betriebs an ihrem Platz ist.
- Schauen Sie nicht direkt in die Flüssigkeitszellen im Detektor oder in die UV Lampe. Zum Inspizieren der Lichtquelle oder der Flüssigkeitszelle benutzen Sie immer einen wirksamen Augenschutz, wie er durch Borsilikatglas oder Polystyrol gewährleistet wird.

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Verfügbarkeit von Ersatzteilen

Es ist Varian's Grundsatz, Ersatzteile für alle Instrumente und die wichtigsten Zubehöre für einen Zeitraum von fünf (5) Jahren nach dem Fertigungsauslauf dieser Geräteserie verfügbar zu haben. Nach diesem Zeitraum von fünf (5) Jahren können Ersatzteile auf der Basis *solange vorhanden* bezogen werden. Als Ersatzteil werden hier solche elektrischen und mechanischen Einzelteile verstanden, die unter normalen Bedingungen ausfallen können. Beispiele sind Relais, Lampen, Temperaturfühler, Detektorelemente, Motore usw. Metallbleche, Formteile oder Baugruppen und Gußteile, PC Boards und Funktionsmodule können normalerweise neuwertähnlich für eine brauchbare Lebensdauer instandgesetzt werden und werden deshalb nur auf der Basis *solange vorhanden* nach dem Produktionsauslauf des Instruments geliefert werden.

Serviceverfügbarkeit

Varian bietet seinen Kunden auch nach dem Auslaufen der Garantie eine Vielfalt von Serviceleistungen an. Reparaturservice kann zu attraktiven Preisen über eine Wartungsvereinbarung oder nach Zeit- und Materialaufwand zur Verfügung gestellt werden. Technische Unterstützung und Training bieten wir Ihnen durch qualifizierte Chemiker sowohl auf einer Kontraktbasis als auch nach Ihren Erfordernissen an.

Varian Analytical Instruments Verkaufsbüros

Für Verkaufs oder Servicehilfe und zum Bestellen von Teilen und Zubehören setzen Sie sich bitte mit Ihrem Varian Büro in Verbindung.

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Venezuela
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Tel. +58.41.257.608

United States
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(LC)

VARIAN

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Informations et mesures de sécurité

Instructions de fonctionnement

Ce manuel d'instruction est conçu pour aider l'utilisateur à créer des conditions opératoires lui permettant de faire fonctionner le matériel efficacement et en toute sécurité. Il contient entre autres certaines observations spéciales présentées sous forme de **NOTES, MISES EN GARDE** et **AVERTISSEMENTS.** Il est important de faire fonctionner ce matériel conformément aux instructions du présent manuel et à toute autre information émanant de Varian. S'adresser au bureau régional Varian pour toute question relative à la sécurité ou à l'utilisation correcte du matériel.

NOTE

Information destinée à tirer le meilleur parti du matériel sur le plan des performances

MISE EN GARDE

Attire l'attention sur une situation pouvant occasionner des dommages corporels légers et/ou des dégâts mineurs à l'appareil et indique comment remédier à cette situation

AVERTISSEMENT

Attire l'attention sur une situation potentiellement dangereuse pouvant occasionner des dommages corporels importants et indique comment remédier à cette situation

Symboles d'avertissement	Description
ATTENTION RISQUE D'ELECTROCUTION	Exposition à des tensions dangereuses. Débrancher le matériel du secteur avant de dévisser les panneaux protecteurs.
ATTENTION SUBSTANCES CHIMIQUES DANGER	Présence éventuelle de substances chimiques dangereuses. Eviter tout contact, en particulier lors du remplissage des réservoirs. Prendre les mesures de protection adéquates pour les yeux et la peau.
ATTENTION RISQUE DE BRÛLURES	Exposition à des surfaces chaudes ou traitées cryogéniquement. Prendre les mesures de protection adéquates pour la peau.
ATTENTION DANGER POUR LES YEUX	Les dommages causées aux yeux sont de deux natures différentes : jet de particules et de produits chimiques ou radiations UV. Utiliser des protections du visage et des yeux appropriées.
ATTENTION RISQUE D'INCENDIE	Risque potentiel d'incendie. Se conformer aux instructions du manuel pour faire fonctionner le matériel en toute sécurité.
ATTENTION RISQUE D'EXPLOSION	Risque potentiel d'explosion en raison du type de gaz ou de liquide utilisé.
ATTENTION SOURCE DE RADIATION	Présence d'une source de radiation ionisante. Se conformer aux instructions du manuel pour faire fonctionner le matériel en toute sécurité.
ATTENTION PIECES EN MOUVEMENT	Garder les mains et les doigts hors de portée.

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Précautions générales en matière de sécurité

Les pratiques suivantes garantissent une utilisation sans risques du matériel:

- Effectuer régulièrement des essais d'étanchéité de tous les conduits d'alimentation et de tous les tuyaux du système pneumatique.
- Ne pas travailler avec des conduits de gaz déformés ou percés. Installer les conduits de gaz à l'écart des allées et venues et à l'abri du chaud ou du froid.
- Conserver les solvants organiques dans des récipients à l'épreuve du feu, bien ventilés et portant mention de la nature de leur contenu, en particulier lorsque lesdits solvants sont toxiques et/ou inflammables.
- Ne pas accumuler les solvants de rebut. Les éliminer conformément à un programme agréé d'élimination des déchets et non via les égouts municipaux.

NOTE: Ce matériel a été testé conformément aux dispositions de la directive CME afin de pouvoir porter le sigle CE de l'Union européenne. Il en résulte qu'il peut être sensible à des niveaux de radiation/d'interférence ou à des fréquences se situant hors des limites testées.

ATTENTION Ce matériel est conçu pour effectuer des analyses chromatographiques d'échantillons préparés selon des méthodes appropriées. Il convient de le faire fonctionner avec les gaz et/ou les solvants adéquats et dans les limites des pressions, des débits et des températures maximales spécifiées dans le présent manuel.

ATTENTION Le client est tenu d'informer le service Varian d'assistance à la clientèle que son matériel a été utilisé pour l'analyse d'échantillons biologiques dangereux, radioactifs ou toxiques avant que n'en soit effectué la maintenance.

Risques de chocs électriques

- Déconnecter le matériel de toute source d'alimentation avant d'en démonter les panneaux de protection, sous peine de s'exposer à des tensions dangereuses.
- En cas d'utilisation d'un cordon d'alimentation n'étant pas d'origine, s'assurer que celui-ci soit conforme à la polarité et au codage des couleurs décrits dans le manuel d'utilisation ainsi qu'à toutes les normes régionales de sécurité régissant le secteur de la construction.
- Remplacer les fusibles sautés par des fusibles de même type que ceux stipulés sur le panneau des fusibles ou dans le manuel d'utilisation.
- Remplacer les cordons d'alimentation défectueux ou dénudés par des cordons d'alimentation de même type.
- S'assurer que les sources de tension et la tension de secteur correspondent à la tension de fonctionnement du matériel.

Bouteilles à gaz comprimé

- Ranger et manipuler les bouteilles à gaz comprimé avec précaution et conformément aux normes de sécurité.
- Fixer les bouteilles à gaz comprimé à un mur ou à une structure inamovible.
- Ranger et déplacer les bouteilles à gaz comprimé en position verticale. Avant de transporter les bouteilles à gaz comprimé, retirer leur régulateur.
- Ranger les bouteilles dans un endroit bien ventilé et à l'abri de la chaleur, des rayons directs du soleil, du gel ou des sources d'allumage.
- Marquer les bouteilles de manière à n'avoir aucun doute quant à leur contenu.
- N'utiliser que des connexions et régulateurs agréés.
- N'utiliser que des tuyaux de raccordement propres sur le plan chromatographique (Varian P/N 03-918326-00) et pouvant supporter des pressions sensiblement plus élevées que la plus haute pression de sortie du régulateur.

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Mesures de sécurité en CPG

Système d'échappement

Les détecteurs CPG installés dans une pièce bien ventilée ne nécessitent pas de conduits spéciaux d'échappement excepté lorsqu'ils sont destinés à analyser des substances chimiques dangereuses. Lors de l'installation de tels conduits:

- N'utiliser que des conduits à l'épreuve du feu
- Installer un ventilateur à la sortie du conduit.
- Placer les orifices d'aspiration de manière à ce que les vibrations ou les mouvements d'air n'affectent pas le fonctionnement du détecteur.
- Vérifier périodiquement l'état du conduit.
- S'assurer que le laboratoire est correctement ventilé.

Détecteurs à source radioactive

- Se conformer au manuel d'utilisation de l'ECD Ni^{63}, en particulier à ses **NOTES**, **MISES EN GARDE ET AVERTISSEMENTS**.
- Effectuer les tests de décontamination radioactive décrits dans le manuel d'utilisation de l'ECD Ni^{63}.
- Se conformer aux procédures et au calendrier des essais d'étanchéité.

Risque de brûlures

Les zones des chromatographes à gaz chauffées ou traitées cryogéniquement peuvent rester très chaudes ou très froides durant une période plus ou moins longue après la mise hors tension du matériel. Pour éviter les brûlures, s'assurer que ces zones sont revenues à température ambiante ou utiliser un dispositif adéquat de protection des mains avant de les toucher.

Mesures de sécurité en CPL

Risques liés aux hautes pressions

En cas de rupture d'un tuyau ou en cas d'ouverture accidentelle d'une vanne alors que le système est sous pression, la pompe peut occasionner des dommages en expulsant à grande vitesse des jets de liquides volatiles et/ou toxiques.

- Mettre un masque de protection lors de l'injection des échantillons ou en effectuant les opérations de maintenance de routine.
- Ne jamais déconnecter un conduit de solvant ou une vanne sous pression. Arrêter préalablement la pompe et laisser la pression descendre à zéro.
- Utiliser des réservoirs incassables à 50-60 psi.
- Laisser l'enceinte du réservoir fermée lorsque le réservoir est sous pression.
- Se conformer aux **NOTES**, **MISES EN GARDE ET AVERTISSEMENTS** du manuel d'utilisation**.**

Chromatographie Flash

L'utilisateur aura la connaissance des propriétés physico-chimiques des constituants de la phase mobile.

Eviter le contact direct des solvants avec les tuyaux en polyuréthane : certains solvants sont susceptibles de provoquer des faiblesses et des fuites avec risques d'explosion.

Tous les constituants du système devront être connectés à une source de courant commune et à une prise de terre commune. Cette prise de terre devra être fixe et non mobile.

Les solvants non-polaires peuvent produire de l'électricité statique lorsqu'ils passent au travers du système. Les bouteilles qui contiennent la phase mobile (incluant les tuyaux et les flacons de collecte de fractions) doivent être mises à la terre pour éliminer l'électricité statique.

Utiliser des appareils de mesure et de décharge d'électricité statique (par exemple des ionisateurs d'air) pour combattre la formation d'électricité statique.

Radiations ultraviolettes

Les détecteurs CPL utilisant une source lumineuse ultraviolette comportent un écran destiné à se prémunir contre les expositions aux rayonnements.

Pour s'assurer une protection permanente:

- Vérifier que le couvercle de protection de la lampe des détecteurs opérant à des longueurs d'onde variables et fixes soit bien en place durant le fonctionnement du matériel.
- Ne pas regarder directement les cellules du détecteur ou la source d'UV. Se protéger systématiquement les yeux lors du contrôle de la source lumineuse ou des cellules, par exemple au moyen de verres borosilicatés ou en polystyrène.

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Disponibilité des pièces de rechange

La politique de Varian consiste à fournir des pièces de rechange pour tous les appareils et accessoires majeurs durant une période de cinq (5) ans après livraison de leur production finale. Les pièces de rechange ne sont fournies au terme de cette période de cinq (5) ans que suivant les disponibilités. Il faut entendre par pièces de rechange les pièces individuelles électriques ou mécaniques susceptibles de défaillance au cours de leur utilisation normale. Par exemple, les relais, les lampes, les sondes thermiques, les éléments de détecteur, les moteurs, etc. Les parties en tôles, les éléments ou assemblages structurels et les pièces de fonderie, les cartes à circuits imprimés et les modules fonctionnels sont normalement susceptibles d'être remis à l'état neuf pendant toute la durée de leur vie utile et ne sont dès lors fournies, au terme de la production finale des appareils, que suivant les disponibilités.

Service d'assistance à la clientèle

Varian fournit divers services destinés à aider sa clientèle après expiration de la garantie: service de réparation sur base de contrats de maintenance à prix attractifs ou sur base d'accords à durée limitée portant sur du matériel spécifique; support technique et service de formation assurés par des chimistes qualifiés sur base contractuelle ou en fonction des besoins spécifiques.

Points de vente des instruments analytiques Varian

Contactez votre point de vente régional Varian pour toute question commerciale ou de service d'assistance à la clientèle ou pour passer commande de pièces et de fournitures.

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Informazioni sulla Sicurezza

Instruzioni per l'Uso

Questo manuale ha lo scopo di aiutare l'operatore ad utilizzare lo strumento in modo sicuro ed efficiente. Le considerazioni e le precauzioni speciali vengono presentate in questo manuale sotto forma di avvisi di **NOTA**, **CAUTELA** e **ATTENZIONE**. E' importante che lo strumento venga utilizzato rispettando le istruzioni fornite in questo manuale o che verranno fornite successivamente dalla Varian. Per ogni eventuale chiarimento sull'uso o sulla sicurezza, si prega di contattare la Varian di Leinì (TO).

NOTA

Sono informazioni utili ad ottenere le prestazioni migliori da parte dello strumento.

ATTENZIONE

Allerta l'operatore su situazioni che potrebbero causare ferite leggere e danni limitati allo strumento ed il modo di evitarle.

ATTENZIONE

Allerta l'operatore su situazioni potenzialmente pericolose che possono causare danni molto seri ed il modo di evitarle.

Segnali di ATTENZIONE	Descrizione del Pericolo
 **ATTENZIONE** **Pericolo di folgorazioni**	Nello strumento sono presenti tensioni pericolose. Scollegare il cavo di alimentazione prima di togliere il pannello fissato con le viti.
 **ATTENZIONE** **ESPOSIZIONE A SOSTANZA CHIMICHE**	Possono essere presenti composti chimici pericolosi. Evitare il contatto, specialmente quando si riempiono i contenitori. Usare protezioni opportune per la pelle e per gli occhi.
 **ATTENZIONE** **Pericolo di scottature**	Pericolo di esposizione a superfici molto calde o raffreddate criogenicamente. Usare protezioni opportune per la pelle.
 **ATTENZIONE** **PERICOLO PER GLI OCCHI**	Particelle volanti, agenti chimici o radiazioni UV possono danneggiare gli occhi. Vanno quindi utilizzate le opportune protezioni per gli occhi e per il volto.
 **ATTENZIONE** **Pericolo di incendio**	Pericolo potenziale di incendio. Seguire le istruzioni del manuale per lavorare con una maggiore sicurezza.
 **ATTENZIONE** **Pericolo di esplosioni**	C'è pericolo di esplosioni a causa del tipo di gas o liquido utilizzato.
 **ATTENZIONE** **Pericolo di radiazioni**	E' presente una radiazione ionizzante. Seguire le istruzioni del manuale per lavorare con una maggiore sicurezza.
 **ATTENZIONE** **Parti in movimento**	Non tenere le mani o le dita vicino.

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Norme di Sicurezza

Per lavorare in modo sicuro sullo strumento, Vi consigliamo si adottare le seguenti procedure.

- Verificare periodicamente che non ci siano perdite sulle linee e sui raccordi pneumatici.
- Evitare che le linee dei gas vengano piegate o forate. Le linee vanno posizionate in modo tale da non essere calpestate e lontane da sorgenti o troppo calde o troppo fredde.
- I solventi organici vanno conservati in armadi speciali antiincendio, ventilati e con indicazioni chiare sul contenuto di materiali tossici e/o infiammabili.
- Non accumulare i solventi utilizzati. Adottare un programma regolare di smaltimento, ma mai nelle acque di scarico.

AVVERTENZA: Questo strumento è stato testato secondo le Direttive EMC allo scopo di poter utilizzare il Marchio CE della Comunità Europea. Questo strumento può essere suscettibile a radiazioni/interferenze o frequenze che non sono entro i limiti collaudati.



ATTENZIONE Questo strumento è progettato per l'analisi cromatografica di campioni opportunamente preparati. Deve essere utilizzato usando gas e solventi adatti a questo scopo ed entro i limiti massimi di pressione, flusso e temperatura riportati in questo manuale. Se lo strumento non viene utilizzato secondo le modalità specificate dal costruttore, le condizioni di sicurezza previste potranno non essere sufficienti.



ATTENZIONE E' responsabilità del Cliente informare il Servizio Tecnico Varian, prima di qualsiasi intervento di riparazione, se lo strumento è stato utilizzato per l'analisi di campioni biologicamente pericolosi, radioattivi o tossici.

Pericoli Elettrici

- Prima di togliere i pannelli di protezione, scollegare lo strumento da tutte le alimentazioni elettriche in modo da evitare l'esposizione a voltaggi potenzialmente pericolosi.
- Quando si rende necessario sostituire il cavo di alimentazione, assicurarsi che il nuovo cavo rispetti sia le codifiche di colore e di polarità riportate nel manuale di istruzioni che quelle stabilite dalle norme di sicurezza del laboratorio.
- Sostituire i fusibili bruciati solo con fusibili che abbiano le stesse caratteristiche; queste ultime sono riportate sul pannello dei fusibili e/o nel manuale di istruzioni.
- Sostituire immediatamente i cavi di alimentazione difettosi o consumati con cavi dello stesso tipo e con le stesse caratteristiche.
- Assicurarsi che il voltaggio del pannello di alimentazione corrisponda a quello dello strumento da collegare.

Bombole dei Gas

- Occorre prestare molta attenzione quando si spostano bombole di gas compressi. Rispettare tutte le norme di sicurezza.
- Assicurare le bombole ad una parete o ad una struttura fissa.
- Spostare e conservare le bombole sempre in posizione verticale. Togliere i manometri prima di spostare le bombole.
- Conservare le bombole in un'area ben ventilata, non infiammabile, lontana da sorgenti di calore, non esposta a temperature troppo fredde o alla luce diretta del sole.
- Evidenziare in modo chiaro e che non lasci dubbi il contenuto di ogni bombola.
- Usare solo manometri e raccordi di qualità.
- Usare solo tubazioni cromatograficamente pulite (Numero di Parte Varian 03-918326-00) e calibrate per pressioni superiori a quella massima di uscita dal manometro.

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Procedure di Sicurezza in GC

Scarico dei Gas

Per i rivelatori GC non è richiesto alcun sistema particolare di scarico dei gas, se lo strumento è installato in una stanza ben ventilata e se non viene utilizzato per l'analisi di sostanze chimiche pericolose. Se si deve installare un sistema di scarico dei gas:

- Usare condutture non infiammabili
- Installare un aspiratore in uscita
- Posizionare la presa d'aria in modo che le vibrazioni e il movimento dell'aria non disturbino il rivelatore.
- Eseguire verifiche periodiche per garantire un funzionamento corretto.
- Garantire una buona ventilazione nel laboratorio.

Rivelatori a Sorgente Radioattiva

- Leggere e rispettare tutte gli avvisi di **NOTA**, **CAUTELA** e **ATTENZIONE** riportati nel manuale del rivelatore ECD al Ni^{63}.
- Eseguire tutti i test di contaminazione radioattiva rimovibile descritti nel manuale dell'ECD al Ni^{63}.
- Rispettare tutte le procedure e le scadenze di verifica per eventuali perdite.

Pericolo di Scottature

Le zone calde o raffreddate criogenicamente del gascromatografo possono mantenere la loro temperatura per parecchio tempo, dopo aver spento lo strumento. Per evitare scottature, assicurarsi che le zone riscaldate o raffreddate siano a temperatura ambiente oppure indossare delle protezioni adeguate prima di toccare tali superfici.

Procedure di Sicurezza in LC

Pericolo di Alte Pressioni

In caso di rottura di una linea o di apertura accidentale di una valvola, quando il sistema è sotto pressione, la pompa può liberare liquidi tossici e/o volatili molto pericolosi.

- E' opportuno adottare un sistema di protezione del viso quando si inietta il campione o si esegue una manutenzione routinaria del sistema.
- Non smontare mai una linea del solvente od una valvola quando il sistema è sotto pressione. Fermare prima la pompa ed aspettare che la pressione scenda a zero.
- Usare dei contenitori per solventi infrangibili ed in grado di lavorare a 50-60 psi.
- Quando i contenitori sono sotto pressione, usare una protezione esterna.
- Leggere e rispettare tutti gli avvisi di **NOTA**, **CAUTELA** e **ATTENZIONE.**

Cromatografia Flash

L'operatore deve conoscere le proprietà fisico-chimiche delle componenti della fase mobile.

I solventi non vanno messi in contatto diretto con il tubo di erogazione in poliuretano, dal momento che alcuni solventi possono causare indebolimento e perdite con possibili scoppi.

Tutte le componenti del sistema vanno collegate ad una fonte di alimentazione e ad una messa a terra comuni. E' meglio che per quest'ultima venga utilizzata una spina con polo di terra.

I solventi non-polari possono sviluppare una carica statica quando vengono pompati attraverso il sistema. Tutti i recipienti che contengono la fase mobile (inclusi i tubi e i recipienti di raccolta) devono avere una messa a terra per disperdere l'elettricità statica.

Vanno utilizzati dispositivi di misurazione e scarico (ad esempio ionizzatori d'aria) per evitare l'aumento di elettricità statica.

Radiazioni Ultraviolette

I rivelatori di cromatografia liquida che usano sorgenti a luce ultravioletta montano degli schermi di protezione per evitare che gli operatori siano esposti a radiazioni pericolose.

Per una protezione sicura:

- Assicurarsi che i coperchi delle lampade dei rivelatori a lunghezza fissa e variabile siano sempre al loro posto, quando si lavora.
- Non guardare mai direttamente dentro le celle o alla sorgente di luce UV. Quando si vuole ispezionare la lampada o le celle, usare sempre delle protezioni adatte per gli occhi, quali vetro in borosilicato e polistirolo.

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Disponibilità delle Parti di Ricambio

E' politica della Varian il fornire le parti di ricambio per lo strumento ed i suoi accessori per un periodo di cinque (5) anni a partire dalla data di produzione dell'ultima unità della serie. Le parti di ricambio saranno disponibili anche dopo questo periodo di cinque (5) anni ma solo in base alla disponibilità delle stesse. Per parti di ricambio si intendono i componenti elettrici e meccanici soggetti ad usura durante l'uso, in condizioni normali, dello strumento. Come esempio, citiamo i relay, le lampade, i probe di temperatura , i componenti del rivelatore, i motorini, ecc. Le parti strutturali o da fusione, le schede elettroniche ed i moduli funzionali possono essere ricostruiti e rimessi a nuovo durante tutto il loro periodo di vita e perciò sarà possibile acquistarli, dopo la produzione dell'ultima unità delle serie, solo in base alla loro disponibilità.

Servizi Tecnico

La Varian, alla scadenza del periodo di garanzia, è in grado di fornire ai suoi clienti un'ampia scelta di opzioni. Le riparazioni possono essere effettuate sulla base di contratti di manutenzione particolarmente vantaggiosi od in base ad una tariffa oraria piu' il costo delle parti. A richiesta, si possono avere corsi per operatori sia sotto forma di contratto che a tariffe da concordare.

Uffici Vendite della Divisione Strumenti Analitici della Varian

Per informazioni relative alla Vendita, al Servizio Tecnico o all'acquisto di Parti di ricambio, si prega di contattare l'ufficio Varian piu' vicino.

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Instrucciones de Seguridad

Instrucciones de Operación

Este Manual de Instrucciones está diseñado para ayudarle a establecer las condiciones de operación que le permitan operar su instrumento de forma segura y eficaz. Así mismo, se describen consideraciones especiales ó precauciones, que aparecen en forma de **NOTA**, **PRECAUCION**, y **ATENCION** como se indica más abajo.Es importante que utilice el instrumento de acuerdo con este Manual de Operación y cualquier otra información que le proporcione Varian. Remita a la Oficina Local de Varian cualquier cuestión que tenga respecto al correcto uso de su equipo.

NOTA

Información para ayudarle a obtener unas prestaciones óptimas de su instrumento.

¡PRECAUCION!

Le alerta de situaciónes que pueden causar daños moderados a la salud ó al equipo, y cóm evitar esas situaciones.

ATENCIÓN

Le alerta de potenciales situaciones peligrosas que pueden causar serios daños, y cómo evitar esas situaciones.

Símbolo	Descripción
ATENCIÓN PELIGRO DE DESCARGA ELÉCTRICA	El instrumento utiliza voltages peligrosos. Desconecte el interruptor general antes de retirar los paneles atornillados.
ATENCIÓN PELIGRO QUÍMICO	Peligro de productos químicos. Evite el contacto, especialmente cuando rellene los depósitos. utilice protección de ojos y piel.
ATENCIÓN PELIGRO DE QUEMADURAS	Superficies posiblemente calientes ó frías (criogénico). Utilice protección para la piel.
ATENCIÓN PELIGRO PARA LOS OJOS	Las partículas volátiles, productos químicos o radiación UV pueden causar daños en los ojos. Usar las debidas protecciones para la cara y los ojos.
ATENCIÓN PELIGRO DE FUEGO	Peligro potencial de fuego. Siga las instrucciones del Manual de Operación para su seguro funcionamiento.
ATENCIÓN PELIGRO DE EXPLOSIÓN	Peligro potencial de explosión debido al tipo de gas ó líquido empleado.
ATENCIÓN PELIGRO DE RADIACIÓN	Peligro por Fuente de radiación. Siga las instrucciones del Manual de Operación para su seguro funcionamiento.
ATENCIÓN PARTES EN MOVIMIENTO	Mantenga alejados los dedos y las manos.

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Precauciones Generales de Seguridad

Siga estas indicaciones de seguridad para una correcta operación del equipo.

- Realice verificaciones periódicas de fugas en todas las líneas de suministro y tuberías.
- No permita que las líneas de gas se doblen ó pinchen. Manténgalas alejadas de zonas de paso y del calor ó frío excesivo.
- Guarde los disolventes orgánicos en cabinas ventiladas, a prueba de fuego, y etiquetadas para que puedan ser fácilmente identificadas como material tóxico y/ó inflamable.
- No acumule disolventes inservibles. Deseche todo el material inservible a través de un programa especial de desechos y no a través del sistema convencional.

NOTA: Este instrumento ha sido testado bajo las normas de la Directiva EMC según requerimientos de la Marca CE de la Unión Europea. Por lo tanto, este equipo puede ser sensible a niveles de radiaciones / interferencias ó frecuencias que no estén incluidas dentro de los límites testados.

ATENCIÓN Este instrumento está diseñado para análisis cromatográfico de muestras preparadas apropiadamente. Debe ser operado usando gases y/ó disolventes apropiados y con unos niveles máximos de presión, flujos y temperaturas, según se describe en este manual.

ATENCIÓN El Usuario tiene la obligación de informar al Servicio Técnico de Varian cuando el instrumento vaya a ser empleado para análisis de muestras peligrosas de origen biológico, radioactivo ó tóxico, antes de comenzar a realizar cualquier análisis.

Peligros Eléctricos

- Desconecte el instrumento de todos las conexiones eléctricas a la red antes de retirar los paneles para evitar la posible exposición a peligrosos voltages.
- Cuando sea necesario emplear una clavija eléctrica no original, asegurese de colocar los cables de acuerdo con el código de colores y polaridades descritos en el manual y los códigos de seguridad de la red eléctrica.
- Sustituya los fusibles fundidos con fusibles del tipo y tamaño estipulados en el panel de fusibles ó en el manual.
- Sustituya los cables deteriorados inmediatamente con cables del mismo tipo y graduación.
- Asegureses de que los valores de las líneas de electricidad se ajustan a los valores para los que el Instrumento ha sido preparado.

Botellas de Gas Comprimido

- Guarde y maneje las botellas de gas con cuidado y de acuerdo con las normas de seguridad.
- Asegure las botellas a una estructura inmovil ó a la pared.
- Guarde y mueva las botellas en posición vertical. Retire los reguladores antes de transportarlas.
- Guarde las botellas en un área ventilada, lejos de fuentes de calor, de luz solar directa y de temperaturas extremadamente bajas.
- Identifique las botellas claramente para evitar cualquier duda sobre su contenido.
- Utilice sólamente reguladores y conexiones aprobadas.
- Utilice sólo tubos de conexión cromatográficamente límpios (Varian p/n 03-918326-00) y que tengan una graduación de presión significativamente mayor que la mayor presión del regulador.

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GC Prácticas de Seguridad

Sistema de Extracción

No se necesita un sistema de extracción para los detectores GC instalados en un laboratorio bien ventilado, excepto cuando se analicen muestras químicas peligrosas. Si instala un sistema de extracción:

- Utilice conductos a prueba de fuego.
- Instale un ventilador al final del sistema.
- Instale entradas de aire cuya vibración no afecte al trabajo del detector.
- Compruebe periódicamente el correcto funcionamiento del sistema.
- Asegurese de una correcta ventilación del laboratorio.

Detectores con fuentes radioctivas

- Lea con cuidado y cumpla todas las **NOTAS**, **PRECAUCION**, y **ATENCION** del Manual del Detector Ni^{63} ECD.
- Realice los test de contaminación radioactiva descritos en el Manual del Detector Ni^{63} ECD.
- Cumpla con los plazos y procedimientos de test de fugas.

Peligro de Quemaduras

Las zonas de calor ó frío (criogénicas) del Cromatógrafo de Gases pueden permanecer calientes ó frías durante bastante tiempo después de apagar el instrumento. Para evitar quemaduras asegureses de que todas las áreas que se calienten ó enfríen han vuelto a la temperatura ambiente, ó protejase adecuadamente las manos, antes de tocar las superficies potencialmente calientes ó frías.

LC Prácticas de Seguridad

Peligro de Alta Presión

Si se rompe una línea de presión, ó se abre una válvula de seguridad accidentalmente bajo presión, la bomba puede generar líquidos a alta presión potencialmente peligrosos, produciendo un chorro a alta velocidad de líquidos volátiles y/ó tóxicos.

- Lleve protección facial cuando inyecte muestras ó realice mantenimiento de rutina.
- Nunca abra una línea ó una válvula bajo presión. Apague la bomba antes y deje que la presión baje a cero.
- Utilice depósitos irrompibles que sean capaces de operar a 50-60 psi.
- Mantenga cerrada la junta del depósito cuando se haye bajo presión.
- Lea y cumpla todas las **NOTA**, **PRECAUCION**, y **ATENCION** del manual.

Cromatografía Flash

El operador debe familiarizarse con las propiedades físico-químicas de los componentes de la fase móvil.

Alejar los disolventes del contacto directo con los tubos de poliuretano ya que ciertos disolventes pueden causar reblandecimiento de los tubos o posibles fugas con riesgo de explosión.

Todos los componentes del sistema deben estar conectados a un enchufe común con toma de tierra común. Esta toma de tierra debe ser una toma de tierra verdadera en lugar de flotante.

Los disolventes no-polares pueden originar carga estática cuando son bombeados por el sistema. Todos los recipientes que contienen fase móvil (incluyendo los tubos y los recipientes de recogida) deben estar conectados a tierra para disipar la electricidad estática.

Utilizar medidores de carga estática y los debidos dispositivos de descarga (por Ej., ionizadores de aire) para salvaguardarse contra la creación de electricidad estática.

Radiación Ultravioleta

Los detectores del Cromatógrafo de Líquidos que utilizan una fuente de luz ultravioleta disponen de protección para prevenir exposiciones radioactivas al personal.

Para una correcta protección:

- Asegurese de que las cubiertas de protección de la lámpara de los detectores está correctamente situada durante su funcionamiento.
- No mire directamente a las celdas del detector ó a la fuente de luz UV. Cuando inspeccione la fuente de luz ó la celda, utilice siempre una protección para los ojos como gafas de borosilicato ó poliestireno.

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Disponibilidad de Recambios

Es Política de Varian disponer de Recambios para cualquier instrumento y la mayoría de los accesorios por un periodo de cinco (5) años después del último instrumento fabricado. Los recambios durante esos cinco años estarán disponibles, pero siempre bajo el sistema *"Según disponibilidad"*. Los Recambios están definidos como todas aquellas partes individuales mecánicas ó eléctricas que son susceptibles de fallo durante su normal proceso de operación. Por ejemplo, relés, lámparas, sondas de temperatura, elementos del detector, motores, etc. Las planchas de metal, partes de la estructura, placas de circuitos integrados, y otros módulos funcionales son normalmente susceptibles de reparación y por lo tanto sólo estarán disponibles bajos el sistema *"Según disponibilidad"* después del último instrumento fabricado.

Disponibilidad de Servicio

Varian ofrece una gran variedad de sistemas de Servicio para mantener el soporte a sus usuarios tras el periodo de garantía. El Soporte de Servicio se ofrece a través de atractivos Contratos de Servicio ó bajo un sistema de facturación de mano de obra y materiales. El mantenimiento y el entrenamiento se realiza por ingenieros cualificados bajo Contrato ó petición.

Oficinas de Instrumentación Analítica Varian

Para cualquier consulta sobre Instrumentación Analítica, Servicio Técnico ó Recambios y Accesorios, contacte con su oficina local:

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Functional Description

Introduction

The Saturn® 2000 GC/MS has four principal components:

Gas chromatograph (GC)

Mass spectrometer (MS)

Data system (DS)

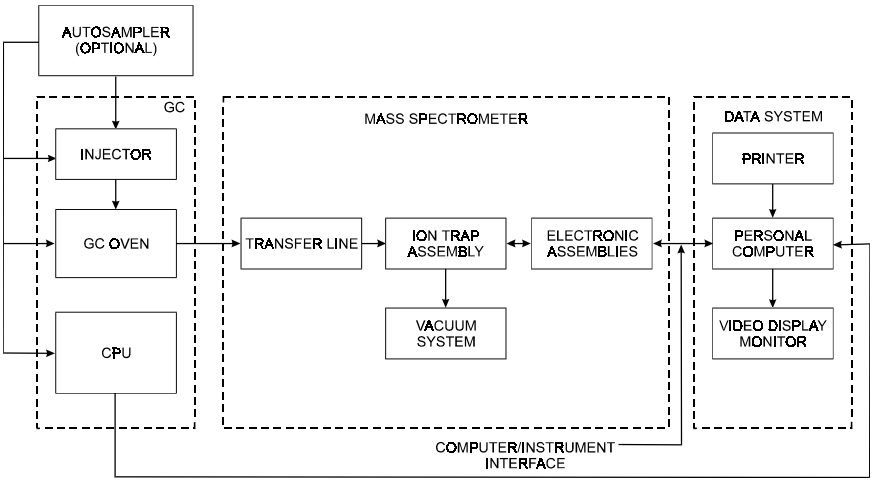
AutoSampler (optional)

The following figure is a functional block diagram of the Saturn GC/MS. A short, line-of-sight transfer line connects the GC and mass spectrometer. The AutoSampler sits on top of the GC.

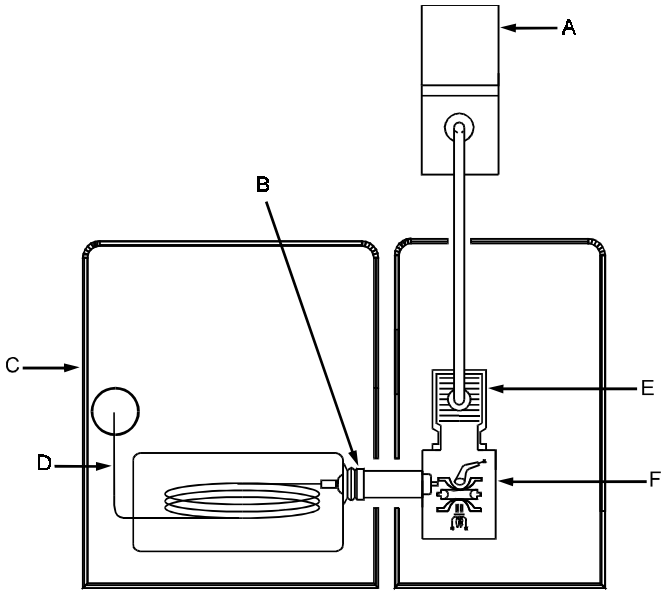
A fused silica capillary column in the GC passes through the transfer line directly into the ion trap assembly (see *Principal Components of the Saturn GC/MS* on page 2). Samples are injected either manually or via the AutoSampler onto the capillary column through the GC injection port.

The gas chromatograph then separates the sample molecules. Effluent from the GC passes through the transfer line and into the ion trap. The sample molecules next undergo electron or chemical ionization before being analyzed according to their mass-to-charge ratios.

The ions are detected by an electron multiplier, which produces a signal proportional to the number of ions detected. The electron multiplier passes the ion current signal to the system electronics, which in turn amplify the signal, digitize the result, and pass it on to the data system for further processing and display. Refer to the following Functional Block Diagram.



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A Foreline Pump **B** Transfer Line **C** GC Oven **D** Capillary Column
E Turbomolecular Pump **F** Ion Trap Assembly

Principal Components of Saturn GC/MS (Top View)

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Technical Specifications

NOTE: Specifications are identical for turbomolecular pump and diffusion pump GC/MS systems unless specified.

Saturn 2000 GC/MS System Performance Specifications

Ionization Mode: Electron Ionization standard, Chemical Ionization optional.

MS/MS: Patented Modulated *Resonant* dissociation provides chromatographic spectral consistency and wide dynamic range. Patented *non-Resonant* dissociation provides spectral consistency and wide dynamic range, as well as additional spectral information via cascading.

Mass Range: 10 to 650 u. Scan range time programmable throughout the analysis.

Full Spectrum Scan Rate: Up to 10 Hz, depending upon mass range selected.

Physical Specifications

Saturn GC/MS:
Height 21 inches (51 cm)
Depth 24 inches (61 cm)
Width 38 inches (81 cm)
Weight 170 pounds (73 Kg)

Installation Requirements:
Supplied by Customer

Power: Two dedicated Fourplexes, each rated at 115 Vac ±15%, 60 Hz, 20A *or* 230 Vac ±15%, 50 Hz, 10-16 A.

GASES:
Carrier Gas: Ultra high purity helium; purity 99.998% with less than one ppm each of water, oxygen, and total hydrocarbons.

CI Reagent Gases: Methane, isobutane, ammonia - purity 99.99%.

Environment: Combined GC/MS/DS will average 15,000 Btu/h-1 output when considering air conditioning needs. Combined GC/MS/DS requires 6-12 inches distance from walls.

Indoor Use
Altitude up to 2500 m

Temperatures:
Turbomolecular Pump: 59-80 F (15-27 C)
Diffusion Pump: 59-95 F (15-35 C).
Relative Humidity: 40-80% with no condensation.
Installation Category II
Pollution Degree: 2

The Gas Chromatograph

The Saturn GC/MS employs the high performance Varian Model 3800 or 3900 Gas Chromatograph. The gas chromatograph comes with a 1079 or 1177 Universal Capillary Injector which provides five modes of injection - isothermal split and splitless, temperature-ramped splitless, on-column and large volume. For further details about the GC, please see the Varian 3800 Gas Chromatograph Getting Started Manual (03-914647-00) and the 3800 GC Operator's Manual (03-914648-00).

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The Mass Spectrometer

The Saturn GC/MS employs an ultra trace ion trap mass spectrometer. The mass spectrometer consists of the mechanical and electronic assemblies. The following sections describe these assemblies.

The instrument is separated into the electronics and analyzer compartments. The electronics compartment includes the

Scan acquisition processor/waveform board (SAP/Wave board)

Power board

The analyzer compartment includes the

Transfer line

Vacuum manifold (including the ion trap)

Vacuum pump and controller

RF coil and generator

Pneumatics manifold

Mechanical Assemblies

The Saturn mechanical assemblies include the following:

Controls and indicators

Cooling fans

Vacuum system

Transfer line

Ion trap assembly

Controls and Indicators

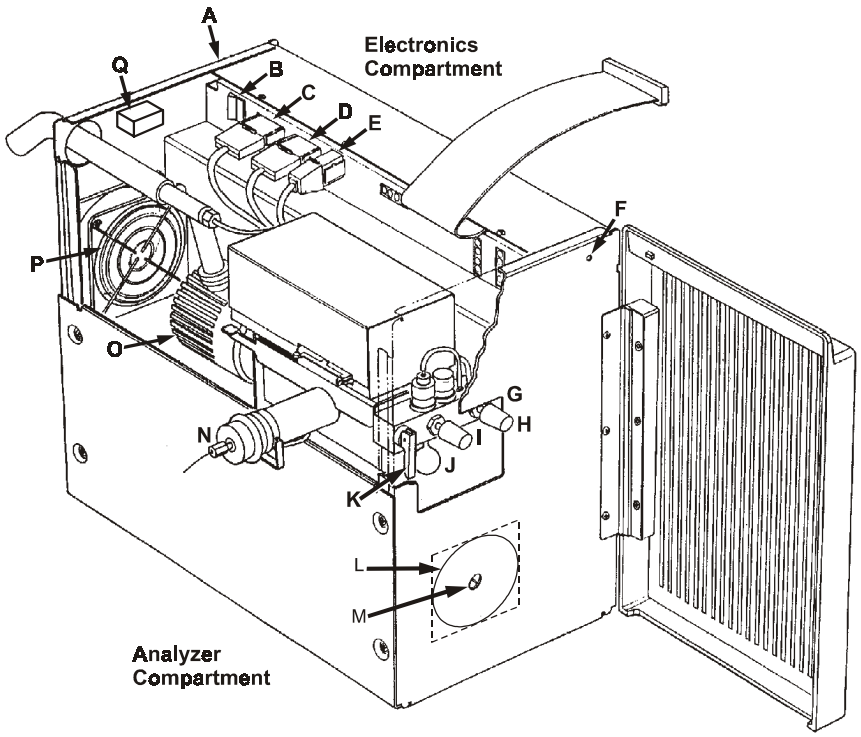
The main power switch for the Saturn GC/MS, located on the rear panel, controls power to the vacuum system and to the electronics.

When the main power switch is turned on, the light-emitting diode (LED) on the Saturn GC/MS front panel is illuminated.

WARNING

In the event of an emergency, shut off of all power to the Saturn GC/MS by placing the main power switch in the OFF position and unplugging the instrument.

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A	Main Power Switch (rear panel)	J	Cal Gas Vial
B	Service Switch	K	Vent Valve
C	Transfer Line Heater	L	RF Coil
D	Trap Heater	M	RF Coil Adjustment Screw
E	Manifold Heater	N	Transfer Line
F	LED	O	Turbomolecular Pump
G	Pneumatics Manifold	P	Cooling Fans
H	CI Cal Gas Adjust	Q	CI Shutoff Valve
I	Cal Gas Adjust		

Saturn 2000 GC/MS Mass Spectrometer

Cooling Fans

CAUTION

To prevent overheating, do not block air intakes.

Turbomolecular Pump System

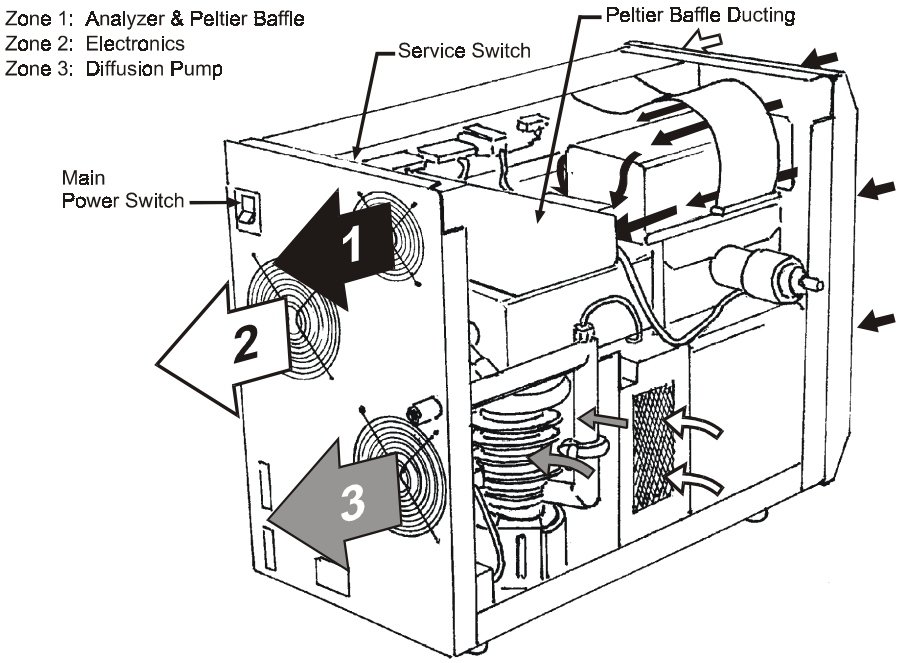
Two fans mounted on the rear of the spectrometer cool the unit. The analyzer compartment fan draws air from the back, blowing it directly on the bearing end of the turbomolecular pump in the analyzer compartment. The air then flows past the manifold electronics and out the front of the instrument. The turbomolecular pump controller supplies power to the analyzer compartment fan.

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The electronics section fan draws air from the back, and blows it across the SAP/WAVE and power boards in the electronics compartment. Hot air from the GC oven does not affect the MS as long as the system is at least six inches from a wall. The power board supplies power to the electronics compartment fan.

Diffusion Pump System

The GC/MS Diffusion pump system has three cooling zones, each with its own fan mounted in the rear of the instrument.



Cooling Zones

Zone 1 is the upper part of the analyzer compartment. Its purpose is to provide forced air-cooling for the Peltier baffle's heat sink. It also provides cooling for the manifold electronics. The upper fan on the rear panel pulls air in through the front of the instrument. The air is drawn over the manifold electronics, ducted over the Peltier baffle's heat sink, and expelled through the rear of the instrument. The diffusion pump controller monitors operation of this fan. Fan failure will trigger a system shutdown.

CAUTION

The Peltier Baffle ducting must be left in position at all times, or the Peltier baffle will overheat allowing back streaming pump vapor to contaminate the analyzer.

Zone 2 is the electronics compartment, diffusion pump controller, and RF generator board. Its purpose is to cool the majority of the instrument's printed circuit boards. The mid level fan on the rear panel pulls air in from two directions. The primary cooling air supply is pulled in through the front of the instrument, over the power board and SAP/Wave board, and expelled through the rear of the instrument. A secondary air supply is pulled in through the left side panel, ducted over the RF generator board, the diffusion pump controller, and then merges with the primary airflow.

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Zone 3 is the diffusion pump compartment. The lower fan on the rear panel pulls air in through carefully positioned vents in the left side panel. Airflow is ducted around the diffusion pump's cooling fins, and expelled through the rear of the instrument.

CAUTION

The left side cover must remain in place whenever the instrument is on. Failure to do so will cause the airflow to bypass the pump, which will overheat and trigger a system shutdown. Fan failure will have the same result. GC side cover must also be in place.

Turbomolecular Pump Vacuum System

The turbomolecular vacuum system evacuates excess water vapor, air, and carrier gas from the mass spectrometer ion trap assembly. Principal turbomolecular vacuum system components include

Vacuum manifold

Turbomolecular pump

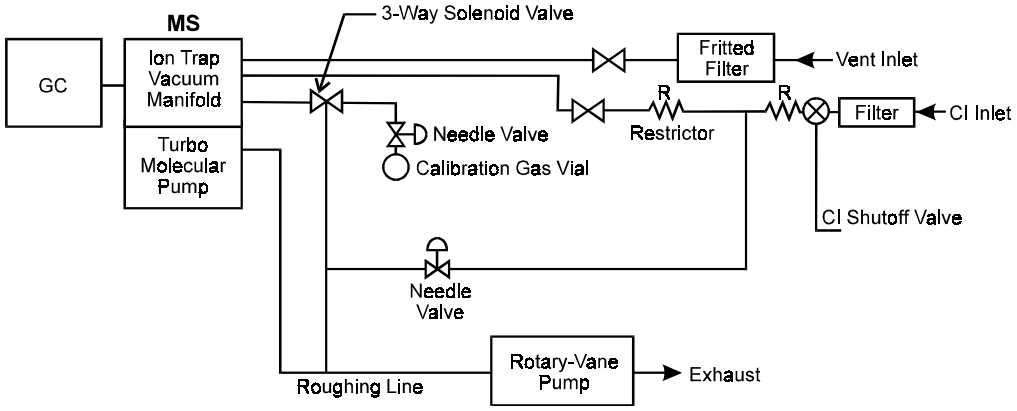
Foreline pump

Vent valve

Calibration gas valve

CI reagent gas valves

Below is a diagram of the vacuum system.



The Saturn Turbomolecular Vacuum System

Turbomolecular Pump Vacuum Manifold

The vacuum manifold, which can be heated for bake out, encloses the ion trap assembly. The vacuum manifold is a stainless-steel tube, which houses the analyzer. The turbomolecular vacuum pump, which evacuates the manifold, discharges into a foreline pump. (Also see Diffusion Pump Vacuum System section for additional vacuum manifold information for the diffusion pump system.)

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The vacuum manifold sits atop the RF coil housing. The turbomolecular pump makes an airtight seal with the manifold, to which it is mounted horizontally with a Viton® O-ring. The ion trap assembly suspends from the analyzer flange, and extends into the body of the manifold. The manifold makes an airtight seal with the analyzer flange, also via a Viton® O-ring. Quick release tabs permit easy removal of the trap in the absence of vacuum.

Eight electrical feedthroughs pass through the analyzer flange, i.e.,

One for the electron gate

Three for the filament assembly

Two for the axial modulation voltages applied to the filament and multiplier endcap electrodes of the ion trap assembly

One for the high voltage to the electron multiplier cathode

One for the ion current signal from the electron multiplier anode

Another feedthrough passes through the underside of the manifold to provide radio frequency (RF) voltage to the ring electrode.

An ion gauge monitors the pressure inside the manifold by generating and collecting ions from any gas present. The ion gauge also passes through the analyzer flange.

Four additional inlets introduce material into the vacuum manifold. These inlets include

One for the transfer line

One for the CI reagent gas

One for introduction of the calibration gas

One for venting

Turbomolecular Vacuum Pump

A turbomolecular vacuum pump provides the high vacuum for the Saturn GC/MS. Under normal operating conditions, this pump supplies a vacuum of approximately 10^{-5} Torr (1.33×10^{-3} Pa) in the manifold region outside the ion trap assembly. The pump is rated at 70 liters/second and operates at 60 liters/second; it is air cooled and thermostatically protected. If the temperature of the pump housing near the bearing exceeds 60 C, the pump speed will automatically shut down.

A turbomolecular-pump controller regulates and supplies power to the pump. The controller sits below the pump in the analyzer compartment of the spectrometer. Turning off the main power switch on the rear panel of the mass spectrometer shuts off power to the turbomolecular-pump controller and thus to the pump.

NOTE: The electronics service switch does not control the vacuum pumps.

The turbomolecular-pump controller monitors the pump's rotational speed. The controller sends a signal proportional to the pump speed to the SAP/Wave board via the power board. You can monitor the turbomolecular pump speed from the Instrument Control Page.

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If the speed of the pump is 92% or more of the maximum operating speed, the signal from the controller prompts the power control board to send a TURBOMOLECULAR SPEED OK signal to the SAP/Wave board. The SAP/Wave board uses the signal for enable or disable the filament, electron multiplier voltage, RF generator, CI reagent gas valve, and calibration gas valve by means of an electronic interlock.

If the pump speed falls below 92% of its maximum operating speed, the TURBOMOLECULAR SPEED OK signal to the SAP/Wave board turns off. The filament, electron multiplier, RF generator, CI reagent gas valve, and calibration gas valve turns off automatically. This condition probably indicates a major air leak in the system or that the pump is too warm. If this is the case, you will have to locate and fix the leak to make your system fully operational.

Diffusion Pump Vacuum System

The diffusion pump is an alternative vacuum pump to the turbomolecular pump. It is less costly to replace, has a longer life span, and can be operated in ambient temperatures up to 35 °C. However, servicing the instrument does take slightly longer because the diffusion pump must be fully cooled and the Peltier baffle warmed up to room temperature before breaking vacuum.

The diffusion pump vacuum system removes air, carrier gas, adsorbed water vapor, and analytes from the mass spectrometer ion trap assembly. Principal diffusion pump components are shown, and include:

Vacuum manifold

Peltier baffle

Diffusion pump

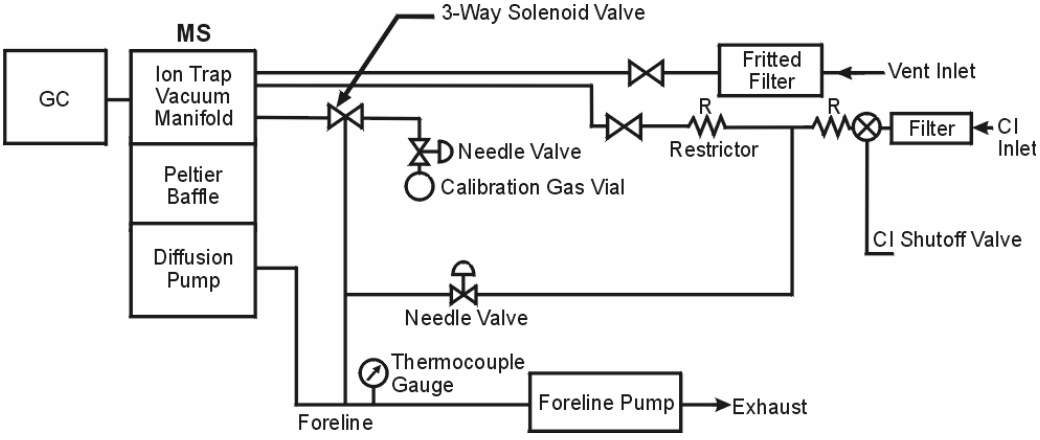
Thermocouple gauge

Foreline pump

Vent valve

Calibration gas valve

CI reagent gas valves (optional)



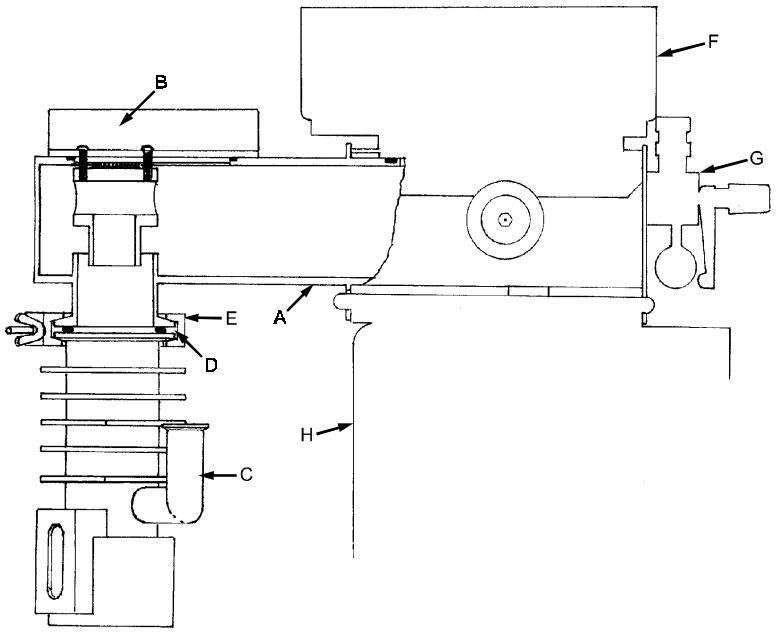
Saturn Diffusion Pump Vacuum System

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Diffusion Pump Vacuum Manifold

The vacuum manifold is a stainless steel tube that maintains the ion trap assembly in a vacuum. Carrier gas is fed into the ion trap via the transfer line, and calibration gas and Chemical Ionization gases are fed into the ion trap via the pneumatics assembly. The vacuum manifold is evacuated and maintained at vacuum of approximately 1 x 10^{-5} Torr (1.3 x 10^{-3} Pa) by a diffusion pump. A Peltier baffle is incorporated in the manifold to minimize background contamination caused by the back streaming of pump vapors.

The vacuum manifold, analyzer assembly, pneumatics assembly, Peltier baffle, and diffusion pump, are shown.



A Manifold **B** Peltier Baffle **C** Diffusion Pump **D** Inlet Seal **E** Inlet Clamp
F Analyzer Assembly **G** Pneumatics Manifold **H** RF Coil

Cross Section of the Diffusion Pump Vacuum System

Peltier Baffle

The Peltier baffle is a cooled line of sight baffle that reduces back streaming of vacuum pump vapors into the vacuum manifold. The design consists of a one-piece baffle that is cooled by a thermoelectric cooling element (TEC). The TEC is essentially an electronic heat pump based on the Peltier effect. A voltage is applied to the TEC, causing heat to be pumped from the cold side of the TEC to the hot side. The cold side of the TEC draws heat from the baffle, thereby cooling it, and the hot side of the TEC pushes heat into the heat sink. The heat sink is cooled by forced air convection.

The TEC is activated when the system is started, and remains on until it is switched off during the shutdown procedure.

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Diffusion Pump

The ion trap assembly requires a vacuum of approximately 1 x 10^{-5} Torr (1.3 x 10^{-3} Pa) for the generation and detection of ions. The Varian AX65 air-cooled diffusion pump with a pumping speed of 30 l/s for air and 65 l/s for helium provides this.

The pump features two safety devices. The first is an over temperature switch that prevents catastrophic pump failure and subsequent ion trap contamination from over heating problems, such as a cooling fan failure or a blocked air inlet. The second feature is a sight glass that allows inspection of the diffusion pump fluid level and condition without breaking vacuum. This reduces periodic maintenance time, and helps prevent the pump being run without fluid.

Diffusion Pump Controller

The diffusion pump controller controls and provides power to the following vacuum components:

TEC in the Peltier Baffle

Peltier baffle fan

Diffusion pump

Diffusion pump fan

Thermocouple gauge

The diffusion pump controller is activated when the system's main power switch is in the ON position. It will remain activated until the system is switched OFF. Upon activation, the controller will provide power to the TEC, Peltier baffle fan, and diffusion pump fan. It will also check the foreline pressure reading from the thermocouple gauge. If the foreline pressure has reached the diffusion pump's required operational pressure after fifteen minutes, the controller will provide power to the diffusion pump. After another fifteen minutes (thirty minutes total) the diffusion pump will reach operational temperature, and the controller will issue a "DIFFUSION PUMP NORMAL" signal to the SAP/Wave board, which in turn provides power to the ion trap.

During normal running conditions the diffusion pump controller will continue to monitor the TEC, Peltier baffle fan, diffusion pump, and thermocouple gauge. The controller will initiate a system shutdown and send a fault signal to the SAP/Wave board if a power failure is detected on any of these components, or a pump over temperature is detected. The SAP/Wave board will shut off power to the ion trap. The controller will also discontinue power to the diffusion pump, and send a fault signal to the SAP/Wave board if a foreline overpressure is detected. Power to the diffusion pump will be restored, and the fault signal canceled when the overpressure problem no longer exists.

The diffusion pump controller also ensures a safe shutdown when the instrument must be switched off for maintenance, repair, or relocation. The controller receives a shut down command from the SAP/Wave board, and immediately discontinues power to the diffusion pump. The controller will wait fifteen minutes before discontinuing power to the TEC. After another fifteen minutes (thirty minutes total) the controller issues a DIFFUSION PUMP OFF signal to the SAP/Wave board, and the shut down procedure may be completed.

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The diffusion pump may be restarted at any time during the shutdown procedure providing no fault condition exists. The controller will restore power to the diffusion pump if it receives a restart command during the first fifteen minutes of the shut down procedure. The diffusion pump will reach operational temperature, and the controller will issue a "DIFFUSION PUMP NORMAL" signal to the SAP/Wave board after fifteen minutes. A full thirty-minute start up will be initiated if the controller receives a restart command during the second fifteen minutes of the shut down procedure.

Thermocouple Gauge

A thermocouple gauge is a simple, rugged, vacuum gauge that is used to measure vacuum pressures in the 2 Torr (267 Pa) to 1 x 10^{-3} Torr (1.3 x 10^{-1} Pa) range. The gauge's main purpose is to enable the diffusion pump controller to detect gross leaks and foreline pump failure.

The thermocouple gauge is active whenever the diffusion pump controller is active. It is monitored during start up to ensure the vacuum system has been pumped down to the diffusion pump's required operational pressure. Once the diffusion pump is operational, the thermocouple gauge is monitored to ensure the operational pressure is maintained.

The Pneumatics Manifold

The pneumatics manifold is an aluminum block mounted to the front of the vacuum manifold. It is equipped with two solenoid and needle valves for the cal gas and CI, the glass cal gas vial, and vent valve.

The vent valve is a manually operated valve that connects to atmosphere via the pneumatics manifold. You open and close the vent valve via a toggle arm, which is accessible from the front of the instrument.

The calibration-gas-valve assembly consists of a metering needle valve, an ON/OFF solenoid-operated valve, and a glass vial containing the calibration liquid. The assembly sits directly behind the instrument's door. The needle valve controls calibration gas flow into the vacuum manifold through the solenoid valve.

The calibration compound is perfluorotributylamine (PFTBA) or $C_{12}F_{27}N$, also known as fluorocarbon-43 (FC-43). A small glass vial attached to the valve assembly holds the compound. You set the flow of calibration gas into the manifold manually via a needle valve. The data system controls the opening and closing of the solenoid-operated valve.

Two solenoid valves control the flow of CI reagent gas into the manifold. First, the shutoff valve near the rear panel opens to permit reagent gas flow into the instrument through a fitting. When this valve is open, the foreline pump removes a portion of the CI gas to prevent CI gas surges (pressure pulses) in the ion trap. The gas then flows through the shutoff valve through metering and solenoid-operated valves before entering the vacuum manifold. With the CI gas solenoid open, the CI needle valve determines the split ratio of the reagent flow between the manifold and foreline pump.

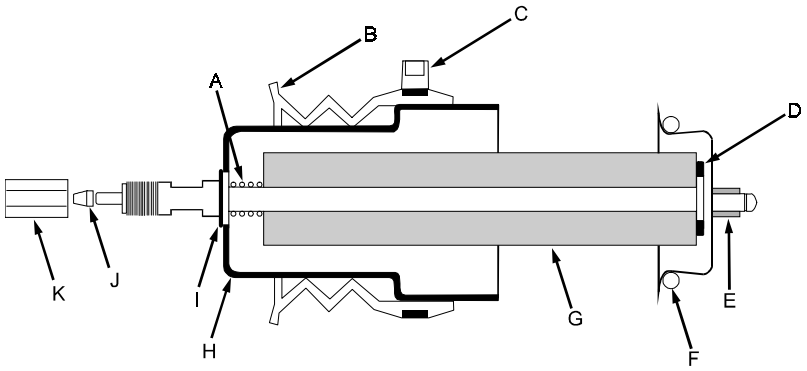
You turn the CI reagent gas valve on and off via the data system from the Instrument Control Page or Acquisition, you adjust the flow rate of the reagent gas into the manifold by means of a metering valve.

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The Transfer Line

A stainless-steel-tube transfer line directly couples the GC to the mass spectrometer. The transfer line keeps the GC column warm as the column enters the mass spectrometer. The transfer line is 12 cm (5 in.) long, and has a diameter of 4.1 cm (1.6 in.). One end enters a hole in the right side of the GC before passing into the GC oven. The other end enters the vacuum manifold with the transfer-line tip inserted into the ion trap.

The body of the transfer line consists of a stainless-steel weldment fitted with a center tube, a heat exchanger, and a boot. The heat exchanger is an aluminum cylinder that contains a cartridge heater and a thermocouple as the temperature sensor. The temperature sensor measures the temperature of the tube. The cartridge heater heats the cylinder, which in turn distributes heat evenly throughout the length of the transfer line tube. The boot of the transfer line, which mates to the GC, prevents hot air leakage from the GC Oven.



Transfer Line

A Spring **B** Boot **C** Tie Wrap **D** Washer **E** Transfer Line Tip
F O-Ring **G** Heat Exchanger **H** Nose **I** E-Ring **J** Ferrule **K** Nut

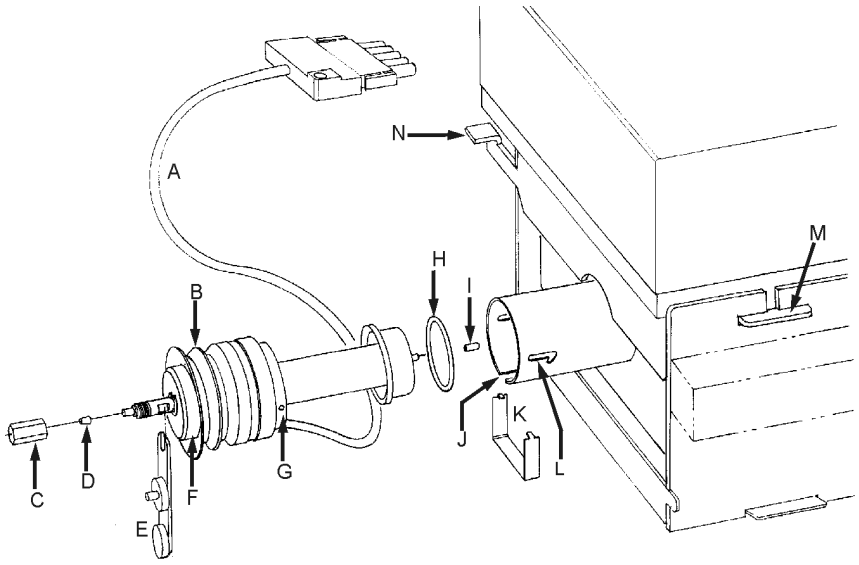
A bayonet mount feature secures the transfer line. Before you remove the trap, push gently on the bayonet mount as you twist it counterclockwise and pull the mount out. Make sure the transfer line extends out from the trap.

NOTE: Failing to remove the transfer line before removing the trap may damage the trap heater post.

The power board supplies power to the cartridge heater via a transfer line heater cable. The heater cable projects out from one end of the transfer line. It then plugs into a soft-shell connector on the top of the power board panel.

You set the transfer line temperature from the Instrument Control Page. The maximum temperature that the transfer line can sustain is 350 C; the minimum temperature depends on the GC oven and trap temperatures. In general, you can set the transfer line temperature as much as 30 C below the maximum column operating temperature and not observe adverse chromatographic effects (e.g., retention time shifts or peak broadening).

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A	Heating Cable	H	O-ring
B	Boot	I	Transfer Line Tip
C	Nut	J	Heating Cable Slot
D	Ferrule	K	Nose Clip
E	Transfer Line/Alignment Tool	L	Bayonet Mount
F	Nose	M	Analyzer Assembly Tongue
G	Nose Hole	N	Analyzer Assembly Lock-Down Tabs

Transfer Line Exploded View

Ion Trap Assembly

The ion trap assembly consists of

Trap oven

Filament assembly

Electron gate

Ion trap electrodes (3)

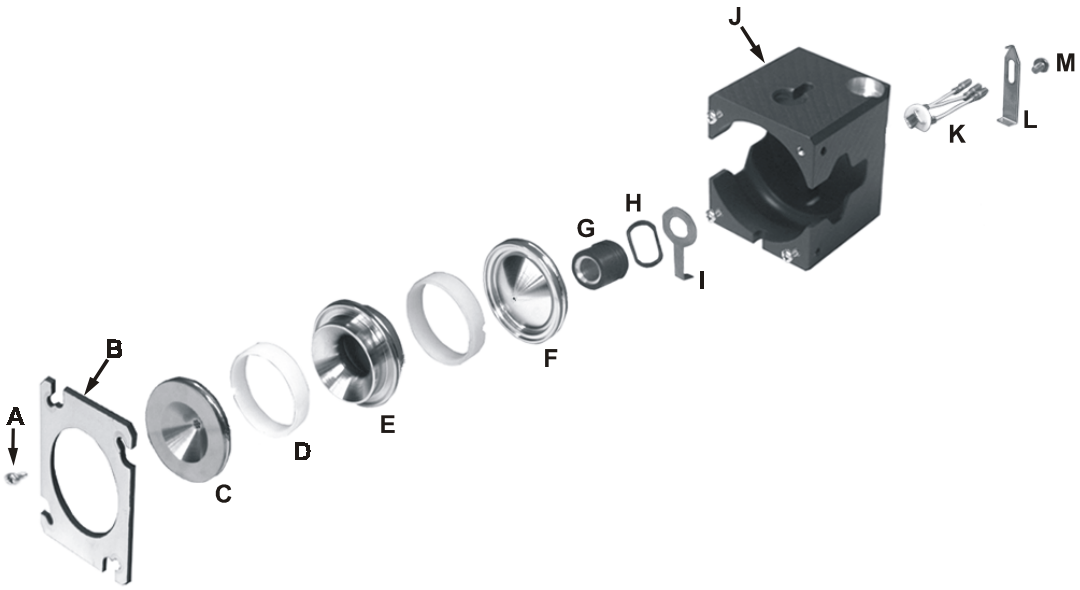
Quartz rings

Electron multiplier assembly

The figure below shows the ion trap assembly along with its three electrodes, electron gate, and filament lens.

NOTE: The Silica Coated Spacers have a shiny, mirror like finish on the inside surface.

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A	Screw, 6/32, 4 places	H	Wave Washer
B	Clamping Plate	I	Gate Conductor
C	Exit End Cap	J	Trap Oven, “T” is located this side.
D	Quartz or Silica Coated Spacer, 2 places	K	Filament Assembly
E	RF Ring Electrode	L	Filament Clip
F	Filament End Cap	M	Screw
G	Electron Gate		

Ion Trap Assembly

Trap Oven

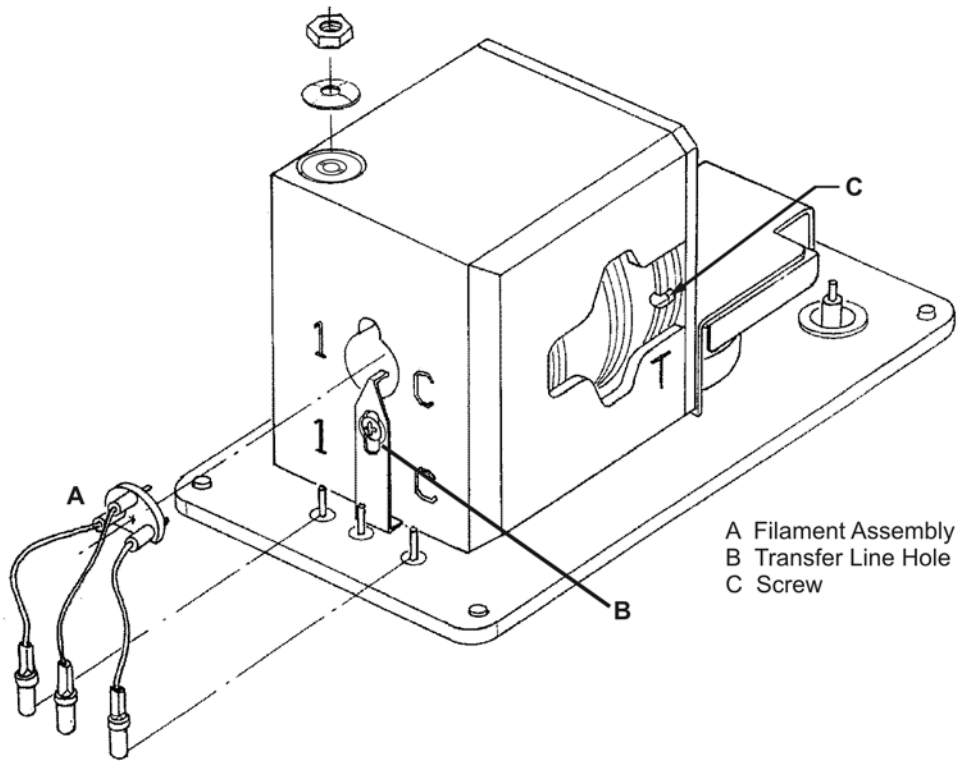
The trap oven is a heated anodized aluminum block that maintains a uniform temperature for the trap electrodes. A heater post on the manifold flange generates the heat. A thermal well measures the oven temperature. In addition, the oven holds the ionization filaments, and acts as a lens for focusing the ionizing electrons before they enter the trap.

Filament Assembly

The filament assembly sits in the trap oven. It is connected to three feedthroughs on the manifold flange.

The filament assembly consists of two filaments and a repeller plate. The two filaments are mounted side-by-side, with each filament approximately equidistant from the entrance hole of the oven’s electron focusing lens. Note that the Saturn GC/MS only uses one filament at any given time; the extra filament is provided as a back up in case the first one burns out.

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Filament Assembly Shown with Ion Trap

Each filament is a rhenium wire. When sufficiently heated by electric current, the filament produces electrons by thermionic emission. The filament emission current refers to the flow of emitted electrons from the filament. The magnitude of the filament emission current is set in the Instrument Control Page. Emission current settings range from 5 to 100 μA.

NOTE: It is unlikely that two filaments will have the same net flow of electrons into the ion trap. Thus, the signal amplitudes from two different filaments will probably not be the same. A typical difference is 2:1, but it may be as high as 5:1.

Electron Gate

The electron gate is a cylindrical electrode that controls the entry of electrons into the ion trap cavity. When electrons emitted from the heated filament are not needed for ionization, the electron gate is held at a -150 Vdc potential. The electron gate sits inside the trap oven, in front of the lens and behind the endcap electrode. An anodization layer insulates it from the filament endcap.

When the ion trap requires electrons, the electron gate potential changes from -150 to +150 Vdc. The gate potential remains positive for a variable length of time, e.g., from 10 μsec to 65 ms. During this interval, the electrons are focused into the ion trap cavity with sufficient energy, usually, 50 to 80 eV, to achieve electron ionization of the sample molecules (or of the reagent gas molecules in the case of chemical ionization).

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Ion Trap Electrodes

The ion trap assembly contains three stainless steel electrodes:

Filament endcap electrode

Exit endcap electrode

RF ring electrode

The filament endcap, exit endcap, and RF-ring electrodes have hyperbolic inner surfaces. Together, these electrodes form a cavity in which ionization, fragmentation, storage, and mass analysis take place.

Energetic electrons enter the ion trap cavity through the filament endcap via the electron gate.

There are seven holes in the center of the exit endcap electrode. Sample ions produced in the ion trap are ejected through these holes into the electron multiplier.

Two identical quartz or silica-coated spacers separate the central ring electrode from the filament and exit endcap. The trap oven and its clamping plate hold the electrodes and spacers in place. A cutout is provided in the quartz spacers and in the exit endcap to allow the transfer line to enter the ion trap.

The RF generator assembly provides high voltage RF that is applied to the RF ring electrode.

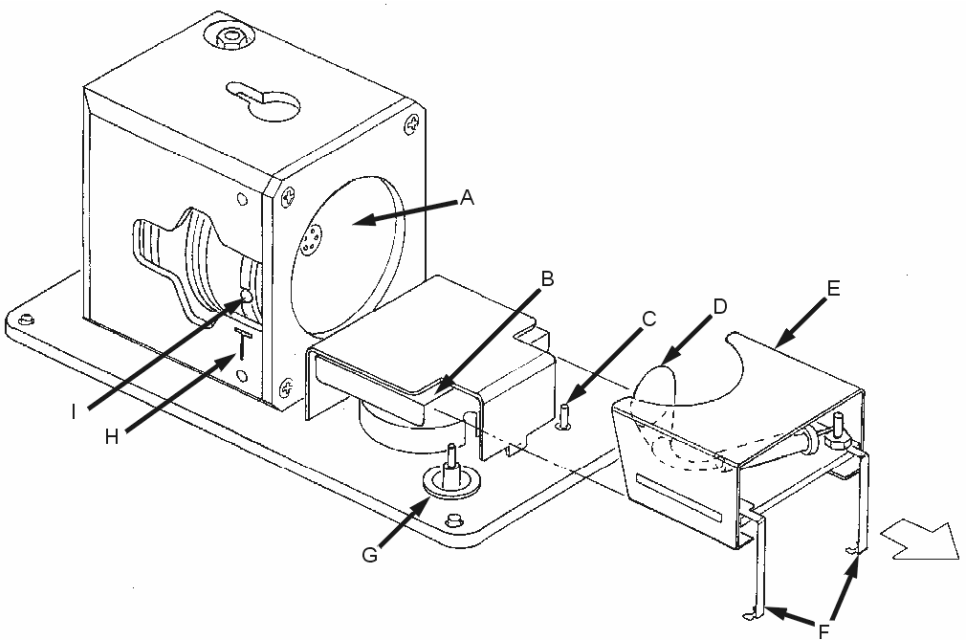
Under the proper RF voltage, the ion trap electrodes create a three-dimensional, hyperbolic electric field. This field is capable of trapping the ions in stable, aperiodic orbits. As the RF voltage increases, however, the ion trajectories become unstable in increasing order of mass per charge. The ion trap ejects the ions and sends them to an electron multiplier for detection.

During mass analysis, a supplementary RF voltage of 485 kHz is applied to the filament and exit endcaps. This voltage, termed the axial modulation voltage, improves spectral mass resolution and analytical sensitivity. Other voltages may be applied between the endcaps to implement such options as SECI and MS/MS. For further details, see the Saturn Method Editor for description of scan functions.

Electron Multiplier

The electron multiplier is positioned at the exit endcap electrode. It mounts in a pre-aligned position on a protective metal clip that you can easily remove to replace the multiplier. The multiplier detects positive ions as the ion trap ejects them through the holes in the exit endcap electrode. The continuous-dynode electron multiplier consists of a lead-oxide/glass, funnel-like resistor. A negative voltage of between -800 and -3000V is applied to the front end of the electron multiplier, referred to as the cathode. The back end of the cathode is held at ground potential, and is referred to as the anode.

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A	Exit End Cap	F	Multiplier Contacts
B	Electron Multiplier Track	G	Multiplier High Voltage Pin
C	Multiplier Signal Pin	H	Transfer Line Alignment
D	EM Grid	I	Transfer Line Entrance Hole
E	Electron Multiplier Mount		

Position of the Electron Multiplier Relative to the Ion Trap

The negative voltage applied to the cathode attracts the positive ions ejected from the ion trap cavity. These ions strike the cathode with sufficient velocity to dislodge electrons from the inner curving surface of the cathode. The increasingly positive potential gradient draws the ejected electrons into the electron multiplier, further accelerating them in the process. Because the electron multiplier is curved, the ejected electrons do not travel far before they again strike the inner surface of the multiplier, resulting in the emission of more electrons. This configuration produces a cascade of electrons that are accelerated toward ground potential at the exit end of the cathode.

The anode collects the electrons, and passes the resulting ion current signal on to the integrator circuit on the lower manifold board. The ion current signal is proportional to the total number of electrons that the ion trap ejects. Typically, you will adjust the voltage that is applied to the electron multiplier until the gain is about 10^5, i.e., until each ion that enters the electron multiplier generates approximately 10^5 electrons.

Ion Gauge

The optional Saturn GC/MS ion gauge design is based on the Bayard-Alpert gauge tube. The specifications for the gauge are similar to those of commercially available gauges. Fixed pressure readings with nominally identical gauges may exhibit variations of ±15%. An accuracy of ±25% in mid-range for any one gauge is considered typical.

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In general, the ion gauge exhibits good repeatability. However, the ion gauge response depends on gas composition. A certain pressure of air and water will give a different reading than that of Helium. The Ion Gauge is meant to be a rough indicator of vacuum conditions. It is not a precise quantitative tool.

The gauge uses thoria-coated iridium (ThO-Ir) filaments. These filaments are burnout resistant, and therefore exhibit high tolerance to air and water in the vacuum manifold. There is a time delay associated with heating the filament. This delay translates to a delay in determining whether a filament is open. From 15 to 20 seconds are usually required after you turn the filament on to obtain a stable reading.

The ion gauge will measure pressures between 10^{-6} and 10^{-2} Torr. A logarithmic amplifier amplifies the collector current, and the data system interprets this current as measured vacuum.

Foreline Pump

A foreline pump has two purposes. The first is reducing the vacuum system pressure to a level that will allow the operation of high vacuum pumps such as turbomolecular pumps and diffusion pumps. The second is maintaining the vacuum system pressure by removing the high vacuum pump's exhaust gases.

The foreline pump is connected to the high vacuum pump by a 2.1m (84 in.) length of 1.9 cm (0.75 in.) ID vacuum tubing. The pump plugs into the rear panel outlet labeled "J2 - LINE VOLTAGE - PUMP ONLY" on the rear of the MS. Power is supplied through this outlet and is controlled by the power switch on the rear panel.

The foreline pump used on the Saturn GC/MS is a two-stage rotary vane pump with a pumping speed of 90 L/min. and a vacuum potential of 1.5×10^{-3} Torr (2×10^{-1} Pa).



WARNING:
CHEMICAL HAZARD

If you use the Saturn GC/MS to analyze hazardous materials, be sure to affix the foreline pump exhaust to an exhaust system that complies with applicable safety regulations.

Electronic Assemblies

The electronic assemblies consist of the following:

Power input subsystem and turbomolecular (or diffusion) pump controller (See Diffusion Pump Controller).

Power board

Scan acquisition processor/waveform (SAP/Wave) board

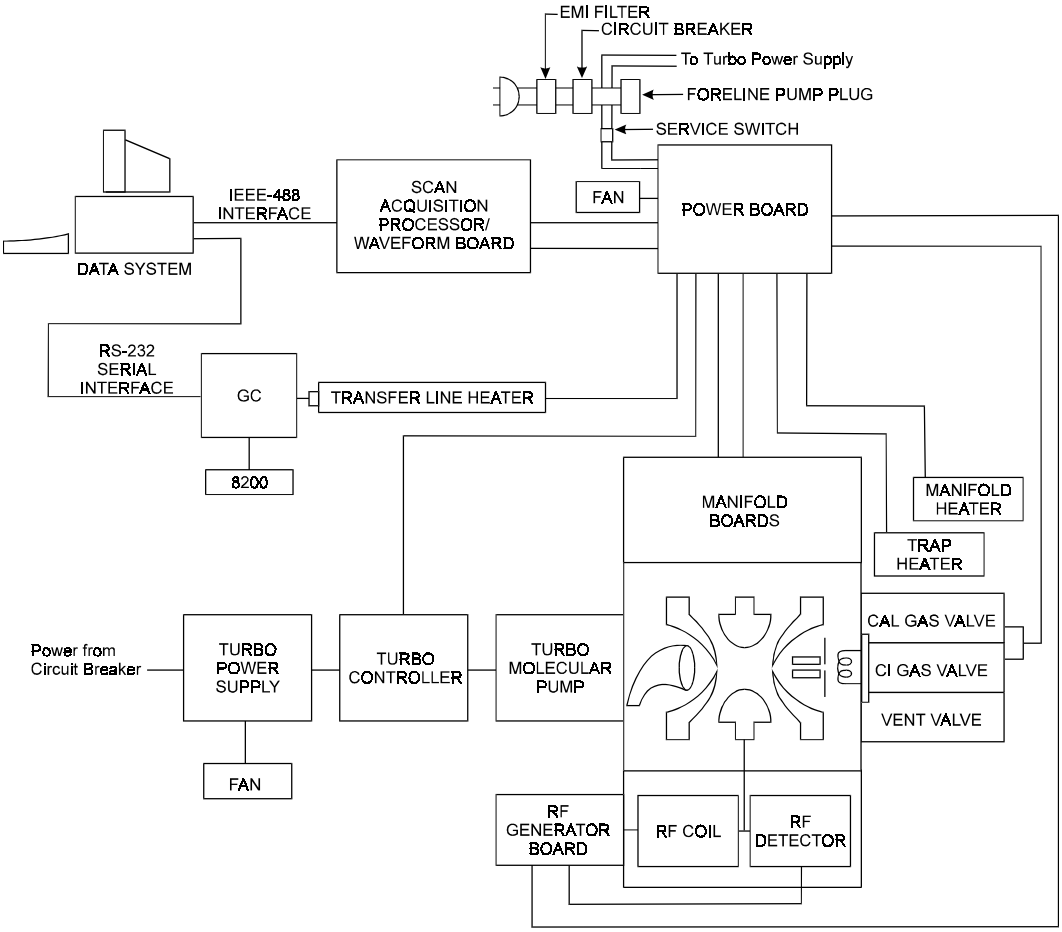
Manifold electronics assembly

RF generator board

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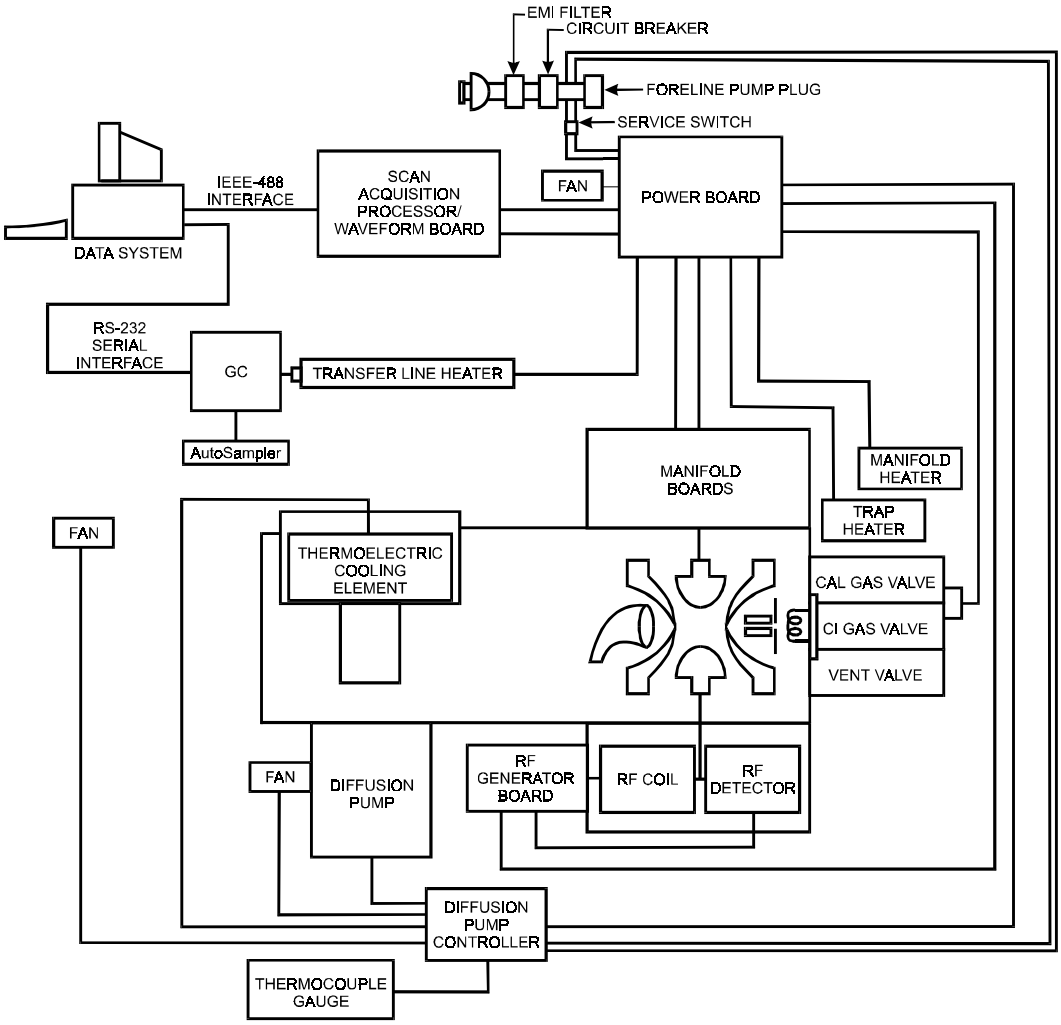
The electronics functions have been distributed throughout the spectrometer to minimize cable lengths between critical components. The SAP/Wave and power boards reside in an electronics enclosure that is separated from the analyzer section by a sheet metal bulkhead. The manifold electronics are enclosed directly above the analyzer. The RF generator attaches to the rear of the RF coil assembly.

Below are diagrams of the electronic assemblies used in the Turbomolecular and Diffusion Pump Saturn 2000 GC/MS.



The Saturn 2000 GC/MS Turbomolecular Pump Electronic Assemblies

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The Saturn 2000 GC/MS Diffusion Pump Electronic Assemblies

The Power Input Subsystem and Turbomolecular Pump Controller

The power input subsystem contains the following circuits and switches:

Main power switch

SERVICE switch

Line voltage switches

Main Power Circuit

Line power of 115 Vac ±15%, 60 Hz ±3 Hz (or 230 ±15 Vac, 50 Hz ±3 Hz) first enters the rear panel of the mass spectrometer, through J1, then passes through the line filter and the circuit breaker. After the circuit breaker, power is split in two directions. One path supplies the turbomolecular pump controller and foreline pump via J2. The second path goes to the electronics service switch, which controls power going to the power board and the rest of the electronics. The

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electronics service switch allows the vacuum to the maintained in the event that the electronics need to be serviced.

The line voltage switches are located on the power board and the turbomolecular controller. These switches are set at the factory.

The turbo controller regulates the speed of the turbo pump. The controller provides turbo speed and startup power to the power board.



WARNING:
SHOCK HAZARD

In the event of an emergency, shut off all power to the Saturn GC/MS by placing the main power switch in the OFF position.

Power Board

The power control board supplies power to all electronics components except the turbomolecular controller. It controls the heaters, ion trap and ion gauge filaments and solenoid valves.

NOTE: The switching power supply is protected by a 5A, Non-Time-Delay, fuse.

The following switching power supplies reside on the board:

The +5V dc power supply, which supplies +5V dc voltage to all digital circuits.

The -15V and +15V dc power supplies, which supply the voltages to the analog circuits on the power board and the manifold electronics assembly.

The +20V and -20V dc power supplies, which supply the voltages to the SAP/Wave and RF generator board's analog circuitry.

The +24 Vdc power supply supplies power for the solenoid valves, electronics compartment fan and the electron multiplier power supply.

The +55 Vdc power supply, which supplies unregulated +55 Vdc voltage to the RF generator board.

The 180-volt power supply that supplies voltage to the ion trap electron gate circuit and the ion gauge.

The following circuits also reside on the board:

The trap and ion gauge filament control circuits, which provide current to heat the filament and regulate the emission current from the filament. You set the trap filament emission current between 5 and 100 A via the data system.

Three heater control circuits that provide feedback control for the manifold, trap and transfer line heaters. The trap heater uses a proportional integral (PI) control circuit. Because there is an integrator component in this controller, removing power from the circuit will produce a lengthy stabilization time, e.g., up to two hours (dependent on the temperature set point).

Three solenoid control circuits, which turn the calibration gas, CI reagent gas, and CI shutoff valve solenoids on and off.

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The electron energy control circuits, which controls the dc bias on both the ion trap and ion gauge filaments.

The diagnostic multiplexer circuit, which routes the voltage output of various components, and circuits on the power control board to the SAP/Wave board. You can access these voltage outputs through the diagnostic pages.

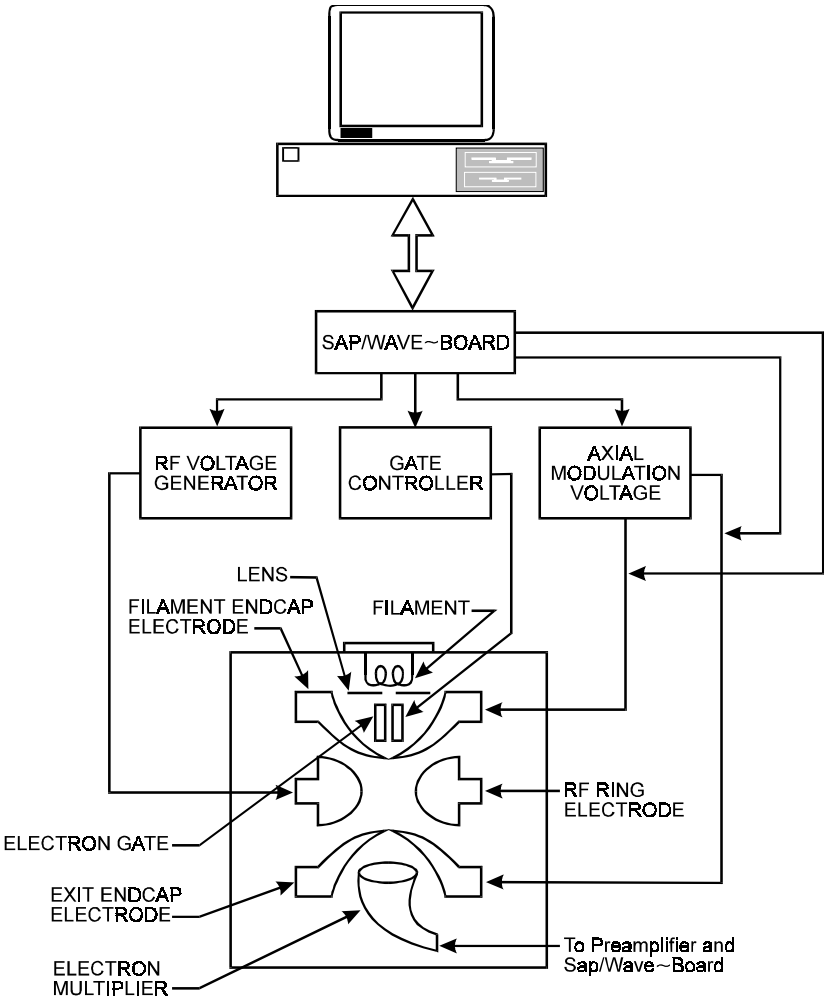
Mounted on the top edge of the power board are 15 monitor LEDs. When illuminated, these lights indicate that the voltages of the various circuits on the power board are at their proper levels, and that there are no faults. During normal operation all LEDs except the ±180 volts should be on. The ±180 volts only turns on when the filaments are on.

The RF Generator Assembly

The RF generator assembly consists of an RF generator circuit board, an RF detector circuit board, and the RF coil. A shielded housing beneath the vacuum manifold encloses the coil and RF detector circuit board. The RF generator circuit board is attached to the back of the shielded housing.

The RF generator circuit board receives an analog signal from the SAP/Wave circuit board that is proportional to the current mass position in the scan, which is in turn proportional to the desired RF voltage applied to the ion trap. The RF detector circuit board sends a signal proportional to the actual amount of RF voltage applied to the ion trap to the RF generator board. The RF generator board compares the desired and actual amount of the RF voltage and adjusts the gain of an RF amplifier to cause the actual RF voltage to equal the desired RF voltage. Since the high voltage required at the ion trap exceeds the capabilities of conventional electronic amplifiers, a resonant LC circuit consisting of the RF coil and the ion trap capacitance is used. At resonance, the RF voltage at the ion trap end of the coil is about 100 times that at the RF generator circuit end of the coil.

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The Ion Trap Assembly

The Manifold Electronics Assembly

Two boards reside in the enclosure directly atop the Analyzer flange. The following circuitry, which is critical to the functioning of the ion trap or that must be in close proximity to the trap, resides on these boards.

The electron multiplier power supply, which supplies high voltage (-800 to -3000 Vdc) to the cathode of the electron multiplier.

The integrator circuit, which receives the amplified ion current from the anode of the electron multiplier, converts the current into voltage, e.g., 10^{-7}A into 1.0V, and passes the voltage on to the SAP/Waveboard.

The trap filament selection relay.

The electron gate control that controls the gate polarity.

The axial-modulation low and high frequency transformers.

The ion gauge support circuitry, which includes filament On/Off and selection relays and a log amplifier for gauge read-back signal conditioning.

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The Scan Acquisition Processor/Waveform Generator Board

The scan acquisition processor/waveform generator (SAP/Wave) board is a real-time control and acquisition microcomputer that makes use of an 80C186 microprocessor. The SAP/Wave board communicates with the data system via an IEEE-488 interface board installed in the data system computer bus. The SAP/ Waveboard performs the following functions:

Interprets instrument commands from the data system and produces a sequence of analog and digital signals that control operation of circuits on other Saturn GC/MS boards.

Collects analog and digital diagnostic data from other subsystems and transmits that information to the data system.

Filters, integrates and digitizes the ion current signal and transmits the spectra to the data system.

Generates axial modulation waveforms, including waveforms used by SECI, MS/MS and SIS options.

Upon power-up, the 80C186 processor runs a ROM resident program that initializes the board. The program permits the processor to receive information through the IEEE-488 interface. When you start up the Saturn data system, operating information is downloaded to the SAP/Wave board's RAM memory. The SAP/Wave board then performs its operations in response to the commands sent through the IEEE-488 interface.

NOTE: The SAP/Wave board is accessed through two connectors on the rear panel of the instrument. J42 is an IEEE connection used for interconnection to the Data System. J43 is a D-shell connector labeled 'Remote Option' and is used for special research applications and the GC start signal.

When a mass spectrum is acquired, the data system downloads parameters such as electron multiplier voltage, scan range and time, ionization mode, etc. The SAP/Wave board uses this information to create a scan over the desired mass range. During the scan, ion current data is accumulated and, at the end of the desired scan time, sent to the data system for further processing and display.

The waveform generator is capable of generating waveforms over a wide range of frequencies and amplitudes. The data system produces a digital version of the desired time domain waveform, and downloads the resulting binary file RAM. At the appropriate time, the data is clocked out of the RAM into a waveform reconstruction DAC. The DAC output is then filtered to remove undesirable frequencies. The Saturn GC/MS uses the waveform generator in chemical-ionization (SECI), MS/MS, or SIS applications; as well as in normal axial modulation.

Characteristics of the waveform generator include the following:

Dual-port RAM (256 Kbytes) to provide memory for single or multiple digitized waveforms

A selectable frequency generation clock (625 KHz, 1.25 MHz, or 2.5 MHz and a 15-bit variable length counter to control timing

A 12-bit DAC, low pass filter and amplifier to reconstruct waveforms

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A variable operational frequency range that depends on whether you are using the high frequency transformer (12 to 500 KHz) or low frequency transformer (200 Hz to 1.25 KHz)

Application of the waveform output to the endcap electrodes of the ion trap is done via the two transformers located in the manifold electronics assembly.

NOTE: Before you can use any of the waveform options, i.e., SECI, MS/MS, or SIS, the waveform key(s) must be inserted into sockets U5, U6 and/or U7. The key(s) should be installed by the factory, or by a Varian Customer Support Representative.

The Data System

The data system (DS) has both hardware and software components. The hardware includes a computer/instrument interface, personal computer, video display monitor, and optionally, a printer.

The software stored on the fixed disk drive includes programs to control the Saturn GC/MS, to automatically set Saturn system parameters, and to oversee scan-control, data-acquisition, and data-processing programs. For a complete description of Saturn software, refer to the **Saturn Software Reference Manual**.

Computer/Instrument Interface

The computer/instrument interface for the Saturn GC/MS is an IOtech IEEE-488 Interface Board. This board is installed in the computer. The IEEE-488 is a standard computer/instrument communications link for all types of computers. For a complete description of the IEEE-488 Interface Board and its functions, please refer to the documentation provided by the manufacturer.

The Computer

Please refer to your owner's guide for any information about your computer. Also see the Release Notes, which lists compatible computer hardware and software.

The AutoSampler

The optional AutoSamplers available are the Varian 8200, 8400 and 8410 AutoSamplers. For complete installation and operating instructions, please refer to your AutoSampler Operator's Manual.

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Chemical Ionization Options

Introduction

Chemical ionization (CI) provides mass spectral data that complement electron ionization (EI) data for the analysis of complex compounds. In the standard CI mode of operation, a CI reagent gas is introduced into the ion trap analyzer from an external gas supply cylinder. The reagent gas is ionized by EI to form reagent ions. These reagent ions then ionize sample molecules entering the ion trap with He carrier gas from the capillary column. The operation and adjustment of reagent gases for the standard CI option are described in the first part of this section.

NOTE: The CI mode is an option on the Saturn GC/MS. If your system does not have this option, you will not be able to perform CI analyses.

Two additional options allow the selection of certain liquids as sources for CI reagent. These are the Liquid CI Inlet (or LCI Inlet) and the Multiple CI Module (or MCI Module). The installation and operation of these options is described later in this section.

Installing CI Reagent Gas

Before evacuation, new gas lines will contain a significant amount of adsorbed water vapor. The longer the gas line, the greater the amount of adsorbed water and the greater the pumping time required to evacuate water from the line. To minimize the pumping time required to evacuate the gas line, we recommend that the line be as short as possible. Make sure, however, that the gas line is long enough to run to the rear of the Saturn GC/MS and to accommodate the movement of the mass spectrometer 9 inches (23 cm) to the right (for access to the transfer line and turbomolecular pump).

Gas cylinders or lecture bottles should not be stored where they can damage cables or gas lines, and they should be secured in accordance with standard safety practices. Lecture bottles have rounded ends and will require some means of support (e.g., Matheson Model 505 Non-Tip Stand).

Before installing the CI reagent gas supply, you should complete the following procedures:

Tune the instrument in EI mode

Check the Saturn GC/MS system for leaks

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CI Reagent Gas Requirements

These paragraphs give the requirements for the reagent gases used for CI operation with Saturn GC/MS. The following reagent gases are recommended: methane, isobutane, and ammonia. Other reagent gases can also be used successfully with the Saturn GC/MS.

We recommend that you use a high-purity reagent gas for maximum sensitivity and good spectral quality. Impurities in the reagent gas may limit the number of sample ions that can be formed, thus reducing spectral sensitivity. In addition, impurities may react with sample ions, thereby creating confusing mass spectral data.

The amount of reagent gas consumed during CI operation is very low (typically 1 to 2 mL/minute). We recommend that you use a K size gas cylinder of the selected reagent gas.

The requirements for the recommended gases are as follows:

Methane	Methane should have a purity of 99.99% or better. Use a gas cylinder with a two-stage pressure regulator that has a stainless steel diaphragm and maximum inlet pressure of 15 psi (1 bar).
Isobutane	Isobutane should have a purity of 99.99% or better. Use a gas cylinder with a two-stage pressure regulator that has a stainless steel diaphragm and maximum inlet pressure of 15 psi (1 bar).
Ammonia	Ammonia should have a purity of at least 99.99% and be anhydrous grade. Use a gas cylinder with a two-stage pressure regulator that has a stainless steel diaphragm and maximum inlet pressure of 15 psi (1 bar).

NOTE: Gases other than methane, isobutane, or ammonia can be used successfully as CI reagent gases with the Saturn GC/MS. For assistance in selecting and using other reagent gases, please contact your Varian Customer Support Representative.

The CI reagent gas should contain less than 1 ppm of water. Water in the CI reagent gas may interfere with CI operation.

Copper or stainless steel gas lines should be used for methane or isobutane. Stainless steel lines should be used for ammonia. All gas lines should be free of oil (and other contaminants) and preferably flame dried. If possible, use the pre-cleaned copper tubing from the GC Start-Up Kit.



WARNING:
CHEMICAL HAZARD

DO NOT flame dry the reagent gas lines with CI reagent gas present.

Setting Up the CI Reagent Gas Supply

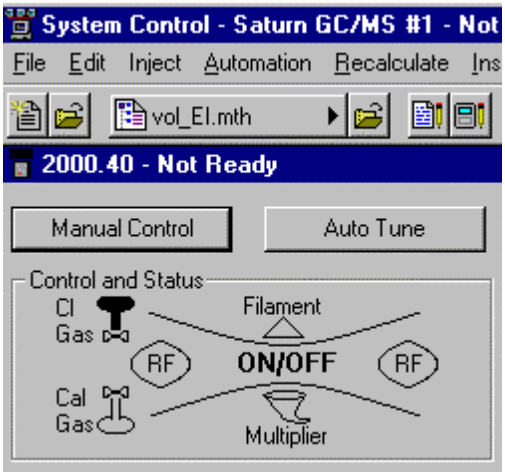
Use the following procedure to set up the CI reagent gas supply.

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WARNING:
CHEMICAL HAZARD

CI reagent gases may be hazardous. Use proper protection when installing the reagent gas.

1. Enter the System Control and select the Manual Control tab dialog.



2. Make sure that the electron multiplier, filament, and RF voltage are all off. The Multiplier, Filament, and RF text should be red or black - not green.

NOTE: Two solenoid-operated valves control the flow of CI reagent gas into the manifold. The valves are opened and closed by clicking on the CI button on the Instrument Control display. A needle valve controls the amount of reagent gas flowing into the manifold. The needle valve is mounted directly behind the door of the mass spectrometer. The needle valve is adjusted manually by using the knob labeled CI GAS. Turning the knob clockwise increases the flow of reagent gas into the manifold. See Functional Block Diagrams in the **Turbomolecular Vacuum Pump** or **Diffusion Pump Vacuum System**.

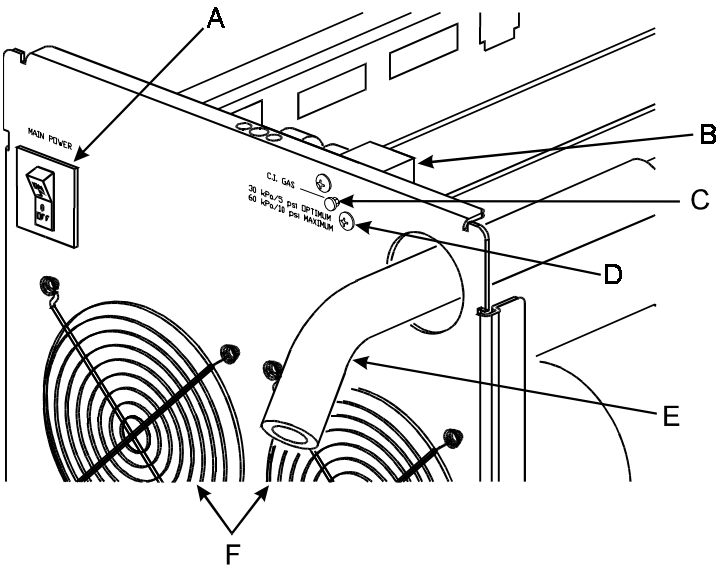
3. Verify that the CI gas solenoid valves are closed. When these valves are closed, the CI Gas icon to the left of the ion trap symbol is not green. (If the CI icon is green, click on the icon so that it turns to red or black.)
4. Install a two-stage pressure regulator on the reagent gas cylinder or lecture bottle. Tighten the connection securely.

NOTE: A two-stage pressure regulator typically consists of the following components: Secondary valve, Pressure adjustment valve, Supply pressure gauge, and Delivery pressure gauge

5. Reagent gas is turned on and off with the Main valve on the cylinder or lecture bottle. The secondary valve on the pressure regulator is next in line. This valve is used for coarse control of the flow of gas from the gas cylinder up to the pressure adjustment valve. The supply pressure gauge is used to monitor the gas pressure in the bottle. The pressure adjustment valve is used to set the head pressure of the gas delivered to the mass spectrometer.
6. Connect one end of the 1/8" OD gas supply line to the pressure regulator.

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7. On the back of the Saturn GC/MS instrument, loosen the two screws that hold the plug in the CI Shutoff Manifold 2 to 3 turns. Remove the plug by pulling straight out and twisting.



A Power Switch **B** Shutoff Manifold **C** Plug **D** 6/32" Screws (2 each) **E** Vacuum Hose **F** Fans

Connecting CI Gas Supply

8. Use 1/8" OD tubing for the supply line between the gas cylinder and the CI shutoff manifold. No ferrule is required on the mass spectrometer end of this tube. The seal is made with an elastomer O-ring. Inspect the end of the tubing and assure that the surface finish is smooth. If there are scratches, either cut off the damaged part or use 200-600 grit abrasive paper to refinish the sealing end of the tube.
9. Carefully insert the tube into the CI shutoff manifold hole (the one the plug came out of) until it is firmly seated. Be careful not to scratch the tube. Tighten the two screws.
10. Ensure that the secondary valve on the regulator on the gas cylinder is closed.
11. Open the main control valve on the lecture bottle. Next, open the secondary valve and adjust the pressure adjustment valve to approximately 5 psi so that reagent gas flows at a moderate rate through the gas line.
12. Open the mass spectrometer door. Verify that the CI GAS needle valve is turned fully counterclockwise.
13. Next, flush the gas line of air and water vapor as follows.
    a. If using a diffusion pumped system, monitor the foreline pressure on the diagnostics screen. Do not allow the foreline pressure to exceed 500 mTorr for more than 20 seconds.
    b. Turn the adjustment valve clockwise to reduce the pressure.
    c. Open the CI gas solenoid valves by clicking on the CI icon in the Control and Status field of the Manual Control tab dialog in System Control. When the valves are opened, the CI button is green.
    d. Evacuate the CI reagent supply line for about 30 minutes.

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Checking the Reagent Gas Plumbing for Leaks

To check for air leaks in the reagent gas line connections and the presence of water vapor in the gas line, follow the procedure using a Leak Detection Gas to Troubleshoot for Air Leaks in the Troubleshooting Section. Depending upon the results you obtain, you may need to modify the procedure as follows:

If a large air leak exists, check the CI GAS fitting on the rear of the instrument and the fitting on the pressure regulator for tightness. Then recheck the air/water spectrum; or

If excess water vapor is indicated by a high 19/18 ratio, there may be water in the gas line and/or an atmospheric air leak in the reagent gas plumbing. Proceed as follows:

1. Shut off the flow of reagent gas into the manifold by closing the CI solenoid valves. If necessary, click on the CI icon in the Control and Status field of the Manual Control tab dialog in System Control. When the valves are closed, the CI button is black or red - not green.
2. Recheck the air/water spectrum. If the peak at mass 19 (for water) decreases, then water is present in the gas line. In this case, go to step 3. If the peak at mass 19 does not decrease significantly, little water is present in the gas line. In this case, the MS system probably has an air leak. You will need to fix the leak as described in the Troubleshooting Section. Be sure to check for leaks around:

   The CI GAS port on the rear of the mass spectrometer

   The fitting that connects the reagent gas line to the pressure regulator

3. To flush excess water from the gas line proceed as follows:
   a. Ensure that the electron multiplier, filament, and RF voltage are off.
   b. Open the main valve on the lecture bottle. (The secondary valve on the pressure regulator is already open.)
   c. Turn the CI needle valve fully counterclockwise.
   d. Open the CI gas solenoid valves and allow the system to pump down for about 1 hour.
   e. Close the main valve on the gas cylinder but keep the CI GAS solenoid valves open. Allow the system to pump down for about 15 minutes.
   f. Recheck the air/water spectrum. If excess water is not present, go to paragraph: Setting Delivery Pressure of the CI Reagent Gas.

Setting Flows of CI Reagents

After any leaks have been located and fixed, set the delivery pressure of the CI reagent gas as follows:

1. Ensure that the CI gas solenoid valves are closed. If necessary, click on the CI icon in the Control and Status field of the Manual Control tab dialog in System Control. When the valves are closed, the CI button is black or red - not green.
2. Open the main valve on the lecture bottle. Using the pressure adjustment valve on the regulator set the head pressure to about 5 psi (34 kPa).

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You are now ready to operate the system in the CI mode. If you are a new user, we recommend that you perform the introductory example of CI operation in tuning the Saturn for Chemical Ionization in the Tutorial Manual.

Default Parameters for Gaseous CI Reagents

Reagent Gas	Methane	Isobutane	Ammonia
CI Storage Level (m/z)	13	19	13
Ejection Amplitude (v)	9	15	9
Background Mass (m/z)	45	65	45
Target TIC	5000	5000	5000
Maximum Ionization Time (sec)	2000	2000	2000
Maximum Reaction Time (sec)	60	60	60
Prescan Ion Time (sec)	100	100	100

If you have installed the Liquid CI Inlet or the Multiple CI Module, the following parameters may be used for standard liquid CI reagents.

Default Parameters for Liquid CI Reagents

Reagent Liquid	Acetonitrile	d3-Acetonitrile	Methanol
CI Storage Level (m/z)	19	19	19
Ejection Amplitude (v)	15	15	15
Background Mass (m/z)	65	65	55
Target TIC	5000	5000	5000
Maximum Ionization Time (sec)	2000	2000	2000
Maximum Reaction Time (sec)	40	20*	40
Prescan Ion Time (sec)	100	100	100

* Use short reaction times for deuterated reagents. Longer reaction times allow more H/D exchange with background water and the resulting spectrum will show more $[M+H]^+$ and less $[M+D]^+$.

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Ion Intensities for Standard CI Reagents

The CI Adjust function gives recommendations of an acceptable level of CI reagent ions for each of the five standard CI reagents. The general principles used in implementing these tests are:

Methane	Adjust the reagent gas pressure so that the peak heights at m/z 17 (CH_5^+) and 29 ($C_2H_5^+$) are about equal. The ratio of the ions at m/z 17 to m/z 16 should be about 10:1. The ion at m/z 41 ($C_3H_5^+$) should be visible.
Isobutane	Adjust the reagent gas pressure so that the peak heights at m/z 57 [$(CH_3)_3C^+$] and m/z 43 [$(CH_3)_2CH^+$] are about equal. There may also be an intense reagent ion at m/z 41 ($C_3H_5^+$).
Ammonia	Adjust the gas pressure so that the ratio of the peak heights at m/z 18 [$(NH_3)H^+$] to m/z 17 (NH_3^+) is about 10:1.
Acetonitrile	Adjust the reagent gas pressure so that the ion at m/z 42 [CH_3CNH^+] is about 10 times higher than at m/z 41. The valley between the 41/42 ions should reach a minimum at less than half the height of the m/z 41 ion. The m/z 54 ion [CH_3CHCNH^+] will be present at 10 - 15% the height of m/z 42. Too much acetonitrile in the trap can cause early filament failures.
d3-Acetonitrile	Adjust the reagent gas pressure so that the ion at m/z 46 [CD_3CND^+] is about 10 times higher than at m/z 44. The m/z 58 ion [CD_3CDCND^+] will be present at 10 - 15% the height of m/z 46.
Methanol	The ion at m/z 33 [$(CH_3OH)H^+$] will dominate the spectrum. No ion is observed at m/z 32, but a small peak is observed at m/z 31 and m/z 47.

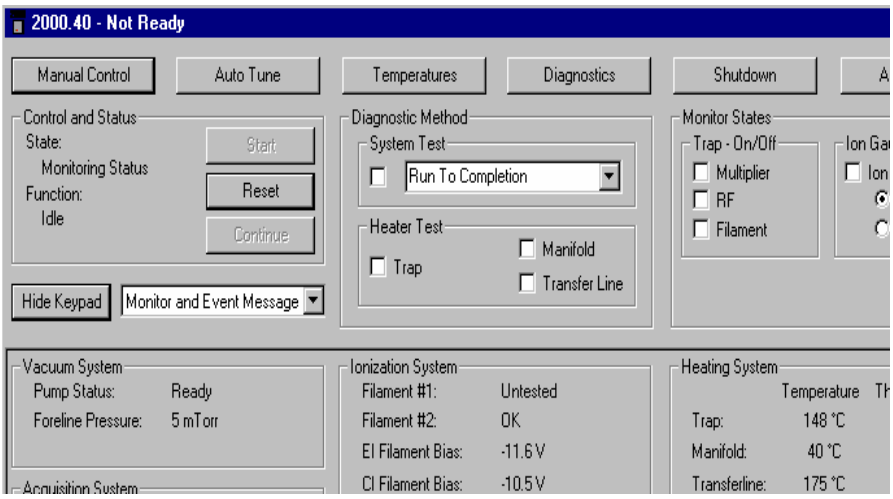
In each case, by following these guidelines, the reagent gas pressure in the ion trap will be approximately 1 to 2 x 10^{-5} Torr (about 1.3 to 2.6 x 10^{-3} Pa). The CI reagent molecules comprise about 1% of the gas pressure in the ion trap. He atoms from column flow are present at 100 times this pressure.

Setting CI Gas Pressure in a Diffusion Pump System

For the diffusion pump system, the CI Reagent Gas delivery pressure should be set to only 5 psi as indicated on the pressure regulator. The foreline pressure should then be checked:

Start System Control and click on the Diagnostics tab.

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Note the **Diffusion Pump Foreline Pressure** reading under the Vacuum System field. The reading should be less than 100 mTorr. Higher readings may indicate problems (i.e., leaks) and the user should refer to the **Troubleshooting** section for additional information. Click on the Manual Control button, and then click the CI icon to the left of the ion trap symbol (it will turn green when On). Wait one minute for the flow to equilibrate. Click on Diagnostics and note the **Diffusion Pump Foreline Pressure** reading. The value should be less than 350 mTorr. If necessary, adjust the delivery pressure of the CI reagent gas (using the valve on the pressure regulator) to give a reading below 350 mTorr. If the value exceeds 500 mTorr the diffusion pump will shut down. It will restart when the pressure drops below 500 mTorr.

The Liquid CI Inlet Option

You may review the installation and use of the Liquid CI Inlet on the Saturn 2000 Maintenance Tutorial CD. Alternatively, you may read the instructions that follow in this section.

Installation of the Liquid CI Inlet

1. Before beginning, shut down and vent the Saturn system. If you are not disassembling the trap, it is not necessary to wait for the trap electrodes to cool down before installing the Liquid CI Inlet assembly.
2. Remove the top cover. Attach the Liquid CI Inlet assembly to the back of the instrument using the following instructions. Refer to the drawings below to more easily identify the parts discussed.
   a. From the back of the instrument, remove one of the two screws that hold the CI shutoff block intact. Replace it, loosely, with a long screw supplied with the kit (12-222006-25).
   b. Remove the remaining screw.
   c. Gently pull the free end of the liquid CI restrictor tube (03-930024-01) from the L-bracket where it attaches to the back of the instrument, while leaving the other end of the restrictor tube attached to the Liquid CI Inlet block.

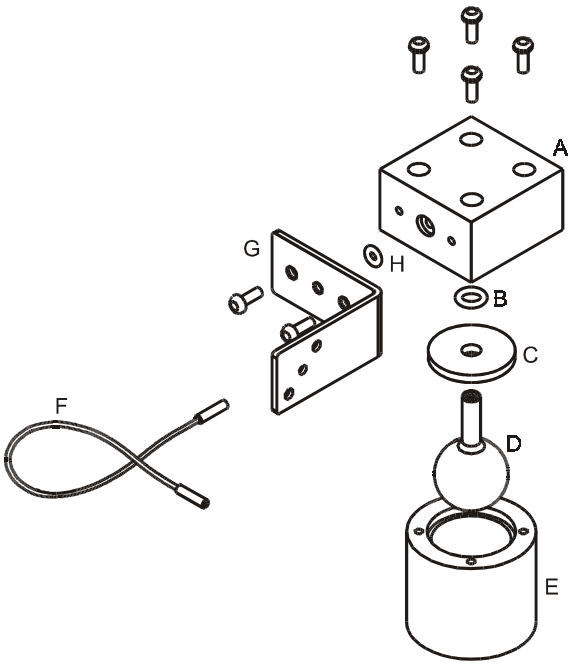
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d. Loosely attach the Liquid CI Inlet assembly to the back of the instrument via the L-bracket with the screw that was removed.

e. Rotate the Liquid CI Inlet assembly out of the way to remove the remaining screw.

f. Rotate the Liquid CI Inlet assembly back into position and loosely attach the liquid CI inlet assembly with the remaining long screw (12-222006-25).

g. Re-insert the liquid CI restrictor tube through the L-bracket into the back of the instrument. The restrictor tube must be inserted far enough to engage the O-ring in the CI shutoff block.



A	Inlet Block (03-930023-01)	E	Reservoir Cover (03-930026-01)
B	Viton O-ring (03-930109-07)	F	Restrictor (03-930024-01)
C	O-ring Retainer (03-930025-01)	G	L-Bracket (03-930027-01)
D	Reservoir Bulb, same as Cal Gas Chamber (03-920270-00)	H	Viton O-Ring (03-930109-04)

3. Replace long restrictor (03-930597-01) with 1/8" OD PEEK tubing (03-930037-01).

   a. With the liquid CI inlet mounting screws still loose, pull out the long restrictor tube from the CI shutoff block.

   b. Loosen the 4 screws on the top of the pneumatics manifold (at the front of the instrument).

   c. Pull out the long restrictor tube from the bottom of the pneumatics manifold. Carefully pull the tube out of the front of the instrument. Save this long restrictor for use with pressurized gases such as methane.

   d. Feed the PEEK tube (03-930037-01) into position, starting from the front of the instrument (occupies roughly the same space as the long restrictor tube).

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e. Gently install the PEEK tube end into the pneumatics manifold, being careful not to let the retaining plate scratch the tube.

f. Do not retighten the 4 screws on the pneumatics manifold yet.

g. Insert the other end of the PEEK tube into the CI shut-off block and tighten the 2 screws from the rear of the instrument.

4. Replace the front restrictor.

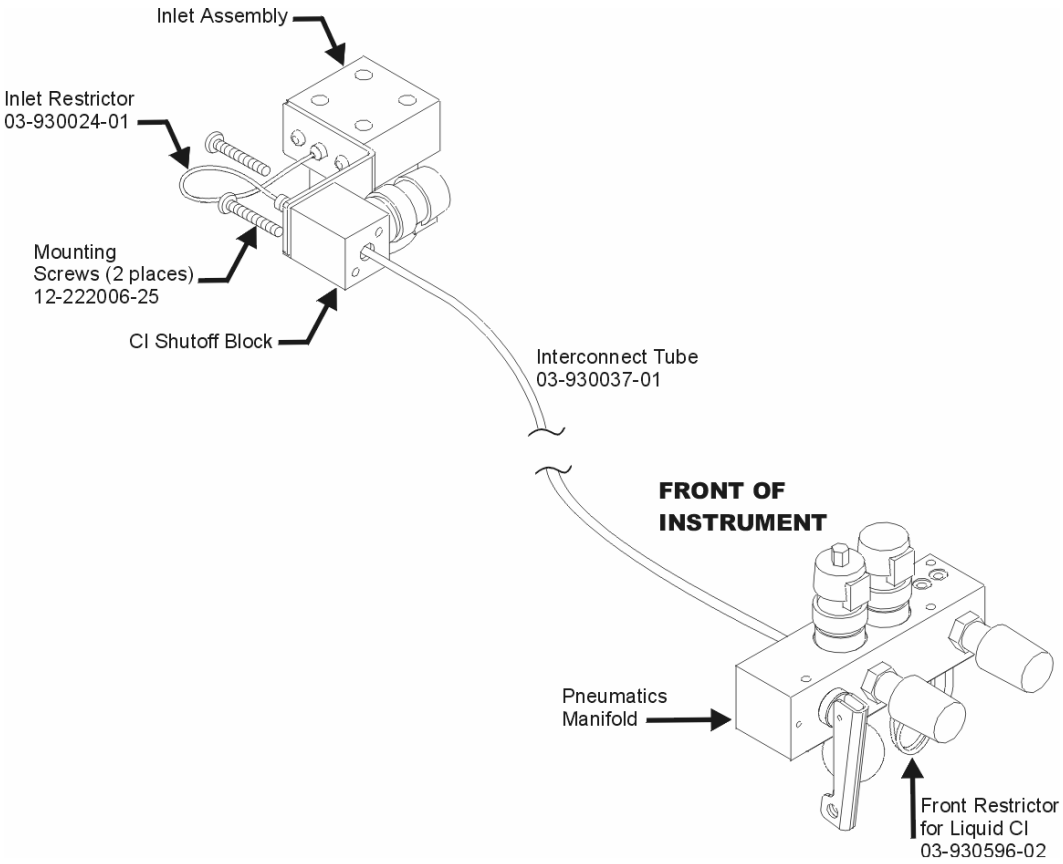
a. Remove the existing short gas restrictor (03-930596-01) from the bottom of the pneumatics manifold.

b. Install the front liquid CI restrictor (03-930596-02) into the same location in the pneumatics manifold. Be careful not to let the retaining plate scratch the restrictor tube ends.

c. Now retighten the 4 screws on the pneumatics manifold.

5. Replace the top cover.

6. Restart the Saturn system.



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Filling/Refilling the Liquid CI Reservoir Bulb

1. Be sure the CI valves are closed. Disengage the 4 screws that retain the liquid CI reservoir cover. They may remain in the block.
2. Remove the reservoir cover.
3. Gently pull the bulb down to remove it from the block. The O-ring and O-ring retainer may stay attached to the bulb.
4. Use the reservoir cover as a stand for filling; place the bulb into the reservoir cover. Place O-ring retainer over the bulb stem. Place the O-ring over the bulb stem.
5. Use a pipette or syringe to fill the bulb halfway with liquid CI reagent. This requires about 3 mL of reagent.
6. Pick up the reservoir cover with the bulb, retainer and O-ring, and insert the bulb stem into the block.
7. Orient the cover so that the 4 screws can engage the cover. Tighten the 4 screws, being careful not to strip the threads in the plastic cover.
8. After installing liquid CI, and each time the reservoir bulb is refilled with liquid, always use care when first opening the CI valves. Do not turn on the filament or multiplier for about 2-3 minutes after opening the CI valves from the Instrument Page. A convenient way to verify that air and water have been removed sufficiently is to check the ion gauge pressure with the CI valves open. Verify that the pressure has returned to less than 35 x 10^{-6} Torr before turning on the Filament and Multiplier. For diffusion pumped systems monitor the foreline pressure. Adjust the CI valve to prevent the foreline pressure from exceeding 500 mTorr. Turn the valve clockwise to reduce the pressure.

Use Polypropylene Caps to Preserve Liquids in Reservoirs

Yellow polypropylene caps have been provided to seal reservoirs containing liquid CI reagents when they are not installed on the instrument.



CAUTION

Never force the cap onto the reservoir stem – it is glass and can break.



WARNING:
EYE HAZARD

Use safety glasses and protective gloves, especially when attempting to remove a cap from a filled reservoir.

Use a gentle, twisting/pushing motion to install the plastic cap onto the reservoir stem.

Use a gentle twisting/pulling motion to remove the plastic cap from reservoir stem.



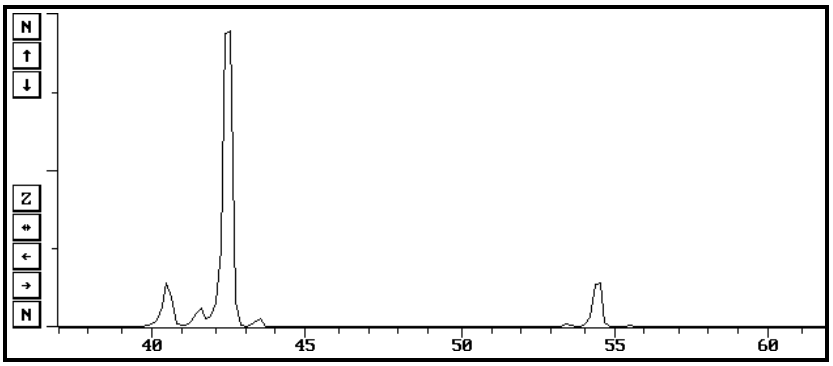
WARNING:
CHEMICAL HAZARD

Be careful not to spill any liquid, especially the few drops which may be in the neck of the bulb.

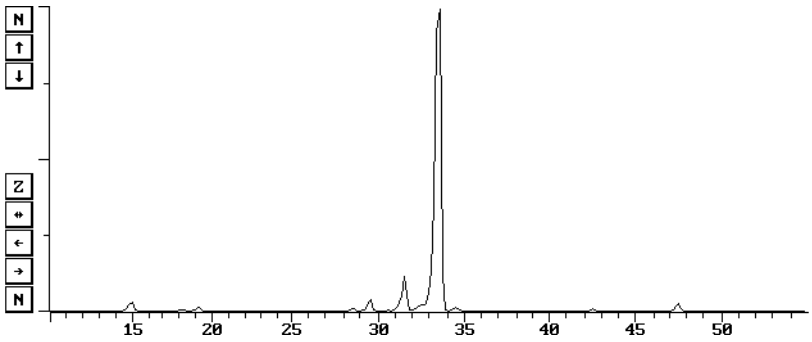
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Setting Flows of Vapor from Liquid CI Reagents

1. Connect a liquid reagent reservoir containing the chosen liquid to the liquid reagent inlet block.
2. Open the CI needle valve 6-7 turns counterclockwise.
3. Open the CI solenoids by clicking on the CI button on the Manual Control page and allow the vapor flow from the reservoir to equilibrate. If, after several minutes, there is not enough CI gas entering the trap, increase the flow by turning the needle valve clockwise.
4. While observing the spectrum using Adjust CI Gas, turn the CI needle valve to increase or decrease the amount of reagent entering the trap until the resolution between M and M+1 just starts to degrade. For best results when using acetonitrile, use a filament emission current of at least 20 A and maintain at least 50% valley between m/z 41 and m/z 42. A convenient way to examine the valley is to click on the top of the m/z 41 peak and drag it to the top of the display using the cursor. See below for a properly adjusted acetonitrile spectrum and for a properly adjusted methanol spectrum.



Properly Adjusted Acetonitrile Reagent Spectrum



Properly Adjusted Methanol Reagent

Returning to Gaseous CI Reagent Operation

To switch from the Liquid CI Inlet back to a pressurized CI gas (such as methane), the CI gas line may be re-installed without removing the liquid CI inlet assembly.

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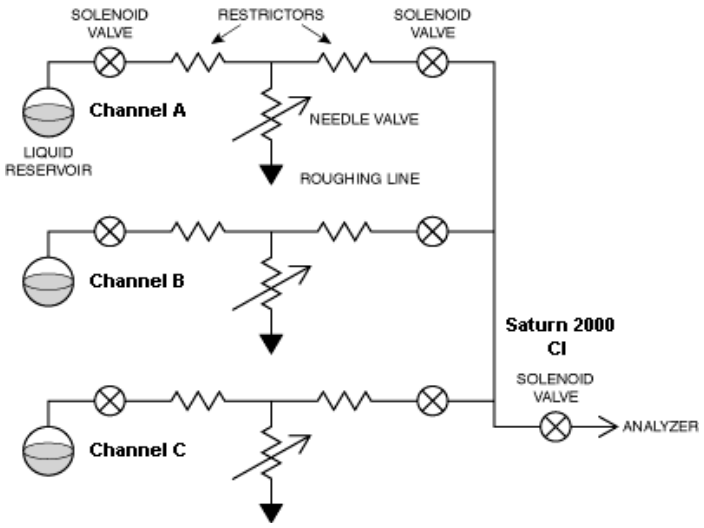
1. Loosen the 2 screws that attach the liquid CI inlet L-bracket to the back of the instrument. Also, loosen the 2 screws that attach the L-bracket to the liquid CI inlet block.
2. Remove the liquid CI restrictor end that inserts into the back of the instrument; rotate the restrictor out of the way.
3. Install the long CI gas restrictor (03-930597-01) between the gas supply and the CI shutoff block, through the L-bracket.
4. Tighten all screws.
5. It is not necessary to replace the front liquid CI restrictor (03-930024-01) with the short gas restrictor (03-930596-01). Reduce the gas pressure to 5 psi at the supply to return to normal gas CI operating conditions.

Installing and Using the Multiple CI Module

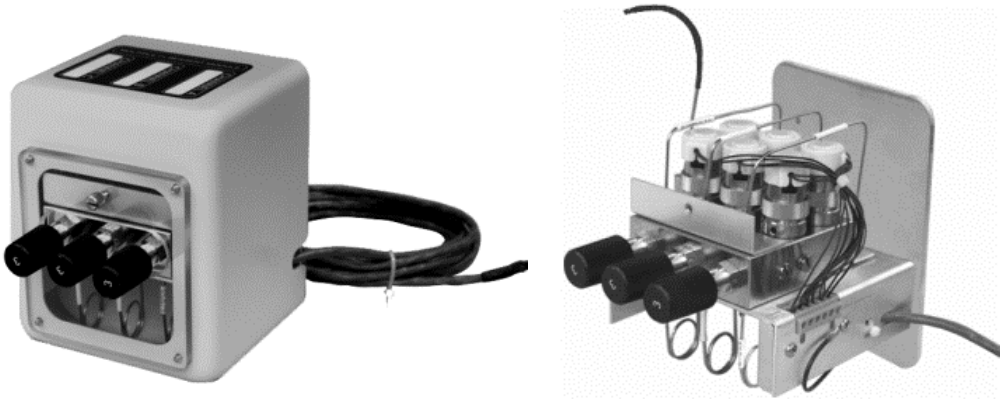
The MCI Module operates essentially as a triplicate of the Standard CI option in the Saturn® 2000. Examine the Channel A section of the following schematic diagram of the module. A liquid (or optional gas) sample is chosen for Channel A. Two solenoid valves intervene between the liquid sample and the main gas line to the Saturn MS on the right of the diagram. These valves are always controlled together — both ON or both OFF. The control of the Valve States is from the External Events (Valve States) section of the GC. The valves may be turned ON and OFF either from the GC front panel or from the GC section of the GC/MS Method. The restrictors between the two solenoid valves for each Channel have been chosen to provide an adequate and adjustable flow of acetonitrile, methanol, methane, or isobutane flow when the MCI Module is set up according to instructions. A third, adjustable, restrictor is the Needle Valve in the line connected to the foreline Pump.

The guiding principle in the design of CI flow is to provide an adequate flow of reagent vapor, which is adjustably split toward the foreline pump and the ion trap. Closing the 15-turn needle valve clockwise (CW) directs more flow to the ion trap; counterclockwise adjustment sends a higher proportion of the flow to the foreline pump. This two-directional flow pattern allows the foreline pump to rapidly clear residual CI reagent from the MCI Module when the Main CI Solenoid in the Saturn 2000 (lower right of the schematic) is turned off in Manual Control. It also allows rapid changeover of flows from one Channel to another.

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Schematic Diagram of the MCI Module



Multiple CI Module (shown with and without cover)

Pre-Installation Checklist

1. Preparing the Mass Spec
   a. The Saturn MS should be shut down, vented, and unplugged.
2. Tools Required
   a. #2 Philips screw driver
   b. Small tipped straight screw driver
   c. 5/32 in or 4 mm drill bit
   d. Electric drill
   e. Side cutters to cut Tygon® tubing

Installing the Multiple CI Assembly

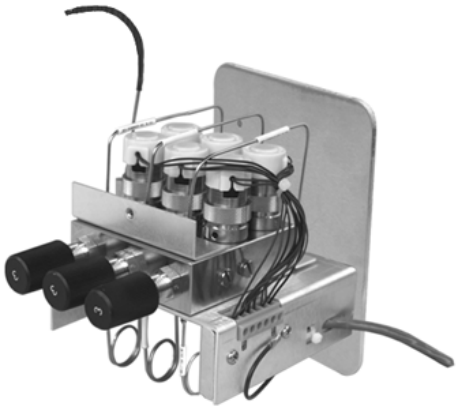
1. Run the Saturn Software.
2. Select Shutdown and wait for the system to shut down.

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3. Vent the mass spec.
4. Unplug the power cord from the back of the mass spec.
5. Unpack the Multiple CI kit and place the parts on a table.
6. Open the front door on the mass spec until it presses against the right side panel.
7. Find the register plate (03-930072-01) in the CI kit.



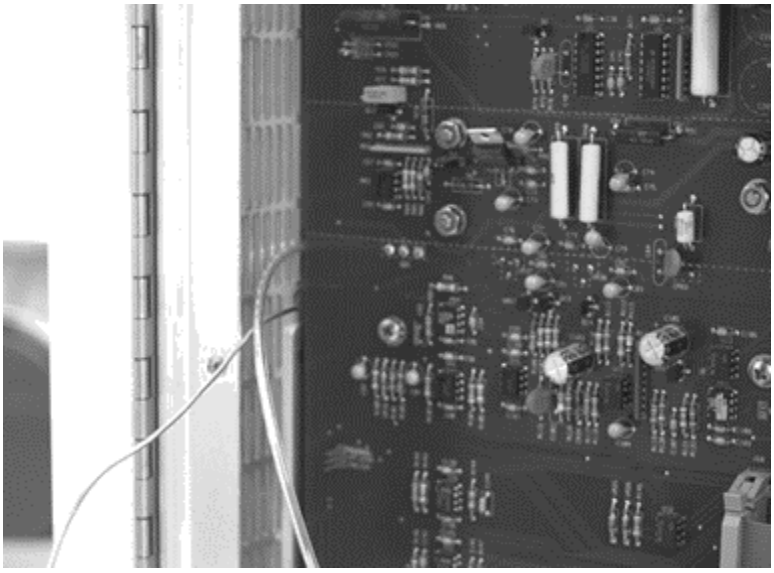
8. Peel off the adhesive strip.
9. Position the register plate 0.25 inches (0.6 cm) from the open front door and 5.25 inches (13.3 cm) from the bottom. Be sure to position the plate parallel to the open front door. Press firmly to adhere the plate to the right side panel.
10. Close the front door and remove the right side panel.
11. Use a 5/32-inch (4 mm) drill bit to drill four holes through the side panel using the register plate as a template.



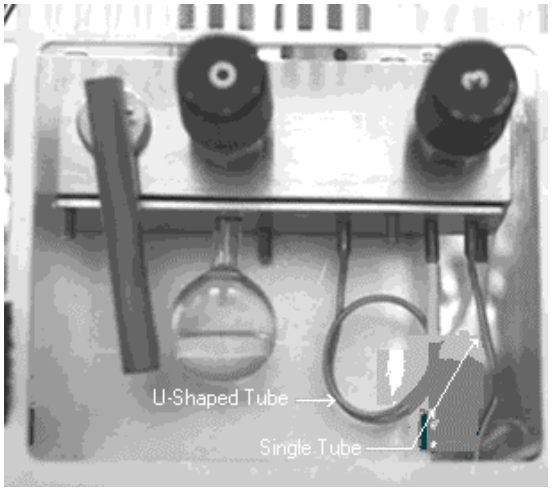
12. There are two more holes in the register plate. Guide the metal tube through the upper hole and the Tygon® tube through the lower hole.

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13. Use two #6 x 0.50 inch long screws to attach the multiple CI manifold to the register plate and side panel.
14. Stand the side panel next to the right side of the mass spec.

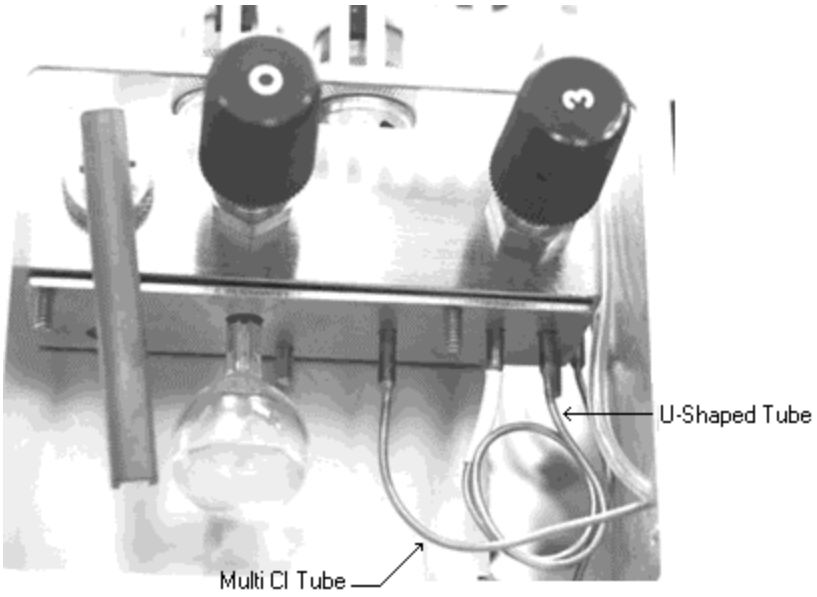


15. Guide the two tubes past the power board and through the opening in the chassis halfway up the middle bulkhead, behind the front panel. Leave the tubes protruding out the opening for the mass spec pneumatics.
16. Reattach the side panel with the #8 screws.

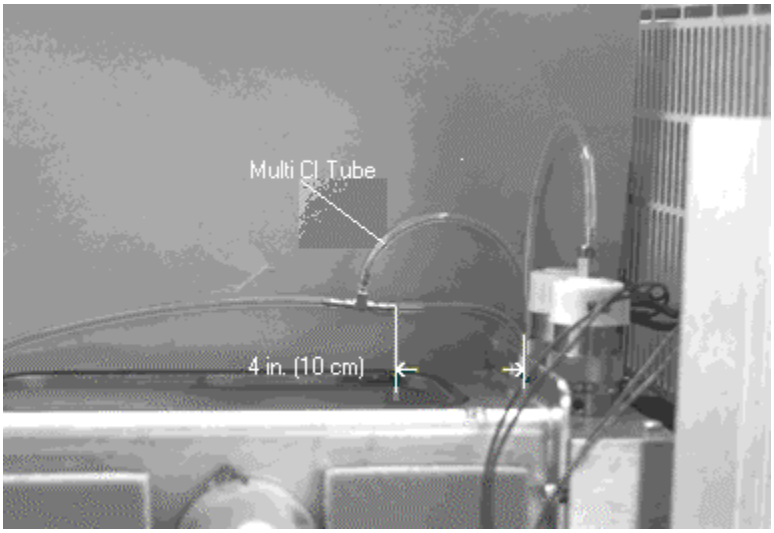


17. Loosen the four screws on top of the pneumatics block.
18. Remove the U-shaped tube from the pneumatics block.
19. Remove the single metal tube from the pneumatics block.

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20. There are now three openings in the pneumatics block.
21. Connect the metal tube from the multiple CI assembly to the opening on the left.
22. Connect the previously removed U-shaped tube, to the two right openings in the pneumatics block.
23. Tighten the four screws on top of the pneumatics block. Do not over tighten them.



24. Cut the Tygon® tubing, which is running from the pneumatics block to the elbow about 4 inches (10 cm) from the pneumatics block.
25. Install the tee and connect the extra fitting to the Tygon tube from the Multiple CI assembly.
26. Connect the cable to the External Events on your GC.

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3800 GC

If you are installing the MCI Module on a 3400 or 3600 GC, skip to the installation instructions following this section.

1. The Multiple CI solenoid cable plugs into the External Events on the 3800 GC.
2. Remove the GC left side, top cover, and the detector cover.
3. Locate the External Events connector J42.
4. Connect the "A" wires to "1", the "B" wires to "2", and the "C" wires to "3". Hold each wire in the connector, and turn the screw clockwise to lock the wire into place.
5. The 3800 GC must have the External Events configured, or the Workstation software will not be able to activate them.
6. On the GC front panel, press the SETUP button.
7. Press 2 to EDIT Instrument Setup.
8. Press 5 to Edit the Valves.
9. The cursor should be on Valve type number 1. Press the DECR key until "Event A" is displayed. Press the down arrow cursor key.
10. The cursor should be on Valve type number 2. Press the DECR key until "Event B" is displayed. Press the down arrow cursor key.
11. The cursor should be on Valve type number 3. Press the DECR key until "Event C" is displayed. Press the down arrow cursor key.
12. Press the blue key below the display menu box entitled "Save and Exit".

3400/3600 GC

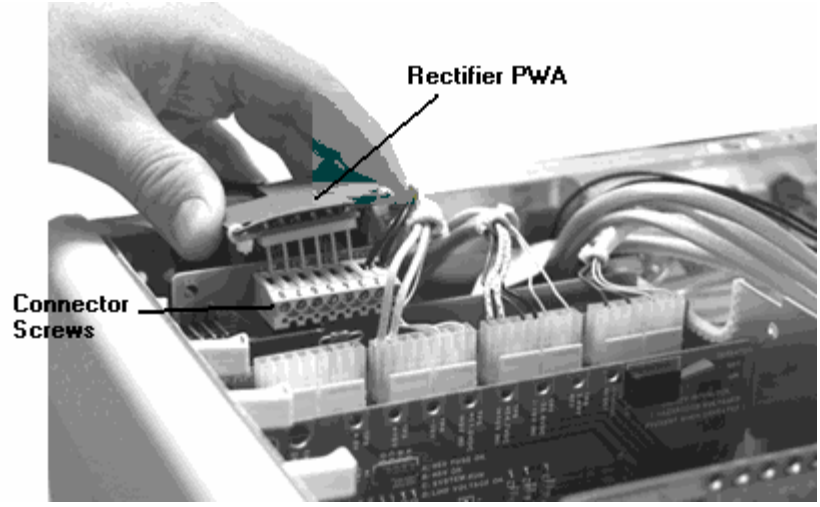


1. Connect the wires as shown to pins 1 and 2 on the Rectifier PWA 03-930346-00.
2. Connect the wires as shown to pins 3 and 4 on the Rectifier PWA.
3. Connect the wires as shown to pins 5 and 6 on the Rectifier PWA.
4. Turn off the GC.

WARNING:
SHOCK HAZARD
Dangerous Voltages Exposed When High Voltage Cover is Removed. Unplug Power Cord. No operator serviceable parts under cover. Refer any questions to high voltage cover to qualified service personnel.

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5. Unplug the power cord.
6. Remove the top covers.
7. Remove the high voltage cover.



8. Connect the Rectifier PWA to pins 3 - 8 on the External Events board in the GC.
9. Tighten all six of the connector screws to ensure good electrical contact.

If there are other electrical devices connected to the GC External Events 2, 3, or 4, they will have to be disconnected while Multiple CI is connected.

1. Install the high voltage cover and top covers.
2. Plug in the GC and turn on power.

After installation, verify that the MCI Module is leak-tight by performing Air/Water and available pressure checks (depending upon the configuration of your instrument) on the Saturn system.

This section describes setup, acquisitions with, and maintenance of the MCI Module.

Cable Connections to the GC External Events Board

A cable to the External Events board of the GC connects each Channel of the MCI Module. Upon installation of the MCI Module, make these connections and identify the External Events connected to each Channel of the MCI Module. For 3800 GCs which have seven External Events, the most likely scenario is that External Events 1, 2, and 3 will be connected to Channels A, B, and C on the MCI Module. For 3400/3600 GCs, which have four External Events, the most likely scenario is that External Event 1 will be used to control split and splitless modes in a 1078 injector. Then Events 2, 3, and 4 will be connected to Channels A, B, and C on the MCI Module. Assure that you are aware of the connection pattern for your system.

For easiest reference in the future, we suggest that you use an erasable marking pen to write the number of the External Event along with the installed reagent on the label for each Channel of the MCI Module.

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Adding Liquid CI Reagents to the MCI Module

The addition of liquid reagents to the MCI Module is accomplished in much the same manner as addition of liquid reagent to the single Liquid CI option (LCI). The LCI liquid filling process is shown in detail on the Saturn Maintenance Tutorial CD under the heading ***MS Maintenance … CI Installation***.

In the MCI Module, this sequence is followed:

1. Turn off all relays related to the MCI module.
2. If you have a **turbo pump system**, skip this step. If you have a **diffusion pump system:** For each channel that will be worked on, close the associated needle valve by turning the knob clockwise. This will reduce the inrush of air into the vacuum system when channels are reactivated.
3. Remove the MCI cover by loosening the thumbscrew on the front cover.
4. Loosen (but do not remove) the four screws located between the solenoid valves on top of the MCI Manifold. Any of the liquid CI reservoirs may now be removed by rotating the bulb and pulling down, away from the manifold. Be careful not to break the fragile necks of the bulbs. Be sure to keep bulbs installed in all positions of the MCI Manifold, whether they contain a liquid reagent or are empty.



WARNING:
CHEMICAL HAZARD

Hazardous chemicals may be present. Avoid contact, especially when replenishing reservoirs. Use proper eye and skin protection.

5. Use the 5 mL syringe supplied in the Accessory Kit to fill the bulb halfway with 3 mL of the chosen CI reagent liquid.
6. Carefully reinsert the bulb in the ¼ inch inlet port of the channel.
7. Retighten the screws on top of the module. The bulbs will be held firmly by the O-ring seals after the screws are tight.
8. Replace the MCI cover and tighten the thumbscrew to hold it in place.
9. After installing CI reagent liquids, and each time a reagent liquid or gas is installed, always use care when first opening the CI valves.
10. If you have a **turbo pump system**, skip this step. If you have a **diffusion pump system**, first turn on the relays, then open the needle valves slowly by turning the knobs fully counterclockwise, to clear out the air in the reservoir bulbs. After a few seconds, monitor the foreline pressure. Do not allow the pressure to exceed 500 mTorr for more than twenty seconds or the diffusion pump will shut down. Return the valve settings to ½ open or their previous setting (approximately 7 turns).
11. Do not turn on the filament or multiplier for 2-3 minutes after opening the CI valves. A convenient way to verify that air and water have been removed sufficiently is to check the ion gauge pressure with the CI valves open. Verify that the pressure has returned to less than 35 x 10^{-6} Torr before turning on the filament and multiplier.

Adding Gaseous Reagents to the MCI Module

To change a channel from liquid operation mode to gaseous, follow the procedure given in the MCI Module Maintenance section.

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Adjusting Flows of CI Reagents

There are two ways to turn Channels of the MCI Module On and Off. The simplest way, which you may want to use when you are adjusting CI flows, is from the keyboard of the GC. The second way is to program a GC/MS Method in the Saturn GCMS Workstation software and download the method to the GC. To select reagent Channels, first identify which External Event is connected to Channel A, B, or C. If you have a 3800 GC, make sure that these External Events are configured from the GC keyboard.

Selecting Reagent Channels from the 3400/3600 GC Keyboard

To program reagent Channels from the 3400/3600 GC keyboard, select the External Event (or Relay) for the chosen Channel by using the command ***Program…Relays*** from the keyboard. If no relays are currently active, the display will read, "Initial Relays -1-2-3-4". If you are activating Channel A connected to External Event 2, press 2 and Enter on the numeric keyboard. The display will change to reflect that Relay 2 is On. You may check the status of the relays at any time from the GC keyboard by pressing Status … Relays. In this example, you would then see the display "Relays On: 2". You can adjust each of the CI reagents installed in the MCI Module by turning on the appropriate relay from the GC keyboard, then using the procedures in **Setting CI/MS Parameters in the MS Method Editor** and in **Adjusting Reagent Flow for Each CI Reagent** to adjust CI reagent flows.

Selecting Reagent Channels from the 3800 GC Keyboard

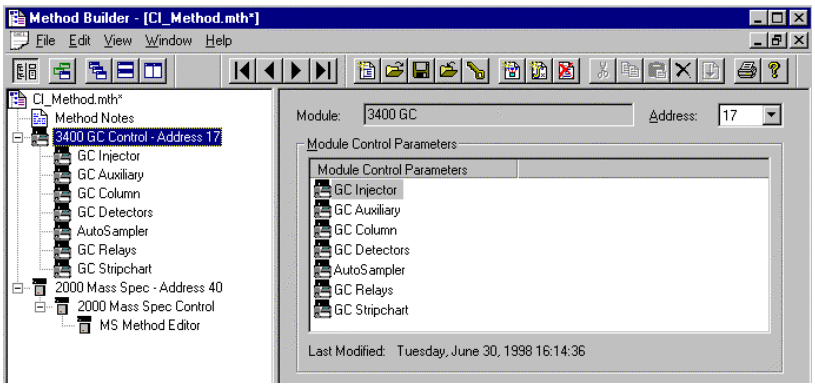
To program reagent Channels from the GC keyboard, select the External Event (or Valve) for the chosen Channel by using the command ***Sample Delivery…Valve States*** from the keyboard. If no relays are currently active, the display will show all Valves in the - State (Off). If you are activating Channel A connected to Valve 1, use the arrow keys to highlight Valve 1 and the Inc. or Dec. key to toggle the State to +. The display will change to reflect that Valve 1 is On (+). You may check the status of the relays at any time from the GC keyboard by pressing ***Sample Delivery…Valve States***. You can adjust each of the CI reagents installed in the MCI Module by turning on the appropriate Valve from the GC keyboard, then using the procedures in **Setting CI/MS Parameters in the MS Method Editor** and in **Adjusting Reagent Flow for Each CI Reagent** to adjust CI reagent flows.

Setting up the Method for 3400/3600 GCs

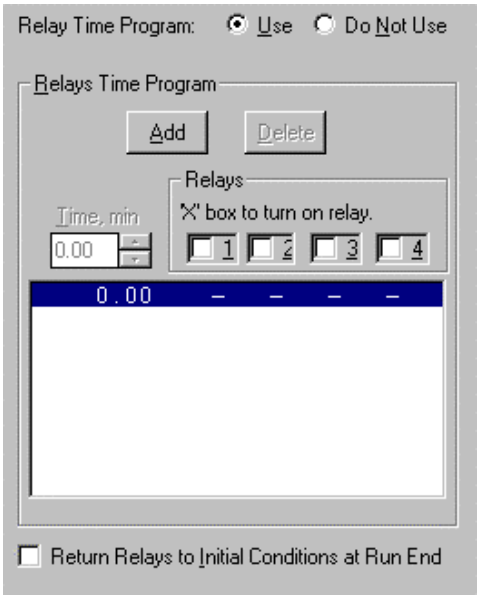
You may adjust the flows of CI reagents from the Manual Control screen of the Saturn System Control Module. However, for the correct Channel of the MCI Module to be selected for adjustments, the GC/MS method should have the correct Channel selected in the GC Relays section of the Method.

Using the Star Toolbar or the ***Start…Programs…Saturn GCMS Workstation*** menu, open the Method Builder application. The Method Directory is shown on the left side of the window, as shown below. Only the relevant sections for 3400 GC and Saturn 2000 control are shown in this example. (Relays in 3600 GC Control are adjusted in the same way as in the 3400 GC).

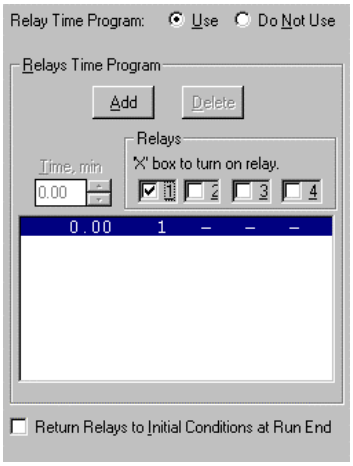
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Select the section GC Relays under 3400 or 3600 GC Control. You will see the following screen:



If you wish to adjust flows of all three CI reagents in the MCI Module, you will want to save three Methods with Relays turned on for each specific reagent. If Channel A is connected to External Event 1 in the GC, click in the box for Relay 1.



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Now use the menu command ***File…Save As*** to save the method with a name such as ChannelA. Check the box for either Relay 2 (Channel B) or Relay 3 (Channel C) and save these methods as ChannelB and ChannelC.

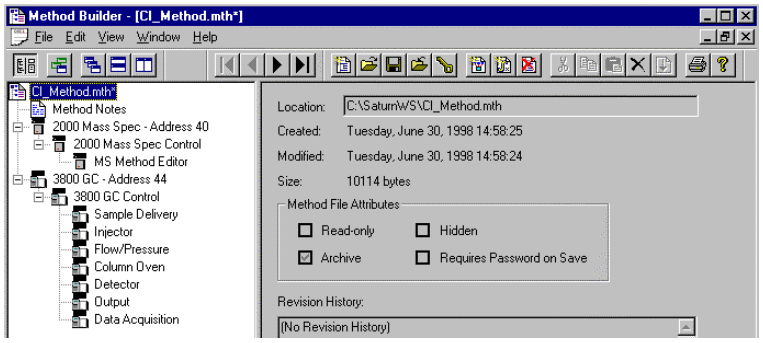
You may now open Channels A, B, or C by using the menu command ***File…Activate…*** (CHANNELx) from the System Control window.

Setting Valve States for 3800 GCs

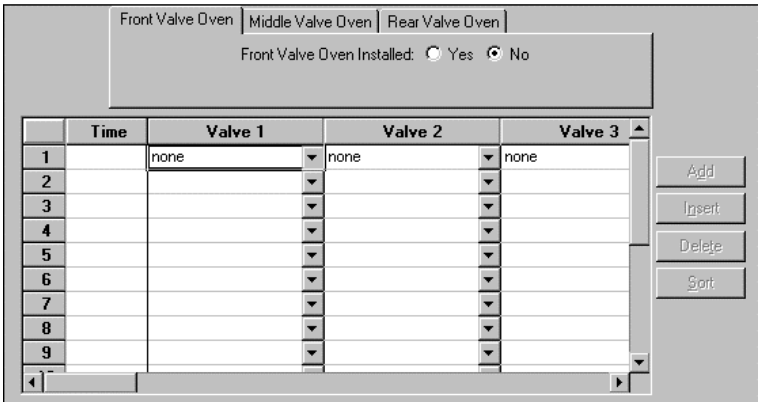
You may adjust the flows of CI reagents from the Manual Control screen of the Saturn System Control Module. However, for the correct Channel of the MCI Module to be selected for adjustments, the GC/MS method should have the correct Channel selected in the GC Sample Delivery section of the Method.

Using the Star Toolbar or the ***Start…Programs…Saturn GC/MS Workstation*** menu, open the Method Builder application. The Method Directory is shown on the left side of the window, as shown in the following Figure. Only the relevant sections for 3800 GC and Saturn 2000 control are shown in this example.

Select the section Sample Delivery under 3800 GC Control.

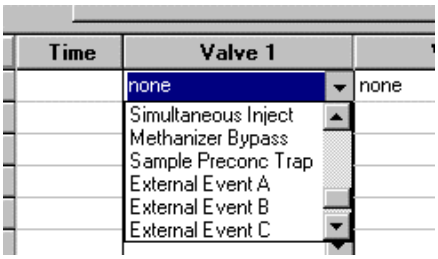


You will see the screen below:

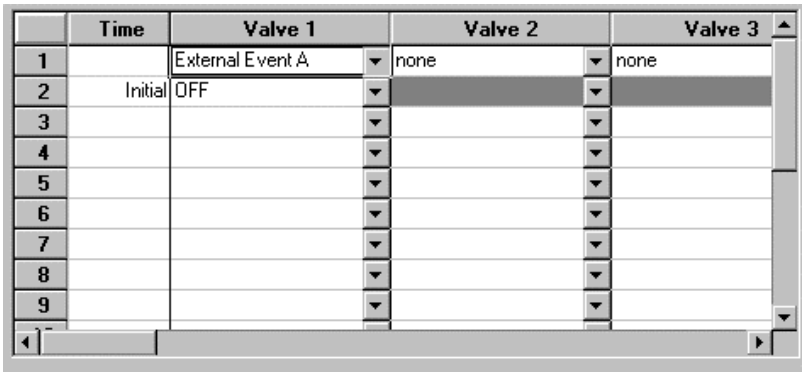


If you have Channel A connected to Valve 1, click in Row 1 under the Valve 1 column. Click on the down-arrow in the combo box and scroll down to find the External Events options for the Valve 1:

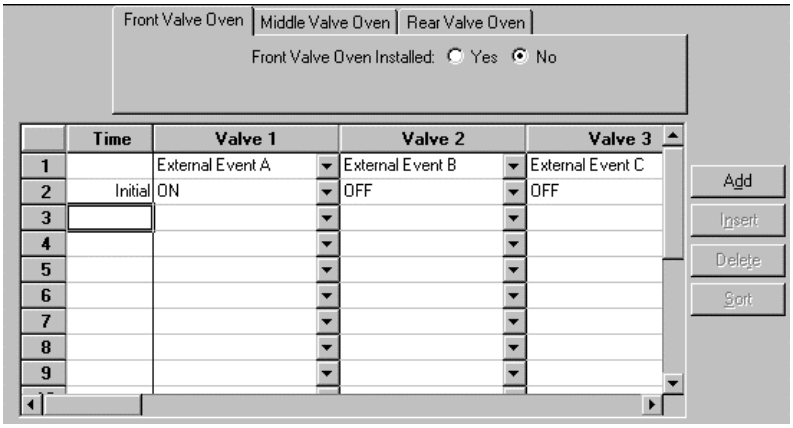
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Highlight External Event A and release the mouse button. You will see the following display:



Now, if Channels B and C are connected to Valves 2 and 3, enter the appropriate state by highlighting the first row under Valve 2 and Valve 3. Otherwise, enter External Events A through C under the appropriate Valve column. The display will now show all three External Events with the correct Valve position, but all Valve States are off. In Row 2 under Valve 1, double-click on the Off symbol or use the arrow key on the right side of the cell to toggle the Valve State to On:



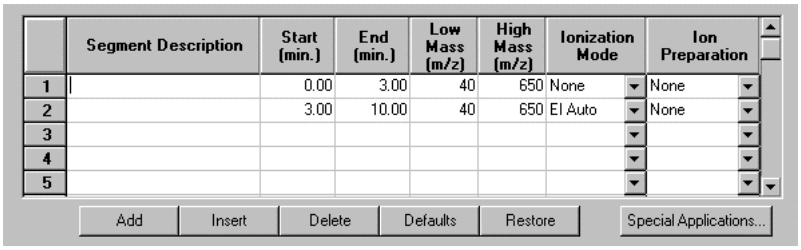
Now use the menu command ***File…Save As*** to save the method with a name such as ChannelA. Change the Valve States to be On for either External Event B (Valve 2) or External Event C (Valve 3) and save these methods as ChannelB and ChannelC.

You may now open Channels A, B, or C by using the menu command ***File…Activate…*** (CHANNELx) from the System Control window.

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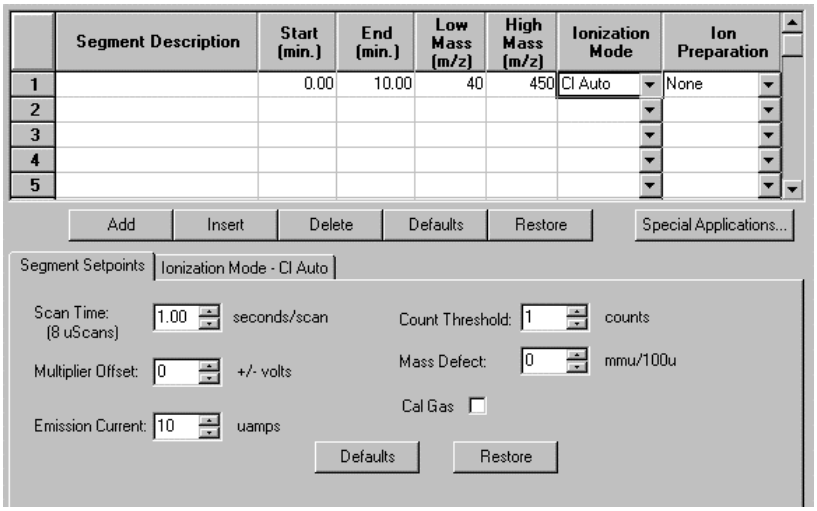
Setting CI/MS Parameters in the MS Method Editor

To adjust CI reagent flows for a given CI gas and to use the appropriate parameters in a CI/MS acquisition, you will need to modify the GC/MS Method for each reagent Channel so that CI/MS parameters for each reagent are appropriate. Open the Method ChannelA (or its equivalent) that you created in the **Selecting Reagent Channels in the GC/MS Method**. From the Method Directory select the entry MS Method Editor under 2000 Mass Spec Control. The MS Method Editor dialog will appear.



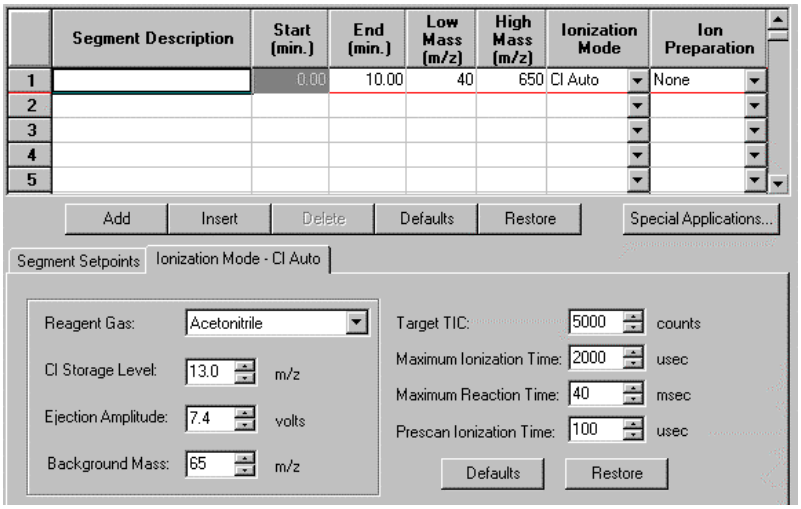
Modify the method to create a single-segment method for CI/Auto acquisition. You may later use this method as a default method for CI acquisition with the MCI Module, so you may wish to adjust method parameters such as Start and End Times and Low and High Mass appropriately for your samples.

NOTE: If you do want to use the method for GC/MS acquisitions, remember to assure that there is a Filament/Multiplier delay segment with ionization method = None.



Click on the tab dialog Ionization Mode - CI Auto to choose CI parameters for this MCI Channel. Parameters for the default CI reagent Methane will be shown. Click on the selection arrow in the Reagent Gas field and choose the CI reagent you have selected for Channel A of the MCI Module. In this example we have chosen acetonitrile for Channel A:

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The values of each parameter for acetonitrile CI are identified in the table **Default Parameters for Liquid CI Reagents** and already entered into the fields on the right side of the table. (If we were setting up for any of the standard gaseous or liquid reagents, their parameters can be entered automatically by clicking on the appropriate Reagent Gas selection. Parameters for other CI reagents may be entered by clicking on the User-Defined selection and entering user-selected parameters.)

Once the CI parameters are chosen, click on the Segment Setpoints tab dialog and choose values for other parameters. The default for ARC Target count is 5000 count for all reagents. Values up to 20,000 are commonly used. You may also want to select an Emission Current specific to the Tune File. Generally an emission current of 10-20 A is used in CI acquisitions.

When you have finished these steps save the Method for Channel A with the menu command ***File…Save As*** ChannelA.mth.

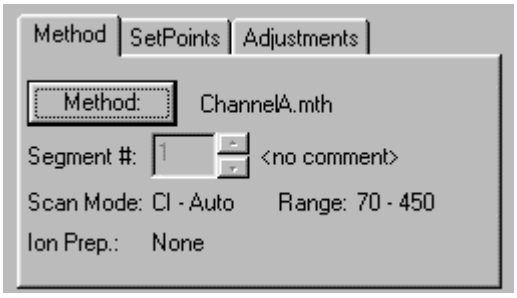
Modify this method for the CI reagents in Channels B and C and save the new methods with the menu command ***File…Save As*** ChannelB.mth or ChannelC.mth. You may then activate the files from System Control with the menu command ***File…Activate***.

Adjusting Reagent Flow for Each CI Reagent

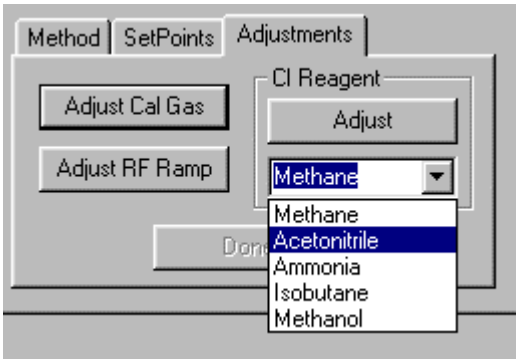
1. Connect a liquid reagent reservoir containing the chosen liquid or connect a selected gas supply to Channel A, B, or C in the MCI Module inlet block. Use the procedures in **Adding Liquid CI Reagents to the MCI Module** or **Adding Gaseous Reagents to the MCI Module**.
2. Open the CI needle valve for the chosen Channel 6-7 turns counterclockwise.
3. Open the CI solenoids for the chosen Channel either from the GC keyboard or by activating a method for that reagent (ChannelA.mth, ChannelB.mth, or ChannelC.mth with the System Control menu command ***File…Activate Method***. In this case, the method ChannelA.mth is activated.
4. Enter the Manual Control dialog of Saturn System Control. Click on the CI button in the Saturn icon on the upper left of the screen and allow a few seconds for the vapor flow from the reservoir to equilibrate. The set of tab dialogs in the center of

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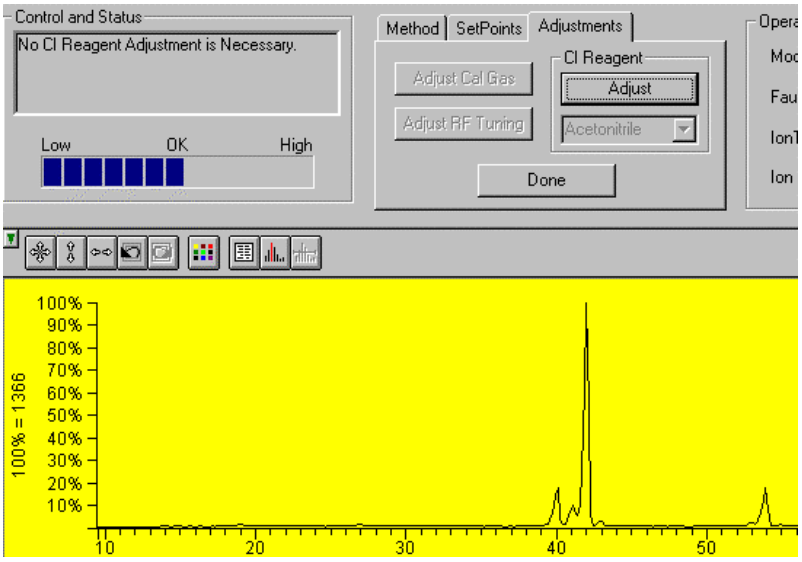
the Manual Control comes up with the Method tab displayed. Note that the method Name, Mode, and Scan Range are displayed.



5. Click on the Adjustments tab dialog and then choose Acetonitrile as the gas and click on Adjust.



6. The adjustment process will begin, as shown.



7. If, after a couple of minutes, there is not enough CI gas entering the trap, increase the flow by turning the needle valve for the chosen Channel on the MCI Module clockwise.

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8. While observing the spectrum using Adjust CI Gas, turn the CI needle valve for the selected channel on the MCI Module clockwise to increase (or counterclockwise to decrease) the amount of reagent until the reagent ions abundances meet the requirements outlined for the chosen reagent in the table shown in **Ion Intensities for Standard CI Reagents**.

Building GC/MS Methods to Use Different CI Reagents

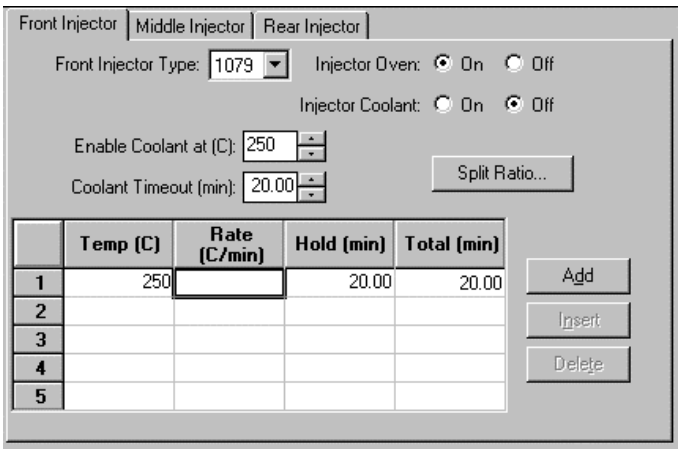
The MCI Module may be used in several different ways to acquire data on a sample for qualitative identification. In general it is advisable to develop a standard GC and EI Method for data acquisition; then to modify the existing method to acquire data in each selected CI mode.

NOTE: Acquisition with each CI reagent using the MCI Module requires a unique GC/MS method. The GC section of the method MUST contain *External Events programming* to select the CI reagent in Channel A, B, or C. The MS section of the method MUST have CI mode selected *with the appropriate CI Tune File*.

Preparing a Standard GC/EI/MS Method

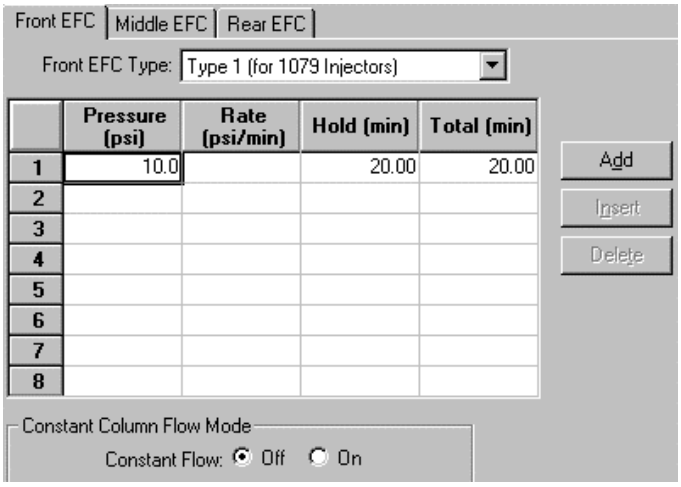
Whether you are going to run methods development on single samples or on a series of samples, it is generally advisable to prepare GC and MS methods for EI/MS acquisitions first.

This example shows GC method development for the 3800 GC. The development of the method for 3400/3600 GCs is similar. In the Saturn Windows Workstation, open a GC/MS method for editing and save it as EI_GC.mth. In the Methods Directory, choose the item GC Injector. Enter 260 as an isothermal injector temperature. (It is assumed that you are using a 1079 injector.)

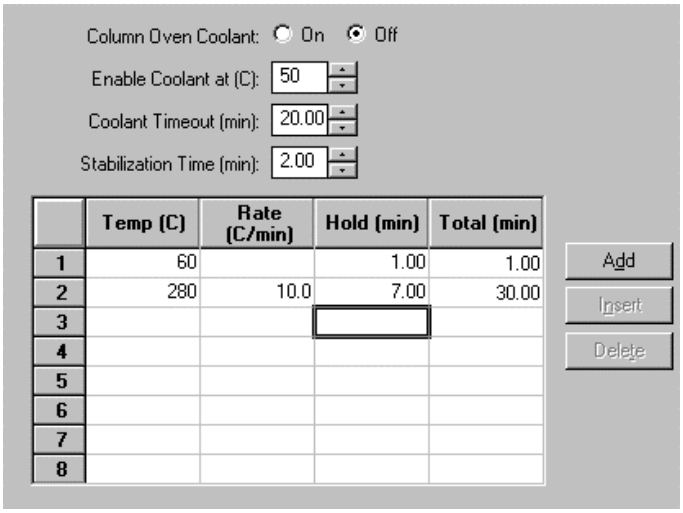


Next, choose the Method Directory item Flow/Pressure and verify that the parameters are acceptable. The following method uses a Type 1 EFC and constant pressure programming at 10 psi:

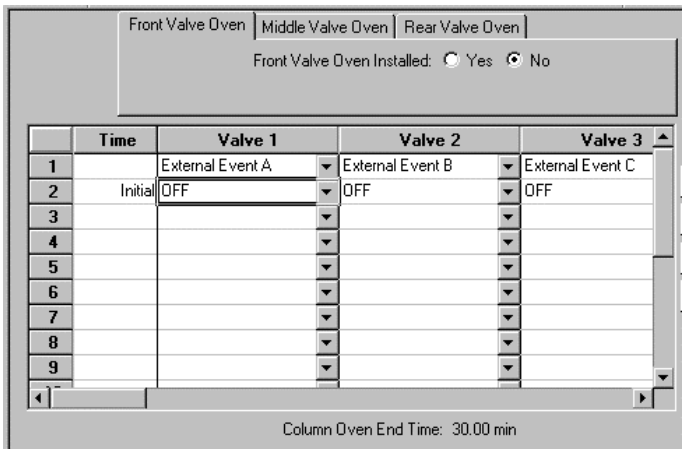
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Now choose the Method Directory item ***Column Oven*** and set an appropriate column oven program. The following program requires a 30-minute run:

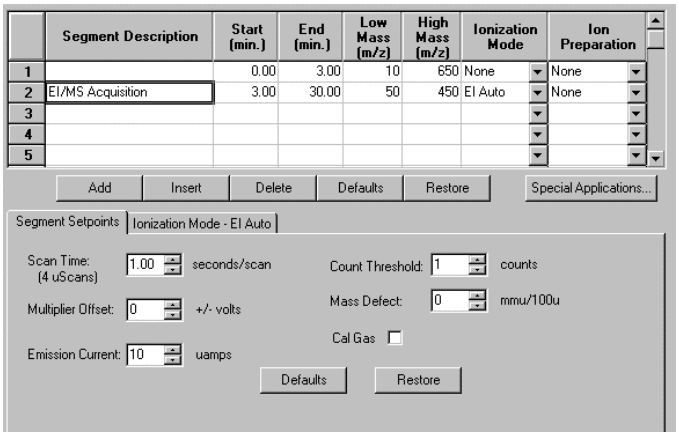


Choose the Method Directory item Sample Delivery and create a Sample Delivery method with all External Events Off:



Click on the MS Method Editor item under 2000 Mass Spec Control and create a standard EI/MS section with a run time matching that of your EI_GC section.

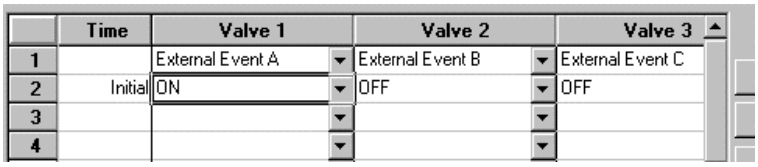
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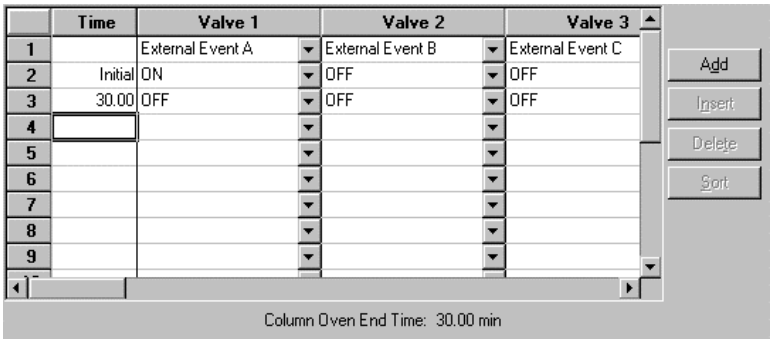
Save the GC/MS Method.

Methods for Single CI Reagents

Open the standard GC/MS Method you have created and saved (e.g., EI_GC.mth) in the Saturn GC/MS Workstation. Before proceeding use the Method Editor menu command ***File... Save As*** to save the file with a name specific to the first CI reagent you want to use (e.g. ACN_CI for acetonitrile CI). Then choose the Method Directory item Sample Delivery to turn on the External Event for that CI gas:



Click on the Add button on the right of the window to add another segment and enter 30 under Time so that External Event A will be turned Off again at the end of the run. In the following example, it is assumed that acetonitrile is in Channel A of the MCI Module, which is activated from Valve 1.

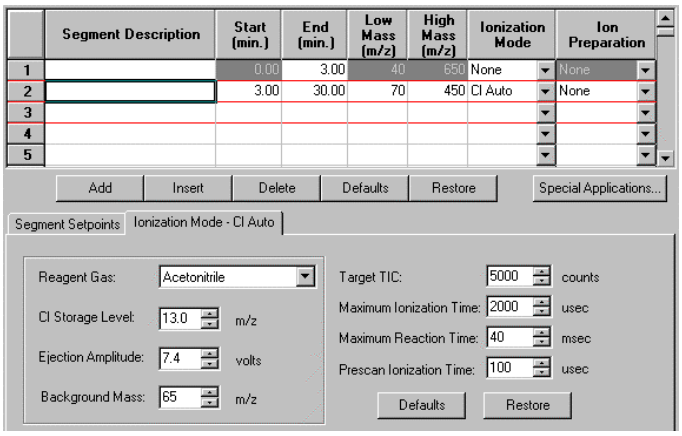


NOTE: It is always a good idea to close the chosen Channel of the MCI Module at the end of a run so that the foreline pump is isolated from the CI reagent. *Otherwise, the reagent will be pumped continuously from the Channel until it is exhausted*.

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If you are planning to use a different CI reagent in each Channel of the MCI Module, save a unique GC/MS Method specific to each Channel of the MCI, each with External Events programming of the correct Event.

Under Saturn 2000 Mass Spec Control choose the Method Directory item MS Method Editor to prepare a CI/MS section of the Method.



Several parameters must be examined or selected for an appropriate acquisition with a given CI reagent.

In this example, note that the low mass limit for acquisition is 70 and the Background Mass is set to 65 for the acetonitrile CI method. Collecting data below this limit might result in significant interferences from acetonitrile reagent ions. Similar parameters for isobutane CI are advised. Acquisitions with methanol, ammonia, and methane reagents can generally be accomplished effectively with lower starting ranges and background masses. See the tables **Default Parameters for Liquid CI Reagents** or **Default Parameters for Gaseous CI Reagents** for suggested background masses. Low mass for acquisition should never be lower than the suggested background mass for a given reagent.

Also note that the mode for acquisition must be changed from EI Auto to CI Auto.

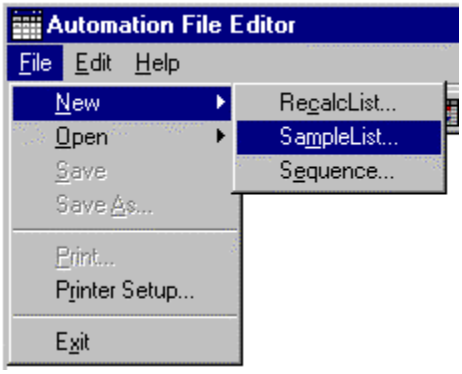
Save the GC/MS Method with a name indicating the CI reagent chosen - in this case we save the method as ACN_CI.mth If you are planning to use a different CI reagent in each Channel of the MCI Module, save a unique GC/MS Method specific to each Channel of the MCI, each with External Events programming of the correct Event.

GC/MS SampleList for Alternating EI/MS and CI/MS Acquisitions

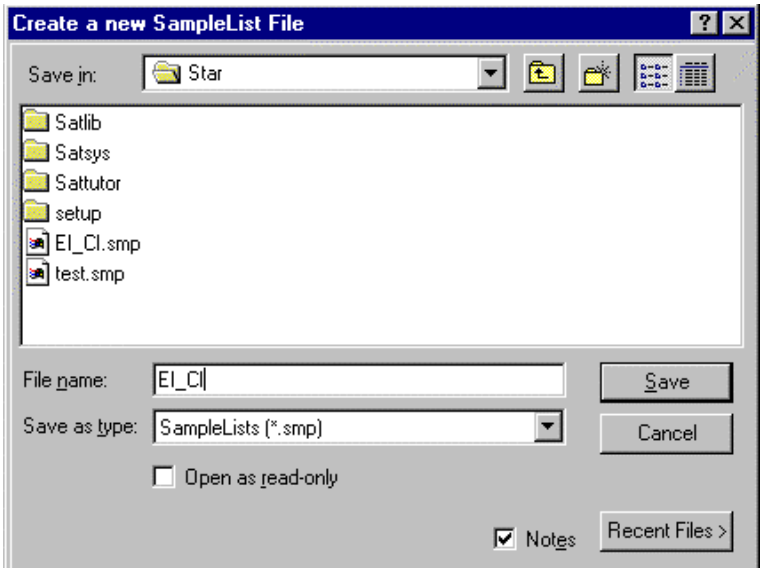
In this example, a set of three samples has been placed in the 8200 AutoSampler in positions 1, 2, and 3 of the sample carousel. When the AutoSampler run is started, each sample will first be run in EI mode using the method EI_GC.mth, then in CI mode with acetonitrile as the CI reagent using the method ACN_CI.mth. Note that care must be taken to use the correct GC/MS method for each entry in the table. The data can now be acquired in automation by preparing appropriate SampleList for the 8200 AutoSampler, the 3800 GC and the Saturn MS.

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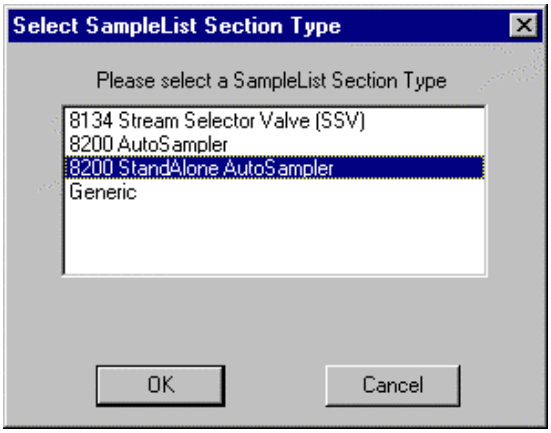
To prepare the Sample List for alternating EI/CI acquisitions, click on the Edit Automation Files button on the Star Toolbar or choose the option ***Start…Programs…Saturn GCMS Workstation…Automation File Editor***. The Automation File Editor Dialog Box will open. Click on the option File…New…SampleList.



Select the name EI_CI for the new Sample List and click on Save.

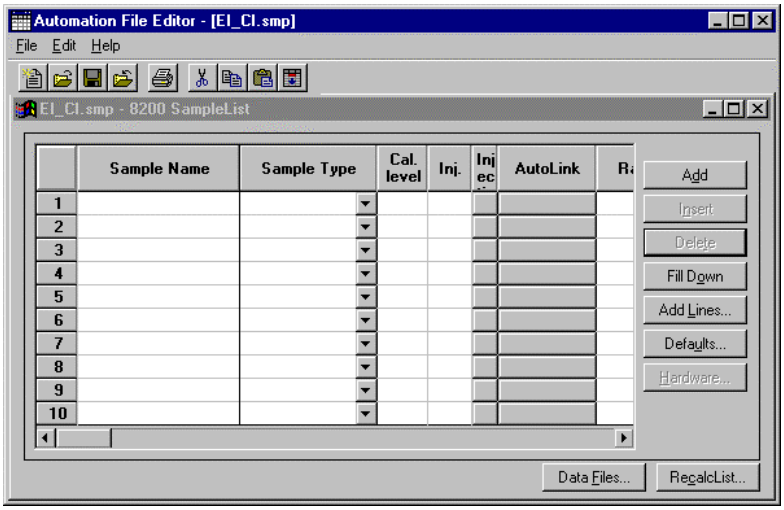


You will see a dialog to Select SampleList Section Type. Select the 8200 AutoSampler and click OK.



You will now see the new EI_CI SampleList ready for entries.

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Since EI and CI analyses are to be performed on three samples in succession, enter the appropriate names for the data files in each row of the SampleList.

	Sample Name	Sample Type	Cal. level	Inj.	Injection Notes
1	EI_01	Analysis		1	none
2	ACN_01	Analysis		1	none
3	EI_02	Analysis		1	none
4	ACN_02	Analysis		1	none
5	EI_03	Analysis		1	none
6	ACN_03	Analysis		1	none
7					
8					
9					
10					

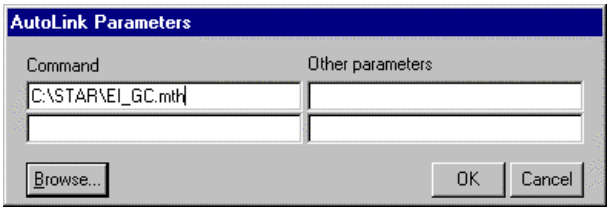
Use the scroll bar at the bottom of the dialog to display fields farther to the right in the SampleList. This will allow you to enter the Method and the 8200 AutoSampler Rack/Vial positions to use for each sample. For this example enter Vial 1 for the first pair of runs and Vials 2 and 3 for the succeeding pairs.

	Sample Name	Injection Notes	AutoLink	Rack	Vial	Injecti Volum
1	EI_01	none	none	1	1	
2	ACN_01	none	none	1	1	
3	EI_02	none	none	1	2	
4	ACN_02	none	none	1	2	
5	EI_03	none	none	1	3	
6	ACN_03	none	none	1	3	
7						
8						
9						
10						

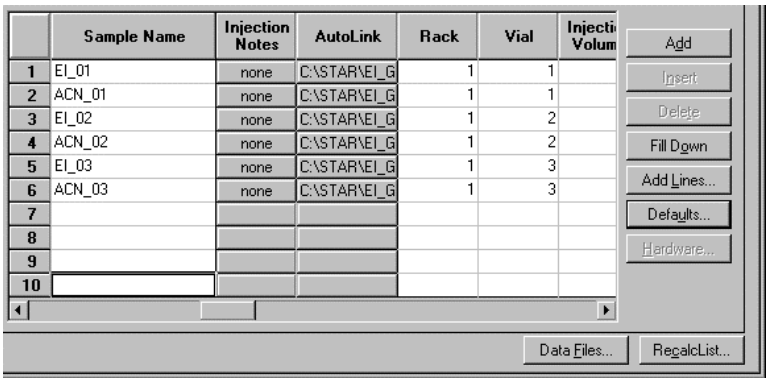
Finally, you need to enter the GC/MS method to be used for each sample. This may be done in the AutoLink section of the SampleList. Click on the AutoLink button in Row 1 of the SampleList. Enter the proposed method for EI/MS

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acquisition in the Command field and click OK. In this example the method is EI_GC.mth.

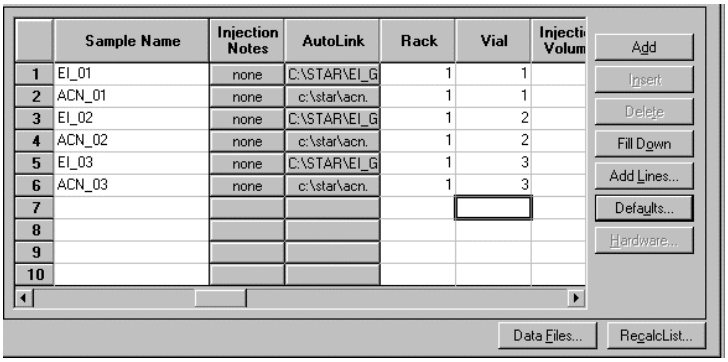


Since the same EI_GC method will be used later in the list highlight the AutoLink button in the list and click on Fill Down.



	Sample Name	Injection Notes	AutoLink	Rack	Vial	Injecti Volum
1	EI_01	none	C:\STAR\EI_G	1	1	
2	ACN_01	none	C:\STAR\EI_G	1	1	
3	EI_02	none	C:\STAR\EI_G	1	2	
4	ACN_02	none	C:\STAR\EI_G	1	2	
5	EI_03	none	C:\STAR\EI_G	1	3	
6	ACN_03	none	C:\STAR\EI_G	1	3	
7						
8						
9						
10						

The EI_GC method is now selected for all entries in the SampleList. The final step in the process is to click on the AutoLink field for each acetonitrile CI sample and substitute the method ACN_CI. After this has been done, the correct GC/MS methods are specified for all entries in the SampleList.

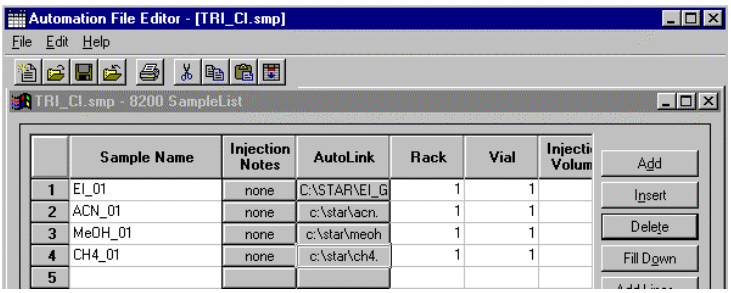


	Sample Name	Injection Notes	AutoLink	Rack	Vial	Injecti Volum
1	EI_01	none	C:\STAR\EI_G	1	1	
2	ACN_01	none	c:\star\acn.	1	1	
3	EI_02	none	C:\STAR\EI_G	1	2	
4	ACN_02	none	c:\star\acn.	1	2	
5	EI_03	none	C:\STAR\EI_G	1	3	
6	ACN_03	none	c:\star\acn.	1	3	
7						
8						
9						
10						

Multiple CI Reagents in Consecutive Runs

If unique GC and MS methods for all three reagents have been set up, it is possible to acquire data either in EI mode or with any of the CI reagents by simply selecting the right GC/MS method for each run. In the following example, a single sample in Rack 1, Vial 1 of the 8200 AutoSampler is used to acquire data in EI, acetonitrile CI, methanol CI, and methane CI modes. Use the procedure outlined above for **GC/MS SampleList for Alternating EI/MS and CI/MS Acquisitions** to create a SampleList as shown.

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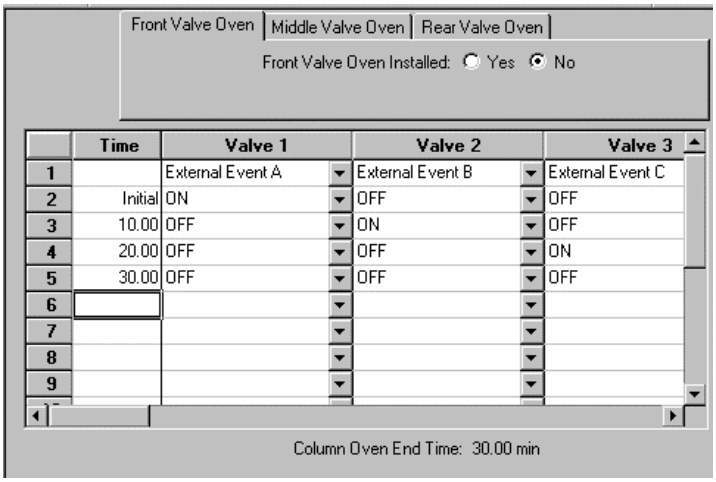
Use the AutoLink field to activate the appropriate method for the EI or particular CI reagent required.

Multiple CI Reagents in the Same Run

In some demanding applications, it may be desirable to change CI reagents within a single chromatographic acquisition. This is done by time programming the GC/MS Method so that the correct External Events are opened during the corresponding MS acquisition time for each CI reagent. In this example, a GC/MS method named TRI_CI is created to use acetonitrile CI (Event A, Channel A) for the first ten minutes of the run, then methanol CI (Event B, Channel B) and methane CI (Event C, Channel C) in the succeeding ten-minute segments. To develop this method, open the Method Builder and choose to edit ACN_CI.mth. After opening the method use the menu command ***File…Save As*** to save the method as TRI_CI.mth.

3800 GC Method Section

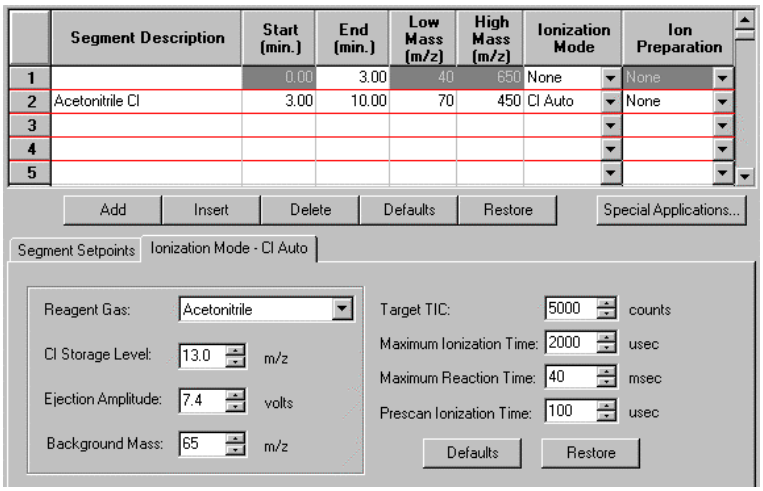
Create an External Events program in the GC Sample Delivery section to open different channels of the MCI Module as desired during the GC/MS run:



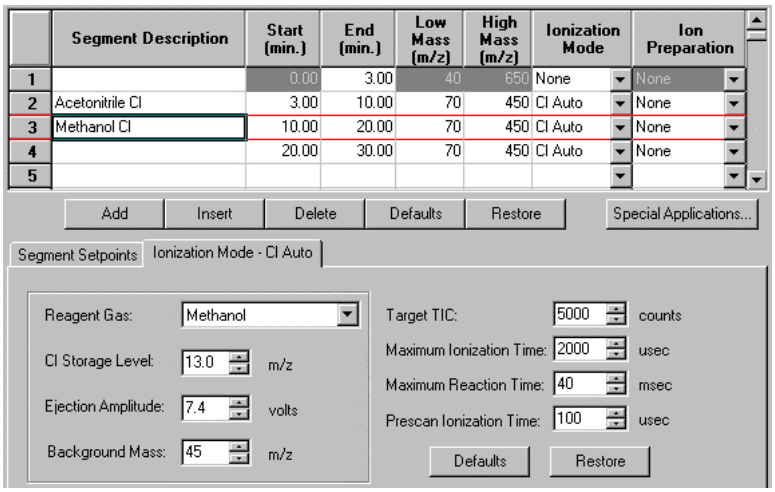
Saturn MS Analysis

Similarly, in the Method Directory item 2000 Mass Spec Control…MS Method Editor, the MS Method is split into time segments. The method is set up first for a 30 minute run using the ACN_CI tune file. Segment 1 is a Filament/Multiplier delay until solvent front elutes from the GC column. Segment 2 is for acetonitrile CI acquisition.

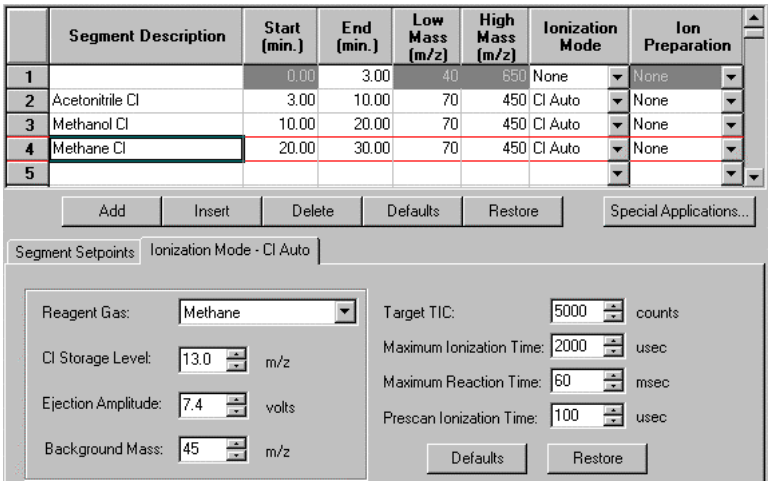
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Then, while Segment 2 is highlighted, click the Add twice to create two additional Segments. Segment 2 is left as an acetonitrile CI segment ending at 10 minutes. Segment 3 parameters are changed in the Ionization Mode tab dialog to those for methanol CI and the end time is set for 20 minutes.



Segment 4 is now set up for methane CI acquisition:



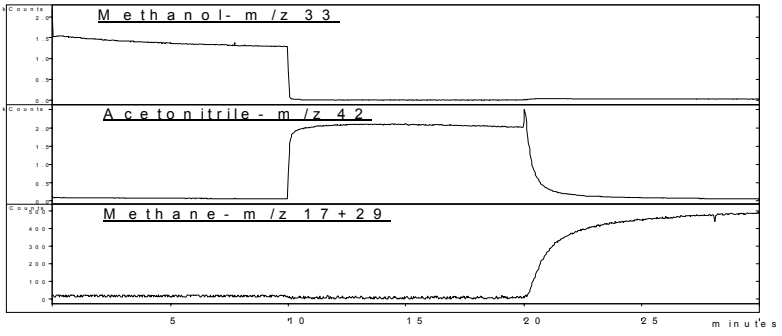
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In a complex method such as this, it is always advisable to review the MS Method to assure that the segment times and acquisition parameters have been entered correctly.

Switching Times Between Reagents

If one is interested in switching CI reagents on consecutive runs, the foreline pump clears residual reagent from the MCI Module lines effectively between runs. However, switching reagents within a single run requires some knowledge of switching times. In the following example chromatogram we show the results of an experiment to switch between several hard and soft CI reagents during a single run. The data have been acquired over a mass range to allow acquisition of the reagent ions for each species. (Acquiring reagent ions also requires lowering the Background Mass in the MS Method to an m/z value less than that of the lowest reagent ion.)

As shown in the chromatogram, the ions for soft CI reagents such as isobutane or acetonitrile first show a high-level spike, and then rapidly equilibrate after a changeover from a harder CI reagent such as methane or methanol spike. Changing from a soft reagent to a hard reagent takes a longer time as the softer reagent (which has a higher proton affinity) will continue to preferentially attract protons in spite of its diminishing pressure.



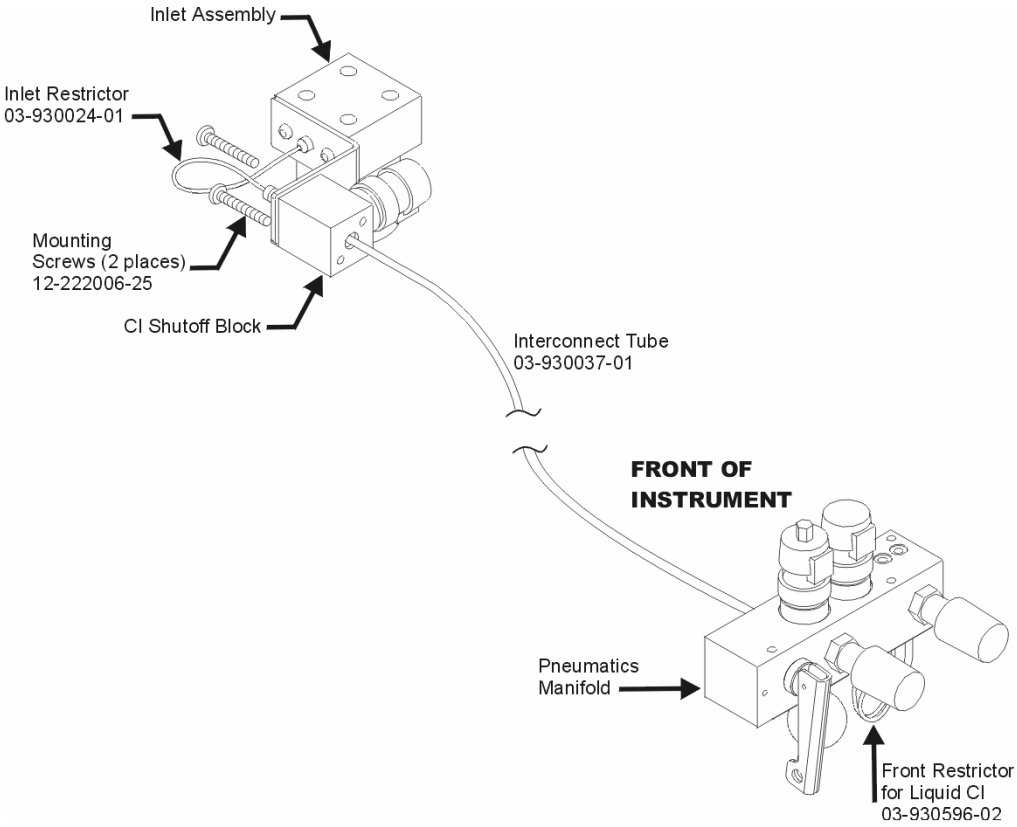
MCI Module Maintenance

It is recommended that all liquid CI reagents be purchased as Reagent Grade solvents. Specialized solvents such as d3-acetonitrile should be 99+% deuterated. This solvent may be purchased from Sigma in quantities of 25 or 50g. A 50g vial will provide enough reagent for 16 fillings of the reservoir to a 3 mL level.

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Handling and Storage of CI Liquids in Reservoir Bulbs

Use the procedure



Filling/Refilling the Liquid CI Reservoir Bulb to fill the reservoir bulbs (03-920270-00) with liquid. If you wish to replace a liquid reagent with a different liquid, you may use a vial cap (03-949870-04) from the MCI Module Accessory Kit to cap the reservoir and store it in the laboratory refrigerator in the Reservoir Stand (03-930073-01) supplied with the Kit. It is a good practice to use a single CI liquid in each channel of the MCI Module. Vapor from the liquid will be absorbed to some extent in the O-rings sealing the vial, restrictors, and solenoids for each channel.

Cleaning Reservoir Bulbs

Withdraw the solvent from the reservoir with the 5 mL Luer syringe supplied in the Accessory Kit (89-988956-00 and 03-930129-01). Rinse the vial with a 3 mL aliquot of the same solvent. Withdraw the wash solvent with the syringe. Dispose of the liquid samples properly. Dry the bulb in a hood or a laboratory oven.

Changing a Channel from Liquid to Gas Operation

To change a channel from liquid operation mode to gaseous, the lower restrictor (03-930596-02) must be replaced by a lower flow rate restrictor (03-930596-01) that was removed from the pneumatics manifold when the MCI module was installed. In addition, the liquid reagent reservoir must be replaced with the gas

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adapter fitting and the long restrictor (03-930597-01). The long restrictor was connected between the pneumatics manifold and the gas shut off valve before the MCI module was installed. Protect the ends of the restrictors to prevent contamination and plugging, when working on the assembly. The MCI Module must have all of its ports connected for proper operation. If fewer than three reagents are installed, then empty reagent bulbs must be installed in the unused positions. Also, if the restrictors are removed for any reason, their ports must be plugged with the pin plugs (17-783512-00) supplied.

1. Turn off all relays related to the MCI module.
2. If you have a **turbo pump system**, skip this step. If you have a **diffusion pump system:** For each channel that will be worked on, close the associated needle valve by turning the knob clockwise. Monitor the foreline pressure. Do not allow it to exceed 500 mTorr for more than 20 seconds. This will reduce the inrush of air into the vacuum system when the channels are reactivated.
3. Remove the MCI cover by loosening the thumbscrew on the front cover.
4. Loosen (but do not remove) the four screws located between the solenoid valves on top of the module.
5. Remove the liquid reagent reservoir by gently rotating and pulling the bulb down and out of the manifold. If there is unused liquid reagent remaining in the bulb, and you wish to save it, cap the bulb with one of the vial caps (03-949870-04) supplied in the accessory kit. You can use the reservoir stand (03-930073-01), also found in the accessory kit, for storage.
6. Remove the lower restrictor (03-930596-02) installed in the two 1/8 inch ports underneath the manifold block. Save the restrictor in a clean, particle free bag, to prevent contamination and plugging.
7. Insert the short lower restrictor (03-930596-01) in these ports.
8. Attach the gas adapter (28-695138-00) to one end of the long restrictor (03-930597-01) with the Teflon® ferrules. The gas adapters and Teflon ferrules are found in the accessory kit. Teflon ferrules are used so that the gas adapter fitting can be removed from the long restrictor, so that you may reuse it in its original configuration. Ensure that the connection is tight to prevent leaks.
9. Fully insert the gas adapter into the ¼ inch inlet port of the channel and route the long restrictor down and back so that it will clear the cover, when it is reinstalled.
10. Tighten the 4 screws on top of the module. The gas adapters and restrictor lines will be held firmly by the O-ring seal after the screws are tight.
11. Replace the MCI cover and tighten the thumbscrew to hold it in place. Make sure that all of the lines are free and clear of the cover before tightening the thumbscrew.
12. Attach the free end of the long restrictor (03-930597-01) to your pressure regulated gaseous reagent supply, set to 5 psi.
13. After installing CI reagent liquids, and each time a reagent liquid or gas is installed, always use care when first opening the CI needle valves.
14. **If you have a turbo pump system**, skip this step. **If you have a diffusion pump system**, first turn on the relays. For each channel worked on, open the needle valve slowly by turning the knob fully counterclockwise to clear out the air in the lines. After a few seconds, return the valve setting to ½ open or their previous setting (approximately 7 turns).

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15. Do not turn on the filament or multiplier for about 2-3 minutes after opening the CI valves. A convenient way to verify that air and water have been removed sufficiently is to check the ion gauge pressure with the CI valves open. Verify that the pressure has returned to less than 35 x 10^{-6} Torr before turning on the Filament and Multiplier.

Changing a Channel from Gas to Liquid Operation

To change a channel from gas to liquid operation, the lower restrictor (03-930596-01) must be replaced by a higher flow rate restrictor (03-930596-02), and a reservoir bulb must replace the inlet plumbing. The free ends of all restrictors and tubes should be capped to prevent contamination and plugging during storage. When finished with the switchover, all ports of the MCI Module must be connected or plugged.

1. Turn off all relays to the MCI Module.
2. If you have a **turbo pump system**, skip this step. If you have a **diffusion pump system:** For each channel that will be worked on, close the associated needle valve by turning the knob clockwise. Monitor the foreline pressure. Do not allow it to exceed 500 mTorr for more than 20 seconds. This will reduce the inrush of air into the vacuum system when the channels are reactivated.
3. Remove the MCI cover by loosening the thumbscrew on the front cover.
4. Using a Phillips-head screwdriver, loosen (but do not remove) the four screws located between the solenoid valves on top of the module.
5. Remove the gas adapter fitting with the long gas line restrictor (28-695138-00 and 03-930597-00, respectively) from the ¼ inch port. Gently twist and pull the adapter out, from under the manifold.
6. Remove the lower restrictor (03-930596-01) installed in the two 1/8-inch ports underneath the manifold block and save it in the MCI Module Accessory Kit.
7. Insert the short lower restrictor (03-930596-02) in these ports.



WARNING:
CHEMICAL HAZARD

Hazardous chemicals may be present. Avoid contact, especially when replenishing reservoirs. Use proper eye and skin protection.

8. Using the 5 mL syringe supplied in the Accessory Kit, fill a liquid CI reagent reservoir halfway with 3 mL of the chosen CI reagent liquid.
9. Insert the reservoir neck into the ¼ inch inlet port of the channel.
10. Tighten the 4 screws on top of the module. The liquid CI reagent reservoir and restrictor lines will be held firmly by the O-ring seal after the screws are tight.
11. Replace the MCI cover and tighten the thumbscrew to hold it in place. Make sure that all of the lines are free and clear of the cover before tightening the thumbscrew.
12. After installing CI reagent liquids, and each time a reagent liquid or gas is installed, always use care when first opening the CI needle valves.
13. **If you have a turbo pump system**, skip this step. **If you have a diffusion pump system**, first turn on the relays. For each channel worked on, open the needle valve slowly by turning the knob fully counterclockwise to clear out the air in the lines. Monitor the foreline pressure. Do not allow it to exceed 500 mTorr

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for more than 20 seconds. After a few seconds, return the valve setting to ½ open or their previous setting (approximately 7 turns).

14. Do not turn on the filament or multiplier for about 2-3 minutes after opening the CI valves. A convenient way to verify that air and water have been removed sufficiently is to check the ion gauge pressure with the CI valves open. Verify that the pressure has returned to less than 35 x 10^{-6} Torr before turning on the filament and multiplier.

Leak Checking

If a leak in the CI plumbing is suspected, use the general leak-checking procedures found in the Saturn Maintenance and Troubleshooting manual under the heading **How to check for leaks**. To isolate suspected leaks within the MCI module, replace the liquid vials or gas lines with empty CI reagent vials as outlined in this manual titled **Adding Liquid CI Reagents to the MCI Module**. After carefully opening the needle valves and relays according to the procedure, allow the air to be pumped from the vials and tubing. Now each Channel can be tested individually by selecting it using the GC relays and with the CI valve open, carefully spraying compressed argon around the fittings while monitoring the spectrum for m/z 40, or you may use tetra-fluoroethane (Dust-Off®) and monitor the spectrum for m/z 69. A leak at one of the O-ring seals may be fixed by cleaning the tubing and O-ring, but usually a new O-ring is required. Extras are provided with the MCI module and also in the accessory kit.

Cross-Contamination Effects

Vapor from liquid CI reagents is absorbed to some extent in the O-ring seals of each Channel used for liquid CI. If the liquid or gas chosen for the Channel is changed, the residual vapor from the previous reagent may create artifact CI reagent ions observable when adjusting the CI gas flow. If these artifact ions comprise more than 10-20% of the total reagent ions observed during CI flow adjustment, they may affect the CI spectra of the analytes. For example, residual soft reagent ions from acetonitrile at m/z 42 and 54 may be observed if one switches the reagent to methanol in a given Channel. These softer reagent ions may lead to an increased proportion of M+1 ions in the methanol CI spectrum compared to the ratios observed without the artifact acetonitrile reagent ions present.

Absorbed solvent in Channel seals may be reduced by prolonged vacuum pumping of the Channel:

1. Replace the liquid CI vial or gas line in the Channel with an empty CI reagent vial.
2. Open the Channel from the GC keyboard. See the instructions in **Selecting Reagent Channels from the 3800 GC Keyboard**.
3. Do not turn on the CI icon in the Saturn software.
4. Open the Needle Valve for the Channel full counterclockwise so that all flow from the Channel is directed to the Foreline Pump.
5. Leave the Channel open overnight or over a weekend.
6. Replace the desired reagent in the Channel position and observe reagent ions during CI gas adjustment.

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Hints for Successful Operation of the MCI Module

1. Acquisition with each CI reagent using the MCI Module requires a unique GC/MS method. The GC section method MUST contain ***External Events programming*** (done in the Sample Delivery section) to select the CI reagent in Channel A, B, or C. The MS method MUST have CI mode selected ***with the appropriate CI parameters designated.***
2. It is always a good idea to close the chosen Channel of the MCI Module at the end of a run so that the foreline pump is isolated from the CI reagent***. Otherwise, the reagent will be pumped continuously from the Channel until it is exhausted***.
3. The MCI Module may be used in several different ways to acquire data on a sample for qualitative identification. Using deuterated reagents can provide extra information when the data are compared with data from non-deuterated reagents. Short reaction times will maximize the number of $[M+D]^+$ ions compared to the number of $[M+H]^+$ ions.
4. With the relays off, unused reagent may be stored in a bulb attached to the MCI Module for extended periods of time.
5. Fewer than three reagents may be connected to the MCI Module at any time. However, the ports on the MCI Module must always be connected, either to the restrictors and reagent vials/gas lines or plugged with the pin plugs supplied with the module and accessory kit. The easiest way to keep all passages closed and clean is to attach empty CI reagent bulbs in any Channels that are not currently needed.

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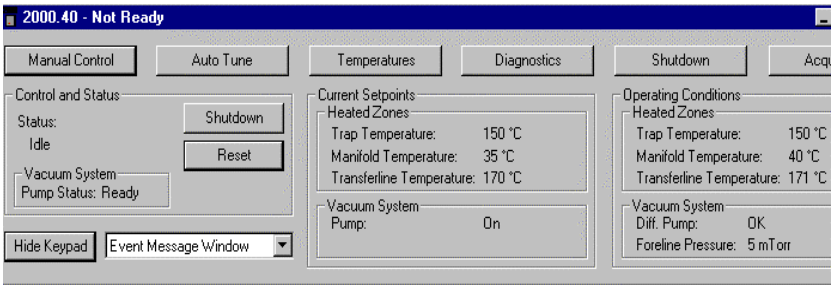
System Start-up and Shutdown

Diffusion Pump Shutdown

NOTE: During the SHUTDOWN procedure, the GC and MS temperature zones are reduced (≤80 °C). The system is manually vented to atmosphere when the trap temperature is less than 80 °C.

From the System Control click on Shutdown tab. The display of the Shutdown program appears and click on Shutdown.

The shutdown procedure and capabilities for the Diffusion Pump system are similar to the turbomolecular system.



Shutdown Page

NOTE: The Diffusion Pump System shutdown sequence takes at least 30 minutes.

The Saturn GC/MS heaters are turned OFF.

The GC temperature zones should be cooled downed before maintenance is performed.

The diffusion pump heater is turned OFF while the Peltier Baffle cooler is kept on. The DIFFUSION PUMP STATUS changes from NORMAL to COOLING. After 15 minutes, at which time there is no longer any pump vapor to contaminate the system, the Peltier Baffle cooler is turned OFF. After another 15 minutes, the cooler has warmed to the point that it won't condense water vapor, and the pump is considered to be off. The DIFFUSION PUMP STATUS changes from COOLING to OFF.

NOTE: If the word "FAULT!" is displayed in the Vacuum Status box, click on Diagnostics tab for detailed information on fault.

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This represents a group of error messages indicating that the diffusion pump has been shut down. To precisely identify the problem, the USER should go to the Diagnostics tab, check “System Test and Run to Completion.”. Fault messages may appear on startup or during operation.

Turn OFF main power by placing switch at rear of system to OFF (down) position. Manually vent the system for at least 5 minutes using the lever on the front panel.



CAUTION

DO NOT ATTEMPT to VENT SYSTEM by any other method (via transfer line, foreline vacuum clamps, etc.). Rapid, improper venting of the system will cause diffusion pump fluid to back stream into the manifold and ion trap. Maintenance procedures should NOT be attempted until shutdown program has completed!

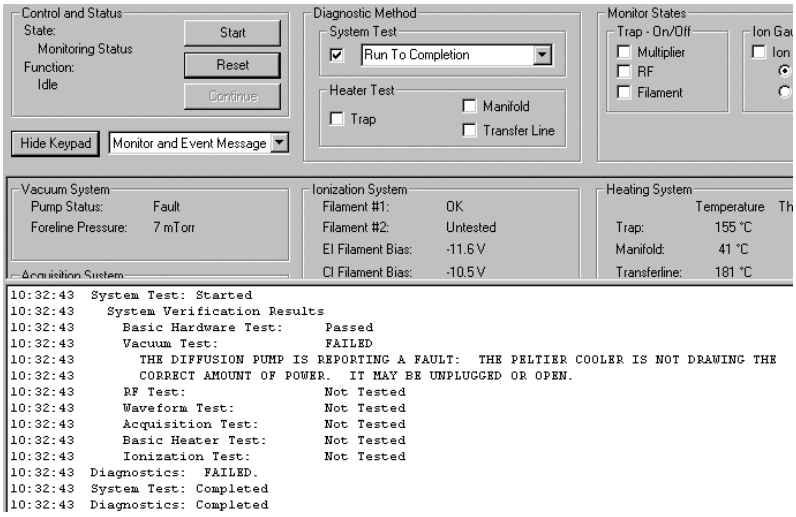
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Diffusion Pump Startup

NOTE: The Diffusion Pump System Startup sequence takes at least 30 minutes.

First, the Peltier Baffle cooler is turned on while the pump heater is left off. This step lasts 15 minutes and allows the cooler to drop in temperature before any pump vapors are created. When the foreline pressure reaches proper vacuum (~500 mTorr), the pump heater is turned on. When the heater has reached temperature, approximately 15 minutes, the ion trap electronics can be turned on.

If a diffusion pump fault occurs the system will go to the shutdown sequence. The user may check for faults on Startup by going to the Diagnostics page and check Vacuum Status for Fault. Run Tests to Completion and check diagnostics report for messages.



Diagnostics Page to Determine Diffusion Pump Status

NOTE: The *Vacuum System* status should be periodically checked during Startup for foreline pressure. The pressure should read below 500 mTorr in 5 minutes and < 100 mTorr after 45 minutes. Higher values may indicate a leak. Refer to *Troubleshooting*.

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Mass Spectrometer Maintenance

Periodic Maintenance

To ensure the Saturn GC/MS peak-performance, you will have to perform periodic maintenance on the vacuum and cooling systems. The following table identifies relevant maintenance intervals.

Procedure	Interval
Check the foreline pump oil level and condition	Weekly
Purge foreline pump oil	Weekly
Check cooling fans	Weekly
Check diffusion pump fluid and condition	Monthly
Change foreline pump oil	Every 6 months
Clean diffusion pump	Every 6 months

Checking Foreline Pump Oil Level and Condition

NOTE: The Saturn 2000 Maintenance Tutorial on CD-ROM provides viewing maintenance procedures on computer screen. **Refer to Pump Maintenance Section.**

The oil level and condition should be checked with the pump switched off, but still warm.

1. The oil level should be between the maximum and minimum levels on the sight glass. If the oil level falls below the minimum level, gradually add more oil (88-299517-00) through the filler port until the oil level is centered between the maximum and minimum levels. A funnel may be helpful.

NOTE: Some Saturn 2000 systems use similar but different models of forepumps. The maintenance procedures are similar but the location and appearance of some components are different. Refer to the pump manual for details.

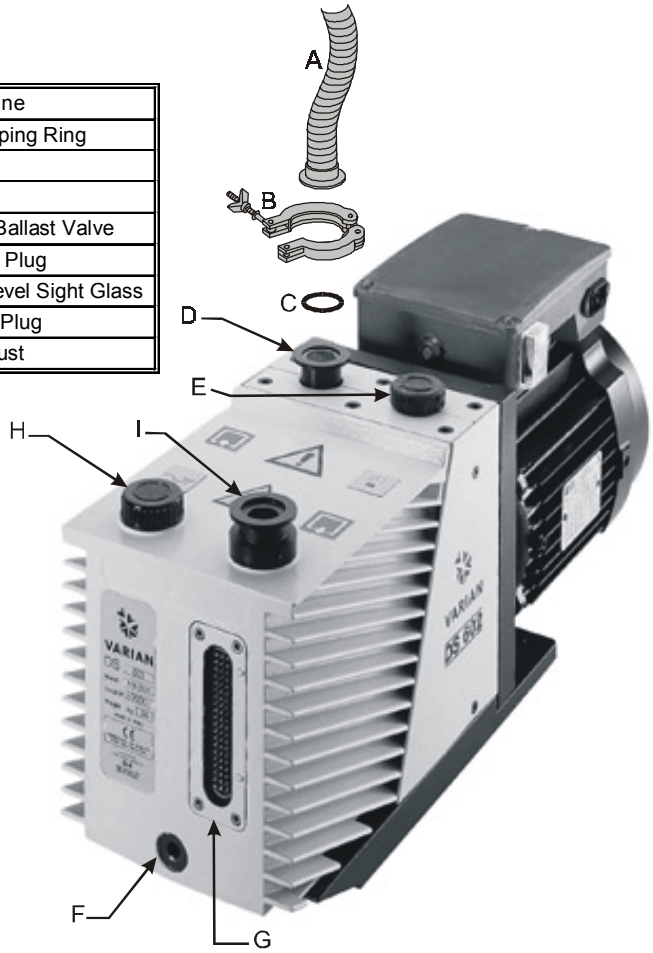
2. The pump oil should be clear and light amber in color.

   If the oil becomes cloudy, purge it as described in Purging Foreline Pump Oil.

   If the oil becomes thick, dark in color and has a burnt smell, change it as described in Changing Foreline Pump Oil.

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A	Foreline
B	Clamping Ring
C	Seal
D	Inlet
E	Gas Ballast Valve
F	Drain Plug
G	Oil Level Sight Glass
H	Filler Plug
I	Exhaust



Foreline Pump

Purging Foreline Pump Oil

Condensable vapors accumulate in the foreline pump oil during routine operation. These condensates will reduce pump efficiency and shorten the life of the oil. However, the pump oil may be rejuvenated with a weekly purge.

Purging can be done without interrupting system operation. However, this should not be done while the Saturn is acquiring data, when the filament is on, or the electron multiplier is on.

To purge:

1. Place an exhaust vent over the open exhaust port.
2. With the foreline pump running, turn the gas ballast valve counterclockwise to the open position. The pump will become noisy and emit oil vapor.
3. After 10 minutes, turn the gas ballast valve back to the closed position.
4. Remove the exhaust vent.

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Changing Foreline Pump Oil

To ensure peak performance and maximum pump lifetime, change the pump oil whenever the oil becomes thick, dark in color and has a burnt smell; or at least every six months. The oil change must be performed while the oil is warm.

To change the pump oil:

1. Turn off and vent the MS.
2. Disconnect the pump's power cord from the rear of the Saturn GC/MS.
3. Disconnect the vacuum hose from the foreline pump by removing the clamping ring.
4. Pull the hose free, and place the seal on a clean lint free surface for later use.
5. Carefully place the foreline pump on a raised surface. The surface should be high enough to allow a 1.0-liter (1 US qt) or larger container to be placed under the drain port when the pump is tilted forward. A container with an opening diameter of at least six inches will make this task easier.

   CAUTION

   Pump weighs 25 kg (55 lb.). Use proper lifting techniques.

6. Place an oil pan beneath the drain port to catch any spillage.

   WARNING:
   CHEMICAL HAZARD

   Hazardous chemicals may be present. Avoid contact with skin. Use proper eye and skin protection.

7. Remove the plastic cover and the filler plug on top of the pump.
8. With the container in place to catch the oil, slowly remove the drain plug in the front of the pump.

   WARNING

   Toxic residues from mass spectrometer samples will build up in used pump oil. Dispose of all used pump oil in accordance with applicable regulations. Place a hazards warning label on the container, if appropriate.

9. Tilt the pump forward and hold until oil flow ceases.
10. Return the pump to the horizontal and refit the plug.
11. Run the pump for approximately ten seconds with the intake port open. This will remove any residual oil from the pumping block.

    CAUTION

    Avoid breathing oil mist coming from the exhaust port during this operation.

12. Remove the plug, tilt the pump, and drain the oil.
13. Return the pump to the horizontal.
14. Wipe the oil residue from the drainage port, and refit the drain plug.

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15. Fill the pump with fresh oil (88-299517-00) through the filler port until the oil level reaches the maximum level in the sight glass. A funnel may be helpful.

Flushing

The pump should be flushed if the pump oil is particularly dirty. After draining the pump (previous steps 1-13):

1. Remove the inlet filter by removing the inlet port's locking screw with a 4 mm Allen wrench; unscrewing the inlet port with a 30 mm open ended wrench; and pulling the filter up with a pair of tweezers or long nose pliers.
2. Clean the filter in warm soapy water. Rinse and blow-dry with air or nitrogen.
3. Refit the filter.
4. Screw the inlet port back into the pump housing and lock in place with the locking screw.
5. Pour 0.33-Liter / (0.35 US qt) of fresh pump oil in through the inlet port then run the pump.

CAUTION

Avoid breathing oil mist coming from the exhaust port during this operation.

6. Stop the pump, drain the flushing oil, and replace as described previously.

Check Cooling Fans Turbomolecular Pump System

CAUTION

To prevent overheating, do not block air intakes.

The cooling fans maintain an optimal temperature for the turbomolecular pump and the other electronics modules. Without the cooling fans, the lifetime of the turbomolecular pump and temperature-sensitive PC-board components would be shortened. To ensure proper operation of the cooling system, operate the Saturn GC/MS with its covers in place. In addition, be sure to check the fans at least once each week.

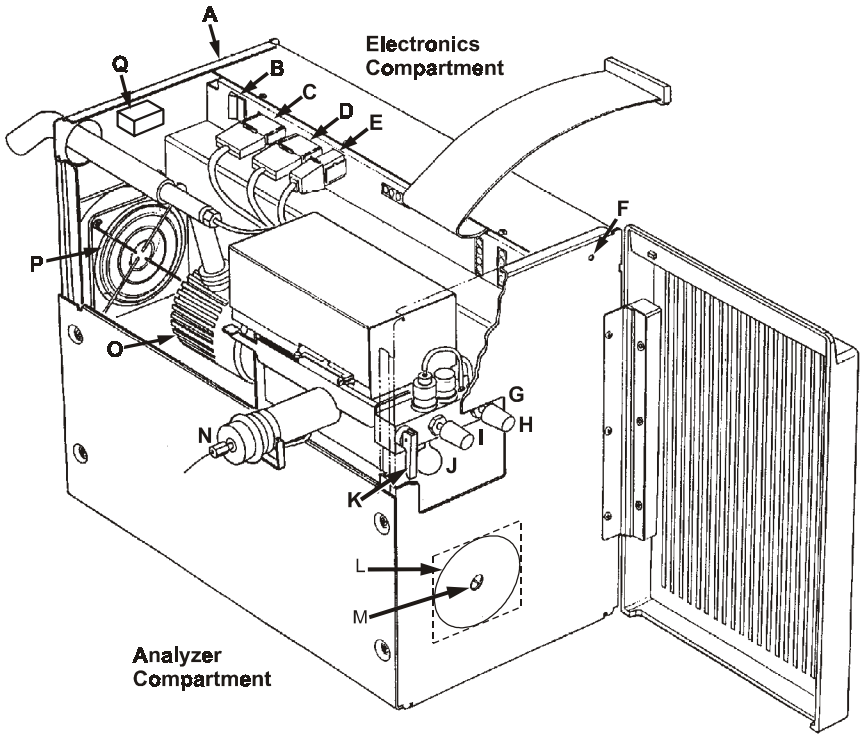
The Saturn GC/MS is equipped with two fans on its rear panel. The function of these fans is to pull air into the instrument. To check fan operation, proceed as follows:

1. Make sure that the Saturn main switch and service switch are turned ON.
2. Place a large sheet of paper over one of the fan guards.

   If the paper is sucked toward the fan guard, the fan is working.

   If it is not, the fan is broken. Contact your Varian Customer Support Representative to arrange for a replacement.
3. Check the second fan in the same manner.

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Saturn 2000 GC/MS, Front View

A	Main Power Switch (rear panel)	J	Cal Gas Vial
B	Service Switch	K	Vent Valve
C	Transfer Line Heater	L	RF Coil
D	Trap Heater	M	RF Coil Adjustment Screw
E	Manifold Heater	N	Transfer Line
F	LED	O	Turbomolecular Pump
G	Pneumatics Manifold	P	Cooling Fans
H	CI Cal Gas Adjust	Q	CI Shutoff Valve
I	Cal Gas Adjust		

If the fans are excessively noisy, i.e., if they whine or whir, one of the fans may be about to fail and it should be replaced.

To identify which of the two fans is about to fail, proceed as follows:

1. Remove the top cover from the Saturn GC/MS.

   If the noise continues, proceed to step 3.

   If the noise stops, proceed to step 2.

2. Turn off the electronics compartment fan via the service switch, and replace the top cover.

   If the noise returns, it is coming from the turbomolecular pump cooling fan. Proceed to step 4.

   If the noise does not return, remove the cover and proceed to step 3.

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3. Turn off the electronics compartment fan via the service isolation switch.

   If the noise continues, it is coming from the turbomolecular pump-cooling fan.

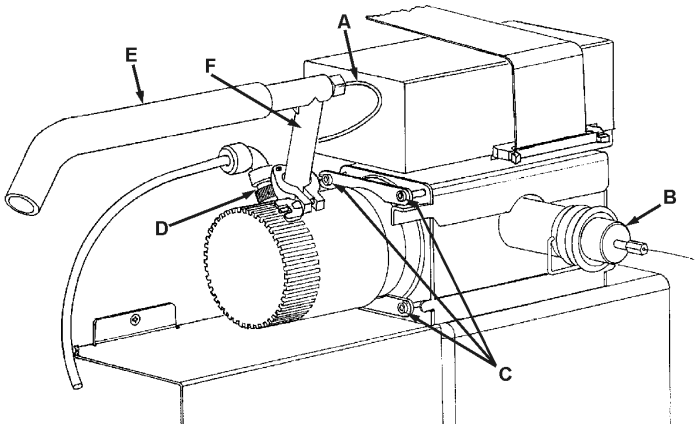
   If the noise stops, it is coming from the electronics compartment fan.

4. Contact a Varian Customer Support Representative to arrange for replacement of the broken fan.

How to Replace the Turbomolecular Pump

To replace the turbomolecular pump, proceed as follows:

1. Turn off the Saturn GC/MS using the shutdown procedure.
2. Confirm that the main power switch is turned OFF and that the vacuum system has been vented.
3. Taking care not to break the GC column, slide the Saturn GC/MS about 12 to 18 inches apart from the GC.
4. Remove the Saturn GC/MS cover by grasping both sides and lifting up.
5. Remove the lower side panel with a Phillips screwdriver.
6. Disconnect the 1/8-in. pneumatics exhaust tube from the vacuum hose elbow.
7. Disconnect the vacuum hose elbow from the turbomolecular pump by removing the clamping ring and pulling the elbow away from the pump.
8. Pull the vacuum hose as far as you can toward the rear of the instrument.
9. Remove the turbomolecular exhaust-port seal and place it on a clean, lint-free surface for later use.
10. Unplug the turbomolecular cable from the turbomolecular pump by rotating the ring on the connector in the counterclockwise direction. Continue rotating until you can pull the connector free.



Turbomolecular Pump Connections

A	Pneumatics Exhaust Tube	D	Turbomolecular Cable
B	Transfer Line	E	Vacuum Hose
C	Clamping Screws (4 places)	F	Vacuum Hose Elbow

11. Loosen each of the four clamping screws about 2 turns with a 3/16-in. hex driver.

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Take care not to completely unscrew the two inner clamping screws. (If you should unscrew them, restart the screws after you have removed the turbomolecular pump from the instrument.)

12. Remove the outside bottom clamping screw.
13. Remove the bottom clamp as you hold the turbomolecular pump in place.
14. Remove the outside top clamping screw (closest to the transfer line).
15. Remove the top clamp as you hold the turbomolecular pump in place.
16. Pull the turbomolecular pump to the rear and lift it clear of the instrument.
17. Remove the large seal from the turbomolecular inlet, and place it on the inlet of the new turbomolecular pump (03-920542-00). The orientation of the seal is not important.

    On the new turbomolecular pump, leave the red cap over the turbomolecular exhaust port.

18. Carefully slide the new turbomolecular pump and seal into position on the end of the manifold.

    Make sure the electrical connection (turbomolecular cable) is tilted towards the bulkhead, i.e., toward the left as viewed from the rear of the instrument.

    Take care not to scratch the sealing surface on the manifold in front of the turbomolecular pump.

19. Insert the top clamp and loosely fasten it into place.
20. Insert the bottom clamp and loosely fasten it into place.
21. Tighten all four clamping screws until snug.
22. Reconnect the turbomolecular cable. Rotate the retaining ring clockwise with downward pressure to lock the cable into position.
23. Remove the red cap over the turbomolecular exhaust port.
24. Place the seal on the turbomolecular pump exhaust port.
25. Reconnect the vacuum hose elbow and clamp.
26. Reconnect the pneumatics exhaust tube.
27. Make sure that the vent valve is closed.
28. Turn on the rear-panel main power switch.
29. Snug up the top and bottom clamp screws.
30. Monitor the turbomolecular pump speed using Diagnostics under Vacuum System Status.
31. Once the pump is running satisfactorily, replace the side panel, top cover, and slide the GC and Saturn GC/MS back together.
32. Discard the old turbomolecular pump. Be sure to comply with all applicable health and safety regulations.

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Check Cooling Fans Diffusion Pump System

CAUTION

To prevent electronics overheating and diffusion pump failure, do not block air intakes or remove covers.

Cooling fans perform two important functions in the Saturn GC/MS. They prolong the lifetime of temperature sensitive electronic components by maintaining optimal temperatures within the electronics compartments and they provide the airflow required by the air cooled diffusion pump and Peltier baffle. Cooling is divided into three zones. Zone one is the upper part of the analyzer compartment. Its purpose is to provide forced air-cooling for the Peltier baffle, and the manifold electronics. Zone two is the electronics compartment, diffusion pump controller, and RF generator board. Its purpose is to cool the majority of the instrument's printed circuit boards. Zone three is the diffusion pump compartment. Its purpose is to cool the diffusion pump.

The Saturn GC/MS is equipped with three fans on its rear panel, one for each zone. Each fan pulls air in through the front and/or side of the instrument and expels it through the rear panel. To inspect the cooling system, ensure the Saturn main power switch and service switch are turned ON (refer to the figure showing these zones). Proceed as follows:

1. **Zone 1:** Upper analyzer compartment. The Zone 1 fan is located in the top left of the rear panel (as viewed from the front of the instrument). Failure of this fan will be detected by the diffusion pump controller, which will initiate a system shutdown. The only components of zone one requiring checking are the Peltier baffle duct and the top cover. To check:
2. Check the front of the instrument is not obstructed.
3. Check the rear of the instrument has at least 250 mm (10") of clearance.
4. Remove the top cover and check the Peltier baffle ducting is in place.
5. Refit the top cover.
6. **Zone 2:** Electronics compartment, diffusion pump controller, and RF generator board. The Zone 2 fan is located in the middle right hand portion of the rear panel. Zone two may be checked as follows:
   a. Check the front of the instrument is not obstructed.
   b. Check the rear of the instrument has at least 250 mm (10") of clearance.
   c. Check the left side cover is in place and not obstructed (fallen paper, tissues, etc.)
   d. Check that the right side cover is in place.

WARNING:
SHOCK HAZARD

Hazardous voltages are present under right side cover. This cover should not be removed.

7. Check the GC and MS are separated by approximately 19 mm (3/4") using the standoffs installed on the MS.
8. Place your finger approximately ½" away from the fan finger guard to feel if air is coming out of the fan.

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If not, the fan is broken and should be replaced. Contact your Varian Customer Support Representative to arrange for a replacement.

9. Zone 3: Diffusion pump compartment. The Zone 3 fan is located in the lower left corner of the rear panel. Failure of this fan will cause the diffusion pump to overheat. This will be detected by the diffusion pump controller, which will initiate a system shutdown. The only components of zone three requiring checking are the air intake and exhaust. To check:

   a. Check the left side cover is in place and not obstructed.

   b. Check the rear of the instrument has at least 250 mm (10") of clearance.

   c. Check the GC and MS are separated by approximately 19 mm (3/4") using the standoffs installed on the MS.

Checking the Diffusion Pump Fluid Level and Condition

Optimum performance of the diffusion pump depends on the pump's fluid level and condition, which should be checked monthly. The fluid can only be checked by removing the left side cover.

NOTE: If the cover is off for more than five minutes the pump will overheat and the diffusion pump controller will initiate a system shutdown.

However, if performed quickly this procedure can be done with the pump running. To check the fluid:

1. Carefully separate the MS from the GC by approximately 250 mm (10").

NOTE: Be careful not to break the GC column.

2. Remove the four screws holding the left side cover in place, and quickly remove the cover.

3. Check the fluid in the diffusion pump's sight glass.

   The fluid level should be within the "FULL HOT" zone.

   If the level is at or below the lower limit of the zone the pump fluid should be topped off.

   The fluid should be clear.

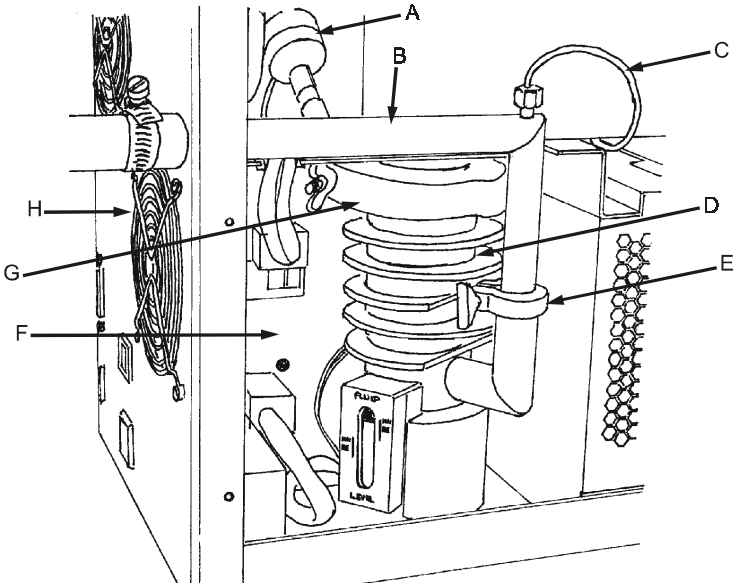
   If the fluid is dark in color and opaque, the pump should be cleaned.

4. Refit the left side cover and fasten in place with the four screws and two spacers.

   If the fluid is to be topped off or changed, the cover must still be refitted during shutdown.

5. Carefully slide the MS to the GC.

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Diffusion Pump Compartment

A	Thermocouple Gauge	E	Exhaust Clamp
B	Elbow	F	Diffusion Pump Controller (behind cover)
C	Pneumatics Exhaust Tube	G	Inlet Clamp
D	Diffusion Pump	H	Fan

Turning Off the Diffusion Pumped Mass Spectrometer

WARNING:
BURN HAZARD

Allow diffusion pump and other heated zones to cool before disassembly.

To turn off the MS:

1. Invoke Saturn shutdown tab from System Control and click on shutdown. See section on system Start-up and Shutdown.

CAUTION

Do not attempt to vent the MS by any other means. Venting through the foreline connections or transfer line will cause a rapid pressure increase that will coat the ion trap and internal surfaces of the manifold with diffusion pump fluid. A transfer line venting will also cause high mass noise in the trap.

2. Maintenance work may begin once the vacuum system has vented to atmospheric pressure. This takes approximately five minutes.

   This may be checked by placing a finger over the vent port to feel for suction.

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Replacing the Diffusion Pump Thermocouple Gauge

The thermocouple gauge will need replacing if its filament has burned out or its thermocouple has become detached. This will be indicated in the Diagnostics report. To replace the thermocouple gauge:

1. Turn off the MS as described in the Start-up and Shutdown section.
2. Carefully separate the MS from the GC by approximately 250 mm (10").

NOTE: Be careful not to break the GC column.

3. Remove the top cover.
4. Remove the transfer line.
5. Rotate the MS to give full accessibility to the left side.
6. Remove the four screws holding the left side cover in place, and remove the cover.
7. Disconnect the manifold and trap heater cables and move out of the way.
8. Remove the Peltier baffle ducting by pulling up at the front and sliding forward.
9. Disconnect the Peltier baffle power leads (orange and yellow wires) from the Peltier baffle and slide out of the way.
10. Remove the two screws holding the Peltier baffle duct base to the rear panel, and remove base by pulling up and forward over the Peltier baffle heat sink.
11. Disconnect the thermocouple gauge cable from the thermocouple gauge.
12. Unscrew the plastic nut and slide it up the 1/8" pneumatics exhaust tube. Withdraw the tube from the elbow, using a twisting motion.
13. At the rear of the instrument, loosen the clamp holding the vacuum tubing onto the stainless steel elbow, and withdraw the tubing. Slightly twisting the tube while withdrawing may help.
14. Remove the small clamp from the diffusion pump's exhaust port by unscrewing the red wing nut, removing the screw, turning the clamp so the open end faces the diffusion pump, and pulling the clamp toward you.
15. Lift the elbow up and wiggle it free of the rear panel.
16. Clamp the elbow in a vice fitted with jaw protectors.
17. Unscrew the thermocouple gauge using a 9/16" open-ended wrench.
18. Wrap three to four turns of Teflon® tape clockwise around the threads of the new gauge (27-229907-00).
19. Check and remove residual Teflon tape from thermocouple gauge port.
20. Screw the thermocouple gauge into the threaded port on the elbow until snug.
21. Remove and inspect the seal on the diffusion pump exhaust port (27-402536-00). **Replace if it is worn or damaged**.
22. Wipe the seal clean with a lint free cloth, and refit to the exhaust port.
23. Guide the tube end of the elbow through the hole in the rear panel, and wriggle it into position on the diffusion pump exhaust port. **Take care not to dislodge the seal.**

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24. Reinstall the clamp by pushing it onto the joined exhaust flanges.
25. Rotate the clamp 180° and install the screw from the left side.
26. Thread the wing nut onto the screw.
27. Rotate the clamp as far to the left as possible, while still allowing room to turn the wing nut. Otherwise, the wing nut will prevent reinstallation of the side panel.
28. Tighten the wing nut.
29. Refit the vacuum tubing to the elbow and tighten the clamp.
30. Insert the pneumatics exhaust tube into the elbow until the O-ring seats. Screw plastic nut in place using fingers.
31. Reconnect the thermocouple gauge cable to the thermocouple gauge.
32. Push the Peltier baffle duct base over the heat sink and onto the rear panel. Fasten in place using the two screws through the rear panel.
33. Reconnect the Peltier baffle leads to the Peltier baffle. **The pins and sockets are differentiated by size.**
34. Refit the Peltier baffle ducting by inserting the tabs into the rear panel and pushing the front of the duct down onto the front post.
35. Refit the left side cover and fasten in place with the four screws and two spacers.
36. Bring the MS alongside the GC and refit the transfer line.
37. Reconnect the manifold and trap heater cables.
38. Refit the top cover.
39. Carefully slide the MS up to the GC.
40. Close the vent valve by lowering the vent valve lever.
41. Turn on the MS.

Replacing the Diffusion Pump Peltier Baffle

The Peltier baffle is a sealed unit that must not be taken apart for cleaning or repair. If the thermoelectric cooling element fails, the whole baffle assembly must be replaced. A failed TEC will be detected by the diffusion pump controller and a system shutdown will be initiated. To replace the Peltier baffle:

1. Turn off the MS, if it has not already been shutdown.
2. Carefully separate the MS from the GC by approximately 250 mm (10"). Be careful not to break the GC column.
3. Remove the top cover.
4. Disconnect and remove the transfer line, manifold, and trap heater cables.
5. Remove the Peltier baffle ducting by pulling up at the front and sliding forward.
6. Disconnect the Peltier baffle power leads (orange and yellow wires) from the Peltier baffle and slide out of the way.
7. Unscrew the front pillar and use a 5/16" socket to remove the rear retaining nuts holding the Peltier baffle in place.
8. Lift and remove the Peltier baffle.

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9. Ensure the new seal and sealing surfaces are clean and free of particles and fibers.
10. Fit the new seal to the Peltier baffle and lower the baffle into position on the manifold. Do not allow the seal to twist.
11. Reconnect the Peltier baffle leads to the Peltier baffle. The pin and sockets are differentiated by size.
12. Close the vent valve by lowering the vent valve lever.
13. Plug in the Saturn power cable.
14. Turn on the MS by switching ON the main power switch on the rear panel. This allows the vacuum to correctly seat and seal the baffle assembly.
15. Refit the retaining nuts and front pillar. These should be snug.
16. Refit the Peltier baffle ducting by inserting the tabs into the rear panel and pushing the front of the duct down onto the front post.
17. Turn the service switch to the OFF position.
18. Reconnect the transfer line, manifold, and trap heater cables.
19. Turn the service switch to the ON position.
20. Refit the top cover.
21. Carefully slide the MS up to the GC.
22. Bring up System Control to download the mass spectrometer software.
23. Bring up the diagnostics page by clicking on the “Diagnostics” tab.
24. Check the Vacuum Status. This will display a snap shot of the vacuum system status, including any faults.

NOTE: The pressure should read below 500 mTorr within the first five minutes, and ≤100 mTorr within 45 minutes. Higher values may indicate a leak. *Refer to Troubleshooting.*

Cleaning the Diffusion Pump Peltier Baffle

To clean the Peltier baffle:

1. Remove the Peltier baffle.
2. Remove the seal to prevent solvent damage during cleaning.
3. Wipe the surfaces of the baffle with a clean, lint free cloth that has been dampened with reagent grade acetone.

CAUTION

Do not immerse the assembly in acetone as it will contaminate porous components, and damage seals.

4. Rinse with isopropyl alcohol.
5. Allow cleaned surfaces to air dry, or bake in the GC oven for 10 min at 100 °C.
6. Install the Peltier baffle, using the original seal.

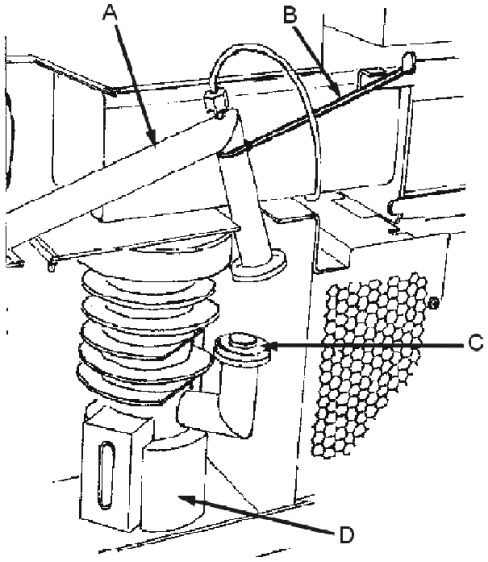
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Removing the Diffusion Pump

1. Turn off the MS.
2. Carefully separate the MS from the GC by approximately 250 mm (10"). **Be careful not to break the GC column.**
3. Remove the top cover.
4. Remove the transfer line.
5. Rotate the MS to give full accessibility to the left side.
6. Remove the four screws holding the left side cover in place, and remove the cover.
7. Remove the small clamp from the diffusion pump's exhaust port by unscrewing the red wing nut, removing the screw, turning the clamp so the open end faces the diffusion pump, and pulling the clamp toward you.
8. Lift the elbow up and secure it to the manifold lugs with a rubber band or tie wrap.

CAUTION

Be careful not to scratch or damage sealing surfaces.



A	Elbow
B	Rubber Band
C	Inlet Seal
D	Diffusion Pump

Elbow Positioning for Diffusion Pump Removal

9. Unscrew the wing nut on the diffusion pump's inlet clamp approximately ten turns.
10. Grip the inlet clamp with both hands and push the wing nut into the clamp until the clamp loosens.
11. Hold pump with left hand and remove inlet clamp by moving the wing nut screw to the left, opening clamp and pulling around the flanges and out.
12. Lower the pump onto the base pan.
13. Remove the inlet seal and place on a clean lint free surface for later use.

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14. Grip the pump with your right hand, tilt towards you until the inlet flange clears the manifold flange.

CAUTION

Be careful not to scratch or damage sealing surfaces.

15. Pull the pump out to the full extent of its cable.
16. Disconnect the cable from the diffusion pump controller.
17. Remove the pump and set it on its base.

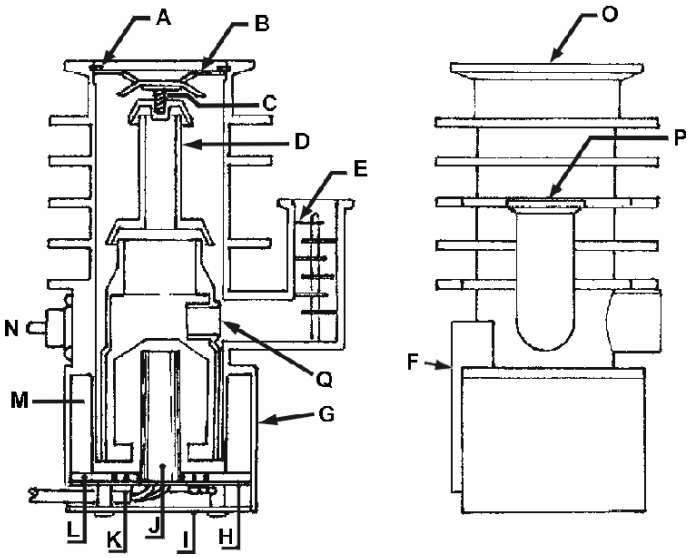
Topping Off the Diffusion Pump Fluid Level

1. Remove the pump.
2. Slowly pour a little diffusion pump fluid (03-930639-01) through one of the holes in the diffusion pump's inlet baffle.

   The fluid is highly viscous and takes a minute or two to reach the reservoir and show in the sight glass.
3. Add fluid until the level is between the mid and maximum mark on the cold arrow.
4. Wipe any spillage from the inlet baffle using a clean lint free cloth.
5. Refit the diffusion pump.

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Cleaning the Diffusion Pump



Diffusion Pump

A	Circlip	J	Heater Assembly
B	Inlet Baffle	K	Harness Clamp
C	Centering Plate & Spring	L	Insulation Disk
D	Jet Assembly	M	Insulation
E	Exhaust Baffle & Circlip	N	Over temperature Switch
F	Sight Glass Assembly	O	Inlet Port
G	Body	P	Exhaust Port
H	Retaining Plate	Q	Ejector Stage
I	Base Plate		

WARNING:
CHEMICAL HAZARD

Hazardous chemicals may be present. Avoid contact with skin. Use proper eye and skin protection.

WARNING

Toxic residues from mass spectrometer samples will build up in used pump fluid. Dispose of all used pump fluid in accordance with applicable regulations. Place a hazards warning label on the container, if appropriate.

To clean the diffusion pump:

1. Layer a number of clean lint free cloths or paper towels on the work surface.
2. Provide a 3" deep x 3" wide x 7" long container filled with acetone to a depth of 2".
3. Remove the pump.

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4. Using a pair of circlip pliers, remove the circlip that holds the exhaust baffle in the exhaust port. Place the circlip on the towels.

CAUTION

Be careful not to scratch or damage sealing surfaces.

5. Withdraw the baffle and place it on the towels.
6. Using a pair of pliers, remove the circlip that holds the inlet baffle in place. Place the circlip on the towels.

CAUTION

Be careful not to scratch or damage sealing surfaces.

7. Withdraw the baffle, centering plate, and spring. Place these items on the towels.
8. Use a towel to wipe excess fluid from the circlip, baffle, centering ring, and spring. Place these items into the container of acetone.
9. Withdraw the jet assembly and place it vertically on the towels.
10. After allowing the excess fluid to drain, wipe down jet assembly and lay it down in the container of acetone.
11. Drain the diffusion pump fluid into a suitable container.
12. Clean the interior of the pump body with acetone and rinse with isopropyl alcohol. Allow to air dry.

CAUTION

Do not submerge the pump body as the solvents will be absorbed into the diffusion pump's insulation, creating a fire risk.

13. Rinse all the other parts washed in acetone with isopropyl alcohol, and air dry.
14. Drop the exhaust baffle into the exhaust port, ensuring the shortest end of the central post is uppermost.
15. Using a pair of circlip pliers, refit the circlip that holds the exhaust baffle in place. Orient the circlip to provide the maximum opening between the baffle and exhaust port wall.

CAUTION

Be careful not to scratch or damage sealing surfaces.

16. Place the jet assembly inside the pump body, ensuring the ejector stage lines up with the exhaust port. When correctly positioned, the jet assembly will locate on a pin in the base of the body.
17. Insert the spring into the counterbore of the jet cap.
18. Place the centering plate on the spring.
19. Lower the baffle onto the centering ring.
20. Using a pair of pliers, refit the circlip that holds the inlet baffle in place.

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CAUTION

Be careful not to scratch or damage sealing surfaces.

21. Pour the diffusion pump fluid (03-930639-01) through one of the holes in the diffusion pump's inlet baffle. Part Number 03-930639-01 contains 40 cm^3. This is a full charge, plus an allowance for fluid that remains on the walls of the container.

NOTE: The fluid is highly viscous and takes five minutes for a full charge to reach the reservoir and show in the sight glass.

22. Add fluid until the level is midway in the "Full Cold" zone.
23. Wipe any spillage from the inlet baffle using a clean lint free cloth.
24. Refit the diffusion pump.

Changing the Diffusion Pump Heater

The cartridge heater is factory coated with an anti-seize lubricant to facilitate easy removal of the heater. To change the diffusion pump heater:

1. Remove the pump.
2. Turn the pump upside down and drain the fluid into a suitable container.

WARNING:
CHEMICAL HAZARD

Hazardous chemicals may be present. Avoid contact with skin. Use proper eye and skin protection.

WARNING

Toxic residues from mass spectrometer samples will build up in used pump fluid. Dispose of all used pump fluid in accordance with applicable regulations. Place a hazards warning label on the container, if appropriate.

3. Remove the two screws holding the over temperature switch in position.
4. Remove the two retaining screws and the base plate.
5. Use an 11/32 socket to unscrew the two nuts.
6. Remove the ground wire, harness clamp, retaining plate and insulating pad.
7. Pull the heater out by its leads, twisting if necessary.
8. If the heater does not come out:
   a. Apply penetrating oil around the cartridge heater and let it stand for 10 minutes.
   b. Drive a ¼ inch wide flat blade screwdriver approximately 1/8 deep into the center of the heater between the electrical leads.
   c. Gently turn the screwdriver to break the heater free.
   d. Pull the heater out by its leads, twisting if necessary.

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e. If the heater does not pull out freely, a second application of penetrating oil may be necessary.

9. Apply the anti-seize compound to the new heater and install it in the base.
10. Refit the insulating pad, retaining plate, harness clamp, ground wire, nuts, base plate, and retaining screws.
11. Install over temperature switch.
12. Pour the diffusion pump fluid (P/N 03-930639-01) through one of the holes in the diffusion pump's inlet baffle. P/N 03-930639-01 contains 40cm^3. This is a full charge, plus an allowance for fluid that remains on the walls of the container.

NOTE: Fluid is highly viscous and takes five minutes for a full charge to reach the reservoir and show in the sight glass.

13. Add fluid until the level is midway in the "Full Cold" zone.
14. Wipe any spillage from the inlet baffle using a clean lint free cloth.
15. Install the diffusion pump in the MS.

ATTENTION

IMPORTANT NOTE: The new heater will give off an odor during the first thirty minutes of operation. The odor results from the baking of the anti-seize lubricant, and certain compounds used in the manufacture of heaters. This is normal.

Reinstalling the Diffusion Pump

1. Reconnect the diffusion pump cable to the diffusion pump controller.
2. Place the pump, base first into the diffusion pump compartment and tilt upright.

CAUTION

Be careful not to scratch or damage sealing surfaces.

The exhaust elbow should be on the right side of the pump.

3. Inspect the inlet seal. Replace if it is worn or damaged (27-402294-00).
4. Wipe the inlet seal clean with a lint free cloth, rub a thin layer of diffusion pump fluid onto the O-ring, and place the seal onto the inlet port.
5. Lift the pump into position on the manifold flange and hold.
6. From the left side of the pump, feed the inlet clamp plain end first around the inlet flange.
7. Close the clamp and loosely fasten the wing nut.
8. Rotate the pump so the exhaust port is visible through the cut out in the sheet metal.
9. Let go of the pump.

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10. Inspect the exhaust seal.

    Replace if it is worn or damaged (27-402536-00).

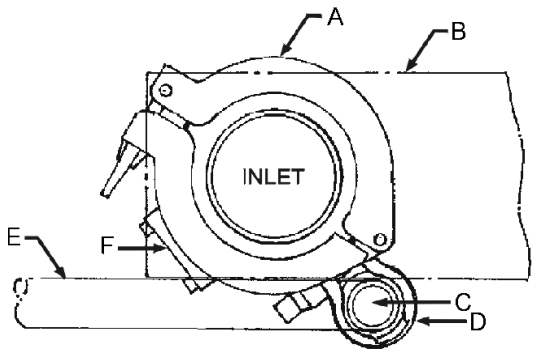
11. Wipe the exhaust seal clean with a lint free cloth, and refit to the exhaust port.
12. Lower the elbow onto the diffusion pump exhaust port.

    CAUTION

    Take care not to dislodge the seal.

13. Reinstall the exhaust clamp by pushing it onto the joined exhaust flanges.
14. Rotate the clamp 180° and install the screw from the left side.
15. Thread the wing nut onto the screw.
16. Rotate the clamp as far to the left as possible, while still allowing room to turn the wing nut.
17. Rotate the diffusion pump so the elbow lies as close to the manifold as possible.
18. Tighten the wing nut on the exhaust clamp.
19. Rotate the inlet clamp as far inboard as possible.
20. Tighten the wing nut on the inlet clamp.
21. Refit the left side cover and fasten in place with the four screws and two spacers. If the elbow or inlet clamp interfere with the side cover, reposition and refit the side cover.
22. Bring the MS alongside the GC and refit the transfer line.
23. Reconnect the manifold and trap heater cables.
24. Refit the top cover.
25. Carefully slide the MS up to the GC.
26. Close the vent valve by lowering the vent valve lever.
27. Turn on the MS.

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A	Inlet Clamp	D	Exhaust Clamp
B	Manifold	E	Elbow
C	Exhaust	F	Diffusion Pump

Relative positions of the manifold, diffusion pump, elbow and clamps as viewed from above.

NOTE: The manifold and elbow are shown as outlines for clarity.

Turning on the Mass Spectrometer

1. Make sure the power switch on the rear panel is in its OFF position.
2. Check that all the heater cables are plugged in.
3. Check that all the Saturn covers are in place, especially the left side cover and the Peltier baffle ducting.
4. Plug in the Saturn power cable.
5. Turn the power switch on the rear panel to its ON position.
6. Bring up the System Control page.
7. Monitor the foreline pressure on the shutdown page until the diffusion pump is ready.

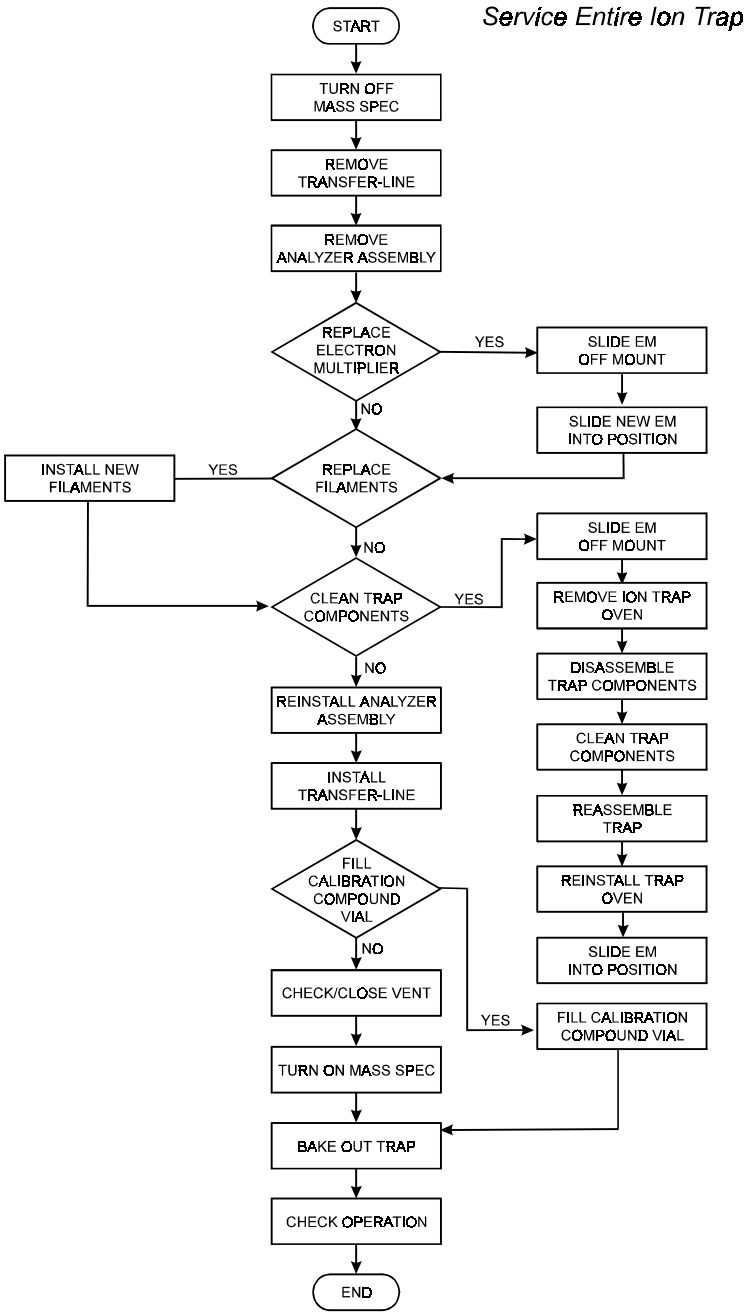
NOTE: The pressure should read below 500 mTorr within the first five minutes, and ≤100 mTorr within 45 minutes. Higher values may indicate a leak. Refer to the **Troubleshooting** section.

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How to Service the Ion Trap

NOTE: The Saturn 2000 Maintenance Tutorial on CD-ROM provides viewing maintenance procedures on computer screen. Refer to MS Maintenance Section.

You will need to service the ion trap if it needs to be cleaned or requires replacement of the filaments or multiplier. The following flow chart illustrates the general sequence of ion trap maintenance operations. Each step is then described in detail.



Flow Chart for Servicing the Ion Trap

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Turn off the Mass Spectrometer



WARNING:
BURN HAZARD

Allow heated zones to cool before disassembly.

Turn off the mass spectrometer by invoking the Shutdown procedure. Refer to chapter on system Start-up and Shutdown.

1. Shut off the turbomolecular pump, foreline pump, and all electronics by turning off the main power switch on the back panel.
2. Disconnect the Saturn power cord.
3. Open the front-panel door and lift the toggle vent valve for 1 sec to slow the turbomolecular pump down.
4. Once the pump has finished spinning down, open the vent valve. Leave it open until the system is fully vented, i.e., about 5-10 minutes.

Retract/Remove the Transfer Line

NOTE: Fully vent the analyzer assembly before attempting to retract or remove the transfer line. Vacuum makes retraction of the transfer line difficult.

To retract the transfer line, proceed as follows:

1. Unplug the transfer line heater cable.
2. Take hold of the transfer line nose.
3. Simultaneously push and rotate the nose counterclockwise.
4. Pull the transfer line away from the analyzer.

   Under most conditions, the transfer line needs only to be retracted in order to remove the analyzer. If it is necessary to remove the transfer line (i.e., to inspect or change the O-ring), perform steps 5 and 6.

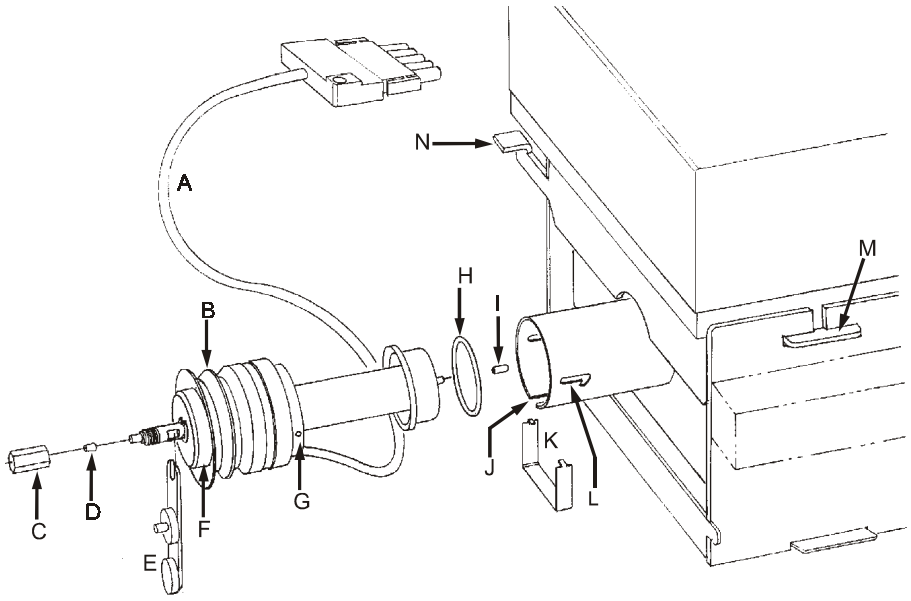
5. Remove the nose clip by pulling both sides away from the boot.

   Take care not to apply excessive force.

6. Pull the nose away from the analyzer until the entire assembly is free of the transfer-line shell.

   Exercise particular care if the column is still connected to the transfer line.

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A	Heating Cable	H	O-ring
B	Boot	I	Transfer Line Tip
C	Nut	J	Heating Cable Slot
D	Ferrule	K	Nose Clip
E	Tool	L	Bayonet Mount
F	Nose	M	Analyzer Assembly Tongue
G	Nose Hole	N	Analyzer Assembly Lock-Down Tabs

Transfer Line Assembly

Remove the Analyzer Assembly

CAUTION

Retract transfer line before removing analyzer assembly.

NOTE: Be sure the transfer line is retracted. Otherwise, you will not be able to remove the analyzer assembly without damaging the analyzer.

To remove the analyzer assembly, proceed as follows:

1. Remove the top cover of the Saturn GC/MS by grasping both sides and lifting up.
2. Unplug the trap heater harness located near the top of the instrument.
3. On the side of the analyzer assembly (near the transfer line), push out the locking tabs on the power ribbon cable. This releases the cable.
4. Pull the ribbon cable out and move it away from the analyzer.
5. Push down and spread the two analyzer release tabs.

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NOTE: Some Saturn systems have a transfer line removal flap warning that will block the locking tabs. If such a flap is present, tip it out of the way during the procedure and return it to its original position once the analyzer is replaced.

6. Tilt the rear end up carefully to remove the analyzer.
7. Move the analyzer assembly toward the rear to free the front tab.
8. Place the analyzer upside down on a flat surface.

NOTE: To prevent contamination when touching parts of the trap or the electron multiplier, wear gloves.

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Replace the Electron Multiplier

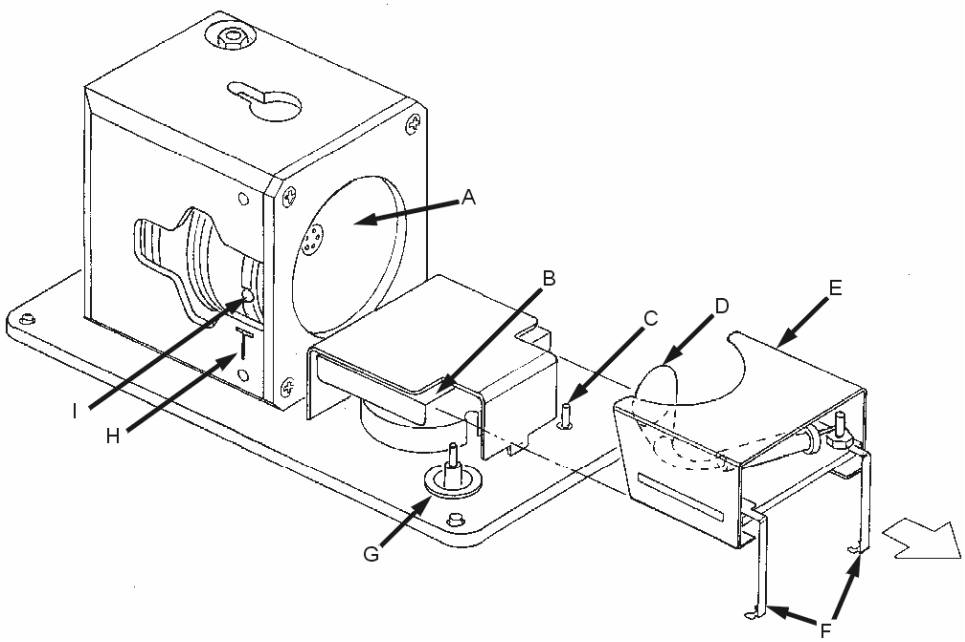
When positioned to collect ions, the electron multiplier sits as close as possible to the ion trap. The electron multiplier grid should never be in contact with the trap.

To remove the electron multiplier, proceed as follows:

1. Slide the electron multiplier back along its track until it clicks into place.
2. Continue sliding the electron multiplier, but with slightly less force, until the multiplier bracket comes free of the track.
3. To protect the electron multiplier, place it with one of its sides facing down on a flat surface. The glass multiplier grid should not be touching anything.

To install the new electron multiplier, proceed as follows:

1. Slide the electron multiplier forward along its track.
2. Push the multiplier bracket forward until it is as close as possible to the ion trap. The assembly should snap into place.
3. Make sure the high voltage and signal contacts are in good contact with the feed-through pins.



A	Exit End Cap	F	Multiplier Contacts
B	Electron Multiplier Track	G	Multiplier High Voltage Pin
C	Multiplier Signal Pin	H	Transfer Line Alignment
D	EM Grid	I	Transfer Line Entrance Hole
E	Electron Multiplier Mount		

Electron Multiplier

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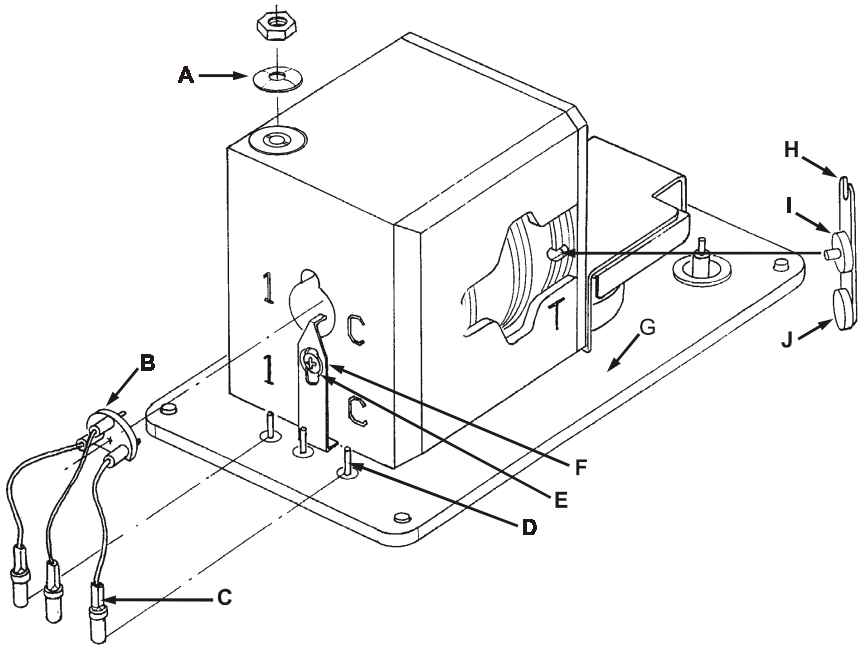
Replace the Filament(s)

To replace the filament(s), proceed as follows:

1. Orient the trap so the filament assembly is facing you.
2. Disconnect the filament connectors from the flange-feedthrough pins by gently pulling each pin connector up until the wires are free from the pins.
3. Using a Phillips screwdriver, loosen the screw on the filament retainer.
4. Slide the filament clip down off the ceramic filament disk.
5. Remove the filament assembly.

NOTE: Inspect the area around the filament entrance hole for carbon deposits. Carbon buildup in this area can lead to lower sensitivity and/or shorter filament lifetime. Area should be cleaned before replacing filament assembly.

6. Place the new filament assembly in the trap oven, and align the posts in the 1, 2, and C positions.
7. Slide the filament clip onto the filament disk and tighten the screws. Be sure that the clip is not touching any of the filament connectors.
8. Connect the filament connectors to the flange post connectors.



A	Belleville Washer	F	Filament Retainer
B	Ceramic Filament Assembly	G	Analyzer Flange
C	Filament Connectors	H	Transfer Line Alignment Tool
D	Post Connectors for Filament	I	Center Disk
E	Screw	J	Feeler Disk

Filament Assembly

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Remove the Ion Trap Oven

Using gloves to remove the ion trap oven, proceed as follows:

1. Remove the electron multiplier and place it on its side.
2. Disconnect the filament wires from the flange feed-through pins (labeled 1, 2, C) by gently pulling each pin connector up until all wires are free of the flange.
3. Remove the nut using the 11/32-in. nut driver (supplied).
4. Gently lift the trap oven assembly off the heater post and thermo well.

CAUTION

Do not rotate the assembly more than 2 degrees. Otherwise, you may damage the contact springs.

Turn the analyzer assembly over to remove the Belleville washer.

Cleaning the Trap Components

To clean the trap components you will

Disassemble the trap components

Clean the trap components

Reassemble the trap

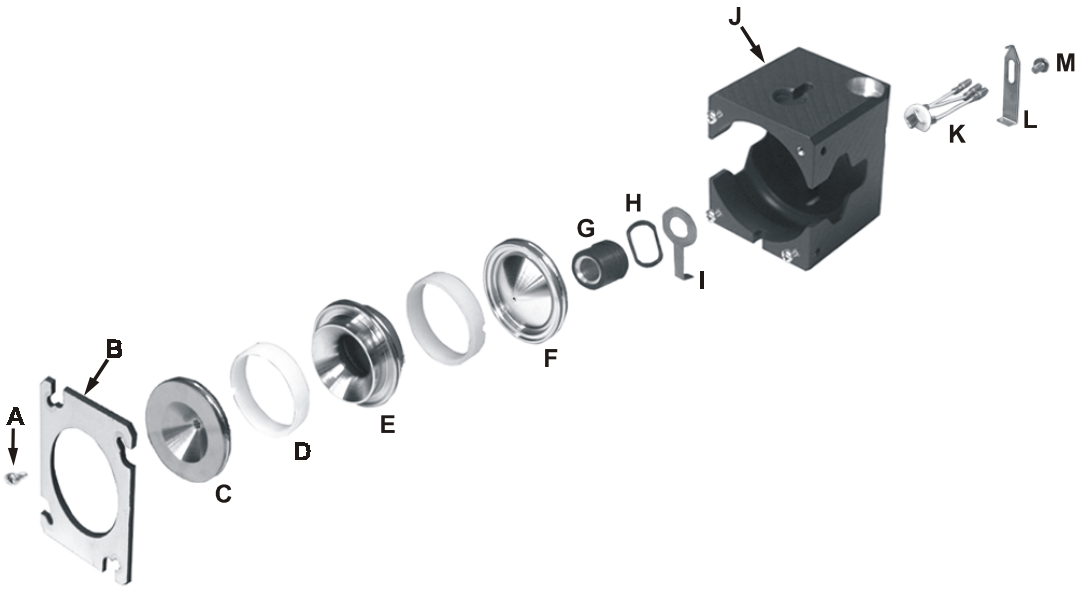
Disassemble the Trap Components

1. Place the oven filament-side-down on its feet or if it has no feet, on the workstand (supplied). This will protect the filament wires from becoming damaged.
2. Loosen the two screws with slotted holes by 3 to 4 turns. Do not remove the screws.
3. Completely remove the two screws in the non-slotted holes.
4. Slide the clamping plate off of the trap oven.
5. Lift out the entire electrode stack, or remove each piece singly.

   Be very careful not to damage the quartz spacers.
6. If you only intend to clean the electrodes, leave the gate parts in the oven. Otherwise, remove the gate, wavy spring washer, and gate conductor by turning the oven upside down.

NOTE: The Silica Coated Spacers have a shiny, mirror like finish on the inside surface.

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A	Screw, 6/32, 4 places	H	Wave Washer
B	Clamping Plate	I	Gate Conductor
C	Exit End Cap	J	Trap Oven, “T” is located this side.
D	Quartz or Silica Coated Spacer, 2 places	K	Filament Assembly
E	RF Ring Electrode	L	Filament Clip
F	Filament End Cap	M	Screw
G	Electron Gate		

Ion Trap Assembly

Clean the Trap Components

To clean the ion trap parts, you will

Clean the stainless steel parts or clean the SilChrom-coated parts

Clean the quartz spacers

NOTE: For SilChrom-coated electrodes, Do Not use Aluminum Oxide.

Clean Stainless Steel Parts

To clean the filament endcap, RF voltage ring electrode, and exit endcap, proceed as follows:

1. Using a slurry of number 600 aluminum oxide in water (or glycerol) and a cotton-tipped applicator, remove all contaminants from the stainless steel ion trap parts.

   Use the wooden end of a cotton swab, cut at an angle, to clean the inside corners, i.e., the holes in the endcaps.

   Contaminants sometimes appear as dark or colored areas, but they may also be invisible. Clean each part thoroughly, even if there is no apparent contamination.

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2. After you clean a part, hold it under running water and use a clean applicator to remove the last visible traces of aluminum oxide.
3. Immediately place the clean part in a beaker containing a solution of detergent and warm water.

NOTE: Do not let the slurry dry on the metal. Dried aluminum oxide is difficult to remove.

4. When you have finished cleaning all of the parts, place the beaker in an ultrasonic cleaner, and subject the beaker and its contents to ultrasound for about 1 minute.
5. Rinse each part with fresh water.
6. Using clean tools, place the parts in a beaker containing de-ionized water, then subject the beaker and its contents to ultrasound for about 1 minute.

   If the water is cloudy afterwards, replace the deionized water and repeat.
7. Rinse the parts with methanol.
8. Place the parts in a beaker of fresh methanol. Subject the beaker and its contents to ultrasound for about 1 minute.

NOTE: Once the ion trap parts are clean, wear clean, lint-free gloves in subsequent handling of the parts to prevent contamination. Do not wear vinyl gloves.

9. Remove the ion trap parts from the beaker, and place them on a clean, lint-free surface.

   Allow the parts to dry in air.
10. Inspect each part to make sure that all spots and particles have been removed.

    If you observe any contamination, clean the part again using the procedure described above.

NOTE: You can clean any small stainless steel parts, e.g., the electron gate conductor, the gate, and wavy washer spring, by placing them along with the other stainless steel parts in methanol and subjecting them to ultrasound for 1 minute.

NOTE: Check the oven trap near the filament entrance hole for carbon deposits. Carbon buildup may result in lower sensitivity and/or shorter filament lifetime. The carbon stains should be removed *only* with a cotton swab and methanol. After cleaning, check filament entrance hole for particles and fibers. Area must be cleaned before reassembly.

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Clean SilChrom Ion Trap Electrodes

The silica top surface of the SilChrom Ion Trap Electrode is a very thin (only about 1 m), but durable layer which is strongly bonded. However, **abrasives** such as alumina powder **must not be used** to clean the trap parts because this will definitely destroy the silica layer! **Strongly acidic or strongly basic laboratory cleaners must not be used** to clean the trap parts because they will also remove the silica layer!

1. For routine cleaning of the SilChrom electrodes, ultrasonicate the ion trap electrodes for 10 minutes in methylene chloride or methanol. Use separate beakers for each electrode to avoid scratching trap surfaces. Trap disassembly and reassembly is otherwise identical to the recommendations Maintenance Section.
2. If heavy matrix (dirty) samples are routinely run on the instrument and the electrodes are visibly discolored where the column enters the trap at the multiplier endcap, one may use a toothbrush and liquid hand soap or dish detergent (pH between 6 and 7.5) to gently scrub the trap parts. The trap is rinsed and then sonicated in water followed by two sonications in methylene chloride or methanol.

CAUTION

DO NOT use Aluminum Oxide or other abrasives because this will remove the silica layer on the trap!

DO NOT use harsh laboratory cleaners because this will remove the silica layer on the trap! Use only mild detergent (pH between 6 and 7.5).

NOTE: You will notice that the initial hydrocarbon background is higher than on the standard ion trap. To speed up the bakeout, you may want to bake out the ion trap overnight at 250 C. In the bakeout mode, the manifold is set to 120 °C.

Clean the Two Quartz or Silica Coated Spacers

NOTE: The Silica Coated Spacers have a shiny, mirror like finish on the inside surface.

1. Wipe all surfaces of the quartz spacers with a clean, soft, lint-free cloth that has been dampened with reagent-grade acetone.
2. Subject the quartz spacers to ultrasound in acetone for 5 minutes.
3. Rinse each of the quartz spacers with de-ionized water.
4. Subject the quartz spacers to ultrasound in methanol for 5 minutes.
5. Dry the spacers in air, or in an oven set to approximately 120 °C for 30 minutes.

Reassemble the Trap

To reassemble the trap assembly, proceed as follows, referring to the Ion Trap Assembly figure:

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NOTE: The orientation of the trap components is important. Make sure that all parts are free of particles, lint, etc.

1. Replace the gate conductor, tab-down into position.
2. Replace the wavy washer on the gate conductor. The washer orientation is not important.
3. Replace the gate so that the flat, shiny surface faces the washer.
4. Replace the filament (single-hole) electrode in the oven.
5. Replace one of the quartz spacers so that the notch faces the filament (single-hole) electrode.
6. Replace the RF electrode, followed by a quartz spacer. The notch in the quartz spacer should face up towards the exit (seven-hole) electrode.

NOTE: Make sure that the notch in the quartz spacer and the notch in the exit end cap are aligned.

7. Replace the exit (seven-hole) electrode so that the notch on this electrode faces the side of the trap labeled with the side-ways T.
8. Slide the clamping plate under the screws on the top of the trap oven assembly.
9. Visually check the transfer line hole, making sure that notches in the quartz spacer and exit endcap electrode are aligned and centered in the trap oven.
10. Tighten the screws.

Re-install the Trap Oven

To replace the trap oven assembly, proceed as follows:

1. Gently slide the trap assembly onto the heater post and thermo well, taking care not to bend the endcap contact springs.

CAUTION

Do not rotate the assembly more than 2 degrees; otherwise, you may damage the contact springs.

2. To set transfer line hole height to the analyzer flange, place the nub of the center disk into the hole created by the notches in the quartz spacer and the exit (seven-hole) electrode, then
3. Rotate the alignment tool so that the feeler disk touches or almost touches the analyzer flange. Proper alignment is achieved when the feeler disk touches the analyzer flange and the alignment tool is perpendicular to the flange.
4. Replace the Belleville washer so that the crown side is facing upwards.

NOTE: When re-installing the trap assembly, make sure that you orient the Belleville washer crownside up. Tighten the nut until the Belleville washer is flat, i.e., until the nut bottoms out.

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5. Replace and tighten the nut until it is snug.
6. Attach filament wires 1, 2, and C to the flange feed-through pins.

Reposition the Electron Multiplier

To install the electron multiplier, proceed as follows:

1. Slide the electron multiplier forward along its track.
2. Push the multiplier bracket forward until it is as close as possible to the ion trap. The assembly should snap into place.
3. Make sure the high voltage and signal contacts are in good contact with the feed-through pins.

Re-install the Analyzer Assembly

To re-install the analyzer assembly, proceed as follows:

NOTE: Make sure that the manifold O-ring is clean and free of particles and fibers.

1. Make sure the transfer line is retracted or removed.

   Align the analyzer with the release tabs toward the rear of the instrument.

NOTE: Take care not to scrape or bang the analyzer parts (e.g., the trap oven assembly, electron multiplier, filament wires, etc.) against the stainless steel manifold flange.

2. With a slight forward downward tilt, check that all cables and hoses are out of the way. Slowly insert the front tongue into the slot.
3. Lower the rear of the analyzer by spreading the release tabs and pushing down gently.

   You should be able to install the analyzer assembly into the manifold without applying force.
4. Engage the release tabs and make sure that the release tabs are secure in their notches.
5. Connect the trap heater cable.
6. Connect the power ribbon cable and lock it into place. Ensure that the cable is firmly connected and that the locking tabs are fully engaged.

Install the Transfer Line

If the transfer line has been removed, re-install the transfer line as follows. If the transfer line has only been retracted, proceed to steps 6 and 7 only.

1. Make sure the O-ring is free of lint, particles, etc.
2. Insert the assembly into the transfer-line shell.

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3. Orient the assembly so that the heating cable fits inside the shell slot.
4. Rotate the nose so that the nose holes line up with the small slots in the shell. These holes will be found at the 4:00 and 10:00 positions.
5. Install the nose clip.
6. Push the nose in, rotating it clockwise to lock it in place.
7. Connect the transfer line heater cable.

Close the Vent

To close the vent, or to check that it is closed, the vent valve lever should be facing down.

Turn on the Mass Spectrometer

To turn on the mass spectrometer, proceed as follows:

1. Make sure that the power switch on the back of the mass spectrometer is in the OFF position.
2. Check that all heater cables are plugged in.
3. Plug in Saturn power cable.
4. Turn ON Saturn power switch at the rear of the instrument.
5. Bring up System Control on the computer.

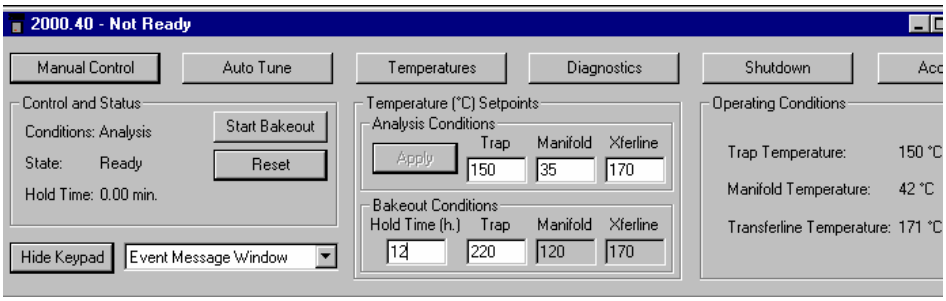
   The most recently set instrument parameters will be loaded into the mass spectrometer.

   The software will stay on the shutdown page until the mass spectrometer is fully restarted.
6. Briefly press down on the analyzer assembly to ensure a good vacuum seal.
7. Replace the Saturn system cover.

Bake Out the Trap

To bake out the trap, proceed as follows:

1. Open the System Control and click on Temperatures.
2. Select Bakeout and enter a bakeout time of 2 to 6 hours at 250 °C or higher.
3. Click on Start Bakeout.



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Check Ion Trap Operation

To check the ion trap operation, proceed as follows:

1. Once bake out is finished, re-establish the analysis temperature in the trap for at least 2 hours to achieve thermal equilibrium.

   The manifold temperature should be below 50 °C.

2. Run Diagnostics.
3. Run Auto Tune or manually tune spectrometer.

Fill the Calibration Compound Vial

The calibration compound used with the Saturn GC/MS is perfluorotributylamine (PFTBA; $C_{12}F_{27}N$). This compound is also known as fluorocarbon-43 (FC-43).

NOTE: There is no need to vent the vacuum system before you fill the cal gas vial with calibration compound, provided the cal gas needle valve is closed. To close the cal gas needle valve, turn it clockwise.

To fill the cal gas vial, proceed as follows:

1. Loosen each of the four retaining screws about 3 turns with a Phillips screwdriver. The four screws are located on the top of the pneumatics manifold.
2. Pull the cal gas vial down gently with a slight twisting motion until it clears the pneumatics manifold.
3. Refill the vial using a Pasteur pipette until the vial is filled about 1/3 full with PFTBA compound (03-920353-00).
4. Remove any liquid that remains in the neck of the vial with a lint-free paper tissue.
5. While holding the vial vertically, carefully push the vial into the cal gas port on the manifold with a slight twisting motion.
6. After you have pushed the vial in as far as it will go, tighten the four retaining screws.
7. Open the cal gas needle valve 10 counterclockwise turns. Leave the needle valve open for at least 30 minutes. Any excess cal gas and water vapor will be pumped away.
8. Bring up System Control, and select Adjust Cal Gas Pressure under Adjustments in the menu bar.
9. Adjust the cal gal pressure, according to the instructions on the screen.

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GC Maintenance

Overview

NOTE: The Saturn 2000 Maintenance Tutorial on CD-ROM provides viewing maintenance procedures on computer screen. Refer to GC Maintenance Section.

It is important for the GC user to learn general maintenance techniques and carry these procedures out on a regular basis. Some common GC maintenance procedures are changing septa and injector inserts, checking for leaks, conditioning columns and changing filters. In this section maintenance information is presented under four headings: general GC maintenance, injector maintenance, and column maintenance.

Note that many maintenance procedures, such as repair or replacement of electronic components, should be performed by a qualified Varian service representative. For maintenance problems where mechanical or electrical assemblies need to be repaired or replaced please call your local Varian service center.

There are certain maintenance tasks that should be carried out on a routine basis. These regular procedures are done to ensure that the 3800/3900 Gas Chromatograph will continue to operate at optimum performance. The following is a brief summary of some common maintenance tasks and their typical frequency. Additional information on the 3800/3900 GC can be found in the Getting Started and Operator's manuals:

Maintenance Task	Frequency
Change septa	Typically 50 - 100 injections
Check column nuts are tight	Daily
Condition column	Daily or as required
Change injector inserts, if necessary	Weekly
Check gas supplies	Weekly
Leak check	Monthly
Change gas cylinders	Quarterly or as required
Condition system	Semiannually
Replace gas purifiers	Annually or as required

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General GC Maintenance

The common general GC maintenance tasks are checking and changing gas supply cylinders, leak checking, and changing gas purifier filters. These should be performed at the frequency suggested above. The following procedures are critical to the successful long-term operation of a Gas Chromatograph. It is very important to leak check the system on a routine basis and to ensure the quality of gas supplies, particularly the carrier gas.

Check and Renew Gas Supplies

The pressure of the various GC gas supplies should be checked on a weekly basis and the following guidelines used for frequency of renewing supplies:

Carrier gas: The carrier gas supply cylinder should be changed when its pressure drops below 200 psi. This ensures that high purity carrier gas is always supplied to the instrument. With typical usage on one Gas Chromatograph an A-size cylinder of carrier gas should last for three to six months. Note that this usage includes also using the carrier gas as the supply of make-up to the detectors. When a new cylinder is installed the regulator and tubing should be purged with carrier gas before connecting to the GC. This will avoid introducing a large amount of air into the GC.

Leak Check

Leak checking is one of the most important maintenance tasks that is carried out on a Gas Chromatograph. The following information refers to general leak checking procedures for the 3800 Gas Chromatograph. Specific information regarding individual 3800 components will be presented in the relevant part of this maintenance section.

Leaks in the GC system can lead to poor chromatographic performance or damage components such as the analytical column. The presence of oxygen in the GC carrier gas at elevated temperatures can lead to permanent column phase degradation. While the use of an oxygen filter on the carrier supply to the instrument can help, leaks downstream of the filter are generally more likely to be the problem.

The use of soap-based leak detection fluids is not recommended for a high performance capillary Gas Chromatograph due to the danger of introducing contaminants into the system. If leak detection fluids are being used they should only be used outside the Gas Chromatograph, i.e., to verify there are no leaks in the plumbing to the Gas Chromatograph. If a leak detection fluid is being used inside the Gas Chromatograph, an alcohol such as isopropanol or a 50:50 mixture of isopropanol and water should be used. Use a dropper or syringe to place a few drops of leak detection fluid on the desired fitting and monitor the area for bubble formation.

The most important step in leak checking is to verify that the GC system can hold pressure. This is done by removing the column from the injector, sealing all exits from the injector and pressurizing the system. Use the following procedure to leak check 3800 injectors:

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NOTE: When conducting leak check procedures it is important to completely seal all carrier gas exits, including septum purge and split vent outlets. If more than one injector is present, then the outlets of all the injectors must be sealed. The following procedure refers to one injector but should be duplicated for every injector on the 3800.

1. Set the column oven and the injector zone temperatures to 50 °C and allow them reach this temperature. This allows safe handling of injector surfaces.
2. Remove injector septum nut and install a new septum. An older septum can often be the source of a substantial leak.
3. Remove the column from the injector. Use the appropriate nut and ferrules to seal the base of the injector. For packed column systems use a 1/4″ Swagelok® blank off plug (16-000154-00). For capillary systems use a capillary nut (03-949551-00) with a no hole ferrule (28-694590-01).
4. If the injector is a 1079, then the septum purge and split vent outlets must be sealed. The septum purge outlets are located on the top frame surrounding the column oven, behind the column oven door. The split vent outlets are located on the left side panel of the 3800 with manual pneumatics or inside the pneumatics compartment with EFC. Seal the septum purge by removing the outlet fitting from the septum purge valve and replacing it with a blank off plug (16-000154-00). Seal the split vent outlet by installing a Swagelok union on the outlet tube and sealing it with a blank off plug.
5. With all outlet ports plugged, pressurize the system to 20 - 30 psi. This can be accomplished by adjustment of manual pneumatic controls or Electronic Flow Control. For information on setting carrier gas pressure see the Basic Operation section of the 3800 Getting Started manual.
6. Shut off the carrier supply at the source and monitor the displayed pressure at the GC for 15 minutes. The pressure should not drop more than 0.5 psi in 15 minutes.

Leak checking ensures that there are no leaks in the GC system up to and including the injector assembly. If the indicated pressure on the GC drops by more than 0.5 psi during the 15-minute test period, this indicates that there is a positive leak in the system. Finding such a leak, particularly if it is a small leak, can be very difficult. In general the best approach is to systematically go through the pneumatic system from the source and tighten each fitting until the leak is eliminated. It is important to note that leaks are often found in the carrier gas supply to the GC.

Locate leaks with an electronic leak detector or leak detection fluid. An electronic helium leak detector is available from Varian (01-900153-01). This device can detect helium concentration in the air as low as 2 ppm and is very effective at identifying the precise location of a helium leak from a GC system.

Gas Purifier Replacement

The most common gas purifiers used in gas chromatography are moisture traps for removing water vapor, hydrocarbon traps for removing low levels of hydrocarbon contaminants and oxygen traps for removing low levels of oxygen. In general the choice of filter depends on the application and detector used. Carrier gas should contain less than 1-ppm oxygen, moisture and trace hydrocarbon contaminants. A combined moisture / hydrocarbon filter is recommended for general applications to maintain detector background levels at

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their lowest possible level. For the MS detector an oxygen filter should be employed as well

Varian supplies several types of carrier gas purifiers. These include a combined moisture / hydrocarbon trap, indicating moisture trap, indicating or non-indicating oxygen traps and a combined moisture / hydrocarbon / oxygen trap. While the choice of purifier depends on the individual configuration and performance expectations, the following configuration is recommended for maximum carrier gas purity and protection.

The carrier gas should first pass through a hydrocarbon trap, then an indicating moisture filter, then a high capacity oxygen trap and finally through an indicating oxygen trap. As moisture reduces the effectiveness of an oxygen trap, a moisture trap should always be placed in front of an oxygen trap. When the indicating oxygen trap begins to change color, the high capacity oxygen trap should be changed immediately. The moisture trap should also be changed immediately when it changes color to prevent breakthrough of moisture to the oxygen trap.

The filters supplies by Varian are mounted either on the rear panel of the instrument or on a filter stand, depending on when the instrument was purchased. Follow one of the two procedures below to replace the filter.

If Filters are Mounted on the Rear of the GC:

Gas purifiers supplied by Varian and most other chromatography suppliers are equipped with 1/8″ Swagelok fittings. This facilitates easy removal and replacement of purifiers. In addition gas purifiers are sealed at both ends for protection. Purifiers should only be uncapped when you are about to install them.

1. Turn off the carrier gas supply at the input regulator. Note the operating pressure to allow resetting to this value after the purifier is installed.
2. Carefully open the carrier gas fitting at the inlet bulkhead to the GC or the existing carrier gas purifier. Wait for the release of carrier gas pressure before removing the fitting.
3. Identify the recommended direction of carrier gas flow on the purifier. This is normally indicated by an arrow on the side of the purifier. Remove the inlet cap from the purifier and immediately connect the carrier gas inlet line to the purifier inlet.
4. Remove the outlet cap from the purifier, turn the carrier supply back on and allow the carrier gas to purge through the purifier for 0.5 - 1 minutes.
5. Connect the outlet of the gas purifier to the inlet of the GC or the inlet of the next purifier, if used. If a new connection is being made, use chromatography grade copper tubing and new Swagelok fittings.

The following are the rear mounted gas purifiers available from Varian.

Purifier	**Part Number**
High capacity oxygen trap	03-949770-02
Indicating oxygen trap	88-501019-00
Combined hydrocarbon and moisture trap	03-949862-00
Indicating moisture trap	01-900007-00

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If Filters are Mounted on a Separate Stand:

Filters have been supplied in either a single combined moisture/hydrocarbon/oxygen filter arrangement or as two filters (a moisture/hydrocarbon filter and oxygen filter). Two valves automatically take care of stopping and starting the gas flow. Each filter is replaced using the following procedure:

1. Remove the saturated filter by unscrewing the knurled nut. The system remains under pressure.
2. Check the O-rings for hairline cracks. Cracked rings may cause leakage. If cracks are found replace all rings.
3. Remove the filter from the packaging and remove the self-adhesive foil from the bottom of the filter. Place the filter onto the connecting unit.
4. Place the knurled ring nut over the filter and screw it on, while pressing the filter down. Some force may be necessary if the system is under high pressure.
5. Carefully check the connection for leakage. This is important as oxygen and moisture from the air enter the system through the tiniest leaks.
6. Mark the date of installation on the calendar in the filter label with a felt tip pen.

NOTE: Review the instructions supplied with the replacement filters.

The following are the stand-alone gas purifiers available from Varian.

Purifier	Part Number
Indicating oxygen trap	CP17970
Indicating moisture trap	CP17971
Combined hydrocarbon/moisture/oxygen trap	CP17973

Injector Maintenance

The injector is the component of the Gas Chromatograph that requires the most frequent maintenance. This is due to the fact that the sample is deposited in the injector, thus leading to potential contamination and build up of non-volatile deposits. The most frequent injector maintenance is septum replacement. In addition insert replacement and injector cleaning are very common. As septum replacement is common to all liquid injectors on the 3800 this procedure is presented first, followed by specific maintenance procedures for the individual injectors.

Septum Replacement

The injector septum is an expendable part and must be replaced on a routine basis. The frequency of replacement depends on the number of injections and whether the injections are by hand or with an autosampler. In general the septum should be replaced every 50 - 100 injections or when symptoms of a septum leak are seen. These symptoms include changing retention times, reduced detector response or a drop in column head pressure. The latter symptom is not always valid as some injectors, such as the 1079, are pressure controlled. With a

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pressure-controlled injector, the column head pressure will remain constant even if a leak is present.

Use the following procedure to change a septum on any Varian injector:

1. Cool the column oven and injector oven to 50 °C. This ensures safe handling of injector parts and protects the column from elevated temperatures while it is exposed to air.
2. Turn off the carrier gas supply to the injector.
3. Remove the injector nut by turning it counterclockwise.
4. Remove the old septum using tweezers or a septum pick (72-000084-00). It is best not to handle any internal parts of the injector.
5. Install the new septum, again using tweezers to avoid contaminating the injector.
6. Replace the injector nut and tighten it finger-tight until you feel resistance from the septum, then tighten an extra 1/4 turn. Turn on the carrier gas supply.

On occasion to save time you may want to change a septum while the injector is hot. Use an injector wrench (03-908423-00) to remove and reinstall the injector nut. In all instances the column oven should be cool before removing the injector nut.

1079 Injector

The 1079 is a universal capillary injector that can be operated in several modes. These modes include split, splitless, on-column and large volume injection. Typically, to change from one mode of operation to another involves changing the injector insert. The insert should also be cleaned or replaced on a routine basis. This is especially important when dirty samples are being analyzed.

After prolonged use, the 1079 Universal Capillary Injector glass insert may need to be removed either:

To clean the current glass insert for reinstallation in the 1079 Injector, or

To replace the current glass insert with a new insert.

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Refer to the figure below when removing and/or replacing the glass insert.

1 Injector Nut
2 Septum
3 Septum Purge
4 Septum Support
5 Graphite Ferrule
6 Carrier Gas Inlet
7 Split Vent
8 Glass Insert
9 Fused Silica Column
10 Capillary Column Nut
11 Vespel® Ferrule
12 Point of Injection

Tools Required

Tweezers or septum pick (72-000084-00)

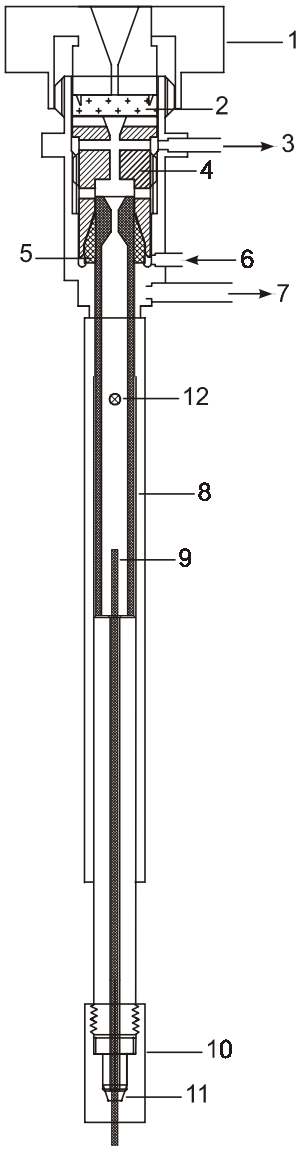
Injector nut wrench (03-908423-00)

Flat-blade screwdriver (short handle)

Clean laboratory tissue

Graphite ferrules (03-925342-02)

Insert/ferrule positioning tool (03-925385-00)



1079 Injector - Cross-Sectional View

Remove the Glass Insert

Follow these steps to remove the glass insert from the 1079 Injector:

1. Use the injector nut wrench to remove the injector nut (Item 1). Place the nut on a clean surface (e.g., clean tissue).

WARNING:
BURN HAZARD

The injector nut may be hot. Lower the injector temperature to 50 C and permit the injector nut to cool before proceeding.

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NOTE: If the GC is equipped with an 8200 AutoSampler, to access the injector nut, push the carrousel release button (back left) and swing the carrousel out.

2. With tweezers or septum pick, lift the edge of the septum (Item 2). Remove the septum.

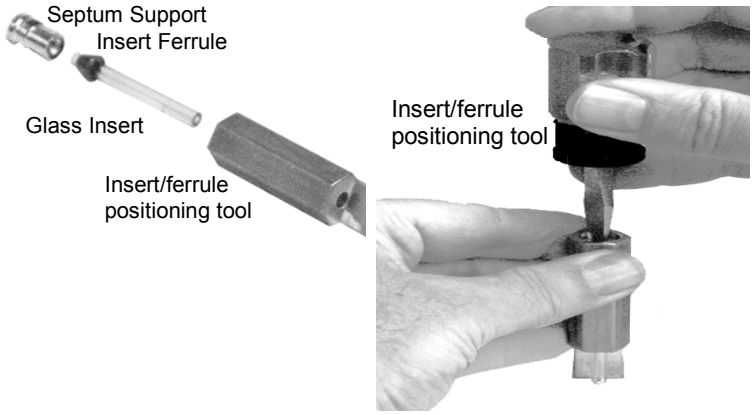
NOTE: Replace the injector septum each time the glass insert is replaced.

3. Use a clean flat-blade screwdriver to unscrew the septum support nut (Item 4) until it is loose.
4. Remove the septum support with the tweezers or septum pick.

NOTE: Typically, when the septum support is removed, the insert and ferrule remain in the septum support. If the ferrule and insert are in the injector body after the septum support nut is removed, use the tweezers to grasp the top of the insert and lift it from the injector body.

5. Use a laboratory tissue to grasp the glass insert and remove it from the septum support nut.
6. To remove the graphite ferrule from the glass insert, use clean lab tissues to hold the graphite ferrule (Item 5) and the glass insert. Gently turn the glass insert while you pull off the graphite ferrule.

NOTE: The glass inserts can be cleaned and reused. Unless the graphite ferrule is obviously damaged, it can be reused as well. However, replace the 5 mm graphite ferrule after the glass insert has been changed three or four times.



Replace the Glass Insert

Follow these steps to replace the glass insert in the 1079 Injector.

1. Use the insert/ferrule-positioning tool supplied in the 1079 accessory kit to set the 5 mm graphite ferrule on the insert and in the septum support. See the above pictures for an exploded view of the tool with septum support, insert ferrule, glass insert and tool as well as the correct position of the tool when setting the ferrule. The objective is to have the ferrule set with the bottom of the insert, flush with the bottom of the tool.

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2. Position the tool as shown above on a flat, clean surface. Use clean laboratory tissue on the surface. Tighten the septum support finger-tight. Holding the tool with a 5/8″ wrench, give the septum support an extra 1/3 to 1/2 turn past finger-tight. Now unscrew the septum support, which now has the ferrule and insert seated in it. If there is any graphite extruded past bottom of the septum support, cut it off with a blade or sharp knife. Carefully wipe off any graphite flakes, which may adhere to the insert or septum support. Gripping the septum support unit with a piece of laboratory tissue, carefully put this unit in the 1079 injector and tighten the septum support 1/6-turn past finger-tight.
3. Use tweezers to place a new septum over the septum support.

NOTE: If the septum has a Teflon® face, place the Teflon face toward the column (down).

4. Place the injector nut on the injector and tighten by hand until you feel some resistance, then tighten an extra 1/4 turn using the injector nut wrench.

NOTE: After the injector nut has been replaced, check the split vent and septum purge flow rates to ensure these values have not changed.

5. Condition the insert by setting the 1079 Injector to the split mode and purging with carrier gas for 30 min at 300 C.

Clean the Glass Insert

Glass inserts must be clean and free from sample residue and particulate matter (such as bits of septum rubber or graphite). Follow these steps to clean the glass insert in the 1079 Injector.

1. Remove the glass insert. It is safest to cool the injector and column ovens to 50 °C before removing the insert.



WARNING:
BURN HAZARD

Use care when removing inserts from the injector. Inserts can be at high temperatures and are likely hot. Place hot inserts on a clean glass or metal surface only.

2. To clean glass inserts, use one of the following procedures (the choice of cleaning procedure depends upon the nature of samples injected):
3. Rinse the inserts with solvent or soak the inserts in hot acid.
4. Heat them in a glass-annealing oven (to 500 °C) or pass the inserts through the flame of a Bunsen burner.
5. Wash in a 1:1:1 mixture of methanol:methylene chloride:hexane in an ultrasonic cleaner for 30-60 min, then dry the inserts in an oven.

NOTE: For the 2 mm glass wool packed glass insert, remove the glass wool by blowing compressed gas in the end of the insert. Clean the insert following one of the procedures listed above. Repack the insert with deactivated glass wool (10-20 mg). Leave ~1.5 cm of the bottom of the glass insert unpacked. The capillary column will be inserted in this empty space when re-installed in the injector body.

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NOTE: Rinsing the glass inserts with strong acids or bases or heating to a high temperature will remove the deactivation coating on the glass inserts. Rinsing the glass inserts with solvents or mixed solvents will not remove the deactivation coating.

Deactivate the Glass Insert

Follow these steps to deactivate the glass insert in the 1079 Injector.

NOTE: This procedure can be used on all glass inserts except inserts packed with 10% OV-101 on Chromosorb W-HP (03-918956-00). Up to three inserts can be deactivated at a time using this procedure.

1. In a 10 mL glass graduated cylinder, add 0.5-1 mL of dimethyldichlorosilane. Fill to 10 mL with isooctane, hexane or toluene.
2. Cover the top of the graduated cylinder with aluminum foil and place the cylinder in an ultrasonic bath. Sonicate for 30 sec to mix the solution.
3. Add up to 3 inserts to the solution.

NOTE: Deactivate glass inserts only after they have been thoroughly cleaned using the above procedure.

4. Sonicate the inserts in the cylinder for 10 min. Rinse the inserts 3 times with 10 mL isooctane, hexane or toluene. Each rinse should include 2-3 min of sonication.
5. Add 10 mL of methanol and sonicate for 2-3 min. Decant the methanol and repeat the methanol rinse step.
6. Decant the methanol. Transfer the deactivated inserts to a small clean glass beaker. Cover the beaker with aluminum foil and bake at 200 °C for 1 hour.
7. After the inserts cool to room temperature, store them in a clean screw cap glass vial or the original packaging.

To clean the injector body, proceed as follows:

1. Set the column oven temperature to 45 C and the 1079 injector temperature to 50 C. Wait for the zones to reach their set temperatures and then turn the column oven off by pressing the “TURN OVEN OFF” softkey located in the Column Oven section of the method.
2. Use the 5/16" open-end wrench to loosen the capillary column nut.
3. By hand, carefully withdraw the fused silica column and nut from the injector assembly. Set the column nut and column end on the floor of the GC oven.

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WARNING:
CHEMICAL HAZARD



WARNING:
FIRE HAZARD

Use proper eye and skin protection. Methanol and acetone are toxic and flammable chemicals. Exercise appropriate precautions when these chemicals are used.

4. Remove the injector nut, septum, and septum support, with ferrule and insert attached.
5. Moisten a cotton swab and a stick with methanol and gently swab center of the injector body.
6. Moisten a cotton swab on a stick with iso-octane and gently swab the center of the injector body.
7. Examine the end of the fused silica column to ensure that it has not been damaged. Slide the end of the fused silica column into the opening of the injector.
8. Gently twist the column nut in the opposite direction used to tighten the nut. Place the column nut on the end of the injector and tighten the nut. This procedure minimizes twisting the column.
9. Use the 5/16″ open-end wrench and tighten with 1/6-turn to secure the column in place.
10. Replace the septum support, insert, ferrule, septum, and injector nut.
11. To check whether the injector is leak-tight, connect a flow meter to the split vent. Set the Relay to the split mode. If the flow meter indicates a flow less than previously measured, the injector has a leak.
12. Turn the column oven back on by pressing the “TURN OVEN ON” softkey in the column oven section of the method.

How to Remove the Capillary Column from the System

To remove the capillary from the system, proceed as follows:

1. Turn off the GC column oven and heater. Shutdown and vent the mass spectrometer.
2. Open the inside of the GC oven. Make sure that about 30 cm (12 in.) of the mass-spectrometer end of the capillary column is hanging freely, so that you can move the mass spectrometer away from the GC without breaking the column.
3. Keep an eye on the capillary column in the GC oven as you gently slide the mass spectrometer away from the GC.

   As you slide the mass spectrometer away, take care not to allow the column to bind or kink. When you have fully withdrawn the mass spectrometer from the GC, the distance separating them should be ≥23 cm (9 in.). The transfer line should be fully removed from the GC oven.

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NOTE: Avoid contamination of the transfer line, injector, and capillary column by using clean tools and wearing clean lint-free Nylon® gloves. As you remove parts, place them on a clean, lint-free, unpainted surface.

4. Use the alignment tool and a 5/16-in. wrench to loosen the brass nut on the end of the transfer line.
5. Remove the capillary column from the transfer line.
6. Remove the brass nut, along with the ferrule, from the column.
7. Remove the ferrule from the nut. Discard the ferrule.
8. From inside the GC oven, pull the transfer line end of the column back into the hole in the side of the GC.

   Leave the free end of the column on the floor of the oven.

To withdraw the transfer line from the vacuum manifold, proceed as follows:

1. Unplug the transfer line heating cable.
2. Grasp the nose of the transfer line, then rotate counterclockwise as you press lightly toward the manifold. Gently slide the transfer line away from the manifold.
3. Remove the nose clip, and then pull the transfer line away from the analyzer.
4. Wrap the transfer line in clean aluminum foil and place it on a clean, dry surface.
5. Cover the analyzer opening with aluminum foil.

To remove the capillary column from the GC injector, proceed as follows:

1. Use a 5/16-in. wrench to loosen the capillary column nut that secures the column to the injector.
2. Carefully remove the nut, ferrule, and column from the injector.
3. Slide the column nut, along with the ferrule, off the end of the column.
4. Remove the ferrule from the column nut. Discard the ferrule.
5. Carefully lift the column support cage, along with the column, from the column hanger. Then, remove the support cage and column from the oven.
6. Seal the end of the column or insert the ends of the column into a septum.
7. Store the column and the support cage.

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How to Install a New Capillary Column in the System

To install a new capillary column in the mass spectrometer, proceed as follows:

1. Unwind about 60 cm (24 in.) of the mass spectrometer end of the column from the support cage.
2. Insert this end of the column through the transfer line hole in the right side of the GC.
3. Insert the column end through the brass nut (to be installed on the GC end of the transfer line). Then slide the nut several inches down the column.

   The wide, threaded opening of the nut should face the end of the column.
4. Place a new graphite/Vespel ferrule on the column, with the taper facing the nut. Slide the ferrule, along with the nut, about 30 cm (12 in.) down the column.
5. Carefully insert the tip of the column into the nose end of the transfer line.
6. Slide the column all the way through the transfer line until the tip of the column projects a few inches beyond the transfer line tip.
7. Using a sapphire-, or carbide-tipped scribing tool or ceramic scoring wafer, score the column once lightly about 2 cm (1 in.) from its end.
8. Bend the column slightly to break it at the mark. The column should break cleanly.
9. Using a Kimwipe® tissue dipped in methanol, carefully wipe the last 15 cm (6.0 in.) of the column.
10. Be sure to wipe toward the end of the column so that the Kimwipe® tissue fibers do not enter the opening at the column end.
11. Position the column in the transfer line as follows.
12. To position the column in the transfer line, proceed as follows:
13. Install the brass nut on the end of the transfer line, but do not tighten the nut completely.
14. Keep an eye on the tip of the column and position it so that about 1 mm (1/32 in.) of the column projects from the transfer line tip.

NOTE: As you tighten the nut, the position of the column in the transfer line may change. If this happens, loosen the nut and readjust the column until about 1 mm (1/32 in.) of the column projects from the transfer line tip.

15. Grasping the transfer line securely with the alignment tool, use a 5/16-in. wrench to tighten the brass nut. Tighten the nut until snug, but do not over tighten.
16. Rotate the transfer line so that the heater cable projects downward.
17. To install the transfer line in the manifold, proceed as follows referring to the Transfer Line Exploded View.
18. Position the transfer line in the manifold, and install the clip into the holes and slots.

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19. Gently push the transfer line toward the manifold, and rotate the collar in the clockwise direction until the bayonet lock engages.
20. Reconnect the transfer line heating cable to the mass spectrometer.
21. Gently push the mass spectrometer toward the GC, until the transfer line boot fits snugly over the collar on the side of the GC oven.

    The capillary column nut should be visible inside the GC column oven.
22. The MS is properly engaged when the bumpers on the left side of the spectrometer achieve full contact with the right side of the GC.
23. Replace the cover on the mass spectrometer.

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Troubleshooting

How to Isolate a GC or Mass Spectrometer Problem

In general, whenever you attempt to isolate a Saturn GC/MS problem, you will check the system in the following order:

Data System

Gas Chromatograph (GC)

Mass Spectrometer

Checking the Data System

Please refer to the Saturn GC/MS software release notes for relevant software troubleshooting procedures.

Checking the GC

The simplest and most effective way of isolating a GC problem is to run a test sample. Running a sample will allow you to check several operational and performance factors, including the carrier gas supply, chromatographic characteristics, and sample-related problems.

The test sample that is most frequently run is the COLTEST mixture. This multicomponent mixture is very well suited to troubleshooting injector and column problems. Please see **How to Run the COLTEST Sample** for a description of the use of this test mixture.

To identify the source of a GC electronics problem, press the STATUS key and a CONTROL key (i.e., injector, column oven, etc.) to determine if a fault is present. If a fault is present the message FAULTED appears. You should also consult the 3800 GC manuals for information about fixing GC faults. Make sure that you are thoroughly familiar with all safety issues before you attempt to repair any electronics component.

Checking the Mass Spectrometer

If your data system and GC are operating normally, the problem could be caused by the mass spectrometer or by the communication channel between it and the data system. Typical problems with the ion trap include lack of response (no spectra), low response, poor resolution, and mass misassignment.

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There are two procedures for isolating problems associated with the Mass Spectrometer. Running the Auto Tune routine from System Control will provide you with information about system performance. Running the diagnostics program will initiate a hardware test. These tests may be used to isolate simple ion trap problems, e.g., air leaks, burned-out filaments, high contamination levels, etc.

NOTE: If diagnostics fail, once the problem is corrected, the *Reset* button must be clicked before further testing.

In certain cases, you may need to physically separate the GC and MS to isolate an ion-trap problem. In these cases, remove the column from the injector, and plug its end with a septum. This will minimize the input of air. Maintain the column and transfer line at ambient temperature to prevent degradation of the stationary phase. You do not need to vent the MS vacuum system to complete this procedure.

If you wish to further isolate the mass spectrometer, you must remove the column from the ion trap by shutting down the system and capping the transfer line with a no-hole ferrule.

How to Troubleshoot Problems with Spectra

The following describes the common problems a user may encounter with an Ion Trap Mass Spectrometer.

What To Do If No Spectrum Appears

If a spectrum fails to appear on the screen when you click on the ion trap icon in the Instrument Control Page, regardless of mass range, you should investigate the following potential causes:

The method segment is a FIL/MUL Delay and ionization is EI (AUTO or FIXED) mode. During FIL/MUL Delay the trap icon is red.

The filament is open.

The turbomolecular or diffusion pump has stopped.

An RF adjustment is required.

The instrument parameters are inappropriate.

The trap has been incorrectly assembled.

There is a problem with the electronics.

The system has not finished baking out.

Before you begin troubleshooting, however, be sure that you have baked out Saturn for at least 2 hours. Run Diagnostics to determine if any hardware problems are present. If you have done this, and the missing-spectrum problem persists, continue as follows. These steps apply if either air/water or cal gas peaks are missing.

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Check for an Open Filament

Diagnostics will determine is one or both filaments are open. If only one filament is open, enter System Control. Click on Set Points. Under Filament Selection, select the other filament.

If both filaments are open, shut down the instrument. Then check the filament continuity and wire connections after you have removed the ion trap assembly from the manifold.

If necessary, replace the filaments.

Check the Turbomolecular Pump

Diagnostics Vacuum test will determine if the Turbomolecular pump speed reading is at least 100 ±2%, or if the Diffusion pump has a fault present

Make sure the pump speed reading is at least 100 ±2%.

If it is not, inspect cooling fans for proper operation.

Check the RF Adjustment

Check whether an RF adjustment is needed (particularly after you have changed the ion trap temperature), proceeding as follows:

1. Open System Control.
2. Click on Adjustments, and select Adjust RF Ramp.
3. Adjust the RF ramp by turning the RF tuning screw.
4. Adjust the RF ramp until the highest value is minimized.

Check the Parameter Settings

Check whether you have set inappropriate method parameters, proceeding as follows:

1. Enter System Control. Click on Auto Tune and select Electron Multiplier Tune. Click on Start Auto Tune.
2. Click on Air/Water Check and Start Auto Tune. If air and/or water levels are out of range, go to section on Air/Water leaks to troubleshoot these problems. If a spectrum is present, enter Method Editor and check if

   You specified the EI ionization mode.

   Make sure that the ionization storage level permits storage in the trap of the ions selected in the scan range.
3. If you are unsure of appropriate levels, then reset parameters by clicking on the Defaults button in each section.

   Save your method file as Default.

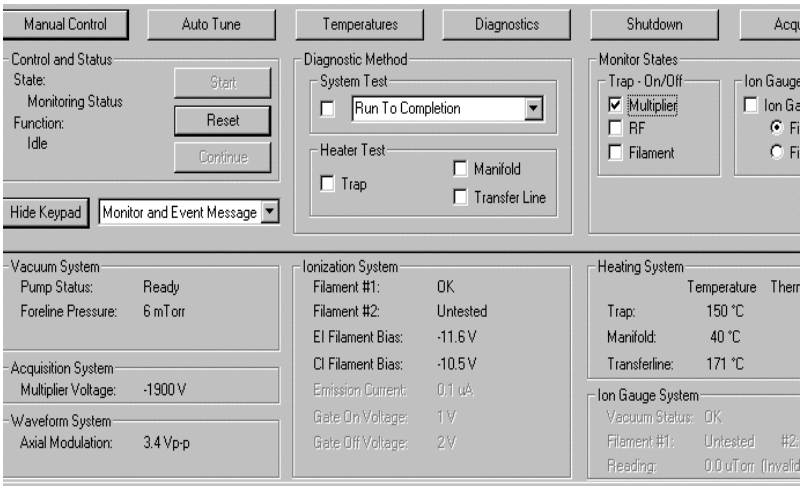
   Activate Default file, turn on trap and Cal gas. Check for cal gas spectrum.
4. If the spectrum returns, note which parameter(s) were causing the problem. If no spectrum is present, and the trap was recently disassembled, the assembly of the trap must be checked.

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Check the Assembly of the Trap

Check whether you have incorrectly installed the oven components, proceeding as follows:

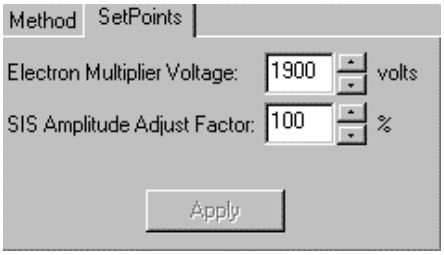
1. Display the axial modulation readback by selecting Diagnostics and checking Axial Modulation under the Waveform System box.



2. If the axial modulation readback is near zero, there maybe a scratch on the trap oven, which is shorting out one of the endcaps. Shutdown the system, remove the trap oven, and use an ohm meter to check for continuity between the electrodes and ground. Use the screws holding the clamping plate as ground. If this test is done without removing the trap from the electronics assembly, there will be continuity to ground.

3. Check whether there is a problem with the electron multiplier, proceeding as follows:

   a. Under Monitor States, click on Multiplier. Under Acquisition System check that the electron multiplier voltage is the same or close to the value displayed in the SetPoints box in the Auto Tune section.



   b. If the electron multiplier voltage in the Diagnostics is only a few volts, the multiplier is shorted to ground. Shut down the system, and replace the electron multiplier or call a Varian Customer Support Representative.

Check the Electronics

Check whether there is an electronics problem, proceeding as follows:

1. From the Manual Control, click on Diagnostics.
2. Click on Run Tests to Completion to isolate the cause of the problem. Note which of the tests fail.

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NOTE: If, after performing these tests, you are still unable to isolate the cause of the problem, contact your Varian Customer Support Representative.

What To Do If You Experience a Loss of High Mass Peaks

The loss of high mass peaks maybe due to:

RF ramp needs Adjustment

Too many low mass ions (i.e., air or water leak)

Improper Ionization storage levels (i.e., settings are too low)

High Trap temperatures may cause loss of high mass Cal Gas peaks

Before you begin troubleshooting, however, be sure that Saturn has baked out for at least 2 hours, and that the manifold temperature is at or below 50 C. If you have done this, and the problem persists, continue as follows.

1. Check for an air leak in Auto Tune Section.
2. Check RF ramp Adjustment
3. Reduce trap temperature to 150 C.
4. Enter Method editor, check method contains EI AGC ionization mode, and Default values for other parameters.

NOTE: If, after performing these tests, you are still unable to isolate the cause of the problem, contact your Varian Customer Support Representative.

What To Do If Part of the Spectrum is Missing

If you do not observe high- or low-mass ions in System Control but the ions in the mid-range of the spectrum appear normal, you should investigate the following possibilities:

An RF adjustment may be required, particularly if you have just changed the ion trap temperature.

The ionization RF level may be incompatible with the scan range.

The trap temperature may be too high to allow you to observe all of the cal gas ions. Reduce trap oven temperature to 150 C, and wait 2 hours for thermal equilibration.

Before you begin troubleshooting, however, be sure that Saturn has baked out for at least 2 hours. If you have done this, and the problem persists, continue as follows.

Check the RF Adjustment

Check whether an RF ramp adjustment is needed, proceeding as follows:

1. Enter System Control.
2. Select Adjustments, and click on Adjust RF Ramp

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3. Adjust the RF ramp by turning the RF tuning screw on the front panel. Adjust to minimize the highest reading.

Check the RF Storage Level

Check whether the RF storage level is incompatible with the scan range, proceeding as follows:

1. Open the Method Editor.
2. Select EI-AGC segment, and click on Ionization Mode. Note Ionization Storage Level. Confirm values are appropriate for mass range. Refer to Method Editor manual or help for details on appropriate rf storage values.

Check the Trap Temperature

Check whether the trap temperature is too high to permit you to observe all cal gas ions, proceeding as follows:

If the trap temperature is too high, the height of the mass 614 peak may be reduced, and the mass 502 peak may disappear entirely (above 200 °C). Reduce trap oven temperature to 150 °C and wait 2 hours for thermal equilibration.

NOTE: If, after performing these tests, you are still unable to isolate the cause of the problem, contact your Varian Customer Support Representative.

What To Do If the Resolution is Poor But the Air and Water Levels are Acceptable

If the peaks are broader than you would have expected, you should investigate the following possible causes:

There are too many ions in the trap (i.e., contamination or high column bleed).

The axial modulation value is too high or too low.

Axial modulation is not functioning properly.

Before you begin troubleshooting, however, be sure that Saturn has baked out for at least 2 hours. If you have done this, and the problem persists, continue as follows.

Check the Ion Content of the Trap

With the trap turned on, note the TIC (total ion current) value. If the TIC value exceeds 20,000 counts in full-scan mode, or a few thousand counts in MS/MS, reduce the number of stored ions.

To reduce the number of ions in the trap, do one or more of the following:

1. Make sure that the electron multiplier is set for a gain of 10^5. In the Method Editor, check that the Multiplier Offset is equal to 0 in the Method. Reduce the trap filament current and/or ion time settings (AGC OFF).
2. Reduce the AGC target value to 10,000 (AGC ON).

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Check the Axial Modulation Setting

Check whether the axial modulation is set too high or too low, proceeding as follows:

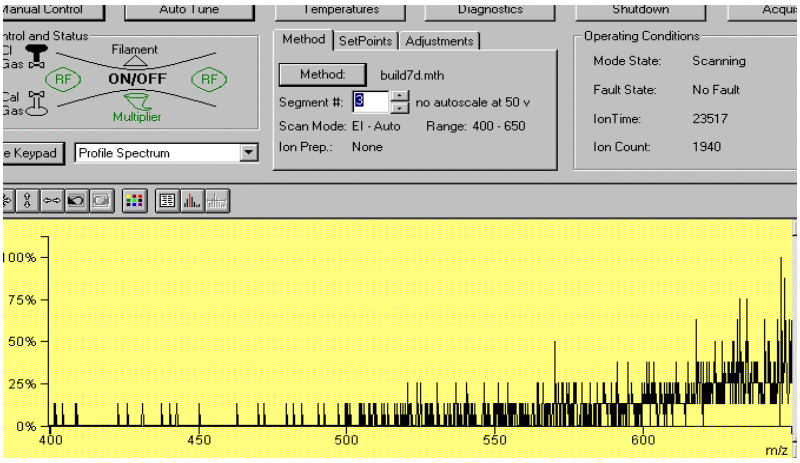
1. Click on Set Points from Manual Control. Make sure the axial modulation is set between 2.5 and 5 volts. If you adjust the axial modulation, check several cal gas ions for resolution (e.g., m/z = 131 and 414).
2. Check whether axial modulation is working properly, proceeding as follows:
3. Enter System Control, turn trap and cal gas ON. Click near m/z 131, to expand the mass range ± 5 about m/z 131. Click on Set Points. Change the Axial Modulation by several volts and click on Apply. Confirm the shift of mass 131. Return axial modulation to initial value.
4. Enter Diagnostics and run tests to completion. Confirm the axial modulation is working properly.
5. Make sure that the axial modulation readback is within 20% of the set point. If the axial modulation readback is out of this range, it will usually result from improper installation of the trap oven causing a shorted endcap.
6. If oven is properly assembled and axial modulation is out of range, contact your Varian Customer Support Representative.

What To Do If There is a High Baseline at High Masses

If the baseline on the instrument page increases sharply between masses 400 and 650, you should investigate whether there are particles on the electrode surface.

Check whether there are particles on the trap electrode surfaces, proceeding as follows:

1. Develop method for EI/AGC ON for mass range 400 to 650. Enter System Control and activate this method.
2. Turn on RF and the electron multiplier (Filament is OFF).
3. Examine the spectrum, and notice whether the baseline increases exponentially at high masses.



If the baseline ramps up, shut down Saturn, then carefully clean the electrode surfaces with a lint-free cloth.

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What To Do If the Trap Function Calibration Fails After the Calibration Ions Have Been Correctly Identified

If the trap function calibration fails after the calibration ions have been correctly identified, you should investigate the following possible causes:

The electron multiplier voltage is too low.

The cal gas pressure is too low.

Check the Electron Multiplier Voltage

Enter System Control. Select AutoTune and click on Electron Multiplier Test. Click on Start AutoTune.

Check the Cal Gas Pressure

Enter System Control. Select Manual and click on Adjustments. Click on Adjust Cal Gas. Set the cal gas pressure to a value at the mid to high end of the scale.

How to Check for Leaks

A major problem in mass spectrometry is keeping the system as leak-tight as possible. Air leaks may result in reduced sensitivity, tuning problems, and decreased resolution; in addition, they may reduce the lifetimes of the capillary column, filaments, and the electron multiplier. Check the system each day for air and water leaks before you begin running acquisitions.

As you use this guide, pay particular attention to any examples in which air and water backgrounds appear in the spectra. Familiarity with these examples will help you to rapidly troubleshoot the system.

How to Establish the Conditions Required to Check for Leaks

To establish the conditions required to check for leaks, proceed as follows:

1. Verify that the carrier gas pressure on the gauge in the front panel of the GC is set correctly.

   With a 30m x 0.25 mm, DB-5 fused silica capillary column, the carrier gas pressure should be about 10-12 psi (83 kPa).

2. Set the trap temperatures:

   Trap heater temperature to 150 C.

   Transfer line temperature to 270 °C.

   Manifold temperature to 35 C.

3. Set the column-oven and injector temperatures to 100 C.

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CAUTION

Often, major air leaks are accompanied by a hissing sound. These leaks may be due to extremely loose fittings, improperly seated O-rings, or open valves. If you suspect a major leak, do not turn on the electron multiplier, RF voltage, or filament. Using the Diagnostics section, confirm that the turbomolecular pump is operating at 100% speed or diffusion pump is ready. If it is not, you may be sure there is a major air leak.

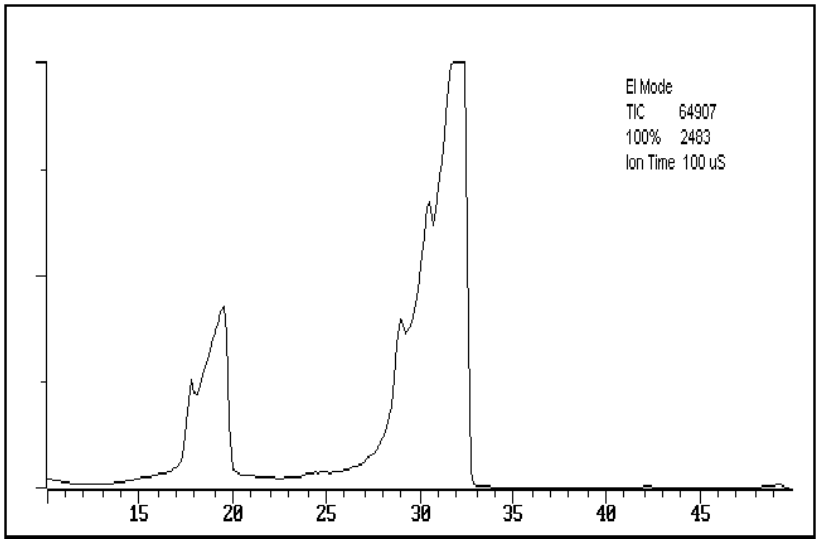
4. Enter System Control:

   Click on Auto Tune Box

   Click on Air/Water Check

   Click on Start Auto Tune

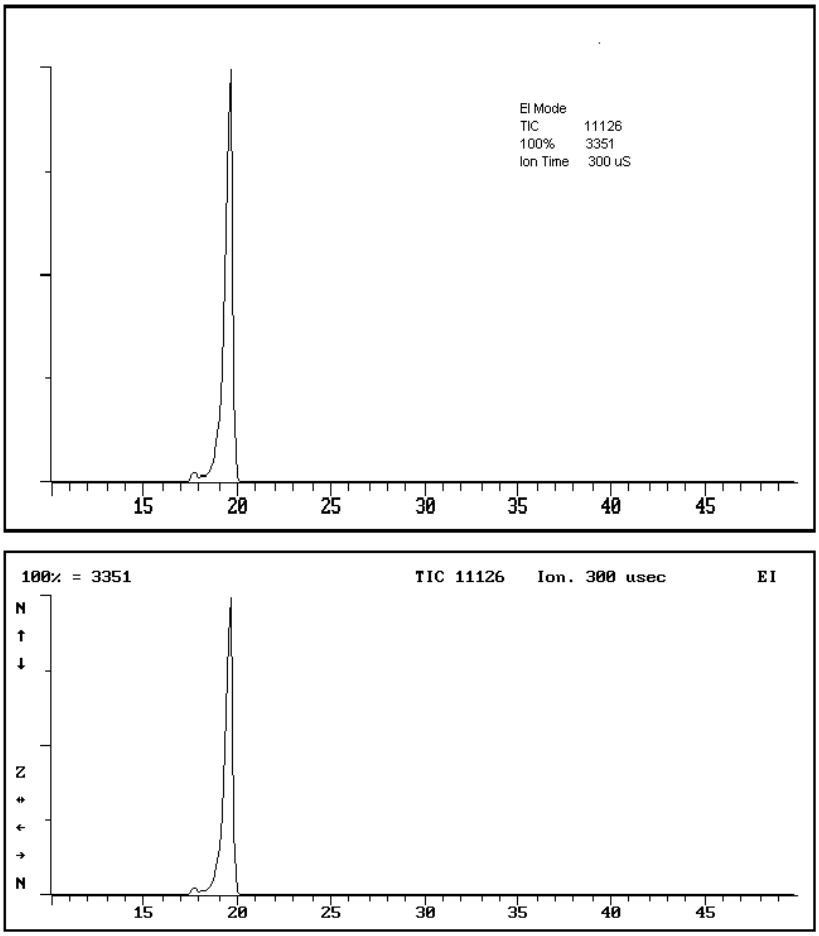
5. Compare your air/water spectra to the following:



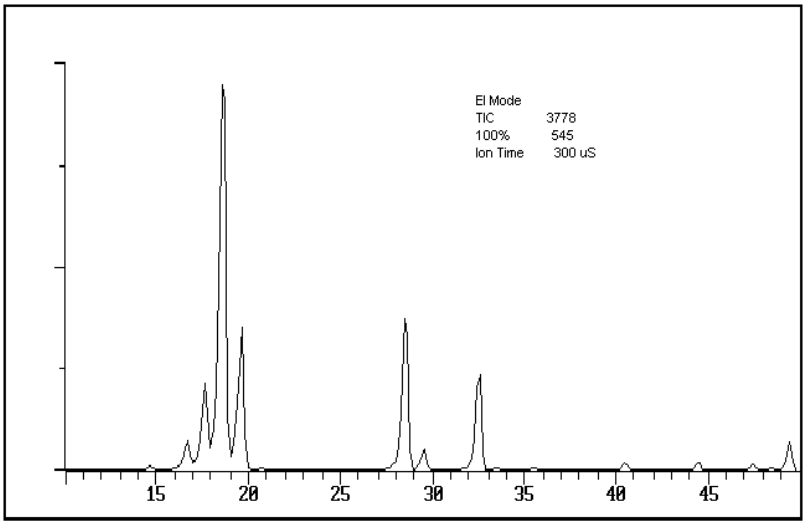
Air/water spectrum from an instrument with a gross air leak

If the peaks at masses 32 (O_2+), 28 (N_2+), and 18 (H_2O+) are severely broadened or undifferentiated, your system has a large air leak. Immediately turn off Air/Water Check.

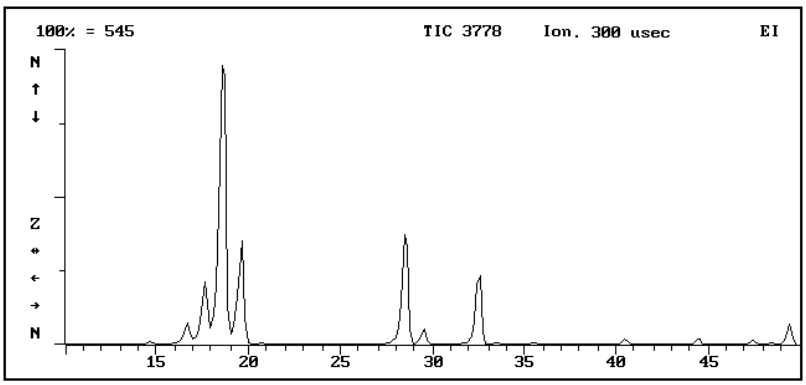
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Air/water Spectrum from a System with a Very High Water Vapor Background



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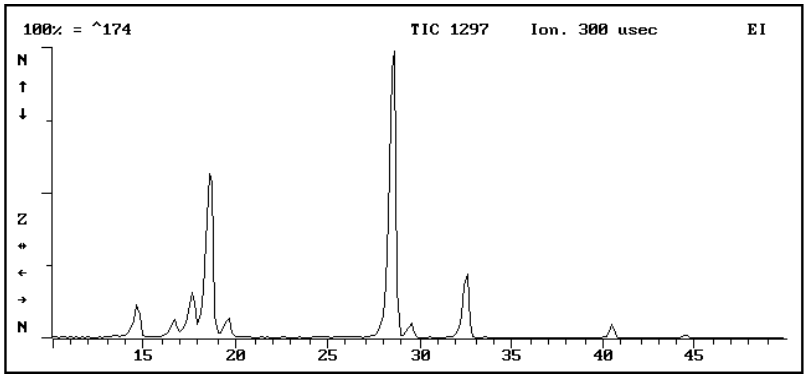


Air/water Spectrum from a System with Excess Water Vapor and a Relatively Small Air Leak

If the ratio of the height of the peak of mass 18 (H_2O^+) to mass 19 (H_3O^+) is about 10:1, there is little water vapor in your system.

If the ratio of peak height of mass 18 to mass 19 is less than 10:1 but greater than 5:1, additional bakeout maybe necessary. Be aware, however, that if you do not eliminate the water vapor, your system's sensitivity and performance may be less than optimal.

If the ratio of the peak height of mass 18 to mass 19 is much less than 10:1, your system contains excess water vapor.



An Air/Water Spectrum Obtained from a System with No Significant Air Leaks and Little Water Vapor as Indicated by:

The peak at mass 18 (H_2O^+) may be the base (highest) peak. This is dependent on the level of water vapor.

The ratio of the peak height at mass 18 (H_2O^+) to that at mass 19 (H_3O^+) is greater than or equal to 10:1.

The 100% counts value is significantly lower than 500.

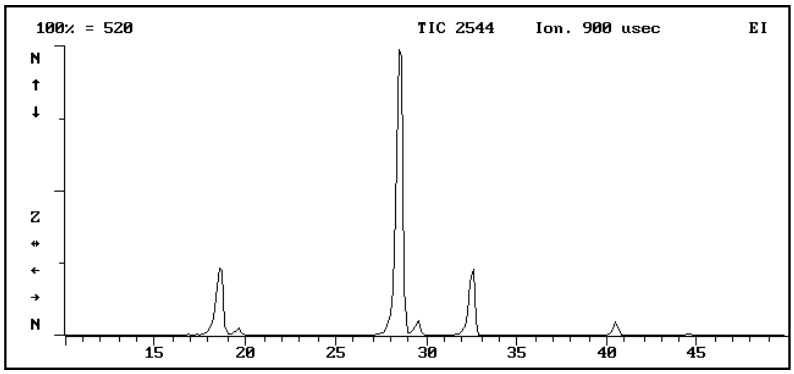
The ratio of the peak height at mass 28 to that at mass 32 (O_2^+) is about 4:1.

6. If there are no air or water leaks in your system, you should obtain the following approximate values. Please note that these values are only typical, so the actual values may vary from system to system.

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100% value	TIC	18:28 ratio	19:18 ratio	28 width
<100	<1000	~ 1:1	10 to 15%	< 1 m/z

7. Spectra observed if there is an air leak in your system.



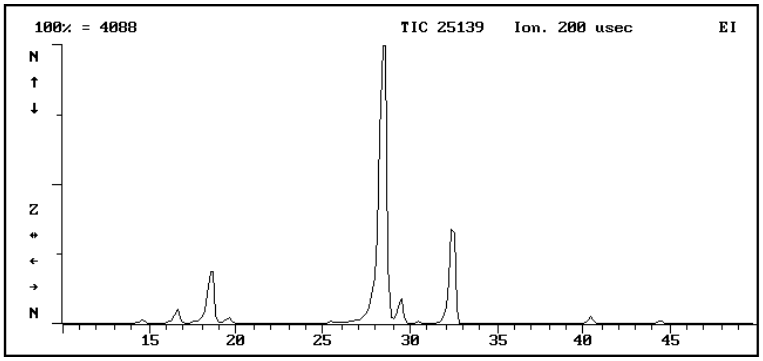
An Air/Water Spectrum Obtained from a System with a Small Air Leak and Little Water Vapor as Indicated by:

The peak height at mass 28 is noticeably greater than that at mass 18.

The ratio of the peak height at mass 28 to that at mass 32 is greater than 4:1.

The 100% scale counts value has increased to greater than 500.

The ratio of the peak height at mass 18 to that at mass 19 is greater than or equal to 10:1.



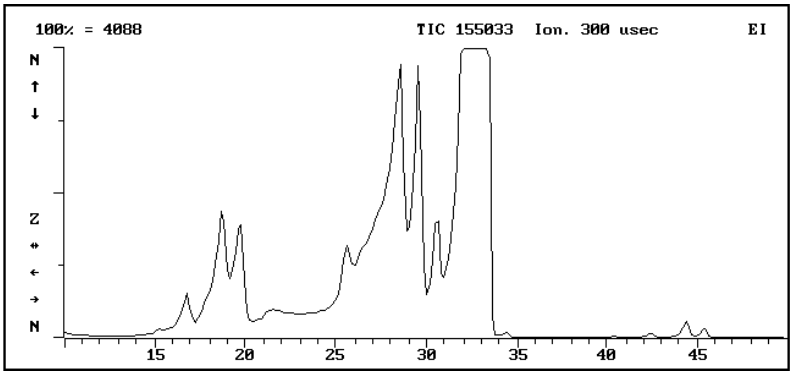
An Air/Water Spectrum Obtained from a System with a Moderate Air Leak and Little Water Vapor as Indicated by:

The peak at 28 starts to overload.

The 100% counts value may be several thousand counts.

The peak height at mass 18 is greater than that at mass 19.

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An Air/Water Spectrum Obtained from a System with a Large Air Leak and Little Water Vapor as Indicated by:

The peak at mass 32 is the base (highest) peak.

The peaks at masses 18, 19, and 28 are broadened. As a leak increases, all peaks broaden and eventually become undifferentiated.

How to Fix High Water Levels

The presence of excess water vapor may be due to

Failure to pump down for a sufficient length of time (i.e., at least two hours, when you vent the system).

Introduction of water vapor when you clean the ion trap.

Introduction of water vapor when you replace the capillary column.

Water vapor in the carrier gas tank.

An atmospheric air leak in the system. This problem most often occurs under conditions of high relative humidity.

You will often observe high water backgrounds after venting the system, and especially after cleaning the trap. Several hours of bakeout may be required for the water vapor to desorb from surfaces in the vacuum system, and for the water level to drop to a stable level. Never operate your Saturn if the mass 18 and 19 peaks are the same height (or if the air/water check shows NO). After the system has baked out sufficiently (i.e. overnight), the presence of excess water is due to contamination in the carrier gas tank or an air leak.

Saturated filters on the GC may produce an increase in the air/water background. Replace the filters at regular intervals, and whenever moisture or other background from the GC becomes a problem.

Using a Leak Detection Gas to Troubleshoot for Air Leaks

You may use a leak detection gas such as Freon or argon to locate leaks. A leak at the transfer line (the high vacuum side) should produce an immediate response. If, on the other hand, the leak is coming from the GC injector, it will take about 90 sec to register a response. (It takes about that length of time for the gas molecules to travel through the capillary column.) If you discover a leak at the injector, you can correct the problem without venting the system; however,

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be sure to wait until all GC zones are cool before beginning. If the leak is coming from the transfer line connection, you will have to shutdown the GC/MS system and vent the system before fixing it.

NOTE: Set the mass range from 35 to 50 if you will be using an argon leak-detection gas, or from 80 to 110 if you will be using a Freon leak-detection gas.

Troubleshoot leaks using argon gas as a leak detecting gas. The mass peak of interest for argon is at Mass 40.

To reduce the risk of damaging the filaments or multiplier, develop a method file with the following parameters:

Set the electron multiplier 100 V below the 10^5 setting.

Turn off AGC and set the ion time to 100 sec.

Set the filament emission current to 10 A.

Set scan range from m/z of 35 to 50 (or 80 to 110)

Enter system control, activate the argon method for troubleshooting and turn the trap ON.

NOTE: Do not spray argon indiscriminately around the fittings. Argon diffuses very rapidly from the fitting you are testing toward a true leak. This could lead you to mistakenly identify the fitting that you are testing as the leak source.

Check for leaks:

Spray a fine stream of argon on the transfer line closest to the analyzer.

Examine the monitor for a response. If a peak at mass 40 does not appear, there is no leak.

If a peak appears at mass 40, there is a leak. The transfer line O-ring may have particles on its surface. Shut down the system and check the O-ring.

Check the following gaskets and fittings for leaks, one item at a time and in the following order. (Tighten the fittings and/or flanges as needed. Wait a few seconds between subsequent applications of argon.)

Calibration gas tube fitting on the pneumatics manifold

Vent valve fitting on the manifold

Top vacuum manifold flange

How to Fix a Large Air Leak

Typical sources of large air leaks in Saturn are

lint or damage on the manifold flange O-ring seal

Lint or damage on the transfer line O-ring seal

The transfer line brass nut

The O-Ring seal between the turbomolecular pump and the manifold

The release tabs of the analyzer are not locked into position.

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The brass nut on the transfer line is not tight enough, recheck the system. Do not over tighten the fittings. Otherwise, you may generate an even larger leak.

If you cannot eliminate the leak, vent the system, and check the O-ring on the manifold and transfer line for particles. Wipe off both O-rings with lint-free paper.

The turbomolecular pump will probably fail to achieve its 100% speed if there is a leak or poor seal at the turbo/manifold interface. Never attempt to operate the system under these conditions.

How To Fix a Small-To-Moderate Air Leak

You may have more trouble finding and correcting a small-to-moderate air leak than a large one. Symptoms associated with small-to-moderate air leaks include the following:

The peak at mass 28 will have increased, becoming significantly larger than the mass 18 peak.

The air leak will probably increase the water background, particularly in humid environments. An increase in water vapor content will be accompanied by a 20% or greater increase in the 19:18 mass ratio.

Check GC Connections:

NOTE: Check the GC Maintenance Section for additional information for trouble shooting leaks.

To identify and correct a leak at the connections between the capillary column and the injector or transfer line, proceed as follows:

Make sure that you are using ferrules of the correct size, i.e., 0.4 mm for 0.25-mm ID columns, and 0.5 mm for 0.32-mm ID columns.

Make sure that the ferrule on the transfer line is a graphite/Vespel mixture. Most transfer line connection leaks occur on the high vacuum side (e.g., around the transfer line O-ring).

In the case of a graphite/Vespel ferrule, tighten each ferrule one-half turn beyond finger tightness. In the case of a graphite ferrule, tighten each ferrule three-quarters of a turn beyond finger tight.

Leaks at the septum may arise from loose injector nuts or overuse of the septum. Regularly change the septum as part of your routine GC preventive maintenance program. To reduce the level of air bleeding into the system and any background from the septum material, use good quality, low bleed septa.

Air leaks in the GC pneumatics are the most difficult leaks to detect and eliminate because detection gases are not particularly effective for this purpose. In general, you should tighten all fittings, and then check for such a leak using a solvent such as methanol.

Saturated filters on the GC may produce an increase in the air/water background. Replace the filters at regular intervals and whenever moisture or other background from the GC becomes a problem.

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How to Troubleshoot the GC

NOTE: Please refer to the GC Operator's Manual for information about GC troubleshooting and diagnostics procedures not described in this section.

This section describes chromatographic troubleshooting, with particular emphasis on GC/MS applications. You will be able to see most of the problems addressed in this section by running the COLTEST mixture (03-920273-00).

The following procedure describes the chromatographic conditions and the expected results when running the COLTEST sample with a 30-m DB-5 column (0.25 mm ID, 0.25 m film thickness).

How to Run the COLTEST Sample

A coltest method can be found in the :\SaturnWS\Service directory of the software.

Set Up the Injector Conditions

If you are using SPI/1079 programmable injection, proceed as follows:

Hold an initial temperature of 40 °C for 0.1 min, then ramp the temperature to 280 °C at a rate of 200 C/min.

If you are using Split/Splitless injection, proceed as follows:

1. Use an isothermal temperature of 260 °C.
2. Set up the following external event program conditions:

NOTE: "Gas saver event", if present, must be ON.

Time	Event 1	Injector Mode
0.00	On	Splitless
0.50	Off	Split

3. Set the splitter flow rate to 100 mL/min.

Set Up the Column

Develop programmable column temperature program with:

1. An initial column temperature to 40 °C.
2. Hold at 40 °C for 2 min.
3. Ramp the temperature, at an initial rate of 10 °C/min to 140 °C, then at a rate of 20 °C/min to 280 °C.

   Do not hold the temperature at 140 °C.
4. Adjust the total run time to 21 min by adjusting the hold time of the last segment.

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Set Up the Transfer-Line and Trap-Temperature Conditions

1. Set the transfer line temperature to 260 °C.
2. Set the trap temperature to 150 °C.
3. Set the manifold temperature to 35 °C.

Set Up the Mass Spectrometer Acquisition Method

To set up the mass spectrometer acquisition method with:

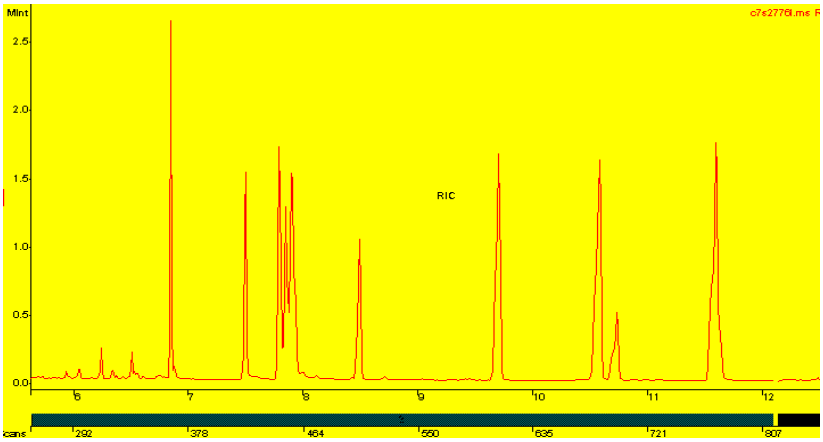
1. Set the mass range to 40 to 350 at a scan rate of 1 scan/sec.
2. Set the background mass to 39.
3. Set a filament/multiplier delay of 180 sec.
4. Set a peak threshold of 1 count.
5. Set a mass defect value of 0.
6. Specify electron ionization (EI Auto).
7. Turn cal gas OFF.

The COLTEST test mixture contains the following compounds at levels of 1 to 5 ng/ L.

No.	Compound	Formula	Integer Weight	Quantitation Mass
1	decane	$C_{10}H_{22}$	142	57
2	1-octanol	$C_8H_{18}O$	130	69
3	undecane	$C_{11}H_{24}$	156	71
4	nonanal	$C_9H_{18}O$	142	67
5	2,6-dimethylphenol	$C_8H_{10}O$	122	107
6	2-ethylhexanoic acid	$C_8H_{16}O_2$	144	73
7	2,6-dimethylaniline	$C_8H_{11}N$	121	106
8	decanoic acid, methyl ester	$C_{11}H_{22}O_2$	186	74
9	undecanoic acid, methyl ester	$C_{12}H_{24}O_2$	200	87
10	dicyclohexylamine	$C_{12}H_{23}N$	181	138
11	dodecanoic acid, methyl ester	$C_{13}H_{26}O_2$	214	143
12	hexachlorobenzene	C_6Cl_6	282	284

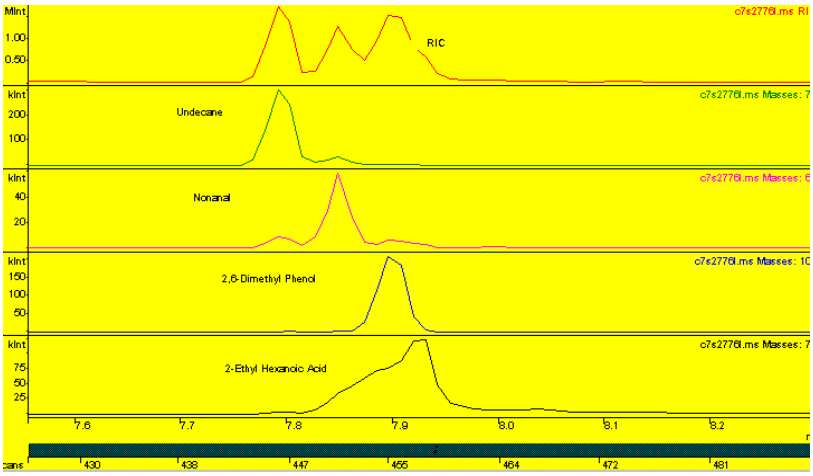
The following is a typical chromatogram for this test mixture. Note that 2,6-dimethylphenol and 2-ethylhexanoic acid coelute normally on a DB-5 column, depending on column and injector.

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Typical Chromatogram of COLTEST Text Mixture

The following figure demonstrates the resolving power of Saturn for coeluting compounds.



Resolution of Saturn for Coeluting Compounds

You can also effectively separate the individual components in the mixture for subsequent data manipulation, e.g., library searches and quantitation. For details about plotting single ion chromatograms for ions specific to a single compound, please refer to the SaturnView help or section in the Software Reference manual.

How to Troubleshoot Common Chromatographic Problems

The COLTEST mixture includes polar or active compounds such as 1-octanol, 2,6-dimethylphenol, and 2,6-dimethylaniline. Also present are some nonpolar or inactive compounds such as decane and dodecane at approximate levels of 1 ppm in hexane. Analysis of the mixture yields information about solvent tailing, column efficiency, dead volume, active sites in the injector/column, etc. You can use the analysis to troubleshoot common chromatographic problems. The following table identifies many of the problems, and proposes solutions.

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Correction of Solvent Tailing or Broadening Problems

Symptom	Solution
Poor column installation resulting in dead volume in the injector	Reinstall the column in the injector. Check the column seal with the insert in the SPI/1079 (on-column). Make sure you have a good cut on the column by examining the column under magnification. Check the 1077/1078/1079 injector for insertion depth.
Solvent flashing in hot injector (usually 1077, 1078 or 1079)	Reduce the injection speed for the hot injectors. If possible, reduce the injector temperature. If you are using sandwich injection, reduce the solvent plug to 0.5 L.
Incorrect temperature control using programmable SPI or 1079.	A typical setting for the SPI is 20 °C below the solvent boiling point. The column temperature is set at the solvent boiling point. Hold the column at this temperature until SPI has finished heating (usually about 2 min).
Septum purge line is plugged	Check that the septum purge flow is 0.5 mL/min for a SPI with a 10-psi head pressure, 2 mL/min for a 1077 or 1078 and 3.5-4.5 mL/min for 1079 with a 10-psi head pressure. If necessary, change the septum purge frit or adjust the valve setting (depending on your injector configuration).
Injector is not purged properly following splitless injection	For a splitless injection, the vent flow should be at least 70 mL/min. The injector should be switched to the split mode 30 to 90 sec after the injection.

Correction of Tailing Sample Peaks for Particularly Active Components

Symptom	Solution
Active sites in the injector insert or liner	Change or clean the injector insert. If necessary, silanize it.
Active sites or degraded phase present in the column	Remove the front 15 cm of the column and reinstall it. If the retention times are changing, or if cutting the column does not fix the problem, replace the column.

Correction of Low Response and Severe Tailing with High Boiling Point Compounds

Symptom	Solution
Injector not hot enough to vaporize high boilers	Increase the temperature of the injector
High levels of column bleed masking component peaks	Condition the column at 30 °C below its maximum operating temperature (320 °C for DB-5). Switch to a high temperature column, (e.g., the SGE HT5), if conditioning does not help.
High levels of silicone or other contamination are coated on the ion trap surfaces	Clean the ion trap as outlined in Maintenance Section. Check Contamination Table for listing of potential contamination.
Insufficient vaporization of the higher boiling point components	Lower the injector temperature and the injection speed. Check that the graphite ferrule in the 1077 or 1078 is free of cracks, and that the septum support is tight.
Trap temperature is too low	Increase the trap temperature in increments of 20 °C.

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Correction of Leading Sample Peaks (Reverse Tailing)

Symptom	Solution
Column overhead due to injection of excessive amounts of a component	Dilute the sample, or perform a split injection.
Degradation of the stationary phase	Change the column.
Carrier gas velocity is too low	Increase the carrier flow rate.

Correction of Poor Resolution[1]

Symptom	Solution
Column temperature or program is not optimized	Modify the method (e.g., slow the column ramp rate) to improve the separation
Carrier gas flow is not optimized	Decrease the carrier gas linear velocity to improve the resolution.
Column cannot separate certain species, (e.g., those with similar boiling points)	Use a more polar column.
Column stationary phase is degraded, resulting in poor efficiency	Replace the column.

[1]Peaks are not well separated, e.g., 2,6-dimethylphenol and 2-ethylhexanoic acid in the COLTEST mixture.

Lack of Reproducibility of Peak Size

Symptom	Solution
Leaking or partially plugged syringe	Visually check that the syringe is pulling up the sample. Check that the nut is tight. Flush the syringe with solvent. Heating the solvent in a hot injector may help if the syringe is plugged; otherwise, replace the syringe.
Leak at the septum	Replace the septum regularly and ensure that the septum nut is tight.
Improper installation of column in the injector, or a leak at the column inlet	Check the installation of the column in the injector. Tighten the capillary column nut.
Sample is being absorbed by active surfaces in the injector or column	Change the injector insert. Remove the front 15 cm of the column, or replace the column.
Incomplete vaporization of sample in the injector	Increase the injector temperature (1077,1078 or 1079). Or increase the maximum temperature to which the injector is programmed (SPI or 1079).
1077,1078 or 1079 splits too soon	Confirm that the switch time is chromatographically optimized.

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Correction of Peak Splitting (Particularly for Low Boilers)

Symptom	Solution
Sample flashing in injector (1077, 1078 or 1079), simulating two injections	Lower the injection temperature, or use a SPI/1079 programmed injection.
Column temperature programming starts before SPI has finished programming	Increase the initial column hold time until SPI/1079 reaches its maximum temperature, (i.e., typically at 2 min.).
Column is cracked	Re-cut and install the column.
A piece of septum is stuck in the injector insert.	Replace the insert and septum.

Correction of Extra, Unexpected Peaks in the Chromatogram

Symptom	Solution
Septum bleed, particularly during temperature programming	Use high-temperature, low-bleed septa. Make sure that the septum purge flow is set to 0.5 mL/min for a SPI injector with a 10-psi head pressure, or 2 mL/min for a 1077 or 1078 injector with a 10-psi head pressure.
Impurities from the sample vials (e.g., plasticizers present)	Confirm that this is indeed the case by running a solvent blank with a new syringe. Use certified sample vials, and keep the samples refrigerated. Check contamination table.
Impurities from the carrier gas present	Install or replace the carrier gas filters.
Injector or GC pneumatics contaminated	Remove the column from the injector and bake it out at elevated temperature, (e.g., 350 °C) using a purge of at least 20 mL/min.
Impurities present in the sample	Confirm that this is indeed the case by running a blank or standard.
Solvents are extracting impurities from the septum.	Switch to a new septum type, lower the injection temperature, or reduce the injection volume.
Impurities present in syringe wash solvent	Use high purity grade solvents.

Correction of Retention Time Differences Between Runs

Symptom	Solution
Unstable carrier gas flow controller/regulator	Check the pneumatics for leaks. If necessary, replace the flow controller/ regulator.
Column contamination or degradation	Condition or replace the column.
Injector leaks	Replace the septum at regular intervals. Check that the septum nut and capillary column nut are tight.

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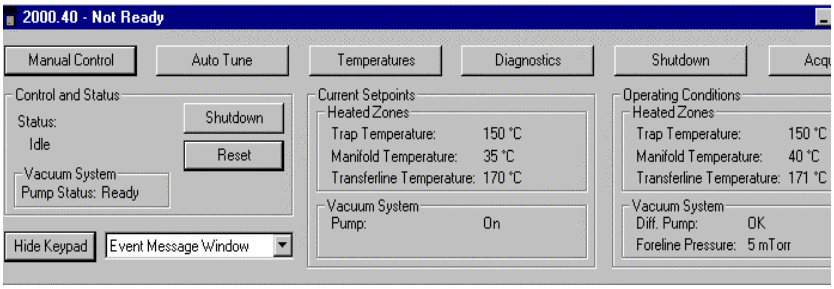
Troubleshooting of Diffusion Pump System

Overview

This section describes symptoms that the user may observe during startup and routine operation.

Problems During Startup

The user should check for faults during Startup by monitoring the foreline pressure on the shutdown page.



Shutdown Page

1. Foreline pressure exceeds 5000 mTorr (Large Air Leak)
   a. Check the GC column is not broken.
   b. Check the foreline hose between the diffusion pump and foreline pump for cracks or collapsed sections.
   c. Check all the vacuum seals: diffusion pump, elbow, foreline pump, etc.
   d. Check for large air leaks. Refer to troubleshooting sections on leaks.
   e. Check the level and condition of the foreline pump oil.
   f. Contact Varian Customer Support Representative.

2. Foreline pressure exceeds 500 mTorr (Moderate Air Leak)
   a. Check the GC column is not broken.
   b. Check the CI valve is OFF using the Instrument Control Page.

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c. Check for air leaks. Refer to **How to Check for Leaks**.

d. Check the fluid level in the diffusion pump.

e. Check the level and condition of foreline pump oil.

f. Check the foreline hose between the diffusion pump and foreline pump for cracks or collapsed sections.

g. Check all the vacuum seals: diffusion pump, elbow, foreline pump, etc.

h. If a foreline trap is used, replace the pellets.

i. Replace the thermocouple gauge.

j. Contact Varian Customer Support Representative.

k. TEC Failure

l. Check cable connections. Connectors and pins are differentiated by size.

m. Contact Varian Customer Support Representative.

3. Peltier Baffle Fan Failure

   a. Check the fan on the rear panel.

   b. Contact your Varian Customer Support Representative.

4. Thermocouple Gauge Failure

   c. Check the cable connections.

   d. Open filament. Gauge must be replaced.

   e. Contact Varian Customer Support Representative.

5. Diffusion Pump Overheated

   a. Check the pump is plugged into the diffusion pump controller.

   b. Ensure left side cover is in place. Side panel of GC is in place.

   c. Check the fan.

   d. Contact Varian Customer Support Representative.

6. Diffusion Pump Heater Failure

   a. Check pump is plugged into diffusion pump controller.

   b. Replace heaters to diffusion pump.

   c. Contact Varian Customer Support Representative.

Problems During Routine Operation

The USER should check for faults by going to the Diagnostics page and checking the Pump Status under **Vacuum System.1. Foreline Pressure Readings**.

1. At typical column flows (0.3-1.0 mL/minute) the foreline pressure will be approximately 0-100 mTorr. If the foreline pressure is significantly above 100 mTorr:

   a. Ensure column flow rate does not exceed 1.0 mL/minute.

   b. Check for air leaks. Refer to **How to Check for Leaks**.

   c. Check the level and condition of the diffusion pump fluid.

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d. Check the fluid level and condition of the foreline pump, if it's time for maintenance, change the oil.

e. If a foreline trap is used, replace the pellets.

f. Check all the vacuum seals: diffusion pump, elbow, foreline pump, etc. The diffusion pump seals may leak if the clamp is not tight or because the seals are worn or damage. Worn or damaged seals must be replaced.

g. Contact your Varian Customer Support Representative.

2. CI Gas Settings (must be checked in Diagnostics)

   a. Pressure Readings should not exceed 350 mTorr. Confirm CI reagent gas head pressure at gas cylinder is set at 5 psi.

3. Diffusion Pump Overheated

   a. Overheating causes the diffusion pump to turn OFF. Switch the power OFF for 15 minutes. then, switch it ON to reset the diffusion pump.

   b. Check the ambient temperature of the laboratory does not exceed 35 °C.

   c. Check fluid in the diffusion pump.

   d. Ensure all baffling is in place.

   e. Check the fan.

   f. Check to make sure left side cover is in place.

   g. Contact Varian Customer Support Representative.

4. High background levels (low ionization time) in the mass spectra may be the result of contamination in the ion trap, GC and/or the diffusion pump. If numerous samples have been analyzed, the high background maybe the result of trap contamination, and the trap components must be cleaned. If the ion trap components have been cleaned and the system has been baked out, the high background levels in the mass spectra maybe the result of contamination in the GC and/or the diffusion pump. Comparison of mass spectra at high and low GC column and injector temperatures may help to identify source.

   a. Reduce GC column and injector temperature to 100 °C or lower and acquire a 2-minute mass spectral data file.

   b. Increase GC column and injector temperature (~250 °C) and acquire 2-minute mass spectral data file.

   c. Identify the most intense mass peaks for both runs, and/or subtract spectra.

   d. Use the following table to identify the most likely source(s) of contamination.

   e. Call your Varian Customer Support Representative.

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Common Contaminant Ions (m/z)	Compound	Possible Source
18, 28, 32, 44	H_2O, N_2, O_2, CO_2	Air Leak
69, **131**, 219, 264, 414, 464, 502, 614	PFTBA	Leaking Calibration Valve
31, 32	Methanol	Cleaning Solvent
43, 58	Acetone	Cleaning Solvent
73, 147, **207**, 221, **281**, 355, 429	Dimethylpolysiloxane	Septum or methyl silicone column coating
77, 92, 115,128,141, 168,184, 223, 233, 260, **354**, **446**	Diffusion Pump Fluid	Diffusion Pump Fluid
149	Plasticizer (Phthalates)	Vacuum seals damaged by high temperature. Solvent Bottle Contamination
Groups of peaks spaced 14 u apart	Hydrocarbons	Foreline pump oil, fingerprints, saturated trap pellets
77, 141, 169, 204	1-chloro-3-phenoxybenzene	Pump oil degassing contamination
146, 148, 111	Dichlorobenzene	Pump oil degassing contamination

NOTE: Numbers in **bold** denote masses more useful for identifying contaminants.

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Miscellaneous Procedures and Instructions

Other Documents

Other documents that you may wish to consult regarding Saturn operation include the following:

Software Reference, 03-914979-00

Saturn GC/MS Workstation Tutorials, 03-914988-00

Pre-Installation Instructions, 03-914629-00

Release Notes, 03-914767-00

Upgrade Notes, 03-914768-00

Site Requirements

Site Preparation

The Saturn GC/MS has been designed to operate reliably under carefully controlled environmental conditions. It is the responsibility of the purchaser to provide a suitable location, a power source of acceptable quality, and a suitable operating environment. Operating a system or maintaining it in operational condition outside of the power and operating environment limits listed below could cause failures of many types. The repair of such failures is specifically excluded from the standard warranty and service contract coverage.

For additional information, please request specific pre-installation support directly through your local Varian Sales/Service Center.

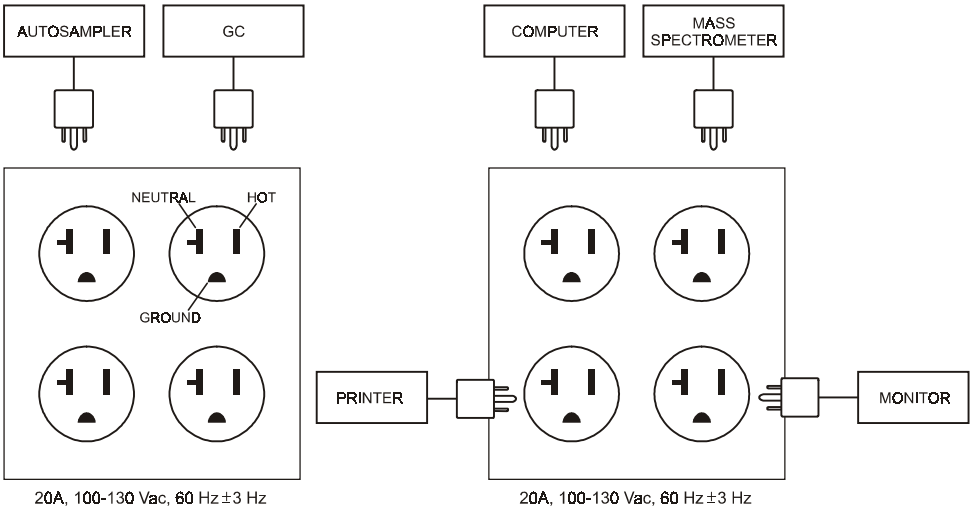
Power

You are responsible for providing two dedicated fourplex single-phase power sources with earth grounds hard-wired to the main power panel ground. Within North America these power sources must be 20A, 100-130 Vac, 60 Hz ±3 Hz, and outside North America they must be 10A, 200-260 Vac, 50 Hz ±3 Hz. One of these fourplex power sources is for the mass spectrometer, computer, monitor; and printer the other fourplex power source is for the gas chromatograph and (optional) AutoSampler. If you have additional sample preparation devices or test

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equipment, we recommend a separate dedicated power source for their operation.

NOTE: Do not use the free outlet for equipment that draws more than 2 amps.



Interconnect Diagram for the Saturn GC/MS

NOTE: Avoid using power supplies from sources that may be subject to RF interference, such as electric motors and elevators.

Care must be taken to ensure that sources of radio frequency interference (RFI) and electromagnetic interference (EMI) are not placed on the same power line, or share the same ground plane, since this can degrade the performance of the GC. Equipment such as motors, solenoids, fluorescent light fixtures, and radio communication transmitters should be isolated from the instrument and connecting cables as much as possible.

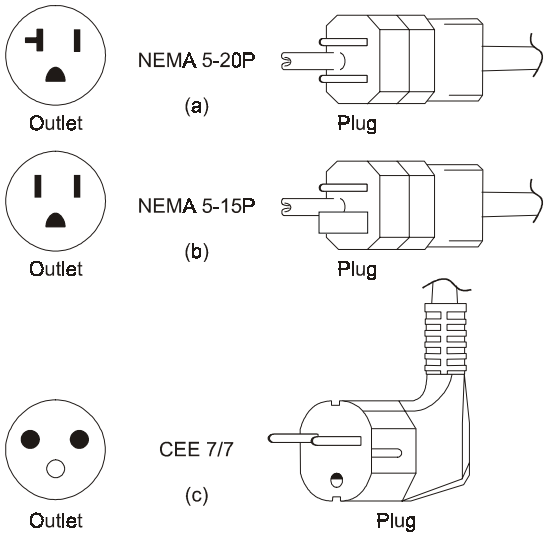
The power cable from the GC is approximately 2m (6 ft) long and fitted with National Electronics Manufacturers Association (NEMA) 5-20P power plugs. The NEMA 5-20P power plug and corresponding outlet are shown in Figure (a). NEMA 5-20P plugs are rated at 20A and 120 Vac.

The power cable from the mass spectrometer is approximately 2.5m (8 ft) long and fitted with US Standard National Electronics Manufacturers Association (NEMA) 5-15P power plugs. The NEMA 5-15P power plug and corresponding outlet are shown in Figure (b). NEMA 5-15P plugs are rated at 15A and 120 Vac.

Systems shipped outside the United States and Canada are fitted with CEE 7/7 plugs; these are rated at 16A and 230 Vac. The CEE 7/7 plug and outlet are shown in Figure (c).

The power cables for the computer, monitor, and printer are approximately 2m (6 ft) long. They are fitted with NEMA 5-15P plugs. The power cable from the 8200 AutoSampler is about 2m (6 ft) long, and is fitted with a NEMA 5-15P plug rated at 120V.

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NEMA 5-20P, NEMA 5-15P, and CEE 7/7 Power Plugs and Outlets

With a 120V power source, the maximum amperage requirements for each of the Saturn GC/MS components are as follows:

Component	Amperes
Mass Spectrometer	12
Gas Chromatograph	20
Varian 8200 AutoSampler	0.5
Computer	3
Monitor	2
Laser Printer	3-4

NOTE: With a 230V power source, the maximum amperage requirement of each of the above components is one-half of the amperage given above.

Never plug the mass spectrometer and the gas chromatograph into the same power source; otherwise, you may overload the fourplex power source. The Interconnect Diagram for Saturn is a diagram for the six power cables from Saturn. Never use the free outlet on each of the power sources for equipment that draws more than 2A.

Quality of Power

The quality of the power supplied to your Saturn is very important. The power must be 100-130 Vac, 60 Hz ±3 Hz (200-260 Vac, 50 Hz ±3 Hz), and it must be stable. It must be free of fluctuations due to slow changes in the average voltage or to changes resulting from surges, sags, or transients.

Slow average changes are gradual, long-term changes in the average root mean square (RMS) voltage level, with typical durations greater than 2 seconds.

Sags and surges are sudden changes in average RMS voltage level, with typical durations between 50 sec and 2 seconds.

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Transients (or impulses) are brief voltage excursions of up to several thousand volts with durations of less than 50 sec.

Constant high line voltage or surges in voltage can produce overheating and component failures. Constant low line voltage or sags in voltage may cause the system to function erratically or to even cease functioning. Transients, even of a few microseconds duration, may cause electronic devices to fail catastrophically or degrade sufficiently to significantly shorten their lives. Therefore, it is important to establish the quality of the line power in your laboratory before you install your Saturn.

Operating Environment

It is your responsibility to provide an acceptable operating environment. Attention paid to the operating environment will ensure continued high performance of your Saturn GC/MS. Expenditures for air conditioning will be more than offset by good sample throughput and a reduction in repair costs.

Temperature

The laboratory temperature must be held between 15 and 30 C (59 and 86 F) for the turbomolecular pump system and 15 to 35 C for the diffusion pump system. The optimum operating temperature is between 18 and 21 C (65 and 70 F).

NOTE: As the laboratory temperature increases, system reliability decreases. All electronic components generate heat while operating. This heat must be dissipated to the surrounding air if the components are to operate reliably.

The turbomolecular pump's temperature cutoff protects the bearing and prolongs its lifetime. If the laboratory temperature is significantly above 30 C (86 C), the pump cutoff temperature could be reached, and this would result in the pump being shutdown.

There must be a good flow of air around the system, and the air conditioning must be capable of maintaining a constant temperature (within operational limits) in the immediate vicinity of the system. The average steady-state heat load of the Saturn GC/MS is 6000 BTUs, with a possible short-term heat dissipation of 15000 BTUs during startup. If a 3600 GC is used, heat dissipation increases by about 1200 BTUs.

Humidity

The relative humidity of the operating environment must be between 40 and 80%, with no condensation. Operating a Saturn GC/MS at very low humidity will result in the accumulation and discharge of static electricity; this will shorten the life of electronic components. Operating the system at high humidity will produce condensation and result in short circuits. High humidity will also block the filters on cooling fans and accelerate wear of the heads in the diskette drives.

Varian recommends that your laboratory be equipped with a temperature/humidity monitor. This will ensure that your laboratory is always in conformance with temperature and humidity specifications.

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Exhaust System

It is your responsibility to provide an adequate exhaust system. Much of what is introduced into the mass spectrometer will eventually be exhausted from the mechanical pump, along with the small amounts of oil vapor that these pumps characteristically emit. Therefore, the pump outlets should be connected to a fume exhaust system. Consult local regulations for the proper method of exhausting the fumes from your system.

Gas Requirements

Helium - GC Carrier Gas

Minimum 99.998% ultra-high purity, with less than 1.0 ppm each of water, oxygen, and total hydrocarbons. One 257-ft3 tank with Matheson regulator #3104-580, or equivalent tank and regulator.

NOTE: The presence of >1 ppm oxygen or water in the carrier gas supply may significantly affect the performance of Saturn, and it damage such components as the capillary column, filaments, and multiplier. Varian recommends that its customers verify that their gas suppliers use controlled tanks; this will ensure that purity standards are maintained. If you purchase pure gases in contaminated tanks, you may end up with a contaminated system requiring costly and time consuming repair.

Methane, Isobutane - CI Reagent Gases (with CI option only)

99.99% purity. One gas cylinder with a two-stage pressure regulator, which has a stainless steel diaphragm and maximum inlet pressure of 15 psi (1 bar).

Ammonia - CI Reagent Gas (with CI option only)

99.99%, anhydrous grade. One gas cylinder with a two-stage pressure regulator, which has a stainless steel diaphragm and maximum inlet pressure of 15 psi (1 bar).

Gas lines for helium, nitrogen, methane, and isobutane should be made of copper or stainless steel. Gas lines for ammonia should be made of stainless steel. All gas lines should be free of oil; they will have preferably been flame dried. The gas lines should be fitted to within 2m of Saturn. Do not store gas tanks or lecture bottles where they can damage cables or gas lines; always secure them in accordance with standard safety practices. Gas supply lines should terminate with 1/8-in., Swagelok® nuts and ferrules.

Cryogenics

Systems equipped with SPI/1079 injectors or column oven cryogenics require one of the following:

Liquid CO_2 at 850-1000 psig

Liquid N_2 at 20-50 psig

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If you are not sure which one of these cryogenic options you ordered, check your purchase order.

Other Gases

If you ordered an 8200 AutoSampler or automated valves, an independent supply of air or N_2 at 40-60 psig may be required.

How to Install Saturn

To install the Saturn GC/MS, proceed as follows:

1. Connect the GC to a helium source, and then purge the system filters, and columns for 15 minutes.
2. Feed the capillary column and nut through the side of the GC. Connect the column to the transfer line.
3. Slide the Saturn GC/MS toward the GC until the transfer line is protruding into the GC oven.
4. Connect vacuum tubing from the rear of the Saturn MS to the foreline pump with a clamping ring.
5. Connect the power cord from the foreline pump to the rear of Saturn. (J2 label pump power only)
6. Connect the GC serial cable to the COM1 port on the computer if using a 3400/3600 GC.
7. Connect the GC ethernet cable to the ethernet port on the computer if using a 3800 GC. There should be a tee connector and a terminator at each end of the 50-ohm coax cable.
8. Connect the IEEE cable to the Saturn GC/MS and the computer.
9. Plug in the GC, ms-spectrometer, and data-system power cords.
10. Switch on the power to the Saturn GC/MS, the GC, and the computer.
11. Bring up Saturn System Control on the computer.
12. Select Diagnostics.
13. Check the turbomolecular pump speed. The pump speed should reach the 100% value within 30 min of turning on the power to the mass spectrometer. The diffusion pump should reach READY state in 30 min.
14. Bake-out the trap (250 C) and manifold (120 C) for at least 2 hours before you tune it.

How to Move Saturn

To move Saturn, proceed as follows:

1. Using the shutdown procedure shut down the GC and mass spectrometer.
2. Turn off the GC and computer. Then unplug the GC, mass spectrometer, and data system power cords.

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3. Open the vent valve lever on the front of the mass spectrometer for ten minutes.
4. Keep an eye on the capillary column inside the GC as you gently slide the mass spectrometer away from the GC. Be sure not to bend or kink the capillary column.
5. Use the alignment tool to prevent the transfer line from turning while you loosen the brass capillary nut connecting the column to the transfer line.
6. Cap the transfer line with a capillary nut and no-hole ferrule.
7. Place the capillary column and nut inside the GC oven. This will protect them from damage.
8. Turn off the carrier gas, then disconnect the helium gas line that is connected to the GC filter.
9. Cap the filters with Swagelok plugs or caps.
10. Move the Saturn GC/MS to its new location. Be sure the new location satisfies the power and environmental requirements.

Parts and Supplies

Listed below are part numbers and descriptions for the available Saturn Field Service Parts. Items are in quantities of one (1) each unless otherwise specified.

Kits, Assemblies, Boards, and Cables

Part Number	Description
03-926082-20	PWA, IEEE INTERFACE, PCI
03-930326-01	IEEE Cable
03-930210-02	PWA, POWER BOARD
03-930250-01	PWA, RF GENERATOR
03-930300-01	Cable, SAP to PWR 26 pins (Ribbon)
03-930301-01	Cable, SAP to PWR 64 pins (Ribbon)
03-930113-91	Replacement Spares Kit
03-930010-01	Assembly, Analyzer Flange
03-930005-91 03-930005-92	Assembly, Transfer Line (115V) Assembly, Transfer Line (230V)
03-930334-01 03-930334-02	Cable, Transfer Line heater (115V) Cable, Transfer Line heater (230V)
03-930008-91 03-930008-92	Assembly, Vacuum Manifold (115V) Assembly, Vacuum Manifold (230V)
03-930558-01	Assembly, Ion Gauge
03-930313-01	Cable, Trap Heater (115V)
03-930313-92	Cable, Trap Heater (230V)

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Trap Components

NOTE: The Silica Coated Spacers have a shiny, mirror like finish on the inside surface.

Part Number	Description
03-930552-01	Gate Conductor
03-930551-01	Gate
14-920009-00	Wavy Washer
03-930315-01	Assembly, Multiplier
03-930535-01	Spacer, Quartz
03-930108-01	Transfer Line Wrench/Analyzer Alignment Tool
03-930601-91	Assembly, Filament disk with wires
14-998238-00	Belleville Washer, Small
03-930657-01	Screw, Long
03-930657-02	Screw, Short
03-936549-01	Filament Clip
03-930591-91	Tip. Transfer Line (Ultra Clean)
03-930500-01	Trap Oven
03-930524-01	Clamping Plate
03-930535-02	Quartz Spacer, Silica Coated
13-122008-00	Nut, 11/32"
14-998228-00	Belleville Washer, Large
03-930539-01	Thermo Well
03-930109-04	Thermo Well O-ring
12-222006-06	Trap Oven screw 6-32 X 3/8
03-930109-03	O-ring, 1.112 ID Transfer Line
03-930109-14	Quad-ring, Viton® Manifold
03-930109-18	Quad-ring, Viton Transfer Line

Pump Spares, Pumps, Pump Conversion Parts

Part Number	Description
03-930650-01	Mechanical Pump, 90 L/min, 115/230V, Varian
03-920358-00	Screen, Turbo Pump (V-70)
03-930316-01	Cable, Turbo Controller to turbo
03-930317-91	Turbo Controller
03-920518-00	7’ Length Tygon® Tubing
03-920542-00	Turbo Molecular Pump (V-70)
88-299517-00	Mechanical Vacuum Pump Oil
28-200438-00	O-ring, Turbo Pump to Manifold

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Diffusion Pump Spares

Part Number	Description
03-930053-01	Chassis Fan, Electronics Side
03-930645-01	Chassis Fan, Pump Side
03-920510-00	Plastic Nut
03-930109-02	O-ring, Elbow
27-402294-00	O-ring, Diffusion Pump Inlet
27-402536-00	O-ring, Diffusion Pump Exhaust
03-930109-16	O-ring, Peltier Baffle
03-930288-01	PWA Diffusion Pump Controller
27-229907-00	Thermocouple Gauge
03-930640-91	Diffusion Pump AX65 (90V 250W) Includes 40 cc Fluid
03-930640-92	Diffusion Pump AX65 (165V 250W) Includes 40 cc Fluid
03-930640-94	Diffusion Pump Heater (90V 250W) Includes 40 cc Fluid
03-930640-95	Diffusion Pump Heater (165V 250W) Includes 40 cc Fluid
03-930639-01	Diffusion Pump Fluid - 40cc - Santovac 5
03-930038-01	Peltier Baffle Assembly
03-930048-91	Assembly, Vacuum Manifold DP (120V)
03-930048-92	Assembly, Vacuum Manifold DP (230V)

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GC Spares

Part Number	Description
03-917742-00	Serial I/O PWA
03-925367-31	PWA, CPU, IBDH, 3400 SOC
03-925367-33	PWA, CPU, IBDH, 3600 SOC
03-918332-01	Insert, SPI, High Performance, Glass
03-949551-00	Nut, Capillary Injector
28-694580-01	Ferrule, 0.4 mm ID X 1/16, pkg. 10
28-694581-01	Ferrule, 0.5 mm ID X 1/16, pkg. 10
03-920357-02	Septa, HT, ThermoGreen™ 11.5 mm (50/can)
03-925342-02	1078/1079 5 mm Glass Insert Ferrule
03-925350-00	1078/1079 2 mm ID Packed Insert
03-918466-00	1078/1079 2 mm ID Open Insert
03-925331-00	1078/1079 0.5 mm ID Open Insert
03-918464-00	1078/1079 3.4 mm ID Open Insert
03-926119-27	1177 4 mm ID Unpacked Single Gooseneck Insert (5/pk)
03-926119-37	1177 4 mm ID Wool Plug Open Insert (5/pk)
03-926119-25	1177 4 mm ID Unpacked Open Glass Insert (5/pk)
03-926119-38	1177 2 mm ID Wool Plug Open Glass Insert (5/pk)
03-926119-24	1177 2 mm ID Unpacked Open Glass Insert (5/pk)
03-926116-82	1177 High Temperature Septa (100/pk)
03-925989-02	1177 Thermogreen Septa (5/pk)
03-926117-64	1177 Viton® O-ring Seal (100/pk)
03-926119-30	1177 Graphite Seal (100/pk)

Tools, Test Samples, etc.

Part Number	Description
03-920270-00	FC-43, Reservoir (Cal Gas Bulb)
03-920273-00	Col Test Sample
03-920275-00	HCB Sample, 100 pg/ L
03-920471-00	Sensitivity Sample EI/CI HCB, Benzophenone, Tetrachlorobenzene 2,10,500
03-920276-00	Aluminum Oxide, 600 Grit
03-920305-00	Benzophenone Test Sample (50 pg)
03-920353-00	GC/MS Calibration Compound, FC-43
55-500346-00	Fuse, 5 x 20 mm, 0.5A
88-999990-00	Applicator, Cotton Tipped, pkg. 100

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Additional Saturn Spares

Part Number	Description
03-914763-00	Saturn GC/MS Workstation Hardware Maintenance Manual
03-914764-00	Saturn GC/MS Workstation Software Reference Manual
03-914765-00	Saturn GC/MS Workstation Tutorials Manual
03-930107-02	Solenoid, 3-way, Cal Gas
03-930100-01	Needle Valve, Cal Gas
27-350005-00	Oil Mist Eliminator
03-925677-91	ChromatoProbe Kit

CI Parts/Spares

Part Number	Description
03-930102-02	Solenoid, 2-way, CI
03-930597-01	Restrictor, long, CI
03-930596-01	Restrictor, short, CI
03-930101-01	Needle Valve, CI Gas
03-930022-91	Liquid CI Inlet Kit
03-930-106-01	CI Solenoid, 2-way, Chemrez

Multiple CI Module Parts Lists

Part Number	Description
03-930061-01	Manifold, Multi, CI Inlet
03-930102-02	Valve, Solenoid, 2 Way, Buna-N
03-930101-01	Valve, Needle
03-930062-01	Plate, Clamping, Bottom, Multi CI
03-930063-01	Plate, Clamping, Top, Multi CI
28-849792-00	Fitting. Plug
28-849793-00	Fitting. Tube, Barb
28-849066-00	Beswick Fitting, Elbow
28-849067-00	Beswick Fitting, 1/8 inch, Viton®
03-917142-00	Ferrule, Viton
03-930064-01	Enclosure, Multi CI (cover)
03-930065-01	View Plate, Enclosure, Multi CI
23-620763-00	Screw, Captive, 6-32
03-920270-00	Reservoir, Bulb
03-930069-01	Restrictor, Tube, Top
03-930596-02	Restrictor, Tube, Bottom
12-222006-22	Screw, 6-32 x 1 1/4, SS

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Part Number	Description
12-222006-08	Screw, 6-32 x 1/2, SS
12-222006-05	Screw, 6-32 x 5/16
28-158923-00	Tubing, Vacuum
28-849918-00	Fitting, Tee, Barb
03-930870-02	Cap, Polypro, 1/8 inch
03-930109-10	O-ring, 2-104
03-930109-17	O-ring, 2-108
03-930071-00	Cover, Connector, Harness
03-930068-01	Assembly, Harness, Solenoids, Multi CI
03-930076-01	Label

MCI Module Accessory Kit

Part Number	Description
17-783512-00	Plug, Pin For plugging 1/8 inch ports on MCI when channel not connected to liquid or gas.
03-930109-10	O-ring, 2-104, Buna-N Replacement O-rings for 1/8-inch ports.
03-930109-17	O-ring, 2-108, Buna-N Replacement O-rings for ¼ inch ports.
28-694638-00	Ferrule, Teflon, rear Replacement ferrules for gas adapter.
28-694639-00	Ferrule, Teflon, front
28-695138-00	Gas Tube Adapters To connect gases to MCI module through 1/8-inch ports.
03-920270-00	Reservoir, Bulb Liquid reagent vials
03-949870-04	Cap, Plug Vial caps for storage of reagent vials.
89-988956-00	Syringe, 5 mL, Luer Syringe for adding reagent liquids to reagent vials.
03-930129-01	Assembly, Luer Teflon “needle” for syringe
03-930073-01	Stand, Reservoir For storage, filling of reservoir bulbs.

Open Split Interface

Part Number	Description
03-920324-00	OSI Restrictor
03-920325-00	Assembly, OSI, Subassembly
03-920326-90	Kit, OSI Parts, Field Service
28-211522-00	Nut, OSI, GC 1/16 X 1.2 mm

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Calling Varian Service

If you have a problem with your Saturn GC/MS that you are unable to resolve using the procedures described, you may want to call a Varian Customer Support Representative. When you call, please be prepared to provide the following information:

- Saturn serial number (located on the rear panel)
- Installed options.
- Diagnostics test results

If you are having problems with the gas chromatograph, please be prepared to provide the following information:

- GC model
- AutoSampler model, if any
- Type of injector you are using
- Cryogenics
- Information about your GC column, (i.e., the manufacturer, bonded phase, film thickness, and ID and length)

If you are having problems with your computer and/or software, please be prepared to provide the following information:

- Computer manufacturer and model
- Windows version
- Mouse driver version
- Printer manufacturer and model
- Network configuration
- Printouts of your Autoexec.bat and Config.sys files
- Saturn software version

In addition, you should observe the following guidelines when describing the problem to the Customer Support Representative:

- Tell the service representative which part of the software, (e.g., System Control, Manual or Acquisition, you were using when the problem occurred).
- Tell the service representative which troubleshooting routines you have used.

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