3700FR/3720 Refrigerated Sampler

Instruction Manual

Part #60-2723-159 of Assembly #60-3704-104

Revision G, July, 2002

ISCO®

Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Isco recommends that you read this manual completely before placing the equipment in service.

Although Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If the problem persists, call or email the Isco Customer Service Department for assistance. Contact information is provided below. Simple difficulties can often be diagnosed over the phone. If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by the Customer Service Department, including the use of the **Return Authorization Number** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Contact Information

Phone:	(800) 228-4373	(USA, Canada, Mexico)
	(402) 464-0231	(Outside North America)
Repair Service:	(800) 775-2965	(Analytical and Process Monitoring Instruments)
	(800) 228-4373	(Samplers and Flow Meters)
Fax:	(402) 465-3022	
Email address:	info@isco.com	
Website:	www.isco.com	

Return equipment to: 4700 Superior Street, Lincoln, NE 68504-1398

Other correspondence: P.O. Box 82531, Lincoln, NE 68501-2531

SAFETY SUMMARY

The Model 3700FR/3720 Refrigerated Sampler is a "definite purpose" device, intended for use **only** with compatible Isco equipment. Do **not** use this product with any other manufacturers' equipment, or for any other purpose. Use for any purpose not described in this manual could cause personal injury or property damage.

Electrical Requirements

The refrigerator is available in both 120 V∿ and 230 V∿ configurations. The required operating voltage for the refrigerator is listed on the Identification and Serial Number label, placed on the inside of the sample compartment door.

Refrigerators configured for 120 V∿ operation are equipped with a North American NEMA 5-15P plug and is intended for use **only** with 120 V∿, 60 Hz. The power source should be rated for 30 ampere service.

Refrigerators configured for 230 V∿ operation are equipped with a Continental European CEE 7/7 plug and is intended for use **only** with 230 V∿, 50/60 Hz. The power source should be rated for 16 ampere service.

Refrigerators in either configuration provide 12.5 V⎓ at 5 amperes for the sampler controller. This output is from the two-pin military-type connector on the cord on top of the refrigerator. This output is intended for 3700 Series Sampler controllers **only**.

The refrigerator must be installed near a suitable power outlet. Never use an extension cord.

The power outlet must be visible and easily accessible. Unplugging the refrigerator is the only means of disconnecting power.

To minimize the risk of electrical shock, the refrigerator must be connected to an outlet with an electrical ground contact.

The power source must be a dedicated circuit. The line must not power any other devices.

Never operate the refrigerator with the lower front or rear panels removed.

Never operate the refrigerator in an explosive atmosphere.

Do not locate the refrigerator where the lower compartment could become submerged.

Do not lift or carry the refrigerator. Use an appliance carrying device.

Fuses must be replaced with the required size, current, voltage, and blow-time specifications. Refer to the *Replacement Parts Listing* for the correct part number.

SAFETY SYMBOLS AND HAZARD ALERTS

The icons on the Model 3700FR/3720 Refrigerated Sampler and those found within this instruction manual alert the user of known hazards. The icons are described below.

This icon identifies a general hazard. Refer to the instruction manual for more information.

This icon indicates the risk of electrical shock. Refer to the instruction manual for more information.

The instruction manual identifies the hazardous condition and any steps necessary to correct the condition. The manual presents this information in one of two ways:

CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

WARNING

Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

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WARNING

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Pages 8 and 10

Note

Read the *Safety Summary* posted at the front of this manual. It outlines the electrical requirements and provides instructions for safe operation.

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CAUTION

If the filter is not cleaned periodically, damage due to overheated components may result.

Page 99

WARNING

Removing the front or back panel exposes electrical and mechanical hazards. Disconnect power before performing any service activities.

Pages 100 (twice) and 101

CAUTION

Pump may actuate without warning. To avoid injury, sampler must be off when pump housing cover is removed for inspection or tubing replacement.

Page 107

WARNING

Removing the back panel exposes electrical and mechanical hazards. Disconnect power before performing any service activities.

Page 111

CAUTION

All refrigeration repair work must be performed by a qualified refrigeration technician.

Always purge the system with nitrogen. NEVER USE AIR to purge the system.

Always recover the refrigerant.

When recharging, do not leave a line tap in the refrigeration system because of possible corrosion or leakage problems.

Page 112

WARNING

Removing the front and back panel exposes electrical and mechanical hazards. Troubleshooting and repair activities should be performed by a qualified refrigeration technician.

Pages 114 and 116 (3)

CAUTION

Disconnect power from the refrigerator and controller when working on the unit.

Keep yourself grounded when handling disassembled equipment.

RECAPITULATIF DES MESURES DE SECURITE

L'échantillon réfrigéré modèle 3700FR/3720 est un appareil "à but défini", qui doit être utilisé uniquement avec du matériel compatible Isco. Ne pas utiliser ce produit avec le matériel d'autres fabricants ou à d'autres fins. Son usage à d'autres fins que celles indiquées dans ce manuel pourrait provoquer des accidents corporels ou des dégâts matériels.

Conditions électriques requises

Le réfrigérateur est disponible en 120 V∿ et 230 V∿. Le voltage nécessaire à son fonctionnement est indiqué sur l'étiquette d'identification et de numéro de série qui se trouve à l'intérieur de la porte du compartiment de l'échantillon.

Les réfrigérateurs configurés pour du 120 V∿ sont équipés d'une prise NEMA 5-15p américaine, et doivent fonctionner exclusivement avec du courant de 120 V∿, 60 Hz. L'alimentation électrique doit être réglée sur 30 ampères.

Les réfrigérateurs configurés pour du 230 V∿ sont équipés d'une prise CEE 7/7 européenne, et doivent être utilisés exclusivement avec du courant de 230 V∿, 50/60 Hz. L'alimentation électrique doit être réglée sur 16 ampères.

Les réfrigérateurs des deux configurations fournissent du courant de 12.5 V⎓ à 5 ampères au contrôleur de l'échantillon. Ce courant est alimenté par le connecteur de type militaire à deux prises qui se trouve sur le fil au-dessus du réfrigérateur. Cette production de courant est destinée exclusivement aux contrôleurs d'échantillons de la série 3700.

Le réfrigérateur doit être installé à proximité d'une prise de courant murale appropriée. Ne jamais se servir de rallonge.

La prise de courant doit être visible et facile d'accès. La seule façon d'éteindre le réfrigérateur est de le débrancher.

Pour diminuer le risque de choc électrique, le réfrigérateur doit être branché dans une prise de courant équipée d'une fiche de terre.

L'alimentation électrique doit provenir d'un circuit unique. Le circuit ne doit alimenter aucun autre appareil.

Ne jamais faire fonctionner le réfrigérateur quand les panneaux inférieur de devant ou de derrière sont enlevés.

Ne jamais faire fonctionner le réfrigérateur dans un environnement explosif.

Veuillez placer l'appareil de façon à ce que la partie inférieure dugroupe frigorifique ne risque pas d'être immergée.

Ne pas soulever ou porter le réfrigérateur. Utiliser un appareil prévu pour le transport des gros appareils électriques.

Les fusibles doivent être remplacés par d'autres de mêmes taille, courant, voltage et puissance. Consulter la liste des pièces de rechange pour obtenir le bon numéro de pièce.

SYMBOLES DE SECURITE ET SIGNAUX DE DANGER

Les icônes placées sur l'échantillon réfrigéré modèle 3700FR/3720 ainsi que celles trouvées dans ce manuel d'instructions avertissent l'utilisateur des dangers connus. Ces icônes sont définies ci-dessous.

Cette icône représente un danger d'ordre général. Consultez le manuel d'instructions pour de plus amples informations.

Cette icône indique le risque de choc électrique. Consultez le manuel d'instructions pour de plus amples informations.

Le manuel d'instructions décrit chaque situation dangereuse ainsi que les mesures à prendre pour la rectifier. Le manuel présente ces renseignements de deux façons:

ATTENTION

"Attention" indique un danger potentiel qui, s'il n'est pas évité, pourrait provoquer des blessures plus ou moins graves. Cette catégorie sert également à informer l'utilisateur des actions ou conditions qui pourraient provoquer des dégâts matériels.

AVERTISSEMENT

"Avertissement" indique la présence de circonstances qui pourraient être très dangereuses pouvant, si elles ne sont pas évitées, provoquer des blessures graves ou même la mort.

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AVERTISSEMENT

Tout changement ou modification fait à cet appareil sans avoir été au préalable approuvé par la personne responsable de son fonctionnement pourrait annuler le droit de l'utilisateur de s'en servir.

Pages 8 et 10

REMARQUE

Lisez le Récapitulatif des mesures de sécurité placé au début de ce manuel. Il explique les conditions électriques requises et fournit les mesures de sécurité d'emploi.

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ATTENTION

Nettoyez le filtre régulièrement pour éviter la surchauffe des composants.

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AVERTISSEMENT

Enlever les panneaux avant ou arrière entraîne des risques électriques et mécaniques. L'appareil doit être débranché avant son entretien.

Pages 100 (deux fois) et 101

ATTENTION

La pompe peut se mettre en marche sans préavis. Pour éviter tout accident, l'échantillon doit être débranché avant d'enlever le couvercle du compartiment où se trouve la pompe, pour en inspecter l'état ou changer les tubes.

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AVERTISSEMENT

Enlever le panneau arrière entraîne des risques électriques et mécaniques. L'appareil doit être débranché avant son entretien.

Page 111

ATTENTION

Toute réparation doit être faite par un technicien qualifié en réfrigération.

Purger toujours l'appareil avec de l'azote. NE JAMAIS UTILISER d'air pour purger l'appareil.

S'il fait ouvrir le système hermétique de la réfrigération pour réparation, toujours capturer le réfrigérant. Jamais ne lâcher pas le réfrigérant dans l'atmosphère. C'est interdit en la plupart de pays et peut endommager aussi l'ozone de l'atmosphère.

Pour recharger le système réfrigérant correctement, ne pas utiliser un robinet, aussi qu'il aura une fuite finalement ou causera la corrosion. Au lieu de cela, braser un tube court au tube de succion. Utilisez ce tube court pour recharger. Puis, écraser le tube court et braser son bout. Utiliser toujours la soudure d'argent.

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AVERTISSEMENT

Enlever les panneaux avant et arrière entraîne des risques électriques et mécaniques. Tout entretien ou réparation doit être effectués par un technicien qualifié en réfrigération.

Pages 114 et 116 (3)

ATTENTION

Débrancher le réfrigérateur ainsi que le contrôleur avant de travailler sur l'appareil.

Rester en contact avec la terre pendant le maniement du matériel démonté.

SICUREZZA

Il campionatore refrigerato R3700FR/3720 è un'apparecchiatura "per scopo specifico", destinata ad essere utilizzata esclusivamente con apparecchiature compatibili Isco. Non utilizzare il prodotto con apparecchiature di terzi né per scopi diversi da quello previsto. L'uso dell'apparecchiatura per scopi diversi da quello previsto nel presente manuale potrebbe provocare lesioni a persone e danni a cose.

Alimentazione

Il refrigeratore è disponibile in versione a 120 V~ e 230 V~. La tensione d'alimentazione richiesta è riportata sulla targhetta d'identificazione e del numero di matricola, che si trova all'interno dello sportello del vano portacampioni.

I refrigeratori in versione 120 V~ sono dotati di spina a norme nordamericane NEMA 5-15P e sono previsti esclusivamente per funzionare a 120 V~ - 60 Hz. La corrente d'alimentazione dev'essere a 30 ampère.

I refrigeratori in versione 230 V~ sono dotati di spina a norme europee CEE 7/7 e sono previsti esclusivamente per funzionare a 230 V~ - 50/60 Hz. La corrente d'alimentazione dev'essere di 16 ampère.

I refrigeratori in entrambe le versioni forniscono tensione a 12,5 V⎓ - 5 ampère al dispositivo di comando del campionatore. L'uscita utilizza il connettore di tipo militare a due contatti applicato al cavo che si trova sulla parte superiore del refrigeratore. Questa uscita è prevista esclusivamente per dispositivo di comando dei campionatori serie 3700.

Il refrigeratore dev'essere installato accanto ad un'idonea presa di corrente. E' vietato usare prolunghe.

La presa d'alimentazione dev'essere visibile e facilmente accessibile. Infatti l'unico modo per disattivare il refrigeratore è scollegarlo dalla rete.

Per ridurre il rischio di folgorazioni, il refrigeratore dev'essere collegato ad una presa dotata di messa a terra.

L'alimentazione dev'essere fornita attraverso un circuito separato, che non deve alimentare altre apparecchiature.

Non far funzionare il refrigeratore senza i pannelli anteriore inferiore e posteriore.

Non utilizzare il refrigeratore in atmosfere esplosive.

Non installare il frigorifero dove la parte inferione possa essere sommersa.

Non sollevare né trasportare il refrigeratore. Servirsi di un dispositivo per il trasporto di apparecchiature.

I fusibili devono essere sostituiti con altri con le stesse caratteristiche di formato, corrente, tensione e tempo d'intervento. Per il codice di ordinazione consultare l'elenco ricambi.

SIMBOLI DI SICUREZZA ED AVVERTENZE DI PERICOLO

I simboli riportati sul campionatore refrigerato modello 3700FR/3720 e quelli che si trovano nel presente manuale d'istruzioni mettono in guardia l'utilizzatore contro i pericoli conosciuti. Segue la spiegazione dei simboli.

Questo simbolo rappresenta pericolo generico. Per ulteriori informazioni consultare il manuale d'istruzioni.

Questo simbolo rappresenta pericolo di folgorazioni. Per ulteriori informazioni consultare il manuale d'istruzioni.

Nel manuale d'istruzioni sono descritte le condizioni di pericolo e le misure da adottare per evitarle. Nel manuale queste informazioni sono presentate in uno dei due modi seguenti:

AVVERTENZA

Avvertenza indica un pericolo potenziale che, se non viene evitato, può comportare lesioni secondarie o modeste. Può inoltre servire a segnalare all'operatore abitudini pericolose o condizioni che possono provocare danni a cose.

ATTENZIONE

Attenzione indica una condizione potenzialmente pericolosa che, se non evitata, può provocare gravi lesioni, morte compresa.

Page 7

ATTENZIONE

Eventuali cambiamenti o modifiche senza l'espressa autorizzazione del responsabile della conformità possono precludere all'utilizzatore il diritto di adoperare l'apparecchiatura.

Pages 8 and 10

Nota

Leggere le note relative alla Sicurezza sul frontespizio del presente manuale, che riportano le specifiche elettriche e le istruzioni per l'uso in condizioni di sicurezza dell'apparecchiatura.

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AVVERTENZA

La mancata pulizia periodica del filtro può provocare danni dovuti al surriscaldamento dei componenti.

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ATTENZIONE

Lo smontaggio del pannello anteriore o di quello posteriore espone a pericoli di natura elettrica o meccanica. Prima di iniziare qualsiasi operazione di manutenzione scollegare l'alimentazione.

Pages 100 (twice) and 101

AVVERTENZA

La pompa può funzionare senza preriscaldo. Per evitare lesioni, il campionatore dev'essere spento quando viene tolto il coperchio dell'alloggiamento della pompa a scopo d'ispezione o di sostituzione dei tubi.

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ATTENZIONE

Lo smontaggio del pannello posteriore espone a pericoli di natura elettrica o meccanica. Prima di iniziare qualsiasi operazione di manutenzione scollegare l'alimentazione.

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AVVERTENZA

Tutti i lavori di riparazione devono essere eseguiti da tecnici frigoristi qualificati.

Utilizzare azoto per spurgare il sistema. NON UTILIZZARE ARIA.

Recuperare sempre il refrigerante.

In fase di ricarica non lasciare i rubinetti di linea nel sistema di refrigerazione per via della possibilità di corrosione e di trafilamenti.

Page 112

ATTENZIONE

Lo smontaggio del pannello anteriore o di quello posteriore frontale espongono a pericoli di natura elettrica e meccanica. Le operazioni di ricerca guasti e riparazione devono essere affidate a tecnici frigoristi qualificati.

Pages 114 and 116 (3)

AVVERTENZA

Prima d'intervenire sull'apparecchiatura disalimentare il refrigeratore ed il dispositivo di comando.

Nel maneggiare l'apparecchiatura smontata mantenere il collegamento a terra della propria persona.

ZUSAMMENFASSUNG: SICHERHEIT

Der gekühlte Probenehmer (Refrigerated Sampler) Modell 3700FR/3720 ist ein Gerät für einen bestimmten Zweck, das nur mit kompatiblen Isco Geräten verwendet werden darf. Es darf nicht mit Geräten anderer Hersteller oder für andere Zwecke verwendet werden. Verwendung für andere als in diesem Handbuch beschriebene Zwecke kann Verletzung von Personen oder Beschädigung des Geräts zur Folge haben.

Elektrische Anforderungen

Der Kühlschrank ist in zwei Konfigurationen (120 V∿ und 230 V∿) erhältlich. Die erforderliche Betriebsspannung für den Kühlschrank ist auf dem Kenn- und Seriennummernetikett innen an der Probefachtür vermerkt.

Kühlschränke mit der 120 V∿ Konfiguration sind mit einem in Nordamerika üblichen NEMA 5-15P Stecker ausgerüstet und nur zur Verwendung mit 120 V∿, 60 Hz bestimmt. Die Stromquelle sollte für 30-Ampere-Betrieb ausgelegt sein.

Kühlschränke mit der 230 V∿ Konfiguration sind mit einem kontinental-europäischen CEE 7/7-Stecker ausgerüstet und nur zur Verwendung mit 230 V∿, 50/60 Hz bestimmt. Die Stromquelle sollte für 16-Ampere-Betrieb ausgelegt sein.

Kühlschränke beider Konfigurationen liefern 12,5 V⎓ bei 5 Ampere für den Probenehmer-Controller. Diese Ausgabe stammt vom zweipoligen Anschluß am Kabel oben am Kühlschrank. Diese Ausgabe ist nur für die Probenehmer-Controller der Serie 3700 bestimmt.

⚠ Der Kühlschrank muß in der Nähe einer geeigneten Steckdose aufgestellt werden. Es darf kein Verlängerungskabel verwendet werden.

⚠ Die Steckdose muß sichtbar und leicht zugänglich sein. Der Kühlschrank kann nur durch Herausziehen des Netzkabels ausgeschaltet werden.

⚠ Um die Gefahr von Elektroschocks zu vermindern, muß der Kühlschrank an einer geerdeten Steckdose angeschlossen werden.

⚠ Die Stromquelle muß ein dedizierter Stromkreis sein, d.h. die Leitung darf keine anderen Geräte mit Strom versorgen.

⚠ Der Kühlschrank darf niemals betrieben werden, wenn die unteren Frontplatten (vorne oder hinten) entfernt sind.

⚠ Der Kühlschrank darf nicht in einer Umgebung, wo Explosionsgefahr besteht, betrieben werden.

⚠ Kuehlgeraet so aufstellen, dass in den unteren teil kein wasser eintreten kann.

⚠ Der Kühlschrank darf nicht angehoben oder getragen werden, sondern nur mit einem Gerät zum Transport von Instrumenten oder Geräten fortbewegt werden.

⚠ Bei Erneuerung der Sicherungen sind die vorgeschriebene Größe, Stromstärke, Spannung und Durchbrennspezifikationen einzuhalten. Die entsprechende Ersatzteilnummer ist der Ersatzteilliste zu entnehmen.

SICHERHEITSSYMBOLE UND GEFAHRENHINWEISE

Die Symbole auf dem gekühlten Probenehmer Modell 3700FR/3720 und die in dieser Anleitung aufgeführten Symbole machen auf bekannte Gefahren aufmerksam. Diese Symbole werden nachstehend beschrieben.

⚠ Dieses Symbol kennzeichnet eine allgemeine Gefahrenquelle. Weiterführende Informationen sind im Benutzerhandbuch enthalten.

⚠ Dieses Symbol zeigt die Gefahr eines Elektroschocks an. Weitere Informationen sind im Benutzerhandbuch zu finden.

Das Benutzerhandbuch kennzeichnet die Gefahrenbedingung und mögliche erforderliche Schritte zur Behebung dieser Bedingung. In diesem Handbuch wird eine der zwei Gefahrenkategorien verwendet:

⚠ VORSICHTSHINWEIS

Vorsichtshinweise kennzeichnen eine potentielle Gefahr, die leichte oder mäßige Verletzungen zur Folge haben kann, wenn sie nicht vermieden wird. Diese Kategorie kann den Benutzer auch auf gefährliche Handhabung oder Bedingungen, die Beschädigungen verursachen können, aufmerksam machen.

⚠⚠ WARNING

Warnungen kennzeichnen eine potentiell gefährliche Bedingung, die den Tod oder schwere Verletzungen zur Folge haben kann, wenn sie nicht vermieden wird.

Seite 7

WARNUNG

Umbau oder Änderungen an diesem Gerät, die nicht durch die Partei, die für die Einhaltung der Vorschriften verantwortlich ist, ausdrücklich genehmigt wurden, können die Berechtigung des Benutzers zum Betrieb des Geräts aufheben.

Seiten 8 und 10

HINWEIS

Bitte die Zusammenfassung zu den Sicherheitsbestimmungen zu Beginn dieses Handbuchs lesen. Sie faßt die elektrischen Anforderungen zusammen und gibt Anweisungen für den sicheren Betrieb.

Seite 99

VORSICHT

Der Filter muß periodisch gereinigt werden, um Beschädigung von Komponenten durch Überhitzung zu vermeiden.

Seite 99

WARNUNG

Bei Abnahme der vorderen oder hinteren Frontplatte werden elektrische und mechanische Gefahrenquellen freigelegt. Vor Durchführung von Servicearbeiten stets das Netzkabel herausziehen.

Seiten 100 (zweimal) und 101

VORSICHT

Die Pumpe kann sich ohne Warnung in Betrieb setzen. Zur Vermeidung von Verletzungen muß der Netzstecker des Probenehmers herausgezogen werden, wenn die Abdeckung des Pumpengehäuses zur Inspektion oder Ersatz von Schläuchen entfernt wird.

Seite 107

WARNUNG

Beim Entfernen der rückwärtigen Frontplatte werden elektrische und mechanische Gefahrenquellen freigelegt. Vor Durchführung von Servicearbeiten ist stets das Netzkabel abzuziehen.

Seite 111

VORSICHT

Alle Reparaturarbeiten am Kühlsystem müssen durch einen Spezialisten für Kühlungssysteme durchgeführt werden.

Das System nur mit Stickstoff, NIEMALS MIT LUFT, spülen.

Das Kältemittel immer wiederaufbereiten.

Beim Wiederfüllen niemals ein Abzweigventil im Kühlsystem lassen, da dies Korrosion oder Undichtigkeit zur Folge haben könnte.

Seite 112

WARNUNG

Beim Entfernen der vorderen und hinteren Frontplatten werden elektrische und mechanische Gefahrenquellen freigelegt. Fehlersuche und Reparaturarbeiten sollten nur durch einen Kühlsystemexperten durchgeführt werden.

Seiten 114 und 116 (3)

VORSICHT

Vor der Durchführung von Arbeiten am Gerät ist die Stromzufuhr zum Kühlschrank und Controller zu unterbrechen.

Bei der Handhabung von ausgebautem Gerät auf ausreichende Erdung achten.

RESUMEN DE SEGURIDAD

El modelo 3700FR/3720 Refrigerated Sampler es un dispositivo con un "propósito definido", que se puede utilizar solamente con equipos compatibles Isco. No use este producto con cualquier otro equipo de otros fabricantes o para cualquier otro propósito. El uso de este producto para cualquier otro propósito que no sea el descrito en este manual, puede ocasionar daños personales o daños al producto.

Requisitos eléctricos

El refrigerador se encuentra disponible en las configuraciones 120 V∿ y 230 V∿. El voltaje requerido para su funcionamiento se encuentra listado en la etiqueta de Identificación y en el Número de serie ubicado dentro de la puerta del compartimiento de muestra.

Los refrigeradores configurados para que funcionen en 120 V∿ están equipados con un enchufe norteamericano NEMA 5-15P y solamente pueden ser utilizados con 120 V∿, 60 Hz. La fuente de corriente eléctrica debe ser clasificada para un servicio de 30 amperios.

Los refrigeradores configurados para que funcionen en 230 V∿ están equipados con un enchufe Continental europeo CEE 7/7 y solamente pueden ser utilizados con 230 V∿, /60 Hz. La fuente de corriente eléctrica debe ser clasificada para un servicio de 16 amperios.

Los refrigeradores, en cualquiera de las configuraciones, proporcionan 12.5 V⎓ a 5 amperios para el controlador de muestra. Esta salida proviene del conector de tipo militar de dos clavijas del cable en la parte superior del refrigerador. Esta salida solamente sirve para los controladores 3700 Series Sampler.

El refrigerador debe ser instalado cerca de un tomacorriente accesible. Nunca utilice un cordón de extensión.

El tomacorriente debe estar visible y accesible. La única manera de desconectar la corriente eléctrica es desenchufando el refrigerador.

Para minimizar el riesgo de una descarga eléctrica, el refrigerador debe estar conectado a un tomacorriente con contacto a tierra eléctrico.

La fuente de corriente eléctrica debe ser un circuito dedicado. La línea no debe transmitir corriente eléctrica a cualquier otro dispositivo.

No utilice el refrigerador si se han quitado los paneles inferiores frontales o posteriores.

No haga funcionar el refrigerador en ambientes con sustancias explosivas.

No poner el refrigerador en un lugar en el que el compartimento inferior pueda quedar sumergido.

No levante o mueva el refrigerador sin utilizar un dispositivo especial para transportar aparatos eléctricos.

Se deben reemplazar los fusibles siguiendo las especificaciones requeridas de tamaño, corriente, voltaje y tiempo de utilidad. Haga referencia a la Lista de repuestos para el número correcto del repuesto.

SÍMBOLOS DE SEGURIDAD Y ADVERTENCIAS

Los iconos en el modelo 3700FR/3720 del Refrigerated Sampler y aquéllos que se encuentran en este manual de instrucciones alertan al usuario de peligros conocidos. A continuación se describen los iconos.

Este icono identifica un peligro general. Haga referencia al manual de instrucciones para más información al respecto.

Este icono indica el riesgo de una descarga eléctrica. Haga referencia al manual de instrucciones para más información al respecto.

El manual de instrucciones identifica los peligros y los pasos necesarios para evitarlos. El manual presenta esta información en una de las dos siguientes maneras:

PRECAUCION

Las precauciones identifican un posible peligro, que al no ser evitado, puede resultar en daños menores. Esta categoría puede también advertirle del uso negligente o de las condiciones que pueden ocasionar daños al refrigerador.

ADVERTENCIA

Las advertencias identifican una condición potencialmente peligrosa, que al no ser evitada, puede resultar en daños muy serios u ocasionar la muerte.

Pagina 7

ADVERTENCIA

Los cambios o modificaciones a esta unidad, que no hayan sido expresamente aprobados por el grupo responsable para su conformidad, pueden anular toda autoridad del usuario en operar el equipo.

Paginas 8 y 10

Nota

Lea el Resumen de seguridad que se encuentra al principio de este manual. Este presenta los requisitos eléctricos y provee instrucciones para su uso seguro.

Pagina 99

PRECAUCION

Los componentes sobrecalentados pueden ocasionar daños si no se limpia el filtro periódicamente.

Pagina 99

ADVERTENCIA

Al quitar el panel frontal o posterior se exponen peligros mecánicos y eléctricos. Desconecte la corriente eléctrica antes de llevar a cabo cualquier servicio de asistencia.

Paginas 100 (dos veces) and 101

PRECAUCION

Es posible que la bomba funcione sin previa advertencia. Para evitar daños, la muestra debe estar desconectada al quitar la cubierta del equipo de la bomba para su inspección o reemplazo de tubos.

Pagina 107

ADVERTENCIA

Al quitar el panel posterior se exponen peligros eléctricos y mecánicos. Desconecte la corriente eléctrica antes de llevar a cabo cualquier servicio de asistencia.

Pagina 111

PRECAUCION

Todos los servicios reparativos de refrigeradores deben ser realizados por técnicos de refrigeración calificados.

Siempre limpie el sistema utilizando nitrógeno. NUNCA USE AIRE para limpiarlo.

Reponga siempre el refrigerante que sea necesario.

Al recargar, no deje una vía lateral en el sistema de refrigeración porque puede ocasionar problemas de corrosión o fugas.

Pagina 112

ADVERTENCIA

Al quitar el panel frontal y posterior se exponen peligros eléctricos y mecánicos. Solamente los técnicos de refrigeración capacitados deben encargarse de solucionar los problemas y realizar las actividades de reparación necesarias.

Paginas 114 y 116 (3)

PRECAUCION

Desconecte la corriente eléctrica del refrigerador y del controlador cuando esté trabajando en la unidad.

Permanezca tocando tierra al manipular equipo desensamblado.

Table of Contents

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Chapter 1 Product Description

INTRODUCTION

This chapter contains of a brief discussion of the organization of the manual, an overall description of the sampler, and a list of technical specifications.

Manual Organization

This manual contains the information necessary to operate, maintain, and service the 3700FR/3720 Refrigerated Sampler. It has six chapters.

Chapter 1 is a general introduction to the sampler and refrigerator.

Chapter 2 covers preparation for use, operating the refrigerator, and automatic refrigerated sampling.

Chapter 3 covers programming guidelines.

Chapter 4 contains maintenance information.

Chapter 5 discusses optional equipment that can interface with the sampler.

Chapter 6 includes servicing information to assist you in correcting problems. It also contains an illustrated list of replacement parts.

Description

The 3700FR consists of a 3720 refrigerator and a 3700 controller mounted on the refrigerator. This instruction manual covers the two configurations in which the refrigerator is available: the 3700FR and the 3720. Each configuration is discussed individually in the following sections.

3700FR REFRIGERATED SAMPLER

The 3700FR/3720 Fiberglass Refrigerated Sampler is a programmable liquid sampler designed for sequential (discrete) sampling. It is one of Isco's 3700 Series of portable and refrigerated samplers. The extensive sampling capabilities, flexible programming, and durable construction make the 3700FR Sampler ideally suited for general purpose or priority pollutant sampling. The 3700 Sampler also provides storm-paced sampling capabilities designed to meet the EPA requirements for storm water run off monitoring.

The 3700FR Sampler, although extremely easy to use, offers a number of very sophisticated features. The following sections introduce key features and provide an overview of the unit's sampling capabilities and a variety of interfacing equipment. Examples of interfacing equipment include:

- Isco 4100 Series Flow Loggers, 4200 and 3200 Series Flow Meters, 3010 FM Ultrasonic Flow Transmitter and 3020 Flow Transmitter (collectively called "flow meters" throughout this manual) for flow weighted sampling and sampler-enable control.
- Isco Field Printers that print the sampler's program settings and sampling results.
- Laptop computers that collect, store, or transfer the same data from a sampler in the field to a computer in the office.
- Isco Model 583 Field Computer, which can be used instead of a laptop computer that gathers data and downloads it to an office-based PC.
- Model 1640 Liquid Level Sampler Actuator for sampling when a liquid level reaches a predetermined height.

The 3700FR Refrigerated Sampler consists of the 3720 Sampler Refrigerator with the 3700 controller installed on the refrigerator at the factory. (The 3720 is discussed in *Technical Specifications, Controls, and Connectors* on page 6.) The controller is housed in the watertight control box mounted on the top of the refrigerator. However, the refrigerator's lower compartment is not watertight.

The controller consists of a microprocessor with software embedded in a PROM (Programmable Read-Only Memory) and supporting electronics. The controller runs the pump, responds to the keypad, and presents information on the display. It governs all automatic sampling according to user-selectable program settings. The controller provides for manual control of the sampler; for instance, you can run the pump forward with the pump forward key or initiate a manual sample with the manual sample key.

The control panel, containing the 40-character alphanumeric LCD (Liquid Crystal Display) and keypad, is located on the top of the control box. The 24-position keypad is used to enter program parameters and direct the following controls: on/off, pump reverse, pump forward, stop the pump, start sampling, resume sampling, display the operating status and move the distributor arm to the next bottle. A desiccator is installed in the control box to prevent moisture damage to the electronics, pump, and distributor systems.

PROGRAMMABLE FEATURES

An intuitive user-interface allows the 3700FR Sampler to be easily programmed for both simple and complex sampling schemes. The LCD prompts you through the programming process by presenting a choice or a question on the sampler's LCD. Programming the sampler is a matter of responding to displayed prompts with the keypad.

Two programming modes, "basic" and "extended," are standard with the 3700FR Sampler. The basic programming mode allows you to set up typical sampling routines easily and efficiently. The extended programming mode expands the versatility of the sampler by providing options which allow you to create complex sampling routines.

The LCD not only prompts you through the programming process, but also allows you to closely monitor a sampling routine as it is executed. The LCD displays pertinent information about the routine – for example, the time of the next sample – and notifies you of any problems encountered during the routine. As the routine progresses, the sampler logs (stores) key information about the results of the routine. The results include the start time, any halt and resume times, time of samples, and cause of any missed samples. This information is accessible during a routine or after a sampling routine is finished. You can view this information from the sampler's display or retrieve it with the Field Printer or a laptop computer running Isco's SAMPLINK software.

Flexible Sampling Intervals

The 3700FR is designed to collect as many as 24 separate sequential (discrete) samples and is fully programmable for true composite sampling. Both sequential and composite samples may be collected at user-definable time intervals (time-pacing) or at equal flow volume intervals using flow pulse inputs from an external flow meter (flow-pacing). The flow interval may be set from 1 to 9999 flow pulses. Sampling can be terminated by a user-defined number of samples.

The sampler offers two types of time-pacing: uniform and nonuniform. Uniform time-paced samples may be taken at regular time intervals, a sample every 15 minutes, for example. The interval between samples can be set from 1 minute to 99 hours, 59 minutes in 1 minute intervals. Using the extended programming mode, you can specify up to 999 (or bottle volume dependent) non-uniform time intervals in minutes. For example, you can program the sampler to take the first six samples at 10 minutes intervals, then four more samples at 15 minute intervals, and so on. Nonuniform time intervals can be from 1 to 999 minutes in 1 minute intervals. Nonuniform times can be specified in a clock-time format by entering a time and date for each sample. The sampler will accept up to 99 nonuniform clock times.

Additionally, the Sampling Stops and Resumes feature allows you to create an intermittent sampling schedule. With this extended programming feature, you can sample only during key periods of the day. For example, you may wish to sample only during the hours of 6:00 am to 8:00 am, and 5:00 pm to 7:00 pm. You can enter up to 12 sampling stops and 12 resumes. Sampling stops and resumes can be used with both flow- and time-paced routines and with uniform and nonuniform time intervals.

Multiplexing

In addition to sequential sampling, which places one sample in each bottle, the sampler provides three standard types of multiplexed sample distribution: samples-per-bottle, bottles-per-sample multiplexing, and multiple bottle compositing. In samples-per-bottle multiplexing, more than one sample volume can be placed in a bottle. Samples-per-bottle multiplexing allows you to collect a series of small composite samples. By depositing several samples in each bottle, the contents of each bottle represent an average of the flow stream during the sampling period. In bottles-per-sample multiplexing, equal sample volumes can be placed in up to 24 bottles at each sample event. Bottles-per-sample multiplexing is ideal for situations where you need identical sets of samples – when you need to use more than one preservative, for example. Both time-paced and flow-paced sequential samples can be multiplexed.

The third type of multiplexing, multiple bottle compositing, is accessible through the extended programming mode. Multiple bottle compositing places more than one sample volume into more than one bottle. At each sample event, a sample volume is placed in several bottles, in sets of up 24 bottles. Multiple bottle compositing combines bottles-per-samples multiplexing and samples-per-bottle multiplexing; it is applicable to situations where you need a series of identical sets of samples. Multiple bottle compositing can also be used when you need to acquire a series of larger volume composite samples by taking a number of smaller samples and distributing them over several bottles.

In the extended programming mode, you can switch multiplexed bottles or bottle sets after a programmed number of samples have been deposited or after a programmed period of time has elapsed.

Both methods can be used with either time-paced or flow-paced routines. By specifying the number of samples to be deposited, you can control the volume of each bottle precisely.

By specifying the sets be switched after specific time periods, you can control the time frame for a series of sample volumes. This is especially useful for flow-paced sampling. Although the flow-rate may vary, each bottle or bottle set represents a fixed time period.

Storm Sampling

The 3700FR Sampler's storm capabilities are ideal for monitoring storm water runoff. The sampler allows you to divide the bottles into two groups. The first group of bottles is normally reserved for a first flush grab sample. The second bottle group receives the flow weighted composite samples. Samples can be distributed in either group sequentially or in any of the three types of multiplexing. Three bottle configurations are available for STORM sampling: the standard 24-bottle configuration with either 1000 or 350 ml bottles, a 12 bottle configuration containing 1 quart (950 ml) glass bottles, and a 4 bottle configuration with 1 gallon (3800 ml) glass bottles.

STORM sampling takes full advantage of the sampler enable programming available through the Isco Flow Meters and the FLOWLINK® software. You can program the flow meter to monitor the flow stream for "storm" conditions— a specific amount of rainfall, for example — and enable the sampler when it detects those conditions.

Accurate Sample Volumes

The sampler can be programmed to take sample volumes of 10 to 9990 milliliters. Equipped with the patented LD90 (Patent 5,125,801) liquid presence detector, the 3700 Sampler delivers accurate, repeatable sample volumes in changing head conditions. The LD90 is a non-wetted liquid presence detector. It detects virtually any pumpable liquid and because it is non-wetted; sample conductivity, viscosity, temperature, and composition do not affect detection. Although it is not normally necessary, samples can be calibrated, if desired.

Flexible Start Times

sampling routine can be programmed to use a specific start time and date or a start time delay. The sampler will accept a specific start time and date up to one month in advance of the current date. The start time delay is the period between the time you press the START SAMPLING key and the time the routine actually starts. It is adjustable from zero to 9999 minutes.

Other features are available. Program storage allows you to store up to three separate programs, eliminating the need to reprogram the sampler for recurrent sampling routines. A program lock is available for protection from unauthorized program alterations. When enabled, a password must be entered before any program settings can be changed, although program settings can be viewed at any time.

Foreign Languages and Metric Units of Measure

The 3700FR provides displays in French, German, and Spanish. Additionally, the software supports entries in metric units of measure. Samplers using French and German language displays support metric units for suction line and suction head measurements. Metric units include volumes in milliliters, suction head and suction line length in decimeters, and suction line inside diameter (ID) in millimeters. Samplers operating with English displays support either English or metric units for suction line and suction head measurements. (Sample volume units are always entered in milliliters, regardless of the selected language.)

DELIVERY SYSTEM

The 3700FR Sampler uses a peristaltic pump for sample collection. The sample liquid is under pumped flow at all times; there are no metering chambers or gravity-fed internal tubing. Each sampling cycle includes an air pre-sample purge and a post-sample purge to clear the suction line both before and after sampling. These features make the 3700FR Sampler ideal for both "suspended solids" and "toxic materials" sampling. Cross contamination between samples is minimized and sites for sediment accumulation in the system are eliminated. Materials in contact with the sample fluid are limited to the strainer, suction line, pump tubing and collection bottles. The system can be easily and safely cleaned by simply replacing relatively inexpensive lengths of tubing.

Pump speed is approximately 250 RPM which generates a velocity sufficient to obtain representative samples. The pumping rate of 3500 ml/minute is generated when using $^3/_8$ inch ID suction line at 3 ft of head. The line transport velocity, using the same suction line and head, is 2.5 ft/sec. Volumetric accuracy is not significantly affected by pump speed since the delivered volume is based on an electronic count of the number of pump revolutions.

Liquid Detector

The LD90 gives the 3700FR Sampler the ability to deliver accurate, repeatable sample volumes regardless of changing head conditions. Typical sample volumes are accurate to within 10% of the programmed volume and repeatable to within ± 10 ml. The detector and a programmable setting provide for automatic rinsing of the suction line when concerns of cross contamination arise. A programmable setting for sampling retries is available.

If the suction line becomes clogged and no liquid is detected in the line, the sampler can be programmed to repeat a purge cycle – up to three times – to clear the clogged line.

Pump Tubing and Suction Lines

The pump tubing is Silastic™ medical grade silicon rubber. Liquid is transferred from the source to the pump through either 1/4 or 3/8 inch ID vinyl or 3/8 inch ID Teflon® suction tubing. The pump tubing and suction lines are easily replaced, minimizing the need for cleaning. The sampler automatically monitors pump tubing wear: a tubing warning indication is reported on the display when the pump revolution count exceeds a user-specified wear limit.

Strainers

There are two stainless steel strainers are available for priority pollutant applications: a larger unit for normal flow and a smaller unit for low flow situations. An all-plastic strainer is available for sampling from highly acidic flow streams. A weighted polypropylene strainer is used for general purpose applications.

Bottle Configurations

A number of sample containers are available for both sequential sampling and composite conversion sampling:

24-Bottle Configurations

- 350 ml glass with Teflon lined caps
- 1000 ml polypropylene bottles with polyethylene foam lined caps

12-Bottle Configuration

- 2500 ml polyethylene with foam lined caps (Note: This configuration is available for Isco's fiberglass refrigerators only.)

4- and 8- Bottle Configuration

- 3800 ml (1 gallon) glass with Teflon lined caps

Single Bottle Composite Configurations

- 9400 ml (2.5 gallon) glass composite bottle with unlined cap
- 9400 ml (2.5 gallon) polyethylene composite bottle with unlined cap
- 15,000 ml (4 gallon) polyethylene composite bottle with unlined cap
- 20,800 ml (5.5 gallon) polyethylene composite bottle with unlined cap

Power Sources

The 3720 operates from 120 V∿, 60 Hz power or 230 V∿, 50 Hz power depending on how the refrigerator was ordered. A 12 V⎓ power converter, built into the refrigerator, supplies power to the controller.

In the case of critical sampling, the sampler's controller may be powered by an external battery-backed power pack, as described in *Connection to a Power Source* on page 10. This allows sampling to continue even if a power failure causes the refrigerator's cooling system to stop functioning.

3720 Sampler Refrigerator

If you want to convert a presently owned 3700 Portable Sampler into a refrigerated unit, or to have both portable and refrigerated options with the same controller, the 3720 Sampler Refrigerator is available. The 3720 includes all the parts necessary to attach the controller from a portable sampler to the refrigerator.

The exterior of the refrigerator is constructed of a fiberglass reinforced polyester with an ultraviolet-resistant gel coat. The interior is made of formed ABS (acrylonitrile-butadiene-styrene) plastic which will not support bacterial growth or retain odors. Both the controller cover and sample compartment may be individually padlocked. The door utilizes a magnetic gasket which seals against a stainless steel bezel.

The refrigerator's solid state thermostat is calibrated at the factory to be accurate at 4°C (39°F). A forced-air condensing coil and front ventilation allow the unit to be positioned close to a wall or in a corner with clearance required only for the controller cover to open. Wrap-around construction of the oversized evaporator plate provides quick and efficient cooling of the sample compartment. Heaters are mounted on the back side of the evaporator plate to keep the sample from freezing in sub-freezing temperatures. Defrosting is automatic under normal operating conditions. The technical specifications of the 3700FR/3720 are found in Table 1.

A full line of accessories and interfacing equipment is available to help you adapt the sampler to your specific application; some of the more common items are briefly discussed below. Other accessories are noted throughout this manual, where

appropriate. A full list of accessories is found in the *Appendix A Accessories List* on page 140.

Isco Flow Meters

The 3700FR Sampler will accept flow pulses from all Isco flow meters and flow loggers for flow proportional sampling.

These instruments are equipped with a sampler enable feature, allowing them to inhibit a 3700FR Sampler until the level of the flow stream reaches a predetermined height; when that height is reached, the flow meter enables the sampler and starts the sampling routine. If the level of the stream falls below the predetermined height, the flow meter can disable the sampler and halt the routine.

The 4200 Series Flow Meters, 4100 Flow Loggers, and certain models of the 3200 Series Flow Meters can monitor rainfall when equipped with a rain gauge. The flow meter can be programmed to enable the sampler when the measured amount of rainfall reaches a predetermined set point. Set points or pairs of set points — pairs can be level and rainfall rates, level and elapsed time, rainfall and elapsed time, and so on — form the sampler enable control condition. A control condition is simply the set of parameters defining the conditions in which a flow meter will enable the sampler. For example, a flow meter can be programmed with a control condition which is satisfied when the flow meter detects 1/4 inch of rainfall in 15 minutes.

In addition to enable control conditions, Isco's flow meters provide internal memory. When programmed with the FLOWLINK software, the flow meters use the memory to store level or flow rate readings, rainfall measurements, and sample event data from the samplers. The stored data, which expands the information available from the sampler's results displays, can be retrieved with a computer running the FLOWLINK software. For more information on sampler enable control conditions and data retrieval, refer to the *FLOWLINK Tutorial* provided with the FLOWLINK software.

Isco Field Printers and SAMPLINK for Sampling Data Retrieval

Isco provides three additional interfacing products. Each of these products collect data from the sampler's memory. The first product is the Isco Field Printer designed to print sampling data from a 3700 Series Sampler. You can initiate the reports from either the printer or the sampler.

The Isco Field Printer prints two reports which reproduce the data collected by the sampler. The first report lists the current status data and program settings for the sampling routine. The second report lists the sampling results currently stored in the sampler's memory. The results include the time, date, and bottle numbers for each sample event and any errors encountered during the routine.

SAMPLINK and Laptop Computers

The second data collection product is a software package: SAMPLINK. SAMPLINK runs on a laptop computer that can be taken to the sampling installation to collect the data. SAMPLINK collects the data and formats it into two files: a text file and a FLOWLINK compatible sample event file. The text file can be loaded into a word processor for editing. SAMPLINK's text file contains the same two reports produced by the Field Printer. The first report contains sampler status information and program settings. The second report contains the sampling results. Because the text file is pre-formatted into report form, you can use DOS printing commands to print the file without editing with a word processor.

The sample event files are identical to those created by FLOWLINK when it retrieves sample event data from Isco's flow meters and flow loggers. Because these files are fully compatible with FLOWLINK, FLOWLINK can use the files in its sampling reports and graphs.

Non-Isco Flow Meters

The 3700 Sampler will accept flow pulses from certain non-Isco flow meters. Two interface accessories convert incompatible (non-Isco) signals to pulses acceptable to the 3700 Sampler. The Type A Interface converts pulse duration input; the 4-20 mA Sampler Input Interface converts 4-20 mA output signals. The 3700 Sampler sends event marks to both Isco and non-Isco flow meters each time a sample is taken.

Liquid Level Actuator

Another item, the Liquid Level Actuator, is used to provide level sensitive control of the sampler. The actuator can be used as an alternative to a flow logger or flow meter.

Model 583 Field Computer

The Isco 583 Field Computer is a rugged, weatherproof hand-held computer designed for retrieving data in the field and downloading it to IBM PC or compatible computers running FLOWLINK software. The unit has a keypad for manual data entry and inputs for sensors such as bar code wands.

Accessories

Two additional accessories are available:

Type A Interface - Converts flow pulse duration output from non-Isco flow meters to flow pulses acceptable to the 3700FR Sampler.

4-20 mA Sampler Input Interface - Converts 4 to 20 mA output signals from non-Isco flow meters to flow pulses acceptable to the 3700FR Sampler.

TECHNICAL SPECIFICATIONS, CONTROLS, AND CONNECTORS

The controls and connectors of the 3700FR/3720 are listed in **Table 1** and **Table 2**. Refer to **Figure 6,** on page 10 for a picture of the controls and connectors.

Table 1 Technical Specifications

Physical Specifications

Physical Size	Height: 47 inches (119 cm) Width: 26 inches (66 cm) Depth: 26 inches (66 cm)
Dry weight	175 lb (80 kg)
Shipping weight	200 lbs (91 kg)
Operational Temperature Range	-20°F to 120°F (-29°C to 49°C)
Storage Temperature Range	0° to 140° F (-20° to 60° C)
Control Box Only (does not include refrigerator)	Self Certified NEMA 4X and 6 ratings (Submersible, watertight, dust-tight, and corrosion resistant)
Temperature set point accuracy	± 1.8°F (1°C) at 39°F (4°C)
Pulldown time	15 minutes, typical (from 75°F [24°C] to 39°F [4°C])
Recovery time	5 minutes, typical (door open 1 minute with unit operating at 39°F [4°C], 75°F [24°C] ambient)
Installation category	II
Pollution degree	2

Power Specifications

Sampler Controller Power Requirement	12 V⎓ AC power converter Sampler standby current 10 mA, maximum
Voltage	120 ±10% V∿, 60 Hz (230 ±10% V∿, 50 Hz available)
Current: Running Starting Stalled compressor	3.5 amp, typical 120 V∿. (1.75 amp, typical 230 V∿) 15 amp, typical 120 V∿. (7.5 amp, typical 230 V∿) 20.7 amp, maximum 120 V∿. (10.4 amp at 230 V∿)
Controller Internal 3V Lithium Battery Capacity	5 years, minimum (maintains internal logic and program settings)

Refrigeration System

Compressor	1/6HP Tecumseh AE1343A for refrigerators with serial numbers before 11901-001 1/5 HP Tecumseh AE1360Y for refrigerators with serial numbers beginning with 11901-001
Refrigerant	R-12, 8.5 oz. charge for refrigerators with serial numbers before 11901-001 R-134a, 7.5 oz. charge for refrigerators with serial numbers beginning with 11901-001

Pump and Tubing Specifications

Suction Tubing (intake)	3 to 99 foot lengths of: 1/4 inch ID vinyl 3/8 inch ID vinyl 3/8 inch ID Teflon® lined

Table 1. Technical Specifications (continued)

Suction Lift	26 feet (7.9 m), maximum
Pumping Rate (at 3 feet of head)	1/4 inch ID suction tubing: 3000 ml/minute 3/8 inch ID suction tubing: 3500 ml/minute
Line Transport Velocity (at 3 feet of head)	1/4 inch ID suction tubing: 5.1 ft/sec 3/8 inch ID suction tubing: 2.5 ft/sec

Clock Specifications

Real Time Clock Accuracy	1 minute/month, typical

Sample Specifications

Sample Volume Accuracy	Accuracy with the liquid detector enabled and automatic compensation for head: typically, the greater of ± 10% or ± 20 ml, over a head range of 1 to 12 feet and sampler supply voltage of 10 to 13 volts.
Sample Volume Repeatability	± 10 ml, typical
Sample Frequency	Selectable from one minute to 99 hours, 59 minutes in 1 minute increments between consecutive samples, or from 1 to 9999 flow pulses in single pulse intervals. Up to 999 nonuniform times may be entered in minute intervals or up to 99 times as specific clock times.

Flow Meter Signal Specifications

Flow Meter Signal Requirements	5 to 15 volt DC pulse or isolated contact closure of at least 25 milliseconds duration. (4-20 mA or pulse duration signal may be converted with optional interface unit).

Table 2 Controls and Connectors

Controls

CONTROL	SETTING	FUNCTION
Thermostat	WARMER, COOLER, 4°C (39°F)	selects the sample temperature

Connectors

CONNECTOR	TYPE	FUNCTION
12V DC	2-pin female mounted	12V DC power supply for sampler
Printer	6-pin female panel mounted	Connects 3700FR to Isco Field Printer or laptop computer
Flow Meter	6-pin male panel mounted	Connects 3700FR to external flow meter
120 or 230 VAC	3-pin grounded male line cord	Supplies line voltage for the unit

⚠ WARNING

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a class A digital 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 instructions, 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.

The 3700FR/3720 Refrigerator has been tested and found to comply with the following standards: EN 61 010 – Safety of Laboratory Equipment, EN 60 335-2-24 – Particular Requirements for Refrigerators, EN 50 082-1 – Light Industrial Generic Immunity Requirements, EN 55 011 – Class A Emissions Requirements, EN 55 022 –Class A for FCC in USA.

Chapter 2 Setup and Operating Procedures

INTRODUCTION

This chapter provides the information necessary for everyday operation of the refrigerator. Included are sections covering setup, operation of the refrigerator, and automatic refrigerated sampling.

SUMMARY OF SETUP PROCEDURES

The following sections detail the preparations made before using the refrigerator. To place the sampler into operation:

> **☑ Note**
>
> Read the *Safety Summary* posted at the front of this manual. It outlines the electrical requirements and provides instructions for safe operation.

1. Install the sampler.

   Although the suction line can extend to a liquid source up to 99 feet from the sampler, note that the maximum lift for the peristaltic pump with either the Teflon or vinyl line is 26 feet. When installing the sampler, be sure the head — the vertical distance between the level of the liquid source and the pump — is no greater than 26 feet. The pump will not be able to deliver samples for heads of 26 feet or greater.
2. Do not install the refrigerator in a location where the lower compartment could become submerged.
3. Be sure the sampler is connected to a 120 V∿ (230V∿) power source. Turn the refrigerator on.
4. Attach the suction line.
5. Place the suction line inlet properly in the liquid source.
6. Connect the sampler to a flow meter or flow logger, if required.
7. Program the sampler. Guidelines for programming the sampler are in **Chapter 3**.
8. Calibrate the sample volume, if desired. (**Chapter 3** contains calibration instructions.)
9. Start the sampling routine.

ATTACHING THE SUCTION LINE

The suction line is the piece of tubing that extends from the sampler's pump tubing intake, at the top of the liquid detector, to the liquid source. There are three standard suction lines available: plasticized vinyl tubing in 1/4 inch (0.64 cm) or 3/8 inch (0.94 cm) inside diameters, or FEP Teflon with a polyethylene cover in 3/8 inch inside diameter. The polyethylene cover over the 0.02 inch (0.051 cm) wall Teflon tubing prevents the Teflon liner from kinking or collapsing in service and protects it from abrasion and other damage.

The vinyl suction tubing contains a very low PPM (parts per million) level of phenols. If this affects your samples, use the Teflon suction line.

Both vinyl and Teflon lines can be cut to any length from 3 to 99 feet in 1 foot increments. Cut the suction line in whole foot increments: lengths of 4 ft, not 3.5 ft. The controller will accept only whole numbers as suction line lengths. To insure the accuracy of the sampler, the suction line length entered must equal that of the actual line measurement. When programming the sampler, you must enter the inside diameter, type, and length of suction line.

Cut the line to the shortest length feasible: this aids the downhill routing. Avoid loops of coiled suction line which may hold residual amounts of liquid which would cross contaminate sample volumes. A shorter suction line will also extend battery life and pump tube life because a shorter pumping cycle will be needed to deliver the sample volume.

ATTACHING THE VINYL SUCTION LINE TO THE PUMP TUBING

Vinyl suction line is attached to the pump tubing with the tube coupling as illustrated in **Figures 1** and **2**. Two couplings are available, one for each size of vinyl line.

Each coupling has two color coded nylon clamps attached to the stainless steel ferrule. The black clamp secures the pump tube to the coupling.

The white clamp secures the suction line. To attach the line or tubing to the coupling, push it onto the appropriate side of the ferrule and tighten the clamp by squeezing the finger pads together. To loosen a clamp, twist the two sides of the clamp until the teeth disengage.

ATTACHING THE TEFLON SUCTION LINE TO THE PUMP TUBING

The Teflon line is attached to the pump tubing by inserting the line into the pump tubing and securing it with a suitable clamp.

Figure 1 Tube Coupling without Suction Line and Pump Tubing Attached

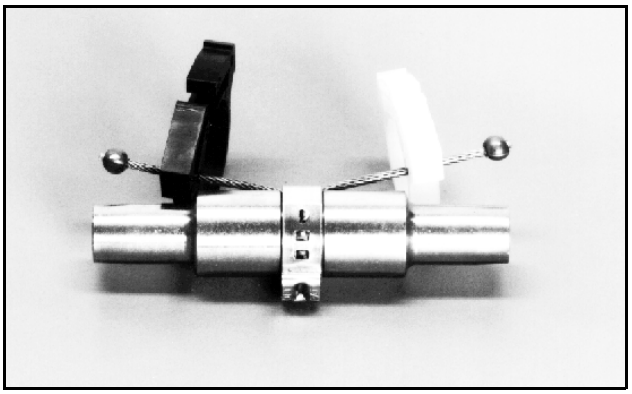
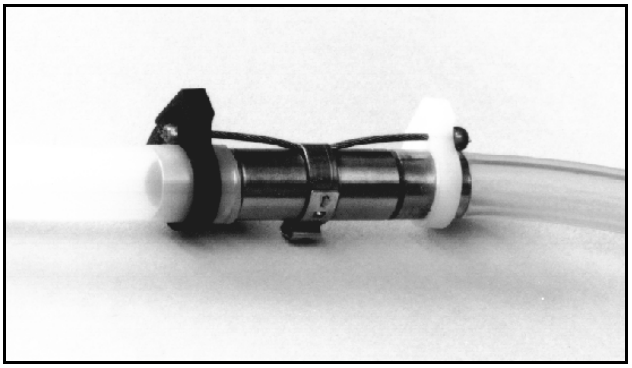


Figure 2 Tube Coupling with Suction Line and Pump Tubing



PLACEMENT OF THE SUCTION LINE AND INTAKE

Route the suction line from sampler to sampling point so that it slopes continuously downhill. This helps drain the suction line when the peristaltic pump purges the line and minimizes the possibility of cross contamination. When the sampler is used in below freezing temperatures, there is a risk of the suction line being frozen. A suitably warm sampling source can usually prevent this, provided there are no loops in the suction line. Some situations may require more protective measures, such as insulation of the suction line, or heat tape. Thoroughly draining the suction line minimizes the possibility of frozen liquid clogging the line.

Strainers

The 1/4 and 3/8 inch ID (inside diameter) vinyl suction lines are shipped from the factory with a polypropylene bodied weighted inlet strainer installed on the end of the suction line, as shown in **Figures 3** and **4**.

Optional stainless steel strainers (see **Figure 5**) are also available for use with the vinyl or Teflon suction lines. For sampling from highly acidic flow streams, an plastic strainer is available. Bulk suction line can be purchased without strainers. Refer to the *Appendix A Accessories List*, on page 140 for more information.

The strainer prevents solid particles over a specific diameter from entering and clogging the suction line. It is recommended for bottom sampling or sampling from streams containing large solids. The 1/4 inch strainers supplied for use with the 1/4 inch ID suction line have 15/64 inch (0.56 cm) diameter holes. The 3/8 inch strainers supplied for use with the vinyl or Teflon 3/8 inch ID suction line have 23/64 inch (0.9 cm) diameter holes.

The suction line tends to float in deep flow streams, dislodging the line and strainer. The table below shows the maximum depths you can submerge the lines and strainers without risks of floatation. At depths exceeding the safe depths, anchor the line and strainer securely.

Strainer	1/4" Vinyl Line	3/8" Vinyl Line	3/8" Teflon Line
Stainless Steel	-------	22 feet	15 feet
Low-Flow Stainless Steel	14 feet	7 feet	-------
Polypropylene	22 feet	11 feet	-------
CPVC	-------	4 feet	-------

ATTACHING THE DEBRIS DEFLECTOR TO THE STRAINER

A debris deflector prevents debris from accumulating on the hose clamp which attaches the strainer to the vinyl line. The 3/8 inch polypropylene strainer is shipped with the line attached and the debris deflector in place.

To replace the strainer line with a debris deflector:

1. Push the deflector back up the line to expose the hose clamp. See **Figure 3**.
2. Loosen the clamp and pull the line from the strainer's ferrule.
3. Remove the deflector from the old line and thread it on the new line. Push the deflector back on the new line; leave enough room to work with the hose clamp.
4. Thread the hose clamp on the new line.
5. Slip the line onto the ferrule and secure it with the hose clamp.
6. Push the debris deflector down the vinyl line and onto the strainer. **Figure 4** shows the deflector in place.

Figure 3 Polypropylene Strainer with Debris Deflector

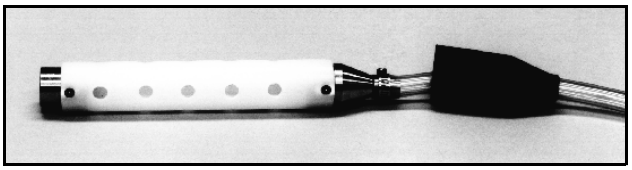


Figure 4 Polypropylene Strainer with Debris Deflector in Place

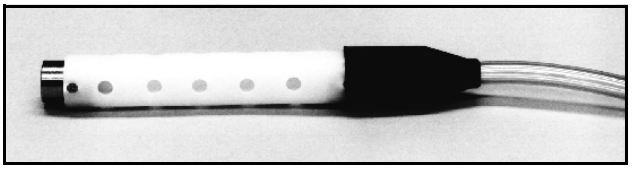
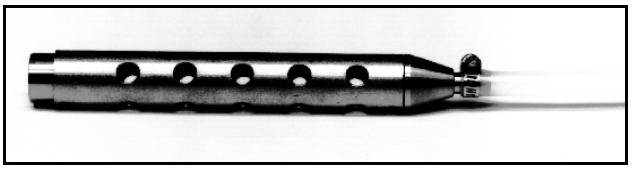


Figure 5 Stainless Steel Strainer



Weighted Strainer Optional

The use of the weighted strainer is optional. When heavy suspended solids are involved and flow stream velocities are significant, some field investigation results indicate more representative samples are obtained without the strainer. If the strainer is not used, a short piece of thin walled aluminum tubing may be attached to the end of the suction line and the tubing anchored in the flow stream so that the inlet is oriented upstream. The thin wall will provide minimum disturbance of the flow stream and aluminum ions are usually not of concern in analysis. Whether the strainer is used or not, the pre-sample purge cycle should be sufficient to remove any debris which may collect over the strainer or tubing entrance between sampling events.

Intake Placement

The proper placement of the sampler intake assures the collection of representative samples. The intake should be placed in the main flow, not in an eddy or at the edge of flow. The vertical position of the intake in the flow is important. An intake at the bottom may result in excess heavy solids and no floating materials, while placement at the top may result in the opposite.

Connection to a Power Source

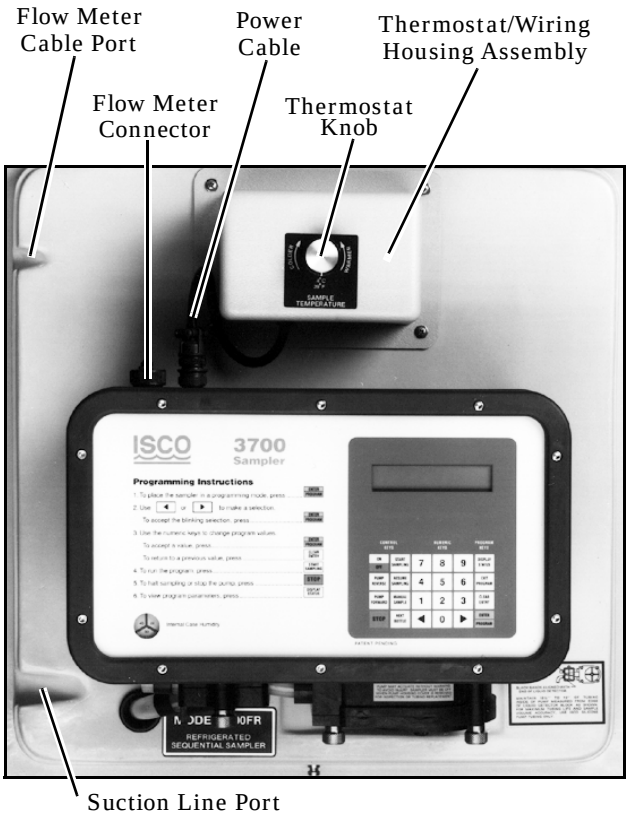
The 3720 operates from 120 V∿, 60 Hz power (230 V∿, 50 Hz). To provide power for the refrigerator and controller, plug the refrigerator's line cord into an appropriate source.

☑ Note

Read the *Safety Summary* posted at the front of this manual. It outlines the electrical requirements and provides instructions for safe operation.

A 12 V⎓ power converter, built into the refrigerator, supplies power to the controller. A 3V lithium battery, with a minimum service life of 5 years, maintains the controller's real time clock and program settings when power is disconnected. The sampler's controller may be temporarily powered by an external 12 V⎓ battery-backed power pack when AC power is not available. Simply disconnect the power cable shown in **Figure 6** and attach the power-pack connector to the sampler's power connector. Refer to the *Power Products Guide* for more information on external power sources for the controller.

Figure 6 Flow Meter Cable Connection and Suction Line Port



Connection to a Flow Meter or Flow Logger

To permit flow proportional sampling, the sampler's controller must be connected to an external flow meter. This connection is made to the flowmeter connector, shown in **Figure 6**. A small port is provided on the left side of the control base for routing the flow meter cable. Refer to **Chapter 5** for information on interfacing devices required to interface the sampler with non-Isco flow meters.

Sample Bottle Rack or Bottle Locating Base

The sample bottle rack is used with both the 24, 12, and 8 bottle configurations to hold the bottles in place inside the refrigerator. The bottle locating base is used with the 2 bottle configuration to position the bottles in place inside the refrigerator. All three configurations are described in detail below.

If you want to use a bottle configuration other than the one presently being used, conversion kits are available. Consult the factory or your sales representative for more information.

Installing the 24, 12, or 8 Bottle Configuration

Install the bottle rack, with bottles, in the refrigerator by sliding it into the unit until it drops over the two ramps which hold it in place. The five posts and two ramps which locate the bottles under the distributor arm are adjusted at the factory; however, manufacturing tolerances may result in misalignment between the bottles and distributor arm. Check the alignment by rotating the distributor arm using the NEXT BOTTLE key. If there is any misalignment, adjust the five posts and two ramps until proper alignment is attained.

Sample Bottle Rack with 24 or 12 Sample Bottle

The sample bottle rack will hold either 24 round 350 ml, glass sample bottles with Teflon lined caps or 24 wedge-shaped 1000 ml, polypropylene sample bottles with foamed-polyethylene lined caps. The 12 bottle rack is similar, using 12 wedge-shaped plastic bottles.

The glass bottles are held in place by a stainless steel retaining ring installed inside the circle of bottles. The ring expands to hold the bottles firmly against the interior of the wire rack. The plastic bottles for both the 24 and 12 bottle configurations are held in place by a plastic, funnel-shaped retaining ring that rests on top of the slanted portion of the bottles and fits down inside the circle of bottles. It is held in place by three large draw cords attached to the bottom of the rack. Each of these draw cords is stretched up and hooked onto a corresponding projection located on the ring.

The sets of glass and plastic bottles are interchangeable in the sample bottle rack. However, since each set of bottles has its own retaining ring, only one type of bottle can be used at a time; they cannot be mixed. The order in which the bottles are filled is indicated on the plate on the bottom of the rack. Since the bottle rack is used for both 24 and 8 bottle configurations, the plate is numbered 1 through 24 and 1 through 8. The 12 bottle rack is numbered similarly.

The bottle rack is removed by slightly lifting the front edge of the rack to disengage it from the two ramps, indicated in **Figure 8**, and pulling it straight out of the refrigerator. Be careful not to catch the distributor arm. The rack with bottles is reinstalled in the refrigerator by sliding it straight in on the shelf provided. Place the bottle caps on the bottles before attempting to remove them so the sample does not spill.

To remove the glass sample bottles, lift each bottle out of the bottle rack leaving the retaining ring in place. Once all bottles are removed, lift the retaining ring out of the rack by squeezing the two finger grips. Place the new glass bottles in the rack as shown in **Figure 9**. Make sure all bottles are fitted properly in the rack. Note the four metal triangles on the inside of the rack which rotationally align the bottles. Finally, replace the bottle retaining ring.

To remove the plastic sample bottles, disconnect the draw cords from the projections on the retaining ring, lift out the retaining ring, and remove the full bottles. Place the new plastic bottles in the rack as shown in **Figure 10**, note the four metal triangles on the inside of the rack which rotationally align the bottles. Replace the bottle retaining ring making sure that all the bottles fit properly into the rack.

> ☑ ***Note***
>
> All 24 bottles must be installed in the rack to ensure they are properly held in place.

SAMPLE BOTTLE RACK WITH 8 SAMPLE BOTTLES

The sample bottle rack, with the 8 bottle adapter, will hold either 8, 1.8 liter, glass sample bottles with Teflon lined caps or 8, 2 liter, polypropylene sample bottles with caps. The glass and plastic bottles are held in place by an 8 bottle adapter that hooks over the four bottle alignment triangles located on the inside edge of the bottle rack. The glass and plastic bottles are interchangeable in the sample bottle rack. Combinations of glass and plastic bottles may be used if desired. Note: All 8 bottles should be installed in the rack to insure that they are properly held in place.

The order in which the bottles are filled is indicated on the plate located on the bottom of the rack. Since the bottle rack is used for both 24 and 8 bottle configurations, the plate is numbered 1 through 24 and 1 through 8.

The bottle rack is removed by slightly lifting the front edge of the rack to disengage it from the two ramps, indicated in **Figure 8**, and pulling it straight out of the refrigerator. Be careful not to catch the distributor arm. The rack with bottles is reinstalled in the refrigerator by sliding it straight in on the shelf provided. To remove the glass or plastic sample bottles, simply lift the bottles straight out of the rack. Place the new bottles in the rack as shown in **Figure 11**. Make sure all bottles are fitted properly in the rack.

Cross contamination caused by splashing between bottles is eliminated by the use of a liquid deflector. The liquid deflector is coated with PTFE (polytetrafluoroethylene) Teflon. It is installed by pushing the short width part of the deflector up between the flat surface of the distributor arm and the pump tubing. See **Figure 7**.

Figure 7 Liquid Deflector

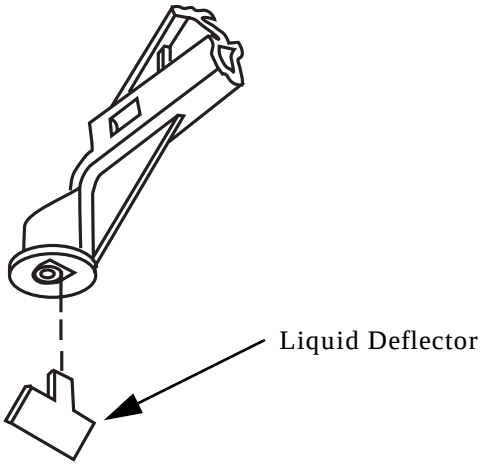


Figure 8 Interior of the 3700FR/3720

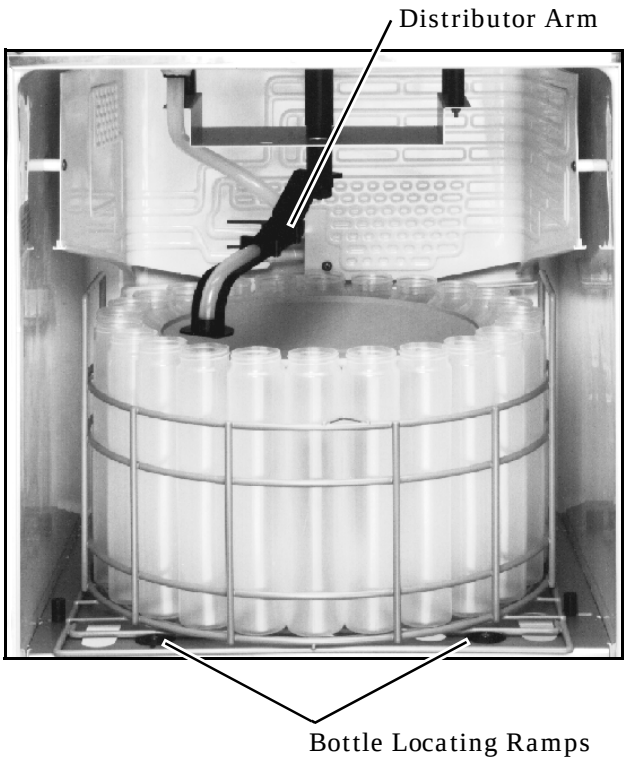


Figure 9 Sample Bottle Rack with 24 Sample Bottles

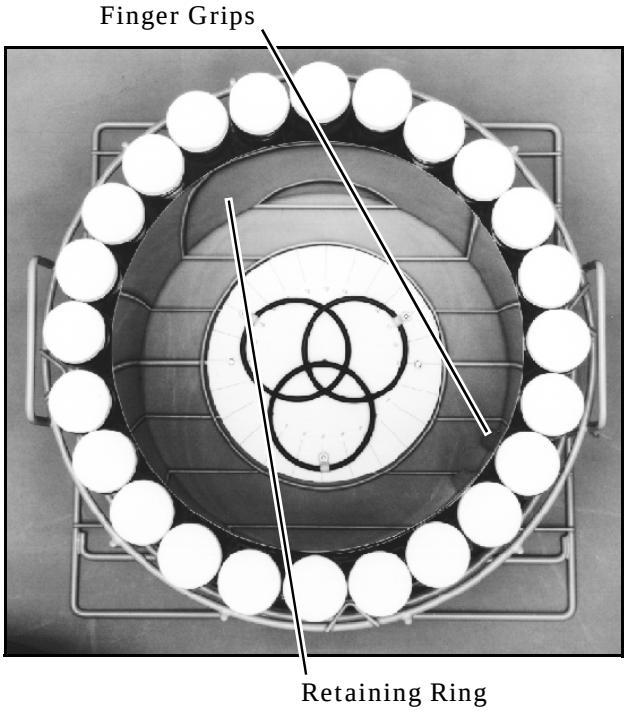


Figure 10 Sample Bottle Rack with 24 Sample Bottles

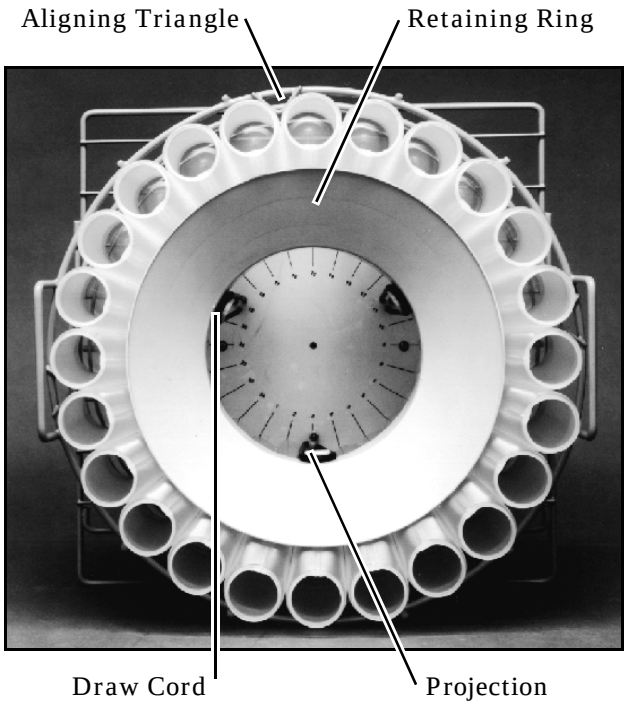


Figure 11 Plastic Sample Bottle Rack with 8 Sample Bottles

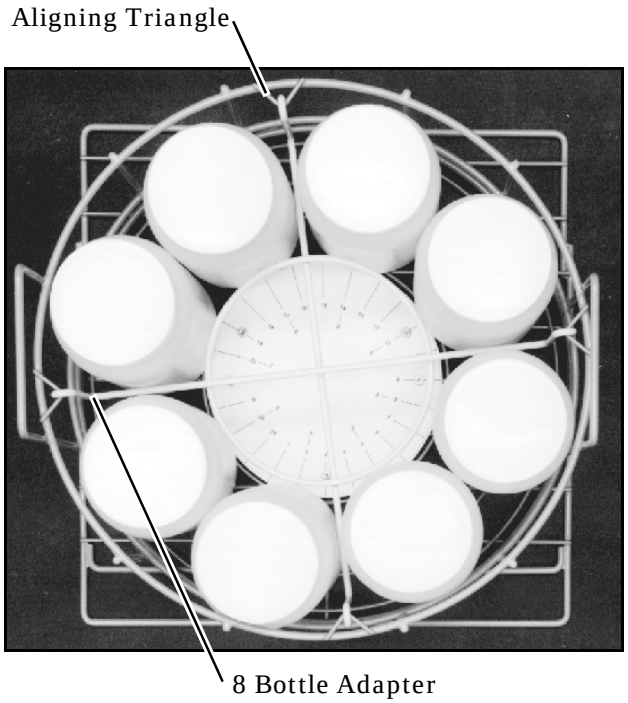
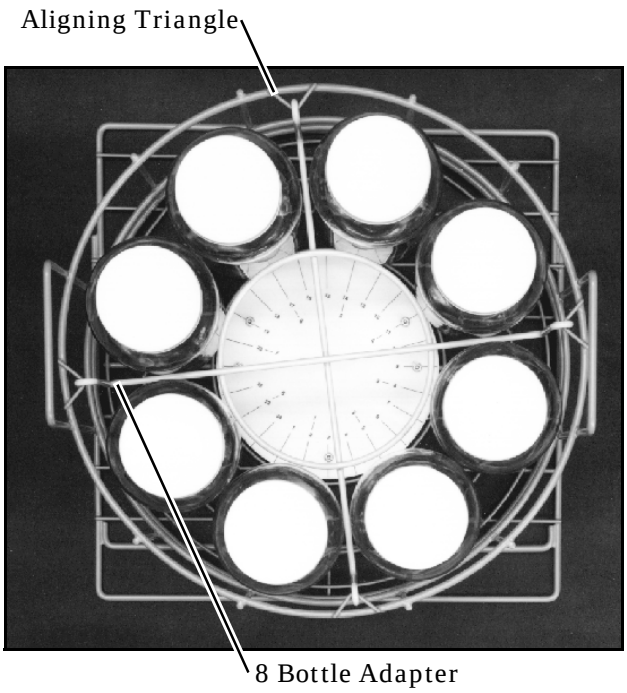


Figure 12 Glass Sample Bottle Rack with 8 Sample Bottles



Bottle Locating Base with 2 Sample Bottles

The locating base is designed to be permanently installed over the wire rack mounting plate. It is held in place by five screws, washers, and nuts and a bottle locating base retainer. Four of the screws, washers, and nuts replace the four locating posts on the wire rack mounting plate. The fifth screw, washer, and nut and the bottle locating base retainer are used to hold the center of the bottle locating base to the wire rack mounting plate. The locating base will hold either the 2.5 gallon glass or plastic bottles.

To install the bottles, center them within the bosses provided on the locating base. Bottle number one is the left bottle when looking from the front of the refrigerator. To remove the bottle, simply lift them out of the refrigerator.

Operation of the Refrigerator

To operate the refrigerator, turn the thermostat knob, shown in **Figure 6**, to the desired sample temperature. The interior air temperature should reach the set value within 20 to 30 minutes. The refrigerator's thermostat is calibrated in sample temperature.

That is, if the temperature is set at 4°C (39°F), the temperature of the sample after being in the refrigerator will be 4°C ± 1°C, although the refrigerator air temperature may vary more than this due to the nature of the refrigeration cycle.

Note

If the thermostat knob is turned to the lowest setting, the sample may freeze.

Automatic Defrosting

Under normal conditions, you should not need to defrost the refrigerator manually. The cooling coil temperature always cycles from below freezing (when the compressor is running) to above freezing (when the compressor is off) during the normal refrigeration cycle.

If the unit is used in hot, humid conditions; you may need to defrost the unit after several days of operation. Turn the thermostat off and allow the refrigerator to defrost. The refrigerator is equipped with a water diverting tray and a drain tube to route defrost water to an evaporating tray in the rear of the refrigerator. Water in the tray is evaporated by the warm air from the condensing system. The refrigerator compressor may not start immediately when the thermostat is turned on or turned to a lower setting due to the action of the compressor overload relay. After a short time, the compressor will start and initiate the cooling cycle.

Chapter 3 Programming Guidelines

INTRODUCTION

This chapter discusses the sampling features of the 3700FR Sampler in detail and covers the procedures used to program the sampler.

We recommend that you have a sampler with you when you read this chapter. The most effective way to learn how to program the 3700FR Sampler is to read this chapter and experiment. The sampler cannot be harmed by improper programming, so there is nothing to be lost by experimenting. A few minutes spent in actually programming the sampler and observing its operation usually proves to be a worthwhile investment of time. Simply "playing" with the sampler is the best way to become familiar with programming, and may help avoid costly delays or problems when the sampler is used in the field.

If you are already familiar with the sampling capabilities of the 3700FR Sampler, you may prefer to begin with*Programming Introduction*, on page 19. This section introduces the specifics of programming the sampler.

Chapter Organization

A description of sampling operations, sample events and the sampling cycle is placed in *Description of Sampling Operations, on page 15*.

The types of samples available with the 3700FR Sampler are listed and discussed in *Types of Samples,* on page 16.

A programming introduction and a discussion of the sampler's program structure is placed in *Programming Introduction,* on page 19. The basic and extended programming modes are introduced.

The three operating states of the sampler are discussed in *Operating States,* on page 19.

The interactive operating state, used to program the sampler, is discussed in *Interactive State,* on page 20.

The programming procedure is outlined in *Introduction to the Programming Procedure,* on page 22.

Using the keypad to program the sampler is discussed in*Using the Keypad to Respond to Displays,* on page 23, *Keypad Description,* on page 23, and *Displays,* on page 25.

Programming examples for the basic programming mode are placed in *Basic Programming Mode Introduction*.

The configure sequence, used to tailor the sampler to your specific application, is discussed in *Configure Sequence,* on page 42.

The extended programming mode and several extended programming examples are discussed in *Extended Programming Mode,* on page 53.

Adjusting the sampler for foreign languages and metric units of measure is discussed in *Foreign Languages and Metric Units of Measure,* on page 72.

The standby state is discussed in *Standby State,* on page 88.

Run state is discussed in *Run State,* on page 94.

DESCRIPTION OF SAMPLING OPERATIONS

This information serves to acquaint you with the 3700FR Sampler's operation during a typical sampling routine. It introduces you to the types of sampling performed by the sampler and the terminology used to describe those capabilities.

SAMPLE EVENTS AND THE SAMPLING CYCLE

A sample event is the process of taking a sample or a series of samples. It includes the full sampling cycle. Although the sampling cycle varies somewhat according to the program settings which define the sampling routine, the cycle described here follows the typical sequence. This information is presented here to provide you with a frame of reference for the remainder of this chapter.

1. A sample event is initiated when the interval following the previous sample has expired. For time based intervals, the samples are taken when the internal clock reaches the time of the sampling event. For flow-paced intervals, the interval is set to the programmed number of pulses received from a flow meter or flow logger; the sample event begins when the pulses are counted down to zero.
2. When the time or pulse interval countdown reaches zero, the distributor moves to the bottle which is to receive the sample.
3. The pump rotates in the reverse direction for the pre-sample purge. The pre-sample purge is an air purge of the suction line and inlet which clears the line of any accumulated debris and residual liquid to avoid cross-contamination of samples.

4. The pump direction changes, pumping in the forward direction to fill the suction line up to the liquid detector.
5. After the suction line has been filled to the liquid detector and liquid has been detected, the sample volume measuring portion of the sampling cycle begins. The pump continues to rotate in the forward direction until the programmed volume of liquid has been delivered to the appropriate sample bottle. In this manual, the amount of liquid delivered to the bottle is referred to as the "sample volume."
6. The pump direction again changes, pumping in the reverse direction for the post-sample purge. Like the pre-sample purge, the post-sample purge is an air purge of the suction line. After the post-sample purge, the pump then shuts off.
7. The sample interval is reset and the cycle begins again at step 1.

TYPES OF SAMPLES

The 3700FR Sampler is principally designed to collect sequential (discrete) samples. However, it may be programmed to collect a number of other types of samples. As noted in Chapter 1, the 3700FR Sampler has two programming modes: basic and extended. The basic programming mode is used for conventional routines which include the types of sampling described and introduced in this section. A discussion of the types of sampling available through the extended programming mode is placed in *Types of Sampling Available Through the Extended Programming Mode*, on page 17 and *STORM Programming*, on page 19.

Sample types can be characterized by sample distribution and by sample pacing. Sample distribution is the order in which the samples are placed in the bottles. Sample pacing refers to the interval between samples.

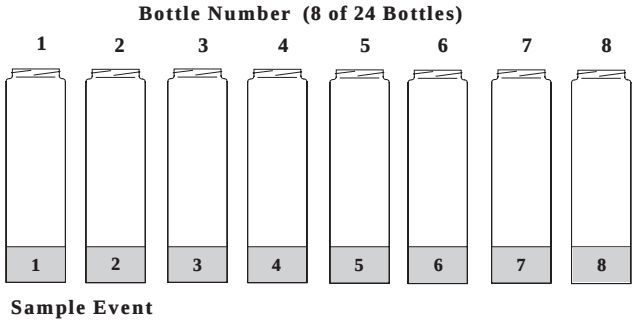
Types of Sample Pacing

There are two types of sample pacing: time-pacing and flow-pacing. In time-paced sampling, the interval between samples is a time interval. In flow-paced sampling, the interval between samples is a certain volume of liquid which has passed a measuring point in a flow stream. Flow-paced sampling requires a flow meter or flow logger. The 3700FR Sampler can also be interfaced with certain non-Isco flow meters. The flow instruments measure the flow quantity and sends a pulse for every predetermined flow quantity to the sampler. The sampler totalizes the number of pulses received from the flow instrument and collects a sample when the total reaches a programmed number.

Types of Sample Distribution

There are two primary types of sample distribution: sequential and composite sampling. In a sequential sample, each bottle receives one sample. A sequential sample represents a "snapshot" of the flow stream at a particular point in time. **Figure 13** shows a diagram of sequential sample distribution. In a composite sample, the individual samples are combined – "composited" – into a single container. A composite sample represents an average of the characteristics of the flow stream over the total elapsed time of sampling.

Figure 13 Sequential Sample Distribution



Note: The 3700FR Sampler is fully programmable for both sequential and composite sampling; however, in addition to programming the sampler for composite sampling, you must convert the sampler mechanically for single bottle compositing. This requires the composite conversion kit which contains the extra equipment needed to adapt the sampler for composite sampling. Conversion procedures are discussed in the instruction sheets provided with the conversion kit.

The types of sample pacing and sample distribution can be combined. Thus, you can take time- or flow-paced sequential samples and time- or flow-paced composite samples. Each combination is noted below.

Time-Paced Sequential: In a time-paced sequential sample, samples are collected at equal increments of time. Each bottle receives one sample.

Flow-Paced Sequential: In a flow-paced sequential sample, samples are collected at equal increments of flow volume, as measured by an associated flow meter. Each bottle receives one sample.

Time-Paced Composite: In a composite time sample, the individual samples are combined – "composited" – into a single container. Samples are collected at equal increments of time.

Flow-Paced Composite: In a composite flow sample, the individual samples are combined into a single container. Samples are collected at equal increments of flow volume, as measured by an associated flow meter.

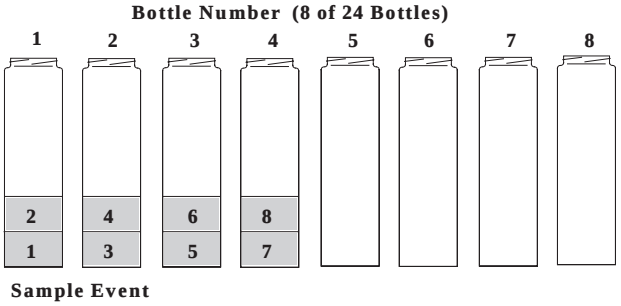
Multiplexing

Both time-paced and flow-paced sequential samples can be multiplexed. Multiplexing places more than one sample in a bottle at different sample events or places a sample in several bottles at the same sample event. Two types of multiplexing are commonly used: samples-per-bottle multiplexing and bottles-per-sample multiplexing.

Samples-per-Bottle Multiplexing

In samples-per-bottle multiplexing, a number of individual samples are deposited in the same bottle. Samples-per-bottle multiplexing is useful when you need to collect a series of small composite samples. In sample-per-bottle multiplexing, the normal sampling cycle (relocate distributor, pre-sample purge, sample delivery, post-sample purge) is modified by altering the number of times the distributor is relocated. Because a bottle will receive more than one sample from more than one sample event, the distributor does not relocate to a new bottle at each sample event. At the first sample event, the distributor relocates, if necessary, to the appropriate bottle. The normal sampling cycle is completed. At the next sample event, the distributor does not relocate, and a second sample is deposited into the same bottle.

Figure 14 Samples-Per-Bottle Multiplexing

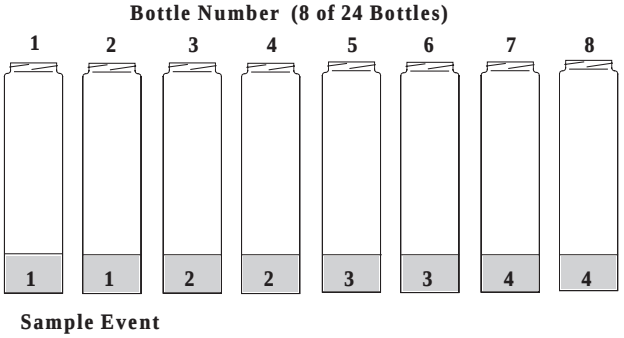


Compositing multiple samples continues up to the programmed number of samples. After the last sample is deposited in the bottle, the sampler pauses until another sample event occurs, the distributor then rotates to the new bottle position, and multiple samples are deposited into the new bottle. **Figure 14** illustrates sample-per-bottle multiplexing.

Bottles-per-Sample Multiplexing

In bottles-per-sample multiplexing, a programmed number of bottles is filled at each sample event. (The programmed number of bottles is called a bottle set; up to 24 bottles can be included in a set.) Bottles-per-sample multiplexing is useful when you need a sample larger than the 350 ml or 1000 ml bottles will contain. It is also useful when you need sets of identical samples; for example when you are using more than one preservative.

Figure 15 Bottles-Per-Sample Multiplexing



When you use bottles-per-sample multiplexing, the normal sampling cycle (relocate distributor, pre-sample purge, sample delivery, post-sample purge) is modified by delaying the complete post-sample purge until sample volumes have been delivered to each bottle of the set. Instead, the pump reverses until the pump tubing is purged just beyond the liquid detector. When the purged liquid passes the detector, the distributor moves to the next bottle, and the pump begins pumping forward to deliver the next sample. This is repeated until each bottle of the set is filled. A full post-sample purge is completed at the end of the sample event. The sampler then pauses until the next sample event occurs, at which time the cycle is repeated for the following bottle set. **Figure 15** illustrates bottles-per-sample multiplexing.

Types of Sampling Available Through the Extended Programming Mode

The extended programming mode expands the variations of sample pacing and distribution. The extended features listed below are used in more complex sampling routines.

Note, however, that the sampling capabilities described above, in *Types of Samples*, on page 16, are available in both the basic and the extended programming modes. STORM programming is available only in the extended programming mode.

Nonuniform Time Intervals

The 3700FR Sampler, through the extended programming mode, can take samples at nonuniform time intervals. With nonuniform time intervals, samples are taken at irregular time intervals, rather than at equal time intervals.

Nonuniform time intervals are typically used in run-off studies (often in conjunction with a Model 1640 Liquid Level Actuator). Nonuniform time intervals permit a number of samples to be collected at short intervals after a rainfall or other event occurs and remaining samples to be collected at widening intervals. For example, when the sampler is used with the Actuator in a runoff study, the Actuator turns the sampler on when the liquid level of the flow stream rises to contact the Actuator's probe. Nonuniform time intervals allow the sampler to collect samples frequently when the flow rate is highest, and to sample less frequently as the flow rate decreases. Nonuniform times can also be used to simulate flow-paced sampling; when the flow rate varies predictably, using nonuniform time intervals allows you to take samples at equal flow volumes. As the flow rate increases, you can take samples at equal flow volumes by decreasing the time interval. As the flow rate decreases, you can increase the time interval.

When you use nonuniform times, the time interval between each sample event is individually programmable. You can enter nonuniform times in two ways: in minutes or in clock times. The first method, minutes, allows you to enter the number of sample events spaced at intervals defined in minutes: 12 samples at 5-minute intervals, 6 samples at 10-minute intervals, 4 samples at 15-minute intervals, and so on. You can also enter a specific time and date for each sample event: sample event 1 at 6:00 on April 20, sample event 2 at 6:30 on April 20, sample event 3 at 7:15 on April 20, and so on. You can specify as many as 999 sample events spaced in nonuniform minutes, or up to 99 events specified as clock times. (If a routine requires a large number of nonuniform times, you can save the routine with the program storage feature so that you do not have to reenter the nonuniform times again.) Nonuniform time intervals can be used with sequential, multiplexed, and composite sampling.

Extended Multiplexing

Multiplexing is somewhat more flexible in the extended programming mode. In the extended mode, you can switch multiplexed bottles or bottle sets after a programmed number of samples have been deposited, or after a programmed period of time has elapsed. Under most conditions, we recommend you switch bottles or sets after a programmed number of samples have been deposited. This allows you to control the number of samples in each bottle precisely. When you switch bottles or sets on a time basis, the total volume of each bottle or bottle set may vary in samples-per-bottle or bottles-per-sample multiplexing.

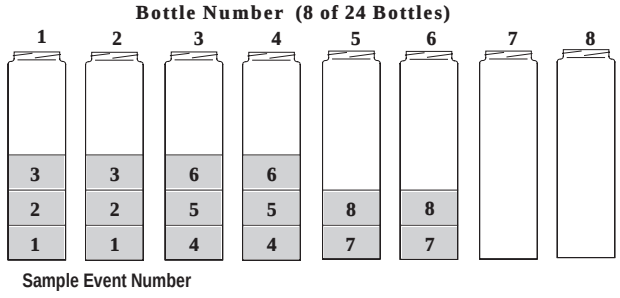
Multiple Bottle

The extended programming mode offers a third multiplexing possibility: multiple bottle compositing. Multiple bottle compositing combines samples per bottle and bottles per sample multiplexing by depositing multiple samples in a bottle set. At each sample event, the sampler places a sample into each bottle of a set. This is repeated until each bottle of the set contains a programmed number of samples. **Figure 16** illustrates multiple bottle compositing. The bottle sets can be switched after a programmed number of samples have been deposited or after a programmed period of time elapses. Multiple bottle compositing is useful when you want a series of identical sets of samples or a larger volume composite sample than can be collected in a single 350 or 1000 ml bottle. Multiple bottle compositing can be used with time-paced or flow-paced routines.

Stops and Resumes

The extended programming mode allows you to create an intermittent sampling schedule. You can program the sampler to stop the routine at a specific time. The routine can then be resumed at a later time. Up to 12 stop times and 12 resume times can be entered. Stops and Resumes can be used with time-paced and flow-paced routines and with routines programmed for nonuniform time intervals.

Figure 16 Multiple Bottle Compositing



STORM Programming

The 3700FR Sampler's STORM programming allows you meet storm water monitoring requirements easily. The sampler's STORM pacing program divides the bottles of the 4, 12, and 24 bottle configurations into two separate groups. The first group receives a first flush (time-paced) grab sample. The second bottle group receives either a flow-paced or time-paced "composite" sample.

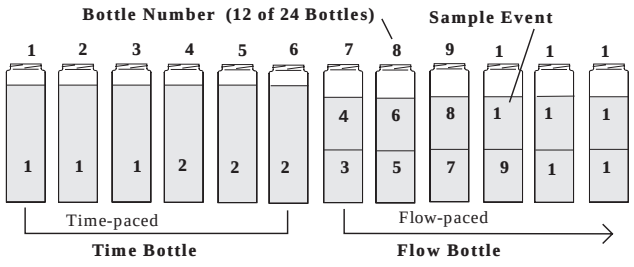
STORM Event Sample Distribution Schemes

A bottle group can consist of one or more bottles. Thus, the first flush sample can be a large sample delivered to a single bottle or distributed to several bottles with a multiplexing scheme. The remaining samples can be distributed to the second bottle group sequentially or according to any of the three available multiplexing distribution schemes — bottles-per-sample, samples-per-bottle, or multiple bottle compositing. By dividing the samples into multiple bottles, you can analyze the pollutant concentration from each phase of the storm event. To obtain an analysis of a composite sample, simply combine the contents of the bottles into a composite for the grab sample and a composite for the flow-weighted samples.

Figure 17 shows a STORM distribution scheme that combines time-paced bottles-per-sample multiplexing with flow-paced samples-per-bottle multiplexing. The program has allocated bottles 1, 2, and 3 for the timed grab samples, and bottles 4 through 24 for flow-weighted samples. At each time-paced sample event, the sampler places a single sample in the first bottle group: bottles 1, 2, and 3. Each bottle of the second group receives two samples per bottle.

If you need to obtain a greater number of samples or a larger volume of samples than a single sampler will permit, use the master/slave option. The master/slave option allows you to use the first sampler to acquire a set of samples based on STORM programming and the second (slave) sampler to continue the sampling.

Figure 17 Storm Distribution Scheme



Programming Introduction

The sampler's programming process is self-prompting. Prompts displayed on the LCD step you through the programming sequence in a logical order, indicating the needed value or option. For example, the sampler will prompt you to enter settings for the interval between samples (time-paced or flow-paced); sample volume in ml; determine whether you want sequential, composite, or multiplexed samples; and other operating controls. These settings can be changed at any time. If the unit is turned off or power is disconnected, the settings are retained in the sampler's memory by the lithium battery. The sampler will accept only appropriate values for the program settings and will reject any unacceptable values.

Operating States

Although there is a certain amount of overlap between the types of operations the sampler performs, there are essentially three operating states: the standby state where the sampler is waiting for your instructions, the run state where the sampler is running a sampling routine, and the interactive state used to program the sampler. Each state serves a different purpose and is discussed separately.

Standby State

In the standby state, the sampler is waiting for your instructions. From standby, you can start a sampling routine, placing the sampler in the run state. You can also access the interactive state to program it. The standby state is discussed in *Standby State*, on page 88.

Run State

In the run state, the sampler's sampling routine is being executed and the sampler is operating under program control. While the sampling routine is executed, the LCD displays a number of messages to communicate the progress of the sampler through the routine. The current bottle or bottle set, current time or flow pulse count, and remaining time or pulse count to the next sample are reported. These status messages vary according to the sampling routine; a representative set of messages are included with the programming examples placed in *Basic Programming Procedure*, on page 27 and *Start Times*, on page 57.

As the routine progresses, the sampler creates a log of sampling results that records pertinent information about each sample event. The results include the time and date of each sample, the number of pump counts occurring until liquid is detected for each sample event, and any problems encountered.

This information can be retrieved with the Display Status procedure, discussed in *Display Status,* on page 91. You can retrieve the results in the middle of a routine or when the routine is done. The results remain in the sampler's memory until you start the sampler again. More information on the run state is placed in *Run State,* on page 94.

INTERACTIVE STATE

The interactive state allows you to program the sampler. The interactive state contains two branches: the program sequence and the configure sequence. **Figure 18** diagrams the structure of the interactive state. The program sequence is used to define the sampling routine; it allows you to enter the interval between samples, the number of samples in each bottle, the sample size, and the start time. The configure sequence provides a number of setup options. Some configure options provide equipment specifications. For example, the 3700FR Sampler can be used with two sizes of sequential bottles: 350 ml and 1000 ml. You must tell the sampler which bottle size you are using so that it can calculate the number of samples of a certain size each bottle can contain. This information is used to prevent overfilling. Other options allow you to set the sampler's real time clock, calibrate the sampler, or enable the password program protection.

Programming Modes

The configure sequence also allows you to select either of the programming modes: basic or extended. The basic programming mode is used for conventional sampling routines. Using the basic programming mode, you can take sequential or composite samples at uniform time intervals or flow pulse intervals. You can multiplex samples, if desired; both bottles-per-sample and samples-per-bottle multiplexing are available.

Extended Programming

The extended programming mode increases the number of available features. These features make more complex sampling routines possible. While all basic programming features are available in the extending programming mode, the less frequently used extended features have been separated to simplify the programming process for conventional routines. For example, you can use STORM programming, multiple bottle compositing, or create an intermittent sampling schedule with the Stops and Resumes feature.

Although the basic and extended program sequences vary in detail, both can be divided into four sections: Sample Pacing (interval between samples), Sample Distribution (number of samples in each bottle), Sample Volume (sample size in ml), and Key Times (start times or, in the extended mode, stop and resume times). These sections are noted in the Program Sequence section of the diagram shown in **Figure 18,** on page 21.

Configure Sequence

The program sequence and the configure sequence are interdependent. The selections you make in the configure sequence determine what settings will be available to you in the program sequence. For example, the basic or extended programming modes are selected in the configure sequence as a setup option. When you select the extended programming mode, the program sequence is modified to accommodate the extended features by adding one or more input displays. For example, because Nonuniform Times are an extended programming feature, the nonuniform times input displays are available in the Sample Pacing program section in the extended programming mode, but not in the basic programming mode.

The extended programming mode not only extends the number of features available in the program sequence, it extends the number of configure options. Refer to **Figure 18**. The configure options marked with asterisks are available only when you select the extended programming mode. As in the programming sequence, less frequently used options have been separated to simplify the configuration process.

Most configure options are available to both programming modes. The configure sequence contains 18 options which are summarized in **Table 3,** on page 21; each option is marked as available in both modes or available only in the extended mode. A detailed discussion of each configuration option is found in *Set Clock,* on page 42 and through *Exit Configuration*, on page 53.

It is usually not necessary to change the configure option settings unless the sampling application changes significantly. The sampler is always programmed and configured: program and configure settings are maintained by the sampler's internal battery. The sampler is shipped with factory program and configure settings. It is configured for the basic program mode and for the bottles and suction line ordered with the sampler. **Table 7,** on page 55 lists the factory settings for the program sequence; **Table 6,** on page 54 lists the factory settings for the configure options.

Figure 18 Interactive State Structure

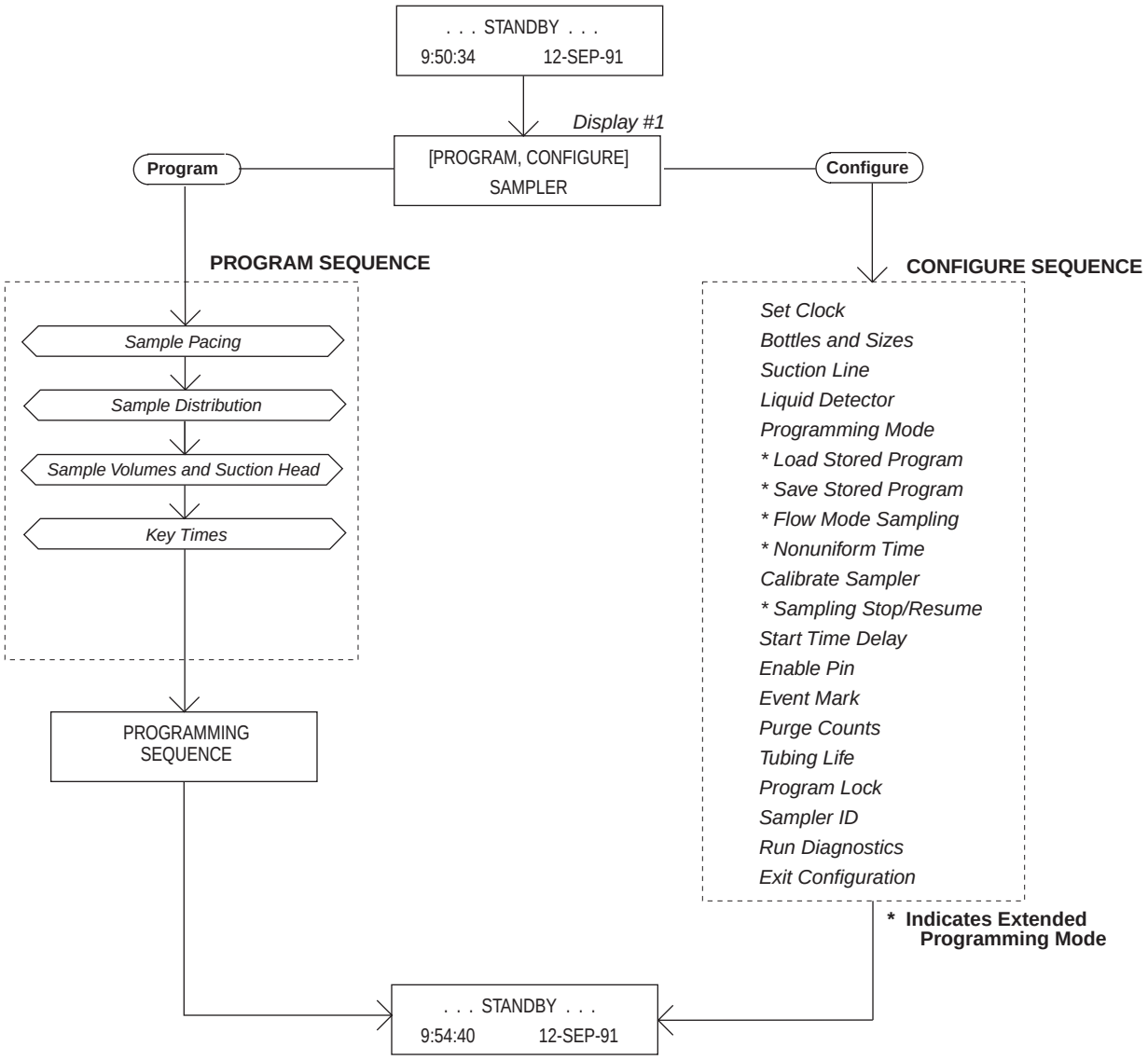


Table 3 Configure Option Functions

Configure Option	Programming Mode	Function
Set Clock	Basic & Extended	Sets the sampler's real time clock.
Bottles and Sizes	Basic & Extended	Sets the number and size of bottles used in the tub.
Suction Line	Basic & Extended	Sets the type of line (vinyl or Teflon), line diameter ($^1/_4$ or $^3/_8$ inch), and line length (3 to 99 ft).
Liquid Detector	Basic & Extended	Enables/disables liquid detector, sets the number of rinse cycles (0 to 3), enables/disables the suction head entry, and sets the number of sampling retries (0 to 3).
Programming Mode	Basic & Extended	Sets the programming mode: basic or extended.
Load Stored Program	Extended	Loads one of up to three previously saved sampling programs.
Save Current Program	Extended	Saves current sampling program.
Flow Mode Sampling	Extended	Directs sampler to take a sample at the beginning of a flow-paced program. Directs sampler to take a sample at time-switches.

Configure Option	Programming Mode	Function
Nonuniform Time	Extended	Directs sampler to accept nonuniform intervals as specific clock times or in minutes.
Calibrate Sampler	Basic & Extended	Enables/disables the calibration sequence.
Sampling Stop/Resume	Extended	Enables/disables Sampling Stops and Resumes feature.
Start Time Delay	Basic & Extended	Sets the start time delay (from 0 to 9999 minutes). If no start time is entered in the program sequence, the program will delay the routine according to the amount of time entered in the Start Time Delay option. The delay begins after the start sampling key is pressed.
Enable Pin	Basic & Extended	Enables/disables the master/slave sampling mode. Directs the sampler to take a sample when disabled and/or enabled by a Liquid Level Actuator or like device. Allows you to restart the sampling interval when the sampler is enabled.
Event Mark	Basic & Extended	Allows you to select one of four types of event marks.
Purge Counts	Basic & Extended	Adjusts the number of pre-sample and post-sample purge counts.
Tubing Life	Basic & Extended	Displays the pump tubing life information. Resets the tubing life count.
Program Lock	Basic & Extended	Enables/disables the password protection for input displays.
Sampler ID	Basic & Extended	Allows you to enter a 10 character ID number for the sampler.
Run Diagnostics	Basic & Extended	Tests the RAM, ROM, pump, and distributor. Allows for re-initialization of certain program and configure settings.

INTRODUCTION TO THE PROGRAMMING PROCEDURE

The procedure used to program the sampler, in the basic programming mode, essentially follows the steps listed below.

Note: because the configuration settings determine portions of the program sequence and affect the accuracy of the sample, check the configuration settings before programming. Steps 2 and 3, configuring and programming the sampler, are covered in greater detail in *Basic Programming Mode Introduction*, on page 26, and in programming **Example 1,** on page 29 through **Example 7,** on page 41.

1. Determine the equipment you will be using with the sampler. You will need to know the size of the bottles you will be using and the inside diameter, type, and length of the suction line. You will need this information when you verify and revise the configuration settings in step 2.

   If you will be using the sampler for composite sampling, you may need to convert the sampler. **Example 6,** on page 39 demonstrates the configuration changes you must make.
2. Configure the sampler. From standby, access the interactive state. Select the configure sequence. Check the configuration settings, revising any settings as needed; select basic or extended programming mode. Return to the standby state.

   Example 1, on page 29 shows you how to check and revise the configuration settings in the configure sequence. We recommend you review *Keypad Description*, on page 23 and *Displays*, on page 25 before you work through the programming examples. These sections discuss the functions of the individual keys and how to use the keys when programming the sampler.
3. Program the sampler. Again, from standby, access the interactive state. Select the program sequence. Enter the program settings for your routine. The sampler will prompt you through the programming process. When the process is completed, the sampler will automatically return to standby. (A more detailed discussion of this procedure is placed in *Basic Programming Mode Introduction*, on page 26). **Example 2,** on page 32 through **Example 7,** on page 41 demonstrate several types of sampling programs in the basic mode. **Example 10,** on page 74 through **Example 17,** on page 86 demonstrate several sampling programs in the extended mode.
4. Install the sampler, if you have not already done so. (The sampler can be programmed on site or in the office before installation.) If desired, connect the sampler to a flow meter or other interfacing equipment. Chapter 2 discusses the installation of the sampler and interfacing equipment. Start the sampler to place the sampler into the run state and execute the routine.
5. As the routine runs, the displays will report the sampler's progress. The programming examples in this manual conclude with the run state displays you should see for each sampling routine. When the routine is done, the sampler will return to standby.

6. Retrieve the filled sample bottles. If desired, use the display status procedure, discussed in *Display Status*, on page 91, to examine the sampler's log of sampling results.
7. If you need to reprogram the sampler, follow this procedure from the beginning. If the sampler's current program is correct, start the sampling routine again.

USING THE KEYPAD TO RESPOND TO DISPLAYS

Configuring and programming the sampler is as simple as responding to displays with the keypad. The sampler will prompt you through many of the entries by presenting a question or a choice on the display. You must respond with the keypad. The LCD and the keypad are located on the 3700FR Sampler control panel, shown in **Figure 19**.

A summary of each key's function is placed in *Keypad Description*, on page 23. For a discussion of the displays presented on the LCD and the way you can use the keypad to interact with the sampler, refer to *Displays*, on page 25.

KEYPAD DESCRIPTION

Keys are grouped together to assist you in identifying related functions. Control keys manually control the sampler, numeric keys enter program values, programming keys monitor the sampler's status and direct programming activities. In this manual, individual keys are indicated in small capital letters.

The individual key switches that make up the keypad provide both tactile and audio feedback to assure you that the key switch has been successfully actuated. You can feel the deflection of the spring member in the switch; an audio indicator inside the sampler will beep once. The sampler has a 10-keystroke buffer which, in some cases, allows you to "type ahead" of the display.

Control Keys

Control keys allow you to turn the sampler on or off, start or resume the currently entered program, and control the sampler manually. The functions of the control keys are listed below.

ON/OFF - Pressing the ON/OFF key when the sampler is off will turn the sampler on, reactivate the display and place the sampler in the standby state. Pressing the ON/OFF key (when the sampler is on) will halt all sampling activity and clear the display.

PUMP FORWARD - While in the standby state, pressing the PUMP FORWARD key will cause the pump to run continuously in the forward direction. The pump will run until the STOP key is pressed.

PUMP REVERSE - While in the standby state, pressing the PUMP REVERSE key will run the pump continuously in reverse. The pump will continue to operate until the STOP key is pressed.

STOP - The STOP key will stop the pump any time it is running. When the STOP key is pressed in the run state, the sampling routine will be halted, the sampler will be transferred to the standby state, and the "PROGRAM HALTED" message will be displayed. Pressing the STOP key while in the interactive state will access the display's reference number.

START SAMPLING - When in the standby state, pressing the START SAMPLING key will begin the sampling program. When entering a sampler ID, the key will type a space.

RESUME SAMPLING - When "PROGRAM HALTED" is displayed, pressing the RESUME SAMPLING key will cause the sampler to continue with the current sample program at the point at which it was halted. When entering a sampler ID, the key will type a period

MANUAL SAMPLE - Pressing the MANUAL SAMPLE key will allow you to take a manual sample. The MANUAL SAMPLE key is valid in the standby state, the run state, and when calibrating the sampler. When entering a sampler ID, the key will type a dash (-).

NEXT BOTTLE - Pressing the NEXT BOTTLE key will cause the distributor to move to the next bottle. If the distributor is positioned over the last bottle, it will move to bottle position 1.

Program Keys

The four program keys are used to enter program settings. Each key's function is listed below.

DISPLAY STATUS - While the sampler is in the standby or run state, pressing the DISPLAY STATUS key will allow you to view the program settings or the sampling results.

EXIT PROGRAM - Pressing the EXIT PROGRAM key while in the program sequence will return the sampler to standby. Pressing the EXIT PROGRAM key while in the run state will halt the program; the message "PROGRAM HALTED" will be displayed.

CLEAR ENTRY - When entering a number, the CLEAR ENTRY key can be used to return to the original entry.

ENTER/PROGRAM - Pressing the ENTER/PROGRAM key, while in the standby state, will cause the sampler to enter the interactive state. While at an input display, pressing the ENTER/PROGRAM key will accept an entered value or a blinking option, and direct the sampler to proceed to the next step. Input displays are discussed in *Displays*, on page 25.

Figure 19 3700FR Sampler Control Panel

Numeric Keys

The numeric keys consist of 10 digit keys, a LEFT ARROW key, and a RIGHT ARROW key. The digit keys are used to enter quantities. The ARROW keys are used to move through lists or program options.

LEFT ARROW - The LEFT ARROW key is used to select one of two or more program options displayed when the sampler is in the interactive state. When more than one numeric entry is displayed – for example, the hours and minutes of a time setting – the LEFT ARROW can be used to step back to a previously entered value. When entering a number, the LEFT ARROW can be used to erase the most recently entered digit.

RIGHT ARROW - The RIGHT ARROW key is used to select one of two or more program options displayed in an input display. It is also steps through status information.

DISPLAYS

There are two types of displays: displays which communicate information about the sampler's status and displays which request input. In many cases, you must respond with the keypad.

Informational Displays

Informational displays communicate information about the sampler's status. For example, when the sampler completes a sampling program, a display similar to the illustration below appears. It communicates the sampler's status, "DONE," the number of samples taken (which will vary according to the program), and the current time and date.

```
DONE. . . 24 SAMPLES
10:32:34   14-JUN-91
```

Input Displays

Input displays can be identified easily because they contain a blinking word or number. The blinking word or number serves as a prompt for input and is said to be "selected." When the input displays shown below first appear, the word "PROGRAM" (display a) and the sample volume entry "250" (display b) will be blinking. Blinking words or numbers are represented in illustrations with *italic* characters.

```
[PROGRAM, CONFIGURE]
SAMPLER
```
a

```
SAMPLES VOLUMES OF
250 ml  (10-1000)
```
b

Display Numbers

Nearly all input displays have a number assigned to them. The number is used to cross reference the input displays with a explanatory listing found in Appendix B - Display Index or in the 3700R/ 3700FR Sampler Pocket Guide. If you have a question about a given input display, you can easily locate the description of the display with the display number.

The display number can be accessed by pressing the STOP key when viewing the input display in the interactive and standby states. (In the run state, the STOP key is used to halt the sampling program.) To see the display number, press the stop key, read the number from the display, then look up the corresponding number in *Appendix B Display Index*, on page 142 for information on that display. The display number for display is "1."

Displays With Choices

There are two types of input displays: displays which prompt you to make a choice (between time-paced and flow-paced sampling, for example) and displays which prompt for numeric input (sample volume, for example). In displays which prompt you to make a choice, you must select one of up to four alternatives placed in brackets.

For example, display a above prompts you to select the program or the configure sequence. The choices, "PROGRAM" and "CONFIGURE," are placed in brackets.

When an input display prompting for a choice first appears, the blinking word indicates the currently selected choice. If the blinking word is acceptable, press the ENTER/PROGRAM key. If the blinking word is not acceptable, select the preferred choice by pressing the LEFT ARROW or RIGHT ARROW key until the preferred choice is blinking; then press the ENTER/PROGRAM key. The sampler will store the selected choice and advance to the next step.

When the display illustrated in a appears, the word "PROGRAM" will be blinking. If "PROGRAM" is acceptable, press the ENTER/PROGRAM key. If "PROGRAM" is not acceptable, press the LEFT ARROW or RIGHT ARROW key until "CONFIGURE" is blinking. Then, press the ENTER/PROGRAM key. The ENTER/PROGRAM key directs the sampler to advance to the next step.

Numeric Input Displays

A numeric input display will prompt for input by blinking the currently stored number. In the display illustrated in b, the number "250" will blink to prompt you to enter a value.

If the blinking number is acceptable, it is not necessary to type the number again: pressing the ENTER/PROGRAM key will store the number and advance the program to the next step. To enter a new number, press the appropriate numeric keys, then press the ENTER/PROGRAM key.

The sampler will not accept a number that exceeds the allowable range of values placed in parentheses on the display. In illustration b, no less than 10 ml and no more than 990 ml can be entered as a sample volume. If an entered number exceeds the range, the sampler will emit a series of beeps and the original number will reappear. An acceptable value must be entered to advance to the next step.

Editing Numbers

The LEFT ARROW key and CLEAR ENTRY key can be used to edit numeric entries if they are used after you press a numeric key and before you press the enter/program key. The CLEAR ENTRY key will clear any typed number and the original number will reappear. The LEFT ARROW will erase the most recently typed number.

Some numeric input displays prompt for more than one value. In the illustration below, the prompt asks for five number entries: hours, minutes, month, day, and year. The LEFT ARROW key and RIGHT ARROW key can be used to move back and forth between each of the five entries. Individual entries can be changed, as discussed above. Pressing the RIGHT ARROW or ENTER/PROGRAM key on the last entry will store the values and advance to the next display.

HH:MM	DD-MM-YY
12:33	21/06/91

Military Times

Times must be entered in military format. For example, to set the sampler's clock to 3:30 pm, enter a time of 15:30. When the display above first appears, the first two digits, "12," will blink. To enter a new time, type in the new hour, "15." Store the hour entry and advance to minutes by pressing the ENTER/PROGRAM key. Although months are displayed with a three-letter abbreviation, you must enter the month as a number. If the month or year entry does not need to be changed, accept the entry by pressing the RIGHT ARROW or ENTER/PROGRAM key. The LEFT ARROW key can be used to return to a previous position. Pressing the RIGHT ARROW or ENTER/PROGRAM key on the last entry, "91," will store the value and advance to the next display.

European Date Format

The sampler uses the European date format where the day precedes the month's three-letter abbreviation. To enter a date, enter the day before the month's number, and the year. The sampler will convert the numeric entry to the three-letter abbreviation for you.

Exit Program Key

The user can exit an input display by pressing the EXIT PROGRAM key. If you use the EXIT PROGRAM key, the currently stored setting will not change.

BASIC PROGRAMMING MODE INTRODUCTION

The following examples demonstrate the steps used to check the configure option settings and program the sampler for several different sampling routines. They are designed to provide you with step-by-step procedures and are provided as models for you to use later when programming the sampler for your "real" applications. Each programming example concludes with the run state displays that appear while that routine is being executed. These displays can be used to monitor the sampler's progress through a routine.

Two Sets Of Examples

There are two sets of examples. Examples for the basic programming sequence are provided in **Example 2,** on page 32 through **Example 7,** on page 41. Because many of the features of the extended programming mode are affected by selections made in the configure sequence, examples for the extended programming sequence follow *Basic Programming Mode Introduction*, on page 26, which discusses each configure option separately. We recommend you become familiar with the basic programming mode procedure and basic programming examples before using the extended programming mode. Most of the procedures used in the extended programming mode duplicate those of the basic programming mode and are not repeated in the section on extended programming procedures.

Examples for both programming modes are accompanied by flow charts. These charts diagram the program sequence structure for each mode. **Figure 20** charts the Basic Programming Mode structure.

Figure 25, on page 65 charts the structure of the Extended Programming Mode. The charts are provided to act as a "map" to the programming process. Both charts are divided into sections - Sample Pacing, Sample Distribution, Sample Volume, and Key Times - which correspond to the steps listed in *Basic Programming Procedure,* on page 27.

Each chart contains the input displays used in the sequence. The input displays, in turn, are labeled with their display number so they can be cross-referenced with the listing found in *Appendix B Display Index*, on page 142. When programming the sampler, the display number can be accessed by pressing the STOP key.

As noted earlier, the sampler is shipped with a test program and factory configuration settings. The examples in this manual assume that all factory settings are being used, that the sampler will use the 24 bottle base, and that a 10 foot length of 3/8 inch vinyl suction line is being used.

Most program and configure settings can be re-initialized to factory settings, if desired. **Tables 6** and **7**, starting on page 54, list factory settings. A discussion of the re-initialize option, located in the Run Diagnostics configure option is found in *Run Diagnostics*, on page 52. Instructions for re-initializing the sampler are also included as part of **Example 1,** and **Example 2** provides detailed instructions to help you work through the procedures detailed in *Basic Programming Procedure*.

BASIC PROGRAMMING PROCEDURE

The steps needed to program the sampler in the basic mode follow the procedure outlined below.

1. Turn the sampler on with the ON/OFF key. The sampler always "wakes up" in the standby state. The "STANDBY" message will appear; or, if the sampler were turned off while running a routine, the "PROGRAM HALTED" message will be displayed. Both messages indicate the sampler is in standby.
2. Press the ENTER/PROGRAM key to access the interactive state. Select the program sequence. Refer to **Figure 20** for displays noted in steps 3 - 6. During the programming procedure, if you want to return to a previous display; press the EXIT PROGRAM key. The sampler will return to standby and you can repeat steps 1 and 2. Then press the ENTER/PROGRAM key to scroll through the settings until you locate the display in question.
3. Enter the Sample Pacing settings. The sampler will prompt you to select either time- or flow-pacing. Depending on your selection, you will then be prompted to enter the time interval between samplers, or the flow pulse interval.

   Note: If you will be using very short sample intervals, be sure the interval is longer than the duration of the sampling cycle. The duration of the cycle can be determined by programming the sampler with the desired settings, pressing the MANUAL SAMPLE key, and simply timing the cycle. For truly representative sampling, the interval – in either time- or flow-paced sampling – should be longer than the duration of the sampling cycle. If the intervals are too short, no sample events will be missed, although some events will occur at improper times.

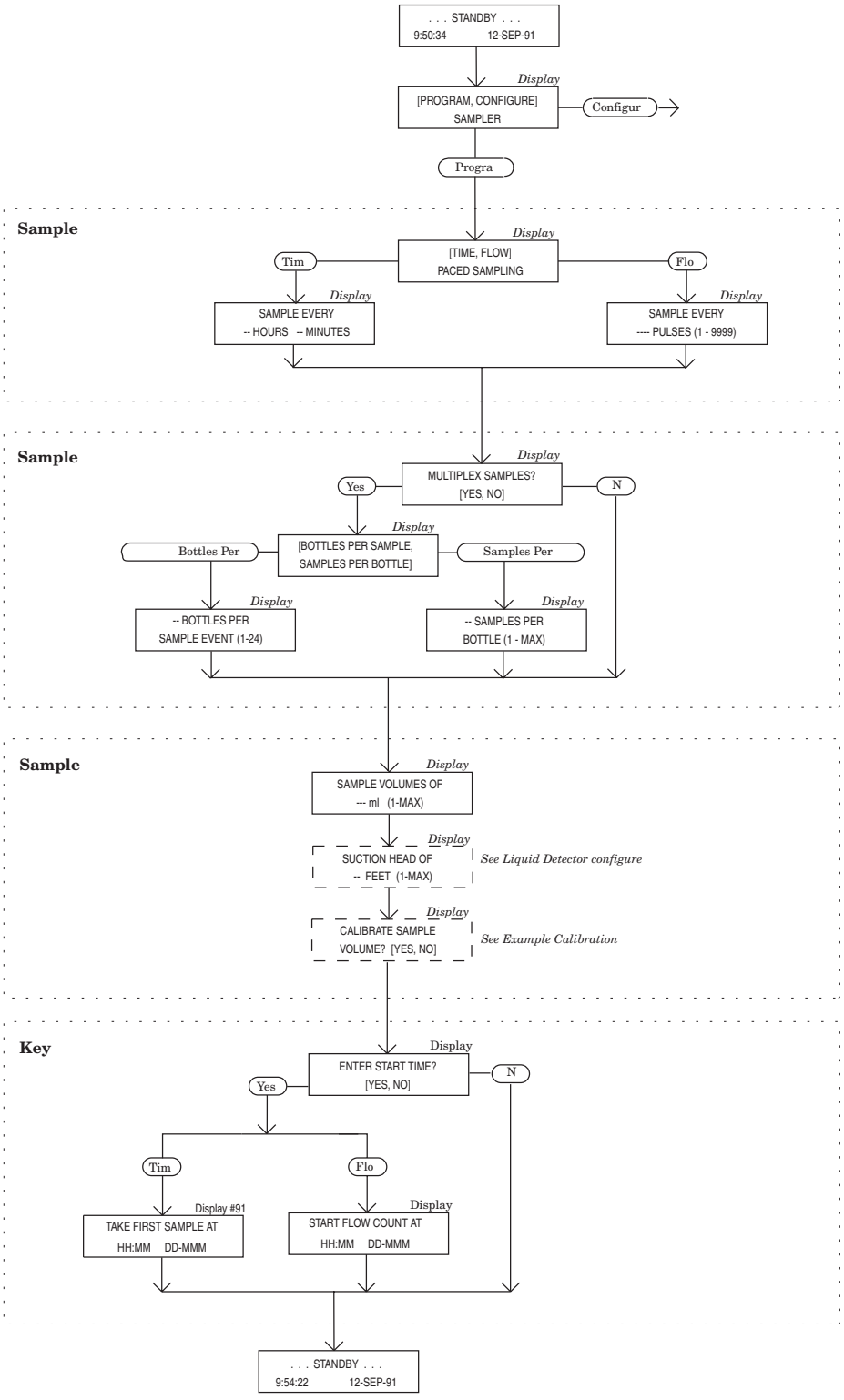
   When programming the sampler for flow pacing, you must enter the number of pulses that make up the flow interval. If the flow meter has been set to send a pulse once every 1000 gallons, you can program the sampler to collect a sample once every 1000 gallons by entering a flow pulse interval of "1." To collect a sample once every 50,000 gallons, you would enter a sample interval of 50 pulses. *Appendix C Calculating Flow Increment Between Samples*, on page 151 provides a discussion of some of the calculations needed when determining flow pulse intervals.
4. Enter the Sample Distribution settings. The settings in the Sample Distribution section allow you to perform sequential or multiplexed sampling. The first display of the Sample Distribution program section asks you if you want to multiplex samples or not. If you want simple sequential sampling – one sample per bottle – select "NO." The sampler will then prompt you for the Sample Volume settings.

   If you want to use bottles-per-sample or samples-per-bottle multiplexing, select "YES." The next display will prompt you to select, "BOTTLES PER SAMPLE" or "SAMPLES PER BOTTLE."

   Bottles-per-sample multiplexing is useful where a sample volume greater than the capacity of a single bottle is required, or where various types of preservatives must be added to the samples. Samples-per-bottle multiplexing is useful when it is desirable to collect a series of small composite samples. For example, four samples at 15 minute intervals can be collected in each bottle, resulting in a series of hourly composite samples. *Types of Samples*, on page 16 discusses the various types of multiplexing.
5. Enter the Sample Volume settings. The Sample Volume program section will always contain prompts for the sample volume. Depending on the selections made in the configure sequence, it may contain prompts for the suction head and for calibrating the sampler.

   When entering the sample volume, the ± 10 ml sample volume repeatability should be kept in mind (refer to **Table 1,** on page 6). Because the sample volume programmed is a "nominal" value, it is prudent to enter a total sample volume which is somewhat less than the volumetric capacity of the bottle, as a safety factor. This will minimize the effects of cumulative error. Refer to *Bottles and Sizes*, on page 42 for notes on cumulative error and bottle size.

Figure 20 Basic Programming Mode: Program Sequence Structure



If bottles-per-sample multiplexing is being used to add preservatives to a number of consecutive samples, be sure to take the volume of the preservative into account.

The sampler can be configured, through the Liquid Detector configure option, to add the suction head setting to the program sequence. The suction head display will appear after you enter the sample volume. However, when the head is unknown or variable, the suction head setting should be omitted by disabling the suction head setting in the Liquid Detector configure option. By disabling the setting, you allow the liquid detector to determine the operating suction head each time a sample is taken. If the Liquid Detector is disabled, the suction head is automatically added to the program sequence and you are required to enter the suction head.

If you want to calibrate the sample volume, the calibration option must be enabled. To enable this option, select "ENABLE" in the Calibrate Sampler configure option. (Refer to *Calibrate Sampler*, on page 49). Enabling the option will add the calibration displays to the Sample Volume program section. These displays are included in **Example 7,** on page 41 which demonstrates the calibration procedure.

6. Enter the Key Times settings. In the basic programming mode, you will be asked if you want to enter a start time for the routine. If you select "YES," you will be prompted to enter a specific start time and date. If you select "NO," the sampler will use the start time delay. The start time delay can be set from 0 to 9999 minutes in the Start Time Delay configure option (see section 3.2.4.12). When you select "NO," the routine will start according to the delay setting in the Start Time Delay configure option. *Start Times*, on page 57 contains an extensive explanation of the sampler's start times.

   When the sampler is operating under factory configuration settings, the first sample will be taken at the start time for time-paced sampling. This is true whether you enter a specific start time and date, or if you use the start time delay. For flow-paced sampling, however, the flow pulse countdown will begin at the start time and the first sample will be taken when the countdown reached zero. Refer to the discussion on the Enable Pin option in *Enable Pin*, on page 50 for additional information.
7. The sampler will automatically return to standby.
8. From standby, start the routine by pressing the START SAMPLING key. This places the sampler into the run state. You will be prompted to enter the starting bottle number. If you want to begin with bottle 1, press the ENTER/PROGRAM key. If you make no response within 60 seconds, sampler will automatically begin with bottle 1. If you happen to start the routine after the programmed start time, the sampler will allow you to reprogram the start time. For more information, see *Standby State*, on page 88.
9. Use the run state displays to monitor the sampler's progress.

Example 1 Checking the Configure Option Settings

Before programming the sampler – especially if you are unfamiliar with the settings used in the previous routine, or if you think the settings have been changed – you should verify the configure option settings. You must change the settings if they do not match the number or size of the bottles, or the suction line used with the unit. The entries suggested in this example configure the sampler for 24 1000-ml bottles, a 10-foot length of $^{3}/_{8}$-inch vinyl suction line, enable the liquid detector, and select the basic programming mode among other settings. Procedures for reinitializing the program settings and configure options to factory settings are placed in steps 22 through 26.

Not all configure options are discussed in this example; however, the options noted in this example include all the configure options which are not reinitialized to factory settings when the reinitialization process is run.

Step No.	Display	Procedure
1	**. . . STANDBY . . .** **10:34:50 19-JUN-91**	If the sampler is not already on, press the ON/OFF key to turn it on. The standby display shown here will appear. Press the ENTER/PROGRAM key to access the interactive state. The next display you'll see is shown in step 2.
2	**[*PROGRAM*, CONFIGURE]** **SAMPLER**	Access the configure sequence by selecting "CONFIGURE." Select "CONFIGURE" by pressing the RIGHT ARROW key once. When "CONFIGURE" blinks, accept the selection by pressing the ENTER/PROGRAM key.

Step No.	Display	Procedure
3	**SELECT OPTION: (← →)** **SET CLOCK**	Press the LEFT ARROW or RIGHT ARROW key to scroll through the configure options. The first option displayed is the Set Clock configure option. If the time displayed on the LCD in the standby message is not correct, reset the time with the Set Clock configure option. Access the Set Clock input display by pressing the ENTER/PROGRAM key.
4	**HH:MM MM/DD/YY** ***10*:35:20 19-JUN-91**	Use this display to reset the time. This display requires five entries. The LEFT ARROW and RIGHT ARROW key can be used to move back and forth between each of the five entries. Use the ARROW keys until the entry you want to change blinks. Type in the new entry. Press the ENTER/PROGRAM key to accept the new entry. Pressing the RIGHT ARROW or ENTER/PROGRAM key on the last entry will store the values and advance to the next display.
5	**SELECT OPTION: (← →)** **BOTTLES AND SIZES**	To verify the Bottles and Sizes settings, press the ENTER/PROGRAM key. The display shown in step 6 will appear.
6	**[PORTABLE, *REFRIG*.]** **SAMPLER**	The 3700 Series portable and refrigerated samplers use the same controller. Because the 3700FR Sampler is a refrigerated sampler, select "REFRIG." Accept the selection by pressing the ENTER/PROGRAM key.
7	**[1, 2, 4, 8, 12, *24*]** **BOTTLES**	For the purposes of this example, select "24" when you are using the 24 bottle base. Use the ARROW keys until "24" blinks, then press the ENTER/PROGRAM key. Select "1" when you are using a single bottle for composite sampling. NOTE: The 12 bottle configuration is available for Isco's fiberglass refrigerated samplers only.
8	**BOTTLE VOLUME IS** ***1000* ml**	Enter the bottle size here. Enter "350" for the 350 ml glass bottles, "1000" for plastic bottles. Press the ENTER/PROGRAM key. If you enter a number that exceeds the standard bottle size, the message, "WARNING: STANDARD BTL VOLUME EXCEEDED!", will be displayed for a short time. The sampler will then prompt you to confirm the volume entered. This prompt is displayed in step 9.
9	**1001 ml! . . . ARE YOU** **SURE? [YES, NO]**	Select "YES" if you want to use the non-standard bottle volume. Select "NO" if you want to revise the entry. The display shown in step 8 will reappear; use it to enter the revised bottle volume. Press the ENTER/PROGRAM key to accept the entry and advance to step 10.
10	**SELECT OPTION: (← →)** **SUCTION LINE**	Press the ENTER/PROGRAM key at this display to access the Suction Line input displays shown in steps 11 - 13.
11	**SUCTION LINE ID IS** **[1/4, *3/8*] INCH**	Select "1/4" if you are using 1/4 inch suction line, "3/8" if you are using 3/8 inch suction line. Press the ENTER/PROGRAM key to accept the entry and advance to the next step. If you select "1/4," you will not see the display shown in step 12; instead you will be prompted for the suction line length, as shown in step 13. (1/4 inch suction line is only available in vinyl, so you do not need to specify the line type.)
12	**SUCTION LINE IS** **[*VINYL*, TEFLON]**	This display appears when you have selected "3/8" in step 11. Select "VINYL" if you are using vinyl suction line, "TEFLON" if you are using Teflon suction line. Press the ENTER/PROGRAM key to accept the selection.

Step No.	Display	Procedure
13	**SUCTION LINE LENGTH IS *10* FEET (3 - 99)**	Enter the length of the suction line. The length should not include the tube coupling or the strainer. Press the ENTER/PROGRAM key to accept the entry and move to the step 14. If you change the suction line settings, the ". . . CALCULATING . . . PUMP TABLE VALUES" message will appear for a short time.
14	**SELECT OPTION: (← →) LIQUID DETECTOR**	Press the ENTER/PROGRAM key at this display to access the Liquid Detector input displays shown in steps 15 - 18.
15	**[*ENABLE*, DISABLE] LIQUID DETECTOR**	Select "ENABLE" to turn the Liquid Detector on, "DISABLE" to turn the Liquid Detector off. For the purposes of the following examples, select "ENABLE." Press the ENTER/PROGRAM key to accept the selection. The detector should normally be left enabled unless you suspect it is malfunctioning. If you disable the detector, you will be required to enter the suction head in the program sequence.
16	***0* RINSE CYCLES (0 - 3)**	This display appears when you have selected "ENABLE" in step 15. Enter the number of rinse cycles. For the purposes of this example, enter "0." Press the ENTER/PROGRAM key to accept the entry. Rinse cycles condition the suction line to reduce cross contamination.
17	**ENTER HEAD MANUALLY [YES, *NO*]**	This display appears when you have selected "ENABLE" in step 15. Select "YES" to add the suction head setting to the program sequence. For the purposes of the following examples, select "NO" to omit the setting. Press the ENTER/PROGRAM key to accept the selection.
18	**RETRY UP TO *0* TIMES WHEN SAMPLING (0 - 3)**	This display appears when you have selected "ENABLE" in step 15. Enter the number of retries. For the purposes of this example, set the number of retries to "0." Press the ENTER/PROGRAM key to accept the entry. This setting determines the number of times the sampler will try to detect the presence of liquid for each sample event.
19	**SELECT OPTION: (← →) PROGRAMMING MODE**	To verify the programming mode setting, press the ENTER/PROGRAM key.
20	**[*BASIC*, EXTENDED] PROGRAMMING MODE**	Select "BASIC." Press the ENTER/PROGRAM key to accept the selection.
21	↓ ↓	Scroll through the remaining options with the arrow keys. Use the techniques demonstrated above to change or verify the settings. If you want to re-initialize the configure and program settings to factory settings, follow the procedures given in steps 22-27.
22	**SELECT OPTION: (← →) RUN DIAGNOSTICS**	To access the displays used in this option, press the ENTER/PROGRAM key.
23	**SOFTWARE REVISION #4.6**	The sampler will display the software revision number for a short period of time.

24	**RAM' PASSED TEST** **TESTING 'ROM'**	The software revision display is replaced by the RAM and ROM test messages. A successful test is indicated by the messages "RAM PASSED TEST" or "ROM PASSED TEST." If either the RAM or ROM fail the test, the sampler will display one of the following messages: "RAM FAILED TEST" or "ROM FAILED TEST" and beep every three seconds until you turn the sampler off. If either the RAM or ROM fail their test, the sampler should be serviced. Contact Isco Customer Service for instructions on returning the sampler.

Step No.	Display	Procedure
25	**ABCDEFGHIJKLMNOPQRST** **UVWXYZ[¥]^_`abcdefgh**	After successful RAM and ROM tests, the sampler will then test the LCD by first filling the display with solid rectangles and then printing the alphabet and other characters. Each character position in the display should contain a character.
26	**PUMP COUNT TEST** **OFF/ON = 105**	The next step tests the pump. During the test, the pump will run briefly and the display will indicate an "OFF/ON" number. The number should fall within the range of 50 to 200. If the count falls below 50 or exceeds 200, the pump should be serviced. A count near 100 is typical.
27	**TEST DISTRIBUTOR?** **[YES, *NO*]**	For the purposes of this example, select "NO" to skip the test. Press ENTER/PROGRAM to accept the selection.
28	**RE-INITIALIZE?** **[*YES*, NO]**	If you want to re-initialize the settings, select "YES." The entire RAM, with the exception of the current pump count total, bottle size settings, and suction line settings, will be re-initialized to factory settings. When you select "YES," the sampler will automatically turn itself off as part of the re-initialization process. Select "NO" leave the controller unchanged. Press the ENTER/PROGRAM key to accept the selection.

Example 2 Time-Paced Sequential Sampling

The steps in this example program the sampler to take samples every 30 minutes. Each bottle is to receive one 250 ml sample volume. The sampling routine is to begin according to the start time delay- one minute after the start sampling key is pressed.

Step No.	Display	Procedure
1	**. . . STANDBY . . .** **5:34:50 19-JUN-91**	If the sampler is not already on, press the ON/OFF key to turn it on. The standby display shown here will appear. Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE]** **SAMPLER**	Access the program sequence by selecting "PROGRAM." Because the choice "PROGRAM" will already be selected (blinking), press the ENTER/PROGRAM key to accept it and move to the next step.
3	**[*TIME*, FLOW]** **PACED SAMPLING**	To enter the interval between samples in time increments, select "TIME." If "TIME" is already blinking, press the ENTER/PROGRAM key to accept the selection. If "FLOW" is blinking, press the LEFT ARROW key once so that "TIME" blinks. Then, press the ENTER/PROGRAM key to accept "TIME."
4	**SAMPLE EVERY** ***0* HOURS, 1 MINUTES**	This display requires two entries: one for the hours, one for the minutes. Enter "0" to set the hours at zero. Press ENTER/PROGRAM to accept the number "0" and move to the minutes entry shown in step 5.
5	**SAMPLE EVERY** **0 HOURS, *30* MINUTES**	Enter "30" to set the minutes entry to 30. Press ENTER/PROGRAM to accept the entry.

Step No.	Display	Procedure
6	MULTIPLEX SAMPLES? [YES, *NO*]	For the purposes of this example, select "NO." Press the ENTER/PROGRAM key to accept the entry. If you select "YES" in response to this question, you would be able to select bottles-per-sample or samples-per-bottle multiplexing for your routine.
7	SAMPLE VOLUMES OF *250* ml (10 - 1000)	Enter "250" to set the sample volume at 250 ml. Press the ENTER/PROGRAM key to accept the entry.
8	ENTER START TIME? [YES, *NO*]	Because this sampling routine does not require a specific start time, use the arrow keys to select "NO." Press the ENTER/PROGRAM key to accept the entry. If you select "YES," you would be able to enter a specific start time and date for the routine.
9	PROGRAMMING SEQUENCE COMPLETE . . .	After this message is displayed briefly, the sampler will automatically return to the standby state.
10	. . . STANDBY . . . 5:42:23 19-JUN-91	After the sampler is properly installed, press the START SAMPLING key to run the program.
11	START SAMPLING BOTTLE 1 (1-24)	To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.
12	BOTTLE 1 AT 5:44 5:42:33	This display appears as the sampler counts down the time remaining to the start time. The first line reports the bottle which will receive the next sample volume. The second line reports the start time at the left and the current time on the right.
13	BOTTLE 1	When the start time arrives, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge. During the purge, the display indicates the bottle number which will receive the sample volume.
	BOTTLE 1 PUMPING 250 ml	As soon as the pump runs forward to deliver the sample volume, the message on the second line appears. This message remains through the post-sample purge.
14	BOTTLE 2 AT 6:14 5:45:11	This display appears when the post-sample purge from the previous sample event is completed. It indicates the bottle number which is to receive the sample at the upcoming sample event. The second line displays the scheduled time for the next event on the left. The current time is displayed on the right.
15	↓ ↓	The cycle of displays, illustrated in steps 12 through 13, is repeated for each bottle until the sampling routine is done.
16	DONE . . . 24 SAMPLES 6:10:35 21-JUN-91	When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

Example 3 Flow-paced Sequential Sampling

This example programs the sampler to take flow-paced samples at intervals of 5 pulses. One 500 ml sample is to be placed in each bottle. The sampling program will default to the start time delay entered in the Start Time Delay configure option.

Step No.	Display	Procedure
1	. . . STANDBY . . . 10:34:50 19-JUN-91	Press ENTER/PROGRAM to access the interactive state.
2	[*PROGRAM*, CONFIGURE] SAMPLER	Access the program sequence by selecting "PROGRAM."
3	[TIME, *FLOW*] PACED SAMPLING	Select "FLOW."
4	SAMPLE EVERY *5* PULSES (1-9999)	Enter "5" as the flow pulse interval. The sampler will take a sample every fifth flow pulse received.
5	MULTIPLEX SAMPLES? [YES, *NO*]	
6	SAMPLE VOLUMES OF *500* ml (10 - 1000)	Enter "500" to set the sample volume at 500 ml.
7	ENTER START TIME? [YES, *NO*]	ENTER START TIME? [YES,þNO] Select "NO."
8	PROGRAMMING SEQUENCE COMPLETE . .	After this message is displayed briefly, the sampler will automatically return to the standby state.
9	. . . STANDBY . . . 10:37:23 19-JUN-91	After the sampler is properly installed, press the START SAMPLING key to run the program.
10	START SAMPLING AT BOTTLE 1 (1-24)	To start the sampling routine with the first bottle, press the ENTER/PROGRAM key. To start the routine with another bottle, enter the starting bottle number here.
11	START AT 10:38 19-JUN 10:37:26 19-JUN	The first line of this display indicates the start time. The second line reports the current time and date.
12	BOTTLE 1 AFTER 5 PULSES	This display indicates the bottle which will receive a sample at the next sample event. The second line indicates the number of pulses remaining to the sample.
13	BOTTLE 1 AFTER 4 PULSES	This display shows that one flow pulse has been received. The pulse countdown will continue until the sample event.
14	↓ ↓	
15	BOTTLE 1	The second line of the display will disappear as the sampler begins the presample purge.

Step No.	Display	Procedure
	BOTTLE 1 **PUMPING 500 ml**	This display appears when the pump begins to run in the forward direction to deliver the sample volume. It remains through the end of the post-sample purge.
16	**BOTTLE 2** **AFTER 5 PULSES**	When the first sample volume has been delivered, the display will indicate the next sample bottle and the number of pulses remaining until the next sample event. This series of displays will repeat until the last sample is taken at bottle 24 and the sampling routine is done.
17	↓ ↓	
18	**DONE . . . 24 SAMPLES** **22:48:32 20-JUN-91**	This display informs you that the sampling routine is completed. The number of sample events is displayed in the upper right corner. The second line indicates the current time and date.

Example 4 Time-paced Multiplexed (Samples-Per-Bottle) Sampling

This programming example demonstrates samples-per-bottle multiplexed sampling. Samples are to be taken every 15 minutes. Each bottle is to receive four sample volumes of 200 ml each, so that bottles are switched every hour. The sampling routine is to start at 6:00 am on the following day.

Step No.	Display	Procedure
1	**. . . STANDBY . . .** **10:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE]** **SAMPLER**	Access the program sequence by selecting “PROGRAM.”
3	**[*TIME*, FLOW]** **PACED SAMPLING**	Select “TIME.”
4	**SAMPLE EVERY** ***0* HOURS,1 MINUTES**	Enter “0” to set the hours at zero. Press ENTER/PROGRAM to store the number “0” and move to the minutes entry.
5	**SAMPLE EVERY** **0 HOURS,*15* MINUTES**	Enter “15” to set the minutes entry to 15.
6	**MULTIPLEX SAMPLES?** **[*YES*, NO]**	Select “YES” to set up the samples-per-bottle multiplexing.
7	**[BOTTLES PER SAMPLE,** ***SAMPLES PER BOTTLE*]**	Select “SAMPLES PER BOTTLE.”
8	***4* SAMPLES PER** **BOTTLE (1 - 50)**	Enter “4” to set the number of samples per bottle to 4.
9	**SAMPLE VOLUMES OF** ***200* ml (10 - 250)**	Enter the sample volume of “200” ml.
10	**ENTER START TIME?** **[*YES*, NO]**	Select “YES” so you can enter the specific start time.

Step No.	Display	Procedure
11	**TAKE FIRST SAMPLE AT *6*:00 20-JUN-91**	When this display first appears, it will show you the sampler's "guess" at the start time. Type in the desired start time. For this example, the start time is 6:00 on June 20.
12	**PROGRAMMING SEQUENCE COMPLETE . . .**	After this message is displayed briefly, the sampler will automatically return to the standby state.
13	**. . STANDBY . . . 10:37:23 19-JUN-91**	To run the program, press the START SAMPLING key after the sampler is installed.
14	**START SAMPLING AT BOTTLE *1* (1-24)**	To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.
15	**1 OF 4, BOTTLE 1 AT 6:00 5:55:33**	This display is used with samples-per-bottle multiplexing. The first line shows the number of the next sample, the number of samples each bottle is to receive, and the current bottle number. Here, the next sample is the first of four samples for bottle 1. The second line shows the time of the next sample and displays the current time.
16	**1 OF 4, BOTTLE 1**	When the scheduled sample event time arrives, the second line will disappear while the sampler completes the pre-sample purge.
	1 OF 4, BOTTLE 1 PUMPING 200 ml	This message appears when the pump begins to deliver the sample. The message remains through the post-sample purge.
17	**2 OF 4, BOTTLE 1 AT 6:15 6:00:26**	When the sampling cycle is completed, the display will again indicate the upcoming sample.
18	**2 OF 4, BOTTLE 1**	The next displays illustrated here, in steps 18 through 20, show the displays as the sample volumes are deposited in bottle 1.
	2 OF 4, BOTTLE 1 PUMPING 200 ml	
19	**3 OF 4, BOTTLE 1 AT 6:30 6:15:27**	
20	**3 OF 4, BOTTLE 1**	
	3 OF 4, BOTTLE 1 PUMPING 200 ml	
21	↓ ↓	
22	**1 OF 4, BOTTLE 2AT 7:00 6:45:25**	When the final sample has been deposited in the first bottle, the display changes to indicate the new sample bottle. This display indicates that the next sample event will place the first of four sample volumes in bottle 2 at 7:00.

Step No.	Display	Procedure
23	**1 OF 4, BOTTLE 2**	This display appears as the pump begins the pre-sample purge for the first sample delivered to bottle 2.
	1 0F 4, BOTTLE 2 **PUMPING 200 ml**	
24	↓ ↓	The cycle of displays is repeated for each bottle until the sampling routine is done.
25	**DONE . . . 96 SAMPLES** **6:10:35 21-JUN-91**	When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

Example 5 Flow-paced Multiplexed (Bottles-per-Sample) Sampling

This example demonstrates the steps needed to program the sampler for a flow-paced routine that is to place a sample in two bottles at each sample event. Sample volumes of 500 ml are to be placed in the bottle sets at intervals of 10 flow-pulses. The routine is to start at 5:00 am, the following morning.

Step No.	Display	Procedure
1	**. . . STANDBY . . .** **10:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE]** **SAMPLER**	Access the program sequence by selecting "PROGRAM."
3	**[TIME, *FLOW*]** **PACED SAMPLING**	Select "FLOW."
4	**SAMPLE EVERY** ***10* PULSES (1-9999)**	Enter "10" as the flow pulse interval. The sampler will take a sample every tenth flow pulse received.
5	**MULTIPLEX SAMPLES?** **[*YES*, NO]**	Select "YES" to multiplex samples.
6	**[*BOTTLES PER SAMPLE*,** **SAMPLES PER BOTTLE]**	Select "BOTTLES PER SAMPLE."
7	***2* BOTTLES PER** **SAMPLE EVENT (1-24)**	Enter the number of bottles per sample event: "2."
8	**SAMPLE VOLUMES OF** ***500* ml (10 - 1000)**	Enter "500" to set the sample volume at 500 ml.
9	**ENTER START TIME?** **[*YES*, NO]**	Select "YES."
10	**START FLOW COUNT AT** ***5*:00 20-JUN-91**	Enter the start time for the sampling routine. Note that the sampler may receive flow pulses before the sampling routine begins. Any pulses received before the start time will be disregarded.
11	**PROGRAMMING SEQUENCE** **COMPLETE . . .**	After this message is displayed briefly, the sampler will automatically return to the standby state.

Step No.	Display	Procedure
12	. . . STANDBY . . . 10:37:23 19-JUN-91	Press the START SAMPLING key to run the program.
13	START SAMPLING AT BOTTLE *1* (1-23)	START SAMPLING?AT BOTTLE 1 (1-23) To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.
14	START AT 5:00 4/20 10:37:23 19-JUN	This display appears after you press the start SAMPLING KEY to start the routine. It reports the scheduled start time on the first line. The second line reports the current time and date.
15	BOTTLES 1- 2 AFTER 10 PULSES	When the scheduled start time arrives, the sampler will begin to count flow pulses. This display indicates the bottles which will receive sample volumes at the sample event. (If the bottle set consisted of four bottles, the first line of the display would read, "BOTTLES 1 - 4.") The number of flow pulses remaining to the sample event is displayed on the second line.
16	BOTTLES 1- 2 AFTER 9 PULSES	The second line of the display changes as each flow pulse is received.
17	↓ ↓	
18	BOTTLES 1- 2 AFTER 1 PULSES	This display shows one pulse remaining until the sample event.
19	BOTTLE 1	When the tenth pulse is received, the first line will report the current bottle number.
20	BOTTLE 1 PUMPING 500 ml	When the pump begins to run forward to deliver the sample volume, the second line appears. After the pump completes the sample delivery, it reverses to purge the liquid from the pump tube past the liquid detector. The suction line is not completely purged; instead, the liquid is pumped just past the liquid detector. At the end of the pump tube purge, the distributor moves to the next bottle of the set. The display remains unchanged until the distributor relocates to the next bottle of the set.
21	BOTTLE 2 PUMPING 500 ml	When the distributor is relocated above the next bottle, the bottle number reported in the display changes to indicate the bottle number. The message, "PUMPING 500 ml," will remain on the display. When the distributor reaches the correct position over the second bottle, the pump delivers the sample volume. When the delivery is completed, the pump reverses to complete the post-sample purge.
22	BOTTLE 3-4 AFTER 10 PULSES	At the end of the post-sample purge, the display changes to indicate the bottle numbers of the next bottle set. The display will change as it receives each flow pulse.
23	↓ ↓	The cycle is repeated until the sampling routine is completed.
24	DONE . . . 12 SAMPLES 6:10:35 21-JUN-91	When the routine is complete, the display will indicate the status of the routine ("DONE"), the number of sample events, and the current time and date.

Example 6 Time-Paced Composite Sampling

This example demonstrates the programming procedures for a composite sampling routine. When using the 3700FR Sampler for composite sampling, the unit must be mechanically converted for single bottle sampling.

After converting the sampler, check the configure settings to verify the sampler is configured for composite sampling. This example begins with a demonstration of the steps needed to check the Bottles and Sizes configure option settings. The Bottles and Sizes configure settings should indicate that only one bottle is being used. Be sure to enter the correct bottle volume. The settings used in this example are for the 4-gallon (15000 ml) composite bottle. Please refer to *Bottles and Sizes*, on page 42. for a discussion of the Bottles and Sizes configure option.

This time-paced routine takes samples at 15-minute intervals for a 12-hour period. Sample volumes are to be 250 ml each. When entering the program settings, you must enter the number of samples required before entering the sample volumes. At four samples per hour, the 12 hour period would yield 48 samples. The total volume at the end of the routine would be 12000 ml (48 samples x 250 ml/sample), well within the capacity of the 4-gallon bottle.

Step No.	Display	Procedure
1	**. . . STANDBY . . .** **10:34:50 19-JUN-91**	If the sampler is not already on, press the ON/OFF key to turn it on. Press ENTER/PROGRAM to access the interactive state.
2	**[PROGRAM, *CONFIGURE*]** **SAMPLER**	Access the configure sequence by selecting "CONFIGURE."
3	**SELECT OPTION: (← →)** **SET CLOCK**	Press the LEFT ARROW or RIGHT ARROW key to scroll through the configure options until the Bottles and Sizes configure option appears.
4	**SELECT OPTION: (← →)** **BOTTLES AND SIZES**	To access the Bottles and Sizes settings, press the ENTER/PROGRAM key.
5	**[PORTABLE, *REFRIG.*]** **SAMPLER**	Select "REFRIG."
6	**[*1*, 2, 4, 8, 12, 24]** **BOTTLES**	Select "1" for single bottle composite sampling.
7	**BOTTLE VOLUME IS** ***15000* ml**	Enter the bottle size here, "15000." (**Table 4,** on page 43 lists the standard Isco bottle sizes.)
8	**SELECT OPTION: (← →)** **SUCTION LINE**	Press the ENTER/PROGRAM key at this display to access the Suction Line input displays.
9	**SUCTION LINE ID IS** **[1/4, *3/8*] INCH**	Select "1/4" if you are using 1/4 inch suction line, "3/8" if you are using 3/8 inch suction line.
10	**SUCTION LINE IS** **[*VINYL*, TEFLON]**	This display appears when you have selected "3/8" in step 9. Select "VINYL" if you are using vinyl suction line, "TEFLON" if you are using Teflon suction line.
11	**SUCTION LINE LENGTH** **IS *10* FEET (3 - 99)**	Enter the length of the suction line. The length should not include the tube coupling or the strainer.
12	**SELECT OPTION: (← →)** **LIQUID DETECTOR**	To verify the Liquid Detector configure options, press the ENTER/PROGRAM key.

Step No.	Display	Procedure
13	↓ ↓	Continue to scroll through the configure options with the RIGHT ARROW key. When you have checked the settings for the desired options, press the EXIT PROGRAM key to return to standby.
14	**. . . STANDBY . . .** **10:38:50 19-JUN-91**	Press the ENTER/PROGRAM key to reenter the interactive state.
15	**[*PROGRAM*, CONFIGURE]** **SAMPLER**	Access the program sequence by selecting "PROGRAM."
16	**[*TIME*, FLOW]** **PACED SAMPLING**	Select "TIME."
17	**SAMPLE EVERY** ***0* HOURS, 1 MINUTES**	Enter "0" to set the hours at zero. Press ENTER/PROGRAM to store the number "0" and move to the minutes entry.
18	**SAMPLE EVERY** **0 HOURS, *15* MINUTES**	Enter "15" to set the minutes entry to 15.
19	***48* COMPOSITE** **SAMPLES (0-200)**	Enter the number of samples to be collected: "48."
20	**SAMPLE VOLUMES OF** ***250* ml (10 - 310)**	Enter the sample volume: "250." Note that the upper limit of the range of acceptable volumes has been adjusted. When 48 samples are to be collected, the maximum sample volume is 310 ml. If you need to use a larger sample volume, you would need to adjust the sample number downward.
21	**ENTER START TIME?** **[*YES*, NO]**	Select "YES" to enter the start time for the routine.
22	**TAKE FIRST SAMPLE AT** ***6*:00 20-JUN**	Enter the start time and date: "6:00" on "4-20."
23	**PROGRAMMING SEQUENCE** **COMPLETE . . .**	After this message is displayed briefly, the sampler will automatically return to the standby state.
24	**. . . STANDBY . . .** **10:40:23 19-JUN-91**	After the sampler is properly installed, press the START SAMPLING key to run the program.
25	**SAMPLE 1 OF 48** **AT 6:00 5:50:43**	The first line of this display indicates the number of the upcoming sample event and the total number of programmed samples. The second line indicates the scheduled time of the upcoming event followed by the current time.
26	**SAMPLE 1 OF 48**	When the time to the next sample event has elapsed and the sampler has initiated the sample event, the sampling cycle begins.
	SAMPLE 1 OF 48 **PUMPING 250 ml**	When the pump reverses for the pre-sample purge, the second line disappears. At the end of the pre-sample purge, the pump runs forward to deliver the sample, and the second line appears on the display. This display remains through the end of the post-sample purge.

Step No.	Display	Procedure
27	**SAMPLE 2 OF 48 AT 6:15 6:00:33**	At the end of the sample event, the display changes to indicate the number and time of the next event. The current time is in the lower right corner.
28	**SAMPLE 2 OF 48**	The cycle is repeated for the remainder of the sampling routine.
	SAMPLE 2 OF 48 PUMPING 250 ml	
29	↓ ↓	
30	**DONE . . . 48 SAMPLES 6:10:35 21-JUN-91**	This display appears when the routine is completed. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

Example 7 Calibration Procedure

This example demonstrates the method used to calibrate the sampler for a 200 ml sample volume. The Calibrate Sampler configure option must be enabled in the configure sequence before the calibration displays shown below appear.

Even without calibrating, the 3700FR Sampler will deliver accurate sample volumes. If your sample volumes vary significantly with the entered values, check the suction line first. Be sure the line slopes continuously downhill and is draining completely after each pumping cycle. Then, please check the suction line entries in the configure sequence to see that they are accurate. The calibration procedure is intended for "fine tuning" only. After you enter the sample volume actually delivered, as shown in step 8, the next sample volume delivered will be adjusted to correct for the difference between the expected sample volume and the actual volume entered. All subsequent volumes delivered will be adjusted. The adjustment can be cleared by changing a suction line entry in the Suction Line configure option or by re-initializing the sampler.

We suggest using a spare sample bottle as the collection container. Because the sample volume can be calibrated to ± 10 ml, a graduated cylinder should be used to facilitate measurement. A graduated cylinder and spare bottles are available as accessories from the factory. Refer to the Accessories List at the back of this manual for details.

The calibration pump cycle will include rinse cycles and retries, if the sampler is configured to perform them (*Liquid Detector,* on page 44). This insures that the calibration procedure includes the pump cycle used while running the sampling program.

Step No.	Display	Procedure
1	**. . . STANDBY . . . 9:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE] SAMPLER**	Access the program sequence by selecting "PROGRAM."
3	**[*TIME*, FLOW] PACED SAMPLING**	Step through the program until the "CALIBRATE SAMPLER?" (step 5) input display appears.
4	↓ ↓	Other program sequence displays.

Step No.	Display	Procedure
5	CALIBRATE SAMPLER? [*YES*, NO]	Select "YES."
6	PRESS MANUAL SAMPLE KEY WHEN READY . . .	Before pressing the MANUAL SAMPLE key, make sure a collection container is underneath the distributor.
7	. . . MANUAL SAMPLE . . . PUMPING 200 ml	The sampler will deliver the programmed sample volume.
8	*200* ml VOLUME DELIVERED	Measure the actual volume delivered and enter that value here.
9	CALIBRATE SAMPLER? [YES, *NO*]	Repeat the procedure if desired, then select "NO." Under normal conditions, you should not need to repeat the procedure more than once.
10	↓ ↓	Other program sequence displays.
11	. . . STANDBY . . . 9:39:50 19-JUN-91	The sampler will return to standby. Press the START SAMPLING key to run the program.

CONFIGURE SEQUENCE

The configure sequence provides a number of setup options. Some options enable sampling features, some provide reference data, and others affect run state operations.

Example 1, on page 29 shows the procedure used to access the configure sequence. (When you see a "SELECT OPTION: (← →)" display, you are in the configure sequence.) Each option uses at least two displays. The first display lists the option name. The following displays are input displays. To access an input display, press the ENTER/PROGRAM key while the desired option name is displayed. Once you've accessed the input display, use the keypad to enter numbers and make choices as described in *Keypad Description*, on page 23 through *Displays*, on page 25.

Note: pressing the EXIT PROGRAM key in the configure option list will return the sampler to standby. Pressing the EXIT PROGRAM key in a configure option input display will return you to the list of configure options without changing the setting.

By pressing the LEFT ARROW or RIGHT ARROW key at the "SELECT OPTION:" display in the configure sequence, you can scroll through the list of configure options without viewing each input display. If you are interested in only one or two options, you can locate the option of interest quickly.

Each option is discussed below in the order in which it appears when configuring the sampler. Individual input displays and their settings, are discussed separately within the discussion of each option. For these, the name of the setting is placed in the left margin so you can identify each topic. Illustrations of displays are not included in each discussion; however, each discussion includes the display number, should you need to refer to display listing in *Appendix B Display Index*, on page 142.

SET CLOCK

The Set Clock option is used to synchronize the sampler's clock with real time. Times must be entered in military time: 9:30 am would be entered as 9:30, 9:30 pm would be entered as 21:30. When the year entry is accepted, the seconds will be reset to zero. (Display #210).

BOTTLES AND SIZES

The Bottles and Sizes option is used to enter the number of bottles and the bottle volume. The option uses four input displays:

- The first display specifies a portable or refrigerated sampler.
- The second display sets the number of bottles (1, 4, 12, or 24) for portable configurations. The second display appears only when you specify a portable sampler in the first display.

- The third display sets the number of bottles (1, 2, 4, 8, 12, 24) for refrigerated configurations. The third display appears only when you specify a refrigerated sampler in the first display.
- The fourth display sets the bottle volume.

Portable or Refrigerated Sampler

Because the 3700 Series portable and refrigerated samplers use the same control box, you must specify the type of unit. The 3700FR Sampler will be shipped with this setting as "REFRIGERATED." This setting is not changed when you reinitialize the settings. You should not specify "PORTABLE" unless you move the control box to portable sampler. (Display #220).

Note

The sampler uses the bottle configuration setting to position the distributor. If you enter a bottle configuration that does not correspond to the actual configuration used in the sampler, the sampler may position the distributor over locations without a bottle and fill the refrigerator instead of a sample bottle.

Portable

If you specify "PORTABLE" in the previous display, you will be able to specify a 1-, 4-, 12, or 24-bottle configuration. The sampler comes configured for the number of bottles ordered with the sampler. Each bottle configuration requires a different base section. The 1-bottle configuration requires the composite base section; the 4-bottle configuration requires the 4 bottle base section, and so on. Change the configuration setting only when you have moved the controller to a portable sampler. If you change the bottle configuration without changing the base section, the sampler will not position the distributor arm over the bottles and will miss the bottle mouth, filling the base section instead of the bottles. (Display #222).

Refrigerated

If you specify "REFRIGERATED," you will be able to specify a 1-, 2-, 4-, 8-, 12-, or 24-bottle configuration. The 2- and 8-bottle configurations are used only with Isco's 3700 Series Refrigerated Samplers. (Display #221).

Continuous Sampling

You can program the 3700FR refrigerated sampler for continuous sampling. A 3700FR programmed for continuous sampling will deposits samples into successive sets of bottles, until it reaches the last set of bottles. It then returns to the first set of bottles and continues sampling indefinitely into successive sets. Continuous sampling is available for all multiple-bottle configurations.

Before programming a sampler for continuous sampling, configure the sampler as follows. Select "refrigerated" and "2," "4," "8," "12," or "24" bottles in the Bottles and Sizes configure option. Next, configure the sampler for extended programming in the Programming Mode configure option. Under these settings, the display illustrated below will appear in the sample distribution section.

SAMPLE CONTINUOUSLY? [YES, NO]

Display #48

Note: The sampler will deposit samples indefinitely, even though the bottles have been filled to capacity. To avoid overfilling the bottles, replace them at regular time intervals or as soon as they are filled.

Cumulative Error

The sample accuracy is the greater of 10% of the sample volume or 20 ml and is repeatable to ± 10 ml. If you wish to fill a 1000-ml bottle with five 200-ml samples, adjust the actual sample volume according to the sample accuracy. Since samples of 200 ml can vary by 10% or ± 20 ml, the cumulative error for five samples would be ± 100 ml. If the sampler consistently places an actual sample volume of 220 ml for each of five samples, the total volume held by the bottle would be 1100 ml. Again, to avoid possible overfilling, enter a bottle volume that is less than the actual bottle capacity.

Table 4 Bottle volume settings for sequential and composite bottle configurations

Bottle Configuration	Bottle Size	Bottle Volume Setting
24 (polypropylene)	1000 ml	1000
24 (glass)	350 ml	350
12 (polyethylene)	2500 ml	2500
8 (polyethylene)	2000 ml	2000
8 (glass)	1800 ml	1800
4 (glass and polyethylene)	1 gal	3800
2 (glass and polyethylene)	2.5 gal	9400
1 (glass and polyethylene)	2.5 gal	2.5 gal
1 (polyethylene)	4 gal	15000

SUCTION LINE

The Suction Line configure option is used to configure the sampler for the type (vinyl or Teflon), diameter, and length of the suction line used. Because the volumetric delivery varies with line diameter, type, and length; it is important that these settings be entered accurately. An incorrect setting will impair the accuracy of the sample volume. If you change the current suction line settings, the ". . . CALCULATING . . . PUMP TABLE VALUES" message will appear for a short time. Because the volumetric delivery of the sample varies with the diameter, type, and length of the suction line, the sampler must revise the internal pump tables. The tables are used as reference for the electronic pump count for sample delivery.

There are three types of suction lines available for use with the 3700FR sampler: 3/8 inch vinyl, 3/8 inch vinyl, and 3/8 inch Teflon. If you specify 1/4 inch line, the sampler will prompt you for the line length immediately. If you specify 3/8 inch line, the sampler will prompt you to specify vinyl or Teflon before prompting for the line length. (Display #'s 230 and 231).

The sampler will accept suction line lengths of 3 to 99 feet. When measuring the line, do not include the tube coupling or the strainer in the measurement. The line should be cut to even foot lengths. It is important to enter these settings accurately. These settings affect the accuracy of the sample volume and are used to determine the number of post-sample purge counts. It is important to have sufficient counts to completely clear the line. (Refer to *Purge Counts*, on page 52.) (Display #232).

LIQUID DETECTOR

The Liquid Detector configure option is used to turn the liquid detector on or off, set the number of rinse cycles, add a suction head setting to the program sequence, and set the number of sampling retries should the suction line become clogged. The option uses four input displays. Each display is discussed below.

Enable/Disable Detector

The recommended setting for the Enable/Disable Detector option is "ENABLE." The 3700FR Sampler determines the delivered sample volume suction head by counting revolutions of the pump rotor.

The volume of liquid delivered by one revolution of the pump rotor is a function of the suction head of the pump; as the suction head increases, the volume delivered by one revolution of the pump rotor decreases and vice versa. By enabling the detector, the sampler can accurately determine the operating suction head. It does not have to rely on a programmed suction head value, but can instead begin its volume delivery count when liquid is detected. This minimizes inaccuracies which can occur in changing head conditions, or when measurement of the suction head is difficult to determine accurately.

The disable option is provided should the detector or its associated circuitry become suspect. If the detector is disabled, the manual suction head setting (Display #70) is automatically added to the sample volume program section in the program sequence. If the detector is disabled, the sampler will use a calculated number of pump counts based on the suction head entry to deliver the correct sample volume. The programmed suction head entry is then used to determine the operating suction head. The sampler will operate at diminished accuracy with the detector disabled. (Display #240).

Rinse Cycles

The Rinse Cycle setting is available only when the detector is enabled. It is used to set the number of suction line rinses, from 0 to 3. Rinses are used to condition the suction line to reduce cross contamination. During a rinse cycle, the pump draws liquid up through the line until it is detected by the liquid detector. At that point, the pump reverses to purge the line. This cycle is repeated according to the number of rinse cycles entered. (See *Sample Events and the Sampling Cycle*, on page 15 for a discussion of the sample event cycle.) (Display #241).

Rinse cycles contribute to the wear on pump tubing; therefore, if you use rinse cycles, it may be necessary to replace the tubing more frequently. The Tubing Life configure option, *Tubing Life*, on page 52, allows you to monitor pump tubing wear.

Enter Head Manually

Entering the head manually is available as an option when the detector is enabled and allows you to add the suction head entry (Display #70) to the program sequence. When the detector is disabled, the Suction Head entry is automatically added to the program sequence. By disabling the suction head setting, you allow the liquid detector to determine the operating suction head each time a sample is taken. Using the Suction Head entry in conjunction with the liquid detector, when the head is stable and known accurately, further increases accuracy of the delivered volume. When the head is variable or unknown, you should select "NO." An incorrect head setting diminishes the delivered volume accuracy. (Display #242).

Sampling Retries

The Sampling Retries option is used to set the number of times, from 0 to 3, the sampler will try to detect liquid in the line before skipping the sample. The option can be used when sampling liquid with a high concentration of solids which tend to clog the suction line or the strainer. The sampler will also retry the rinse cycle when you are using the Sampling Retry option. (Display #243).

PROGRAMMING MODE

The Programming Mode option allows you to specify either the basic or extended programming mode. The basic programming mode is used for conventional routines; the extended programming mode can be used for either conventional or more complex routines. Storm programming is available through the extended programming mode.

Table 5 summarizes the sampling features according to programming mode in the program sequence. **Table 3,** on page 21, placed in *Interactive State*, on page 20, summarizes the features available in the configure sequence. Extended features are normally used in exceptional applications and are not available in the basic mode to simplify the programming process for conventional routines.

Table 5 Sampling capabilities available through the Program Sequence

Pacing:	Mode	Feature
Time-pacing: Uniform Time Intervals	Basic & Extended	Samples taken at regular time intervals from 1 minute to 99 hours, 59 minutes.
Time-pacing: Nonuniform Intervals in Minutes	Extended	Samples taken at irregular time intervals by specifying the amount of time in minutes between each sample. Intervals can be entered from 1 to 999 minutes.
Flow-pacing	Basic & Extended	Samples taken at regular flow intervals. The sampler will totalize flow intervals of 1 to 9999 pulses.

Distribution:	Mode	Feature
Sequential	Basic & Extended	One sample volume placed in each bottle.
Samples per Bottle Multiplexing	Basic & Extended	More than one sample volume placed in each bottle. Bottles can be switched after a specified number of samples have been deposited or after a specified period of time.
Bottles per Sample Multiplexing	Basic & Extended	Sample volumes placed in more than one bottle at each sample event.
Multiple Bottle Compositing	Extended	More than one sample volume placed in a set of bottles. Bottle sets can be switched after a specified number of samples have been deposited or after a specified period of time

Volumes and Accuracy:	Mode	Feature
Sample Volume	Basic & Extended	Volumes from 10 to 9990 ml can be entered.
Suction Head	Basic & Extended	Suction heads from 1 to 20 feet can be entered.
Calibration	Basic & Extended	Sample volumes can be calibrated, if desired.

Key Times:	Mode	Feature
Start Times	Basic & Extended	Specific start times can be entered for both time-paced and flow-paced routines. If no start time is entered, the Start Time Delay will be used.
First Switch Time	Extended	Bottles can be switched after specified time intervals. After the routine is started, the first switch time allows the first bottle or bottle set to receive samples for a partial interval. After the first switch, the remaining sets will receive samples for full time intervals. This allows you to place the sampler “on schedule.”
Stop/Resume Times	Extended	Intermittent sampling can be performed by defining sampling stop and resume times. Up to 12 stop times and 12 resume times can be entered.

STORM Programming (Available in the Extended Mode Only.)

STORM Pacing:	Mode	Feature
Time-pacing	Extended	Samples taken at regular time intervals from 1 minute to 99 hours, 59 minutes.
Flow-pacing	Extended	Samples taken at regular flow intervals. The sampler will totalize flow intervals of 1 to 9999 pulses.

STORM Distribution:	Mode	Feature
Sequential	Extended	One sample volume placed in each bottle.
Samples per Bottle Multiplexing	Extended	More than one sample volume placed in each bottle. Bottles can be switched after a specified number of samples have been deposited.
Bottles per Sample Multiplexing	Extended	Sample volumes placed in more than one bottle at each sample event.
Multiple Bottle Compositing	Extended	More than one sample volume placed in a set of bottles. Bottle sets can be switched after a specified number of samples have been deposited.

STORM Volumes and Accuracy:	Mode	Feature
Sample Volume	Extended	Volumes from 10 to 990 ml can be entered for the time-paced and flow-paced segments separately.
Suction Head	Extended	Suction heads from 1 to 20 feet can be entered.
Calibration	Extended	Sample volumes can be calibrated, if desired. Sets calibration using the timed sample volume, only.

STORM Key Times:	Mode	Feature
Delay to First Timed Sample	Extended	A delay of up to 99 minutes can be entered to delay the first timed sample event after the programmed start time, and, in applications where a flow meter is programmed to enable the sampler, after the sampler is enabled.
Start Times	Extended	A specific start time can be entered for the routine. Bottle groups can be filled concurrently. If no start time is entered, the Start Time Delay will be used.
Maximum Flow Interval	Extended	Maximum period of time can be entered between flow-paced sample events. If this period of time is exceeded, the sampler will terminate the routine.

LOAD STORED PROGRAM

The Load Stored Program option allows you to load one of up to three sampling programs which have been previously saved with the Save Current Program configure option, discussed in *Save Current Program*, on page 48. The loaded program will replace the current program. After loading a program, the sampler will adjust the loaded program's time settings to current times and dates. Check the settings before starting the program to be sure they are appropriate for your application.

When the sampler loads a program, it compares the current Bottle Configuration setting (Display #220) to the Bottle Configuration setting required by the loaded program. If the settings do not match, an error message will be displayed: "LOAD ERROR - BOTTLE COUNT MISMATCH." The load process will be aborted. (Display #250).

The sampler is shipped from the factory with four programs: the current program and three stored programs, numbered from 1 to 3. All four programs contain the factory default program settings. Unless you have previously saved a program under one of the program numbers, loading a program will replace the current program with the factory default settings. When you reinitialize the sampler, all four programs return to the default program settings.

Example 8 Loading a Stored Program.

Step No.	Display	Procedure
1	**. . . STANDBY . . . 10:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE] SAMPLER**	Access the configure sequence by selecting "CONFIGURE."
3	**SELECT OPTION: (← →) SET CLOCK**	Press the LEFT ARROW or RIGHT ARROW key to scroll through the configure options. The first option displayed is the Set Clock configure option.
4	↓ ↓	
5	**SELECT OPTION: (← →) PROGRAMMING MODE**	You can load a stored programmed only when the sampler is configured for the extended programming mode. To verify the programming mode setting, press the ENTER/PROGRAM key.
6	**[BASIC, *EXTENDED*] PROGRAMMING MODE**	Select "EXTENDED." Press the ENTER/PROGRAM key to accept the selection.
7	**SELECT OPTION: (← →) LOAD STORED PROGRAM**	Press ENTER to access the Load Stored Program configure option.
8	**LOAD PROGRAM [#1, #2, #3, NONE]**	Select the number of the program you want to load. Select "NONE" when you do not want to load a program.
9	**SELECT OPTION: (← →) SAVE CURRENT PROGRAM**	When the sampler has loaded the program, it will display the next configure option. When you are done configuring the sampler, press EXIT PROGRAM to return to Standby.
10	**. . . STANDBY . . . 10:37:23 19-JUN-91**	After the sampler is properly installed, press the START SAMPLING key to run the program.

SAVE CURRENT PROGRAM

The Save Current Program option allows you to assign up to three sampling routines a number and store them. This option eliminates the need to reprogram the sampler for recurrent routines. Only the program settings are saved; if different routines require different cofigurations, the sampler must be reconfigured for each routine. For example, if the sampler is used at two sites, each requiring a specific sampling routine and different suction line lengths, the sampling routines can be stored for each site, but the suction line length settings must be reentered each time the line changes. (Display #260).

The sampler is shipped from the factory with four programs: the current program and three stored programs, numbered from 1 to 3. All four programs contain the factory default program settings. Saving a program will replace the default program with the current settings. Reinitializing the sampler will restore the default program settings. The default program settings are listed in **Table 7,** on page 55.

Note: saving a program will overwrite a program saved earlier under the same number. Settings for the current program can be viewed with the Display Status procedure. Refer to *Display Status*, on page 91.

Example 9 Saving a Current Program

Step No.	Display	Procedure
1	**. . . STANDBY . . .** **10:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[PROGRAM, *CONFIGURE*]** **SAMPLER**	Access the configure sequence by selecting "CONFIGURE."
3	**SELECT OPTION: (← →)** **SET CLOCK**	Press the LEFT ARROW or RIGHT ARROW key to scroll through the configure options. The first option displayed is the Set Clock configure option.
4	↓ ↓	
5	**SELECT OPTION: (← →)** **PROGRAMMING MODE**	You can save the current program only when the sampler is configured for the extended programming mode. To verify the programming mode setting, press the ENTER/PROGRAM key.
6	**[BASIC, *EXTENDED*]** **PROGRAMMING MODE**	Select "EXTENDED." Press the ENTER/PROGRAM key to accept the selection.
7	**SELECT OPTION: (← →)** **LOAD STORED PROGRAM**	Press the RIGHT ARROW key to skip the Load Stored Program configure option.
8	**SELECT OPTION: (← →)** **SAVE CURRENT PROGRAM**	Press the ENTER/PROGRAM key to access the Save Current Program configure option.
9	**SAVE PROGRAM AS** **[#1, #2, #3, NONE]**	Select the number you want to use as the program "name." Select "NONE" when you do not want to save a program. When the sampler has saved the program, it will display the next configure option. When you are done configuring , press EXIT to return to Standby.
10	**. . . STANDBY . . .** **10:37:23 19-JUN-91**	When the sampler is properly installed, press the START SAMPLING key to run the program.

FLOW MODE SAMPLING

The Flow Mode Sampling option is used to direct the sampler to take a sample at key times in a flow-paced sampling program. The Flow Mode Sampling option has two settings. The first setting directs the sampler to take a sample at the start time. The second directs the sampler to take a sample at the switch times (when the bottle set changes are based on time). Both settings of the option are disregarded in STORM sampling routines. (Display #40).

Sample at Start Time

If you select "YES," the first sample will be taken at the start time. If you select "NO," the first sample is delayed until the number of flow pulses, set in the program sequence, have been counted. (Display #270).

Sample at Time Switch

If you select "YES," the sampler will switch to a new bottle or set, take a sample, and reset the flow pulse count. The next sample will occur after a full pulse countdown. If you select "NO," the sampler will take no samples at the switch time and will not reset the pulse countdown. The switch will occur in the middle of a pulse countdown and the first sample will be deposited in the new bottle or set when the countdown is completed. (Display #271).

NONUNIFORM TIME

The Nonuniform Time option specifies the method in which nonuniform intervals are to be entered in the program sequence (Display #'s 26 or 27). If you select "clock-time," you will be able to enter a specific time and date for each sample event. If you select "MINUTES," you will be able to enter nonuniform intervals in minutes. Nonuniform times are not available in a STORM sampling routine. (Display #280).

CALIBRATE SAMPLER

The Calibrate Sampler option is used to add the calibration sequence to the program sequence. If you select "ENABLE," the calibration sequence will be added to the program sequence and you will be able to precisely calibrate the sample volumes. (Display #290)

SAMPLING STOP/RESUME

The Sampling Stop/Resume configure option allows you to add stop and resume settings (Display #'s 100, 101, and 102) to the Key Time section of the program sequence. You can enter up to 24 times: 12 stop times and 12 resume times. For example, the Stop/Resume option allows you to define a sampling routine which will take samples at intervals of 15 minutes between 6:00 am to 8:00 am and between 4:00 pm to 6:00 pm. Sampling Stops and Resumes are not available in a STORM routine.

When you are using a time-switched sampling routine which includes stops and resumes, the sampler will reset the time-switch interval at each resume time. For example, if a routine with time-switches every hour is programmed for stop and resume times, the first time-switch would occur one hour after the resume time; switches would repeat every hour until a stop time occurred or the routine was completed. See **Example 10,** on page 74.

There are two other settings which direct the sampler to take samples at stop or resume times.

Enable/Disable

Select "ENABLE" to add the stops and resume settings to the program sequence. (Display #300).

Sample at Stop

The Sample at Stop setting directs the sampler to take a sample at stop times. (Display #301).

Sample at Resume

The Sample at Resume setting directs the sampler to take a sample at resume times. (Display #302).

START TIME DELAY

The Start Time Delay option is used to set the amount of time in minutes, between the time you press the start sampling key and the time the sampling routine is initiated. The sampler's response varies according to specific entries: "0," "1," and entries greater than 1.

---- MINUTE DELAY TO START (0 - 9999)	Display #310

An entry of "0" eliminates the delay to start time; the start time occurs the moment you press START SAMPLING. For example, if you press START SAMPLING at 10:32:15, the sampler will initiate a time-paced sample event at 10:32:15.

However, the sampler will start clocking time intervals at the beginning of the minute (HH:MM:00) of the first sample event. If a sampling routine requires 10 minute intervals and you pressed start sampling at 10:32:15, the sampler would begin the time interval at 10:32:00. It would initiate the second sample event at 10:42:00. The sampler would begin the flow interval at 10:32:15 for flow-paced routines.

If you enter a start time delay of "1," the sampler will begin the routine at the beginning of the next minute. Thus, if you pressed start sampling at 10:32:15, the sampler would initiate the sample event at 10:33:00. The sampler would begin time and flow intervals at 10:33:00. If you enter a start time delay of "2," the sampler would begin time or flow intervals at 10:34:00. (Display #310).

Note: If you enter a start time, the sampler will disregard the start time delay. The sampler will use the start time delay setting when you do not enter the start time in the program sequence. Care must be taken when using a start time delay of greater than zero when the sampler is being inhibited by another sampler or by a Liquid Level Actuator. Refer to *Enable Pin*, on page 50.

ENABLE PIN

The Enable Pin option allows you to program the sampler's response to a device controlling pin F of the sampler's flow meter connector: for example, the Model 1640 Liquid Level Actuator. Samplers configured for refrigerated sampling have four Enable Pin setup options: Sample Upon Disable, Sample Upon Enable, Reset Sample Interval, and Inhibit Countdown. The sampler disregards the Enable Pin configure option setting when running a STORM routine. Each of these options is discussed below.

Sample Upon Disable

When you are using a flow meter, a Liquid Level Actuator, or like device, "SAMPLE UPON DISABLE?" allows you to direct the sampler to take a sample as soon as the sampler is disabled through pin F. A response of "YES" will cause the sampler to take a sample when the pin is disabled; a response of "NO" will prevent the sampler from taking a sample at that time. (Display #321).

Sample Upon Enable

When you are using a Liquid Level Actuator or like device, "SAMPLE UPON ENABLE?" allows you to direct the sampler to take a sample as soon as the sampler is enabled through pin F. A response of "YES" will cause the sampler to take a sample when the pin is enabled; a response of "NO" will prevent the sampler from taking a sample at that time. (Display #322).

Reset Sample Interval

"Reset Sample Interval" is used to control the time or flow pulse countdown. If you select "YES," a full sample interval will begin when pin F is enabled. If you select "NO," the interval will not be reset when the sampler is enabled; the interval is then governed by settings entered in the "INHIBIT COUNTDOWN?" option. If you are sampling on a time-paced basis and wish to synchronize all sampling with real time, do not reset the sample interval. (Display #323).

Inhibit Countdown

"INHIBIT COUNTDOWN?" is only applicable when you respond "NO" to "RESET SAMPLE INTERVAL?" The Inhibit Countdown option is used to control the countdown while the sampler is inhibited. Select "YES" to freeze the countdown to the next sample. The count will resume when the sampler is enabled. Select "NO" to allow the countdown to continue while the sampler is disabled. (Display #324).

The sampler determines an enable or disable condition by monitoring the voltage on pin F. High voltage is interpreted as an enable signal. Low voltage or ground is interpreted as a disable signal.

A sampler which has been inhibited while running a routine will move to the next bottle set when enabled if at least one sample volume has been deposited in the current bottle set. This is true for both time-switched and count-switched routines, and for bottles sets composed of one or more bottles.

A sampler which has been inhibited while running a time-switched routine will advance to the next bottle or bottle set, regardless of the number of time-switches that elapse while the sampler is inhibited. In other words, if the bottle sets were to be switched every two hours and the sampler has been inhibited for six hours, the recommenced routine will begin with the next bottle set. The routine may not continue with the bottle set that would have been used had the sampler not been inhibited.

EVENT MARK

The Event Mark option configures the sampler to send an event mark to an interfaced flow meter or other equipment. The sampler will supply a variable duration pulse of up to 700 mA at 12 V on pin E of the flow meter connector. Four types of signals can be sent: a pulse at the beginning of the pre-sample purge, a pulse at the beginning of forward pumping only, continuous during the entire pump cycle, and continuous during forward pumping only.

The event mark includes a signal sent on pin D which is interpreted and recorded by an Isco flow meter as the bottle number(s) for the sample event. The bottle number signal consists of a number of 100 millisecond, 12 V pulses which equal the bottle number; i.e., four pulses represent bottle 4, twenty pulses for bottle 20.

The type of signal selected from the Event Mark configure option affects both the event mark signal on pin E and the bottle number signal on pin D. **Figure 21** diagrams the signals during a sample event cycle according to the selection made in the option. The figure shows three sample volumes being delivered (to bottles 1, 2, and 3) at the sample event. In **Figure 21(A)**, a pulse signal is sent at the beginning of the pre-sample purge and only the first bottle number of the bottle set is sent to the flow meter. In **Figure 21(B)**, a pulse signal is sent during the sample volume delivery portion of the sample event. Since three sample volumes are delivered, three pulses are sent to the flow meter and three bottle number signals are sent. In **Figure 21(C)**, a continuous signal is sent during the entire pump cycle; the bottle numbers are sent as shown. In **Figure 21(D)**, three continuous pulses are sent for the duration of each sample volume delivery and three bottle number signals are sent.

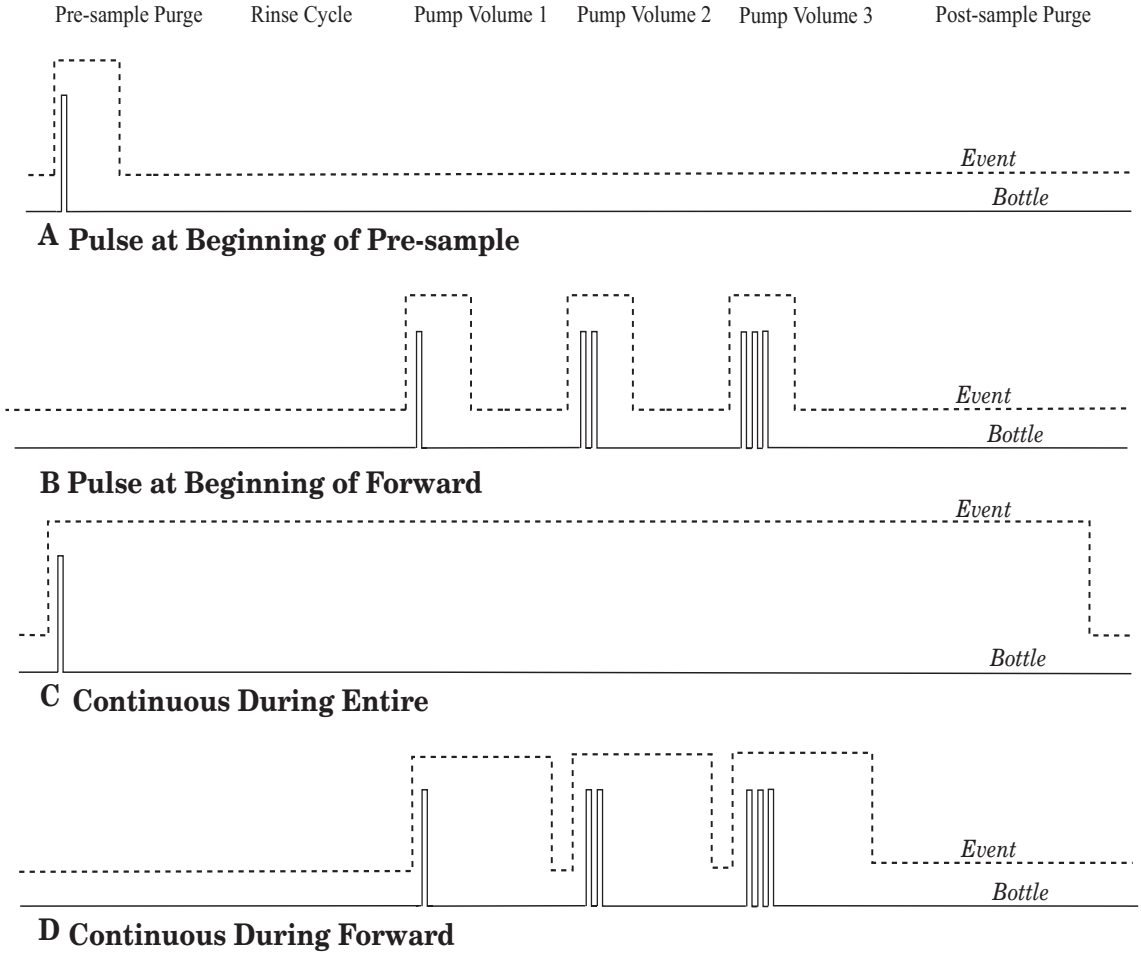
Continuous/Pulse Signal

The Continuous/Pulse setting is used to select either continuous or pulse signals. Pulse signals are three seconds in duration; continuous signals are three seconds or longer and depend on the setting and the pump cycle. (Display #330).

Pump/Cycle Forward Pumping

The Pump Cycle/Fwd Pumping settings will appear when you have selected "CONTINUOUS." Select "PUMP CYCLE" when you want a continuous signal transmitted during the entire pump cycle, from the beginning of the pre-sample purge to the end of the post-sample purge. Select "FWD PUMPING" when you want a continuous signal transmitted while the pump is delivering a sample volume. A signal is transmitted for each bottle when the sampler is programmed for more than one bottle per sample. (Display #331).

Figure 21 Event Mark and Bottle Number Signal Output



Pulse Signal Timing

The Pulse Signal setting will appear when you have selected "PULSE." Two options are available.

The first option, "PURGE," is used to send a pulse at the beginning of the pre-sample purge. The second option, "FWD PUMPING," is used to send a pulse at the beginning of the sample delivery when the pump is running forward. (Display #332).

PURGE COUNTS

The Purge Counts option is used to override the number of pump counts needed to clear the suction line in both pre-sample purge and post-sample purge cycles. The pre-sample purge count is normally set to 150 counts and will be reset to this value if the sampler is re-initialized. The post-sample purge count is derived from the suction line diameter and length settings.

If your observations indicate that a greater or lesser number of pump counts in either purge is needed, you can change the count settings. Acceptable entries are between 0 and 9999 for both purges. A purge count can be obtained using the PUMP FORWARD or PUMP REVERSE keys; refer to *Keypad Description*, on page 23. (Display #'s 340 and 341).

TUBING LIFE

The Tubing Life option is used to set the number of pump counts needed to trigger the "Replace Pump Tubing" warning. You must reset the pump counter after replacing the pump tubing. The warning will be activated when the pump count reaches the entered value. If you consistently experience a tubing failure at a pump count that differs significantly from the current setting, enter that value here. The factory set value of 500,000 pump counts will deliver approximately 500 samples of 200 ml each, using a $^{3}/_{8}$ inch × 10 ft vinyl suction line and a 5 ft suction head. (Display #350, 351, and 352).

PROGRAM LOCK

The Program Lock option allows you to protect program and configure settings with a pass-number. Select "ENABLE" to turn the protection on. When the Program Lock is enabled, each protected display can be viewed, but no values can be changed without first entering the pass-number: 3700. Once the pass-number has been entered, you can change any value or setting in either the program or configure sequence. (Display #360).

SAMPLER ID

The Sampler ID option allows you to enter a 10 character ID for the sampler. The ID number is used to identify sampling reports produced by the Isco Field Printer and in files created by SAMPLINK. The sampler is shipped from the factory with 10 dashes (-) entered for the ID. (Display #365).

Acceptable Characters

The ID field will accept digits, dashes, spaces, and periods. You can enter spaces, dashes, and periods with three of the control keys. Enter a space with the START SAMPLING key, a dash (-) with the manual SAMPLE KEY, and a period with the RESUME SAMPLING key.

RUN DIAGNOSTICS

Run Diagnostics is used to perform a number of diagnostic functions. This option contains the software revision number; tests the sampler's RAM, ROM, display, distributor, and pump; and allows for re-initializing RAM. The display information is discussed below in the order of appearance.

Software Revision Number

The sampler will display the software revision number for a short period of time.

Test RAM and ROM

The software revision display is replaced by the RAM and ROM test messages. A successful test is indicated by the messages "RAM PASSED TEST" or "ROM PASSED TEST." If either the RAM or ROM fail the test, the sampler will display one of the following messages: "RAM FAILED TEST" or "ROM FAILED TEST" and beep every three seconds until you turn the sampler off. If either the RAM or ROM fail their test, the sampler should be serviced. Contact Isco Customer Service for instructions on returning the sampler. Contact Isco Customer Service for assistance: (800) 228-4373.

LCD Test

After successful RAM and ROM tests, the sampler will then test the LCD by first filling the display with solid rectangles and then printing the alphabet and other characters. Each character position in the display should contain a character.

Pump Test

The next step tests the pump. During the test, the pump will run briefly and the display will indicate an "OFF/ON" number. The number should fall within the range of 50 to 200. If the count falls below 50 or exceeds 200, the pump should be serviced. A count near 100 is typical.

Distributor Test

Following the pump test, you can test the distributor. If you elect to test the distributor, the sampler will move the distributor to position 24, then return it to position 1. The positions are indicated on the display. If the message, "DISTRIBUTOR JAMMED" is displayed; check the routing of the pump tubing and the bottles in the tub. If the tubing and bottles are correctly positioned, the distributor drive mechanism may need servicing. (Display #370).

Re-initialize Controller

The final step allows you to re-initialize the sampler. If you select "NO," the sampler will return to the configure option list. If you select "YES," the sampler will reset a number of configuration and program settings, then turn the sampler off. (Display #371).

Table 6, on page 54 and **Table 7,** on page 55 list the re-initialized settings. Note: not all settings are reset. Set Clock, Bottles and Sizes, and Suction Line configure option settings remain unchanged to minimize the settings you would need to change if the sampler were accidentally re-initialized. The Pump Count total is not reset to maintain an accurate count for the Tubing Life Warning.

EXIT CONFIGURATION

This option allows you to leave the configure sequence and return to the standby state. There are no input displays. Press the ENTER/PROGRAM key to exit the configure sequence. The configuration sequence can also be exited at any time using the EXIT PROGRAM key.

EXTENDED PROGRAMMING MODE

All sampling capabilities available in the basic programming mode are available in the extended programming mode; a listing of the capabilities is placed in **Table 5,** on page 45. The extended programming mode provides several additional capabilities: Nonuniform Time pacing, an additional multiplexing scheme (multiple bottle compositing), Sampling Stops and Resumes, program storage, etc.

The procedure used to program the sampler in the extended mode is the same as the procedure used to program the sampler in the basic programming mode. This procedure is outlined in *Basic Programming Mode Introduction*, on page 26. (To avoid duplication, the programming procedure is not repeated here.) There are some exceptions, however. The extended mode modifies the sections of the program sequence to allow you to take advantage of the additional features. The Sample Pacing section is extended to include settings for nonuniform times. The Sample Distribution section is modified to allow you to program the sampler for multiple bottle compositing. The procedure and displays used to program the sampler for bottles-per-sample and samples-per-bottle multiplexing, and sequential sampling are somewhat different. The section is also extended to allow you to switch multiplexed bottles or bottle sets after programmed periods of time. (With the extended mode, you can still switch bottles after a programmed number of samples have been deposited.) The Key Times section is extended to allow you to enter the time of the first bottle or bottle set change. If you have enabled the Sampling Stops and Resumes configure option, it will also include displays for sampling stops and resumes.

Each of these extended features is discussed briefly below. You may find it helpful to refer to **Figure 25,** on page 65 which charts the program sequence in the extended mode.

Table 6 Factory Configure Option Settings

CONFIGURE OPTION	DISPLAY NO.	FACTORY SETTING
SET CLOCK	210	Not Reset
BOTTLES AND SIZES	220,221,222,223	Not Reset
SUCTION LINE	230, 231, 232	Not Reset
LIQUID DETECTOR		
LIQUID DETECTOR	240	ENABLE
RINSES	241	0
ENTER HEAD MANUALLY	242	NO
# OF RETRIES	243	0
PROGRAMMING MODE	250	BASIC
LOAD STORED PROGRAM	255	
SAVE CURRENT PROGRAM	260	
FLOW MODE SAMPLING		
SAMPLE AT START TIME	270	NO
SAMPLE AT SWITCH TIMES	271	NO
NONUNIFORM TIME	280	Minutes
CALIBRATE SAMPLER	290	DISABLE
SAMPLING STOP/RESUME	300	DISABLE
SAMPLE AT STOP TIMES	301	NO
SAMPLE AT RESUME TIMES	302	NO
START TIME DELAY	310	2
ENABLE PIN		
SAMPLE UPON DISABLE	321	NO
SAMPLE UPON ENABLE	322	NO
RESET SAMPLE INTERVAL	323	NO
INHIBIT COUNTDOWN	324	NO
EVENT MARK		
CONTINUOUS/PULSE	330	CONTINOUS SIGNAL
PUMP CYCLE/FORWARD ONLY	331	FWD PUMPING ONLY
PURGE COUNTS		
PRE-SAMPLE COUNTS	340	150
POST-SAMPLE COUNTS	341	BASED ON LINE LENGTH
TUBING LIFE		
RESET PUMP COUNTER	351	NO
# PUMP COUNTS	352	Not Reset
PROGRAM LOCK	360	DISABLE
SAMPLER ID	365	Not Reset
RUN DIAGNOSTICS		

Table 7 Factory Program Sequence Settings

PROGRAM SETTING	DISPLAY NO.	FACTORY SETTING
[TIME, FLOW, PACED] SAMPLING	10	TIME
UNIFORM/NONUNIFORM TIME INTERVALS	11	UNIFORM
[TIME, FLOW, STORM] PACED SAMPLING	12	TIME
-- MINUTE DELAY TO FIRST TIMED SAMPLE	15	0 MINUTES
[DURING, AFTER] TIME MODE	16	DURING
SAMPLE EVERY -- HOURS, -- MINUTES	21	1 HOUR 0 MINUTES
SAMPLE EVERY ---- PULSES (1 - 9999)	22	10
TAKE -- TIMED SAMPLE EVENTS (1-MAX)	23	1
SAMPLE INTERVALS OF --MINUTES (1-99)	24	60
TAKE --- SAMPLES (1 - MAX)	25	10
QUANTITY AT INTERVAL 1. -- AT --- MINUTES	27	1 AT 60 MINUTES
-- BOTTLES PER SAMPLE EVENT (1 - 24)	30	1
-- SAMPLES PER BOTTLE (1-MAX)	31	1
MULTIPLEX SAMPLES? [YES, NO]	35	NO
[BOTTLES PER SAMPLE, SAMPLES PER BOTTLE]	36	SAMPLES PER BOTTLE
CHANGE BOTTLES BASED ON [TIME, SAMPLE]	40	COUNT
CHANGE SETS BASED ON [TIME, SAMPLE]	41	COUNT
CHANGE BOTTLES EVERY -- HOURS, -- MINUTES	42	2 HOURS 0 MINUTES
CHANGE SETS AFTER -- HOURS, -- MINUTES	43	2 HOURS 0 MINUTES
CHANGE BOTTLES AFTER -- SAMPLES	44	1
CHANGE SETS AFTER SAMPLES	45	1
SAMPLE CONTINUOUSLY? [YES, NO]	48	NO
SAMPLE VOLUMES OF --- ml EACH (10 - MAX)	50	200

PROGRAM SETTING	DISPLAY NO.	FACTORY SETTING
--- COMPOSITE SAMPLES (0 - MAX)	60	10
SUCTION HEAD OF -- FEET (1 - MAX)	70	10
ENTER START TIME? [YES, NO]	90	NO
STORM ENABLED AFTER HH:MM MM/DD	93	
ENTER FIRST SWITCH TIME? [YES, NO]	95	NO
-- STOP or RESUME TIMES (0 - 24)	100	0
MAX FLOW INTERVAL OF -- HOURS, --MINUTES	110	2 HOURS 0 MINUTES

EXTENDED MODE SAMPLE PACING

In the extended programming mode, the Sample Pacing section allows you to select one of two types of time-pacing: uniform or nonuniform time intervals. Uniform time intervals are identical to the time intervals entered in the basic programming mode. Nonuniform times allow you to pace the sampler at irregular intervals. You can enter nonuniform intervals in two ways. The first method allows you to define the interval between each sample event in minutes. For example, you can program the sampler to take sample #2 after an interval of 10 minutes, sample #3 after an interval of 30 minutes, sample #4 after an interval of 60 minutes, and so on. Sample #1 would be taken at the start time. The second method allows you to enter a specific time and date for each sample event. For example, with nonuniform time pacing, samples can be collected at specific times and dates at irregular intervals: 6:00 am on April 15, noon on April 15, 7:00 am on April 16, and 1:00 pm (or 13:00 in military time) on April 16. If you have several sequences of nonuniform times, you can use the program storage feature to save the programs using each sequence.

EXTENDED MODE SAMPLE DISTRIBUTION

The extended Sample Distribution section expands the multiplexing capabilities of the sampler. Both the bottles-per-sample and samples-per-bottle multiplexing are available; however, the procedure used to program them differs slightly from the procedure used in the basic programming mode. **Example 12,** on page 77 illustrates the bottles-per-sample multiplexing procedure; **Example 11,** on page 75 demonstrates the procedure used for samples-per-bottle multiplexing. The extended mode also offers multiple bottle compositing; refer to **Example 13,** on page 79.

In the extended programming mode, you can switch bottles or bottle sets after a programmed time period elapses or after a programmed number of samples have been deposited.

The displays used to specify the type of switches are shown in the Sample Distribution section of **Figure 25,** on page 65. Display #40 allows you to select either “TIME” or ”SAMPLES.” If you select “TIME,” the bottles can be changed after a programmed period of time.

If you select “SAMPLES,” the bottles can be switched after a programmed number of samples. In Display #41, which allows you to switch bottle sets, you can select either “TIME” or “SAMPLES/BTL.” If you select “TIME,” the bottle sets can be changed after a programmed period of time. If you select “SAMPLES/BTL,” the bottle sets can be changed after a programmed number of samples. You can use select either “TIME,” “SAMPLES,” or “SAMPLE/BTL” settings with both time- and flow-paced sampling.

Extended Mode Sample Volumes

The extended mode Sample Volumes section is identical to the Basic Mode Sample Volume section.

Extended Mode Key Times

The extended mode Key Times section has two additional sets of displays which allow you to specify the time of the first bottle or bottle set change and to set up the sampling stop and resume times.

First Switch Time

The first switch time displays will appear only when you have specified bottle or bottle set changes based on time in the Sample Distribution section. If you select "TIME" rather than "SAMPLES/BTL" in the "CHANGE SETS BASED ON [TIME, SAMPLES/BTL]" display, you first will be asked if you want to enter a setting for the first switch time. If you respond "YES," you will be asked for the time of the first bottle or set change.

The first switch time setting allows you to control the times of each bottle switch without delaying the routine and thereby missing samples. For example, if you have programmed the sampler for time switches every hour and you want the switches to occur on the hour, you can set the time of the first switch at the next even hour, start the sampling routine early, and deposit samples in the first bottle set until the first switch time. At the first switch time, the distributor moves to the next bottle set. The first bottle set may not be completely filled; however, by starting the routine early, you can sample until the bottle switches are placed "on schedule" to avoid missing any samples. The first time switch displays are indicated by display #'s 95, 46, and 47 in **Figure 17,** on page 19.

If you do not enter a first switch time, the sampler will begin timing the switch interval from the start time for the routine and the first bottle or bottle set will receive samples for the full time period. Switch times are not available in STORM routines.

Stops and Resumes

The Stops and Resumes settings are available only when you have enabled the Sampling Stop/Resume configure option (see *Sampling Stop/Resume,* on page 49). You must first enter the number of stops and resumes, from 0 to 24. (Enter "0" if you want to omit the stop and resume settings without returning to the configure sequence and disabling the Stops and Resumes option.) Then enter the stop and resume clock times beginning with the first stop time. Refer to the Key Times section of **Figure 26**, display #'s 100, 101, and 102.

Start Times

This section discusses the sampler's start times. It begins by outlining the sequence of events preceding the start time for most sampling routines.

Sequence of events preceding sampling routine

After you program a sampler, you must start the sampling routine by pressing the start sampling key. However, depending on the program and configure option settings, the sampling routine may not start at soon as you press the key. The "Delay to Start Time" is the period between the time you press start sampling and the start time for the routine. **Figure 22** diagrams the sequence of events preceding the start time.

The start time for a routine is either the programmed start time or the time at which the delay to start time expires. The programmed start time is determined by entries made in Displays #90, #91, #92 and #93. The delay to start time is determined by the entry in Display #310 of the Start Time Delay configure option. These input displays are illustrated below. They are also illustrated in the program structure charts in **Figure 15,** on page 17 and **Figure 17,** on page 19.

Note: Unless the sampling routine contains a programmed start time (Displays #91, #92, or #93), the sampler will delay the start time according to the amount of time specified in the Start Time Delay configure option. A programmed start time entry always overrides any settings made in the Start Time Delay configure option.

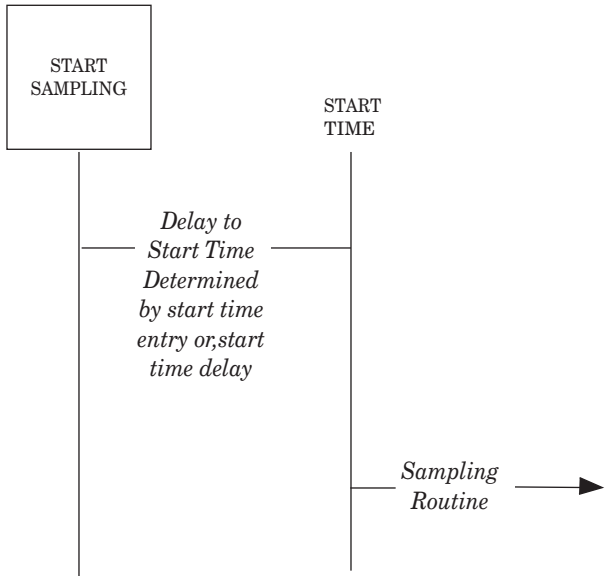
Programmed start time displays (Program Sequence)

ENTER START TIME? [YES, NO]	Display #90.
TAKE FIRST SAMPLE AT HH:MM DD-MMM	Display #91 (time-paced sampling).
START FLOW COUNT AT HH:MM DD-MMM	Display #92 (flow-paced sampling).
STORM ENABLED AFTER HH:MM DD-MMM	Display #93 (storm-paced sampling).

Start Time Delay display (Configure Sequence)

---- MINUTE DELAY? TO START (0 - 9999)	Display #310 (Start Time Delay configure option).

Figure 22 Simplified Start Time Diagram



Isco 3200 and 4200 Series Flow Meters and 4100 Series Flow Loggers provide two essential functions for certain sampling applications. They send flow-pacing signals — flow pulses — to the sampler for flow-paced sampling. The second function provides disable (inhibit) or enable signals to the sampler. A sampler receiving a disable signal will suspend the sampling routine until it receives an enable signal.

The sampler will disregard a disable signal received from a flow meter during the delay to start time. If the sampler is disabled when the start time occurs, it will suspend the routine until it is enabled. Once enabled, the sampler will begin the time or flow intervals. The sampler will initiate a sample event when enabled for all time-paced routines. For flow-paced routines, it will initiate a sample event when the sampler is configured to take a sample upon enable in the Enable Pin configure option (see *Enable Pin*, on page 50).

If the sampler is enabled when the start time occurs, it will begin the routine. The sampler will initiate a sample event at the start time for all time-paced routines. It will initiate a sample event at the start time for flow-paced routines when configured for sample at start time in the Flow Mode configure option (see *Flow Mode Sampling*, on page 49). Refer to **Figure 23**. The diagram shows the sampler's response when enabled or disabled at the start time for most basic and extended mode routines.

Nonuniform Clock Times and Disable Signals

Figure 24 diagrams the sequence of events preceding a routine programmed for nonuniform clock times. Nonuniform clock time programming allows you to enter a specific time and date for each sample event. Samplers programmed with nonuniform clock times may skip a number of samples if disabled for long periods. If the sampler is disabled and subsequently enabled, it will initiate only one event to compensate for the skipped sample events even if several sample event times have been passed.

Note: Nonuniform clock time programming is designed to replace flow-pacing when a flow meter is not available at the site. Before using a sampler programmed for nonuniform clock times with a flow meter, be sure flow-pacing is not a more appropriate application.

Manual Sample Key and Programmed Start Times

The sampler will disregard the manual sample key during the delay to start time and during the disable period. The periods where the sampler disregards disable signals (Delay to Start) and the manual sample key (when disabled) appear in **Figures 23** and **24**.

Start Time Delay

Entries made in the Start Time Delay configure option affect the start times. The sampler's response varies according to specific entries: "0," "1," and entries greater than 1. *Start Time Delay*, on page 49

Figure 23 Start Time Diagram

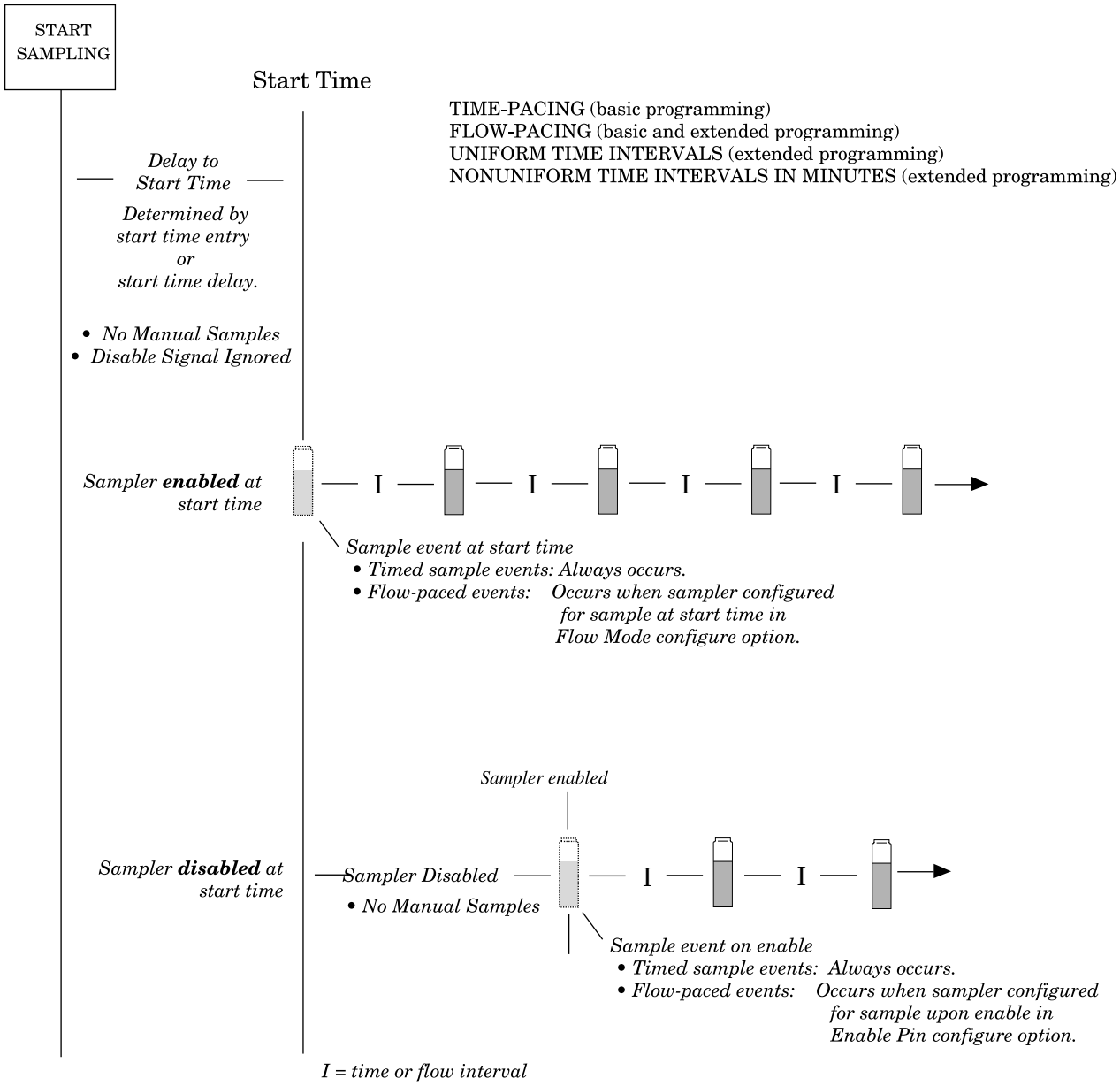
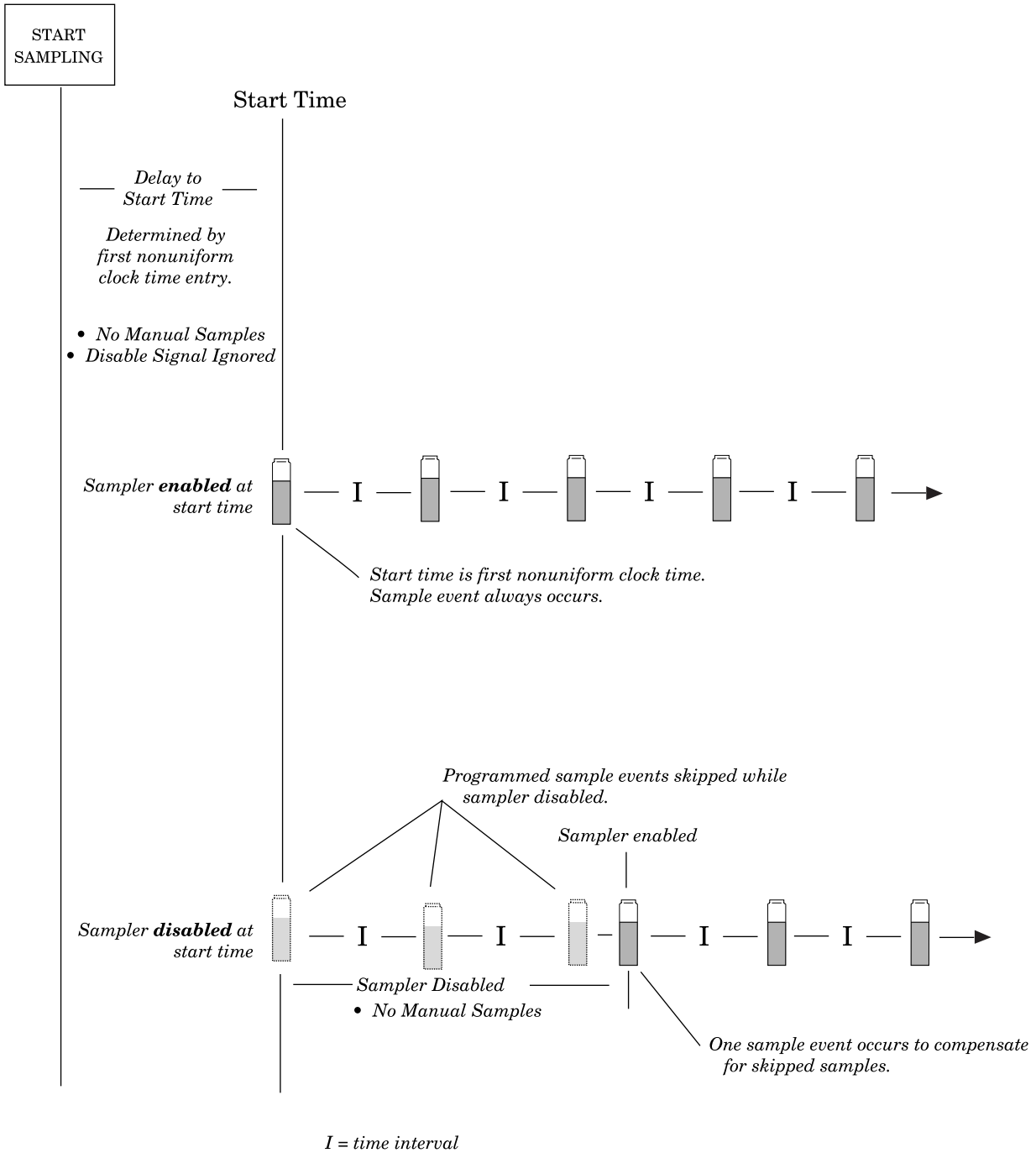


Figure 24 Start Time Diagram for Nonuniform Clock Time Routines



STORM PROGRAMMING

Many STORM water runoff monitoring permits require a first-flush grab sample within the first 30 minutes of the STORM event and a time- or flow-paced composite sample during the remainder of the event. The 3700 Sampler's STORM pacing is ideal for monitoring STORM events. storm pacing allows you to:

- Divide the sampler's bottles into two groups. The first bottle group receives the first flush grab sample. The grab sample is always a time-paced sample. The second bottle group receives either a flow-paced or time-paced sample.
- Collect samples for the second bottle group after collecting the first-flush samples or collect samples for both groups at the same time. See **Figures 29** and **28**.
- Distribute sample volumes to both bottle groups sequentially or in any of the three multiplexing schemes: bottles-per-sample, samples-per-bottle, or multiple bottle compositing.
- Use an Isco flow logger or flow meter to enable or disable the sampler according to the level or flow rate of the flow stream or to specific amount of rainfall.
- You can use a maximum flow interval setting to terminate a STORM routine that uses flow-paced sampling.

  The maximum flow interval setting limits the amount of time between flow-paced sample events. For example, if the flow rate declines so that the amount of time between flow-paced sample events exceeds a maximum flow interval setting of two hours, the sampler will terminate the routine when more than two hours elapses between events.

  The maximum flow interval setting allows the sampler to terminate the routine when the flow rate falls below an acceptable rate or drops off completely. This limits the sampling routine to one STORM event so that samples from multiple STORM events are not deposited into the bottle groups.

STORM SAMPLING CHECKLIST

This section provides two checklists: a list of suggested STORM monitoring equipment and a brief installation checklist. Notes on terminating a routine, manual sampling during a STORM routine, and a STORM routine's run state displays follow the checklist. **Example 17,** on page 86 contains a STORM programming example.

You can find additional information about STORM monitoring installations in the *Isco Storm Water Runoff Monitoring Pocket Guide*. The pocket guide contains the following information:

- How to connect the sampler and rain gauge to the flow meter.
- Programming examples for both the flow meter and the sampler.
- Starting and restarting the monitoring installation.

Equipment Checklist

The equipment listed below is suggested for typical STORM event monitoring:

- 3700 Sampler and power source.

  You can use a 2-, 4-, 8-, 12-, or 24-bottle configuration for STORM routines.
- An Isco flow logger or flow meter with power source.
- A Sampler-to-Flow Meter Connect Cable.

Optional Equipment Checklist

- Rain gauge with cable and connector (Rain gauges are required for rain-event triggered sampling)
- FLOWLINK software (requires IBM-compatible computer system).

  Although the flow meter contains the sampler enable conditions most commonly used in storm water runoff monitoring, you can use the FLOWLINK system to download many additional sample enable conditions to the flow meter. Refer to the FLOWLINK Instruction Manual for more information.
- Interrogator communication line kit to connect a computer to the flow meter.

  This kit provides the computer-to-flow meter cabling. Isco Flow Meters and Flow Loggers can also be equipped with a modem to communicate with the FLOWLINK system over standard telephone lines.
- Solar Panel Battery Charger.

Installation Checklist

This checklist summarizes the four steps required to set up a storm monitoring installation:

1. Program and install the flow meter. Install the rain gauge, if used.

   You can program 3200 and 4200 Series Flow Meter for sampler enable control conditions from the flow meter front panel or use FLOWLINK and a computer to download the desired condition. 4100 Series Flow Loggers can only be programmed with Flowlink.

Note

You can program the sampler to start the routine at a specific time and date with a start time entry. You are not required to use a flow meter to enable the sampler.

2. Program and install the sampler.

   Programming the sampler includes adjusting certain configuration option settings as well as entering the STORM program settings. **Table 8** lists the configure options and their recommended STORM settings.

3. Connect the flow meter to the sampler with the connect cable or connect the flow meter to the master/slave pair with the "Y" connect cable.

4. Turn the flow meter on. Turn the sampler on and start the sampling routine by pressing the start sampling key.

   Connect the flow meter to the sampler and start the flow meter before you press the start sampling key on the sampler. If you are using the flow meter to detect a storm event and enable the sampler when the event occurs, the sampler must be disabled by the flow meter when you press the start sampling key. If the sampler is not disabled, it will begin the routine as soon as you press the key. This means that the flow meter must not detect the enable control conditions. The flow meter will disable a sampler only when the conditions are not satisfied.

Terminating the Routine

A STORM routine will terminate under the following conditions:

- The sampler completes the routine.
- A flow meter disables the sampler when the enable control condition is no longer satisfied. Once a sampler running a STORM routine has been disabled, however, it cannot be re-enabled if control conditions are satisfied again. You can prevent the sampler from being disabled by "latching" the sampler enable through the flow meter's control condition.

  It is particularly important to latch the sampler if you are using master/slave sampling. The master sampler that has been disabled by a flow meter cannot enable the slave sampler.
- The amount of time between flow-paced sample events exceeds the STORM routine's maximum flow interval setting.

Manual Samples

Manual sampling is not available during a STORM routine. If you press manual sample during a storm routine, the sampler will disregard the key.

Run State Displays

Run state displays for STORM routines are identical to displays used with conventional routines. However, the displays for the first and second bottle groups will alternate with each other.

Table 8 Recommended STORM Settings for Configure Options

Configure Option	Display No.	Recommended Setting
SET CLOCK	210	Enter correct time and date.
BOTTLES AND SIZES		
PORTABLE/REFRIG	220	Select "REFRIG."
1, 2, 4, 8, 12, 24	222	Select 2, 4, 8, 12, or 24. Do not select 1. If the sampler is configured for one bottle (composite sampling), the STORM branch will not be accessible.
BOTTLE VOLUME	233	
		FOR: 2 glass or plastic, enter 9400 ml 4 bottles, enter 3800 ml 8 plastic bottles, enter 1800 ml 12 plastic bottles, enter 2500 ml 24 plastic bottles enter 1000 ml 24 glass bottles, enter 350 ml
SUCTION LINE	230, 231, 232	Enter correct settings

Configure Option	Display No.	Recommended Setting
LIQUID DETECTOR		
LIQUID DETECTOR	241	0
RINSES	241	0
ENTER HEAD MANUALLY	242	NO
# OF RETRIES	243	
PROGRAMMING MODE	250	Select “Extended.”
Load Stored Program	255	Load only a stored STORM program.
SAVE CURRENT PROGRAM	260	Not applicable.
FLOW MODE SAMPLING		
SAMPLE AT START TIME	270	Disregarded by STORM routines.
SAMPLE AT SWITCH TIMES	271	Disregarded by STORM routines.
NONUNIFORM TIMES	280	Disregarded by STORM routines.
CALIBRATE SAMPLER	290	Select “DISABLE”
SAMPLING STOP/RESUME	300	
SAMPLE AT STOP TIMES	301	Disregarded by STORM routines.
SAMPLE AT RESUME TIMES	302	Disregarded by STORM routines.
START TIME DELAY	310	Disregarded by STORM routines.
ENABLE PIN		
MASTER/SLAVE	320	Select “Disable” when using a single sampler for Storm monitoring.
SAMPLE UPON DISABLE	321	Disregarded by STORM routines.
SAMPLE UPON ENABLE	322	Disregarded by STORM routines.
RESET SAMPLE INTERVAL	323	Disregarded by STORM routines.
INHIBIT COUNTDOWN	324	Disregarded by STORM routines.
EVENT MARK		
CONTINUOUS/PULSE	330	Select Preferred Event Mark
PUMP/CYCLE/FWD ONLY	331	Select Preferred Event Mark
PURGE COUNTS		
Pre-sample counts	340	Enter Preferred Count.
Post-sample counts	341	Enter Preferred Count.
TUBING LIFE		
RESET PUMP COUNTER	351	Reset if required.
#PUMP COUNTS	352	Enter preferred count.
PROGRAM LOCK	360	Select “ENABLE” or “DISABLE,” as preferred
SAMPLER ID	365	Enter appropriate Id.
RUN DIAGNOSTICS		No setting required.

PROGRAMMING THE SAMPLER FOR A STORM ROUTINE

The extended programming mode contains two program sequences. The first sequence contains the displays for time- and flow-paced routines. The second sequence contains the displays for STORM paced routines. **Figure 25** shows the displays for the first sequence.

The storm input displays are divided into three sections. Each section is marked in **Figures 25 through 27**. The first section contains the displays that control the pacing and distribution to the first bottle group. The second section contains the displays that control the pacing and distribution for the second bottle group. The third section controls the start time for the routine and may include calibration and manual suction head displays.

First Section: Settings for the First Bottle Group

The first section contains the input displays that:

- Set a delay to the first sample event of the first bottle group.
- Set the time-pacing for the first bottle group.
- Allocate the bottles for the first bottle group.
- Determine the sample distribution for the first bottle group: sequential, samples-per-bottle multiplexing, bottles-per-sample multiplexing, or multiple bottle compositing.

The "TIME MODE" message marks the beginning of the first section. This message is followed by Display #15, below.

-- MINUTE DELAY TO FIRST GROUP SAMPLE	Display #15

Use this display to set amount of time between the time the sampler is enabled and the first sample delivered to the first bottle group. (The sampler may be enabled at the start time.) The acceptable range of values for the delay to first group sample is 0 to 999 minutes. If the delay is zero, the sampler will take the first sample when enabled by the flow meter. Subsequent time-paced samples will occur at the time interval entered in Display #23.

How to Allocate Bottles to the Bottle Groups

Use the next three displays to determine the both the sample distribution and the number of bottles allocated to the bottle groups.

TAKE 2 TIMED SAMPLE EVENTS (1 - MAX)	Display #23

3 BOTTLES PER SAMPLE EVENT (1 - MAX)	Display #30

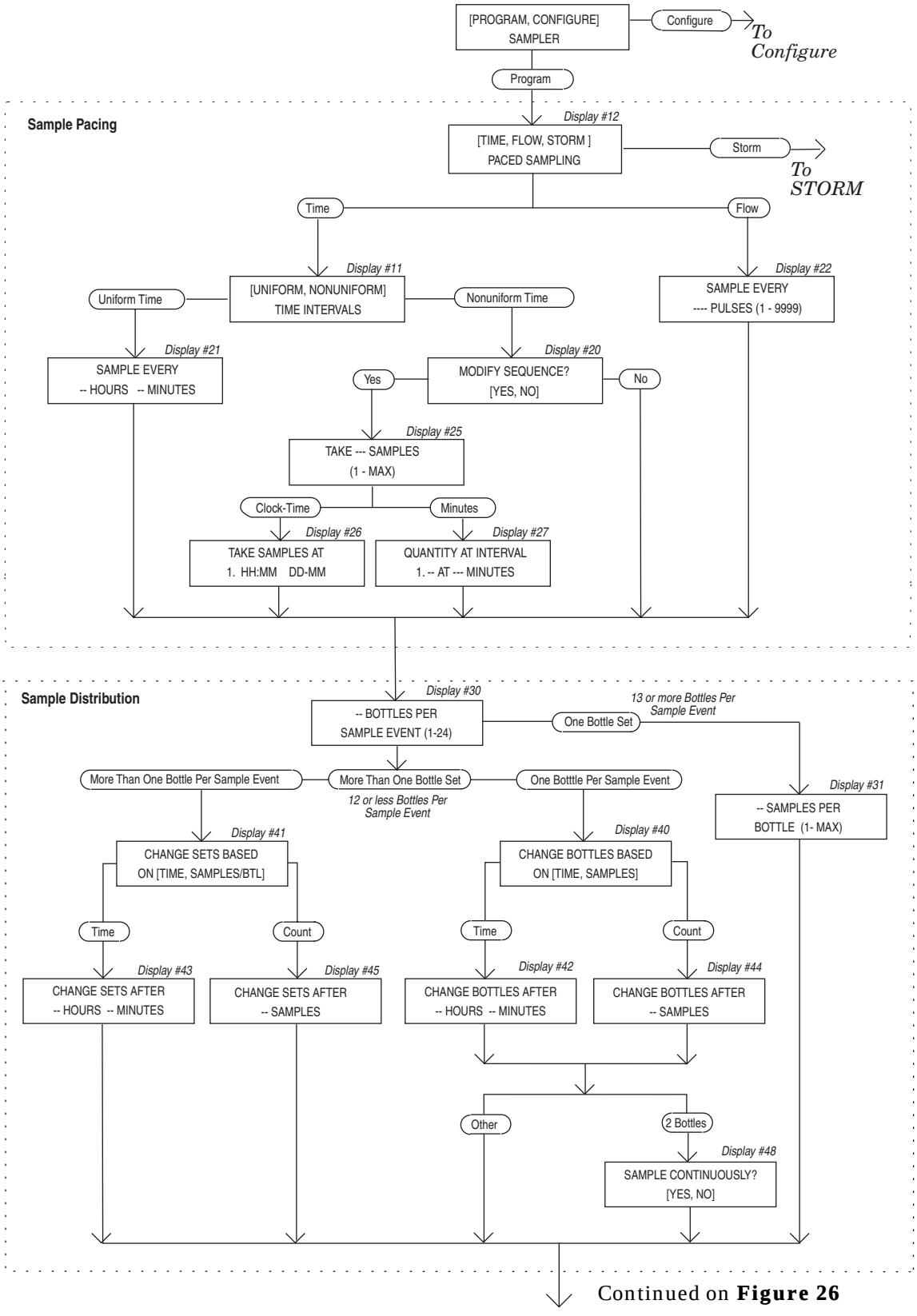
1 SAMPLES PER BOTTLE(1 - MAX)	Display #31

A bottle group can contain one or more bottles. You can allocate all bottles but one to the first bottle group. The STORM routine will automatically allocate the remaining bottles (or bottle) to the second bottle group. (It obtains the total number of bottles from the bottle number setting in the bottles and sizes configure option.) Refer to the displays above; a 24-bottle sampler programmed to distribute samples to three bottles at two sample events would allocate six bottles to the first bottle group. It would allocate the remaining 18 bottles to the second bottle group.

Sample Distribution and Sample Volumes for the First and Second Bottle Groups

STORM sampling supports sequential sampling as well as all three types of multiplexing: bottles-per-sample multiplexing, samples-per-bottle multiplexing, and multiple bottle compositing. These distribution schemes are available for both bottle groups. Because STORM programming is part of the extended programming mode, the sample distribution displays used (Display #'s 30 and 31) are identical to other extended mode programming routines. Refer to **Example 11** for an example of samples-per-bottle multiplexing, **Example 12** for bottles-per-sample multiplexing, and **Example 13** for multiple bottle compositing. To enter a sample volume for the first bottle group, simply enter the volume in Display #50.

Figure 25 Extended Programming Mode: Sample Pacing and Sample Distribution



Continued on **Figure 26**

Figure 26 Extended Programming Mode: STORM Programming

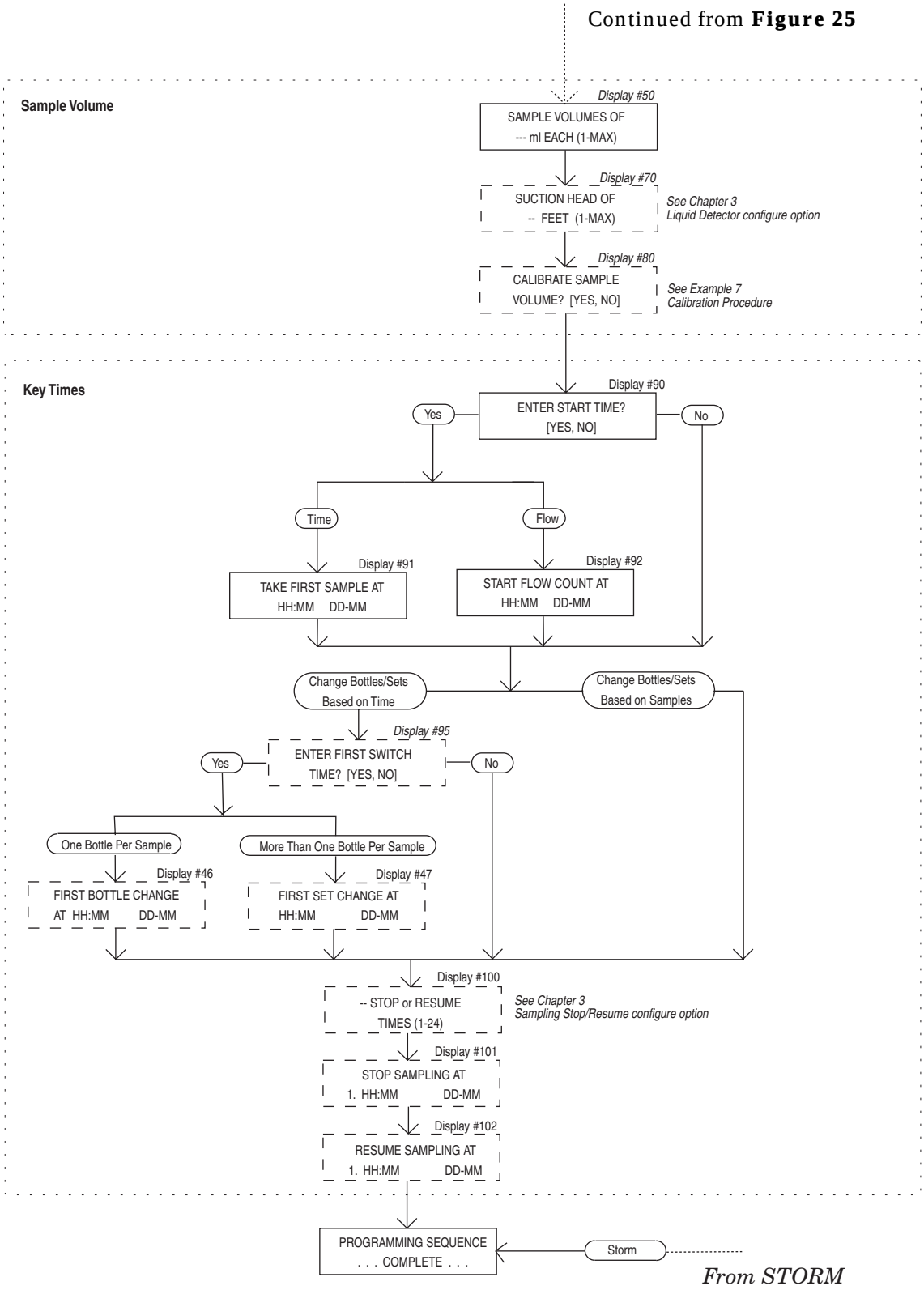
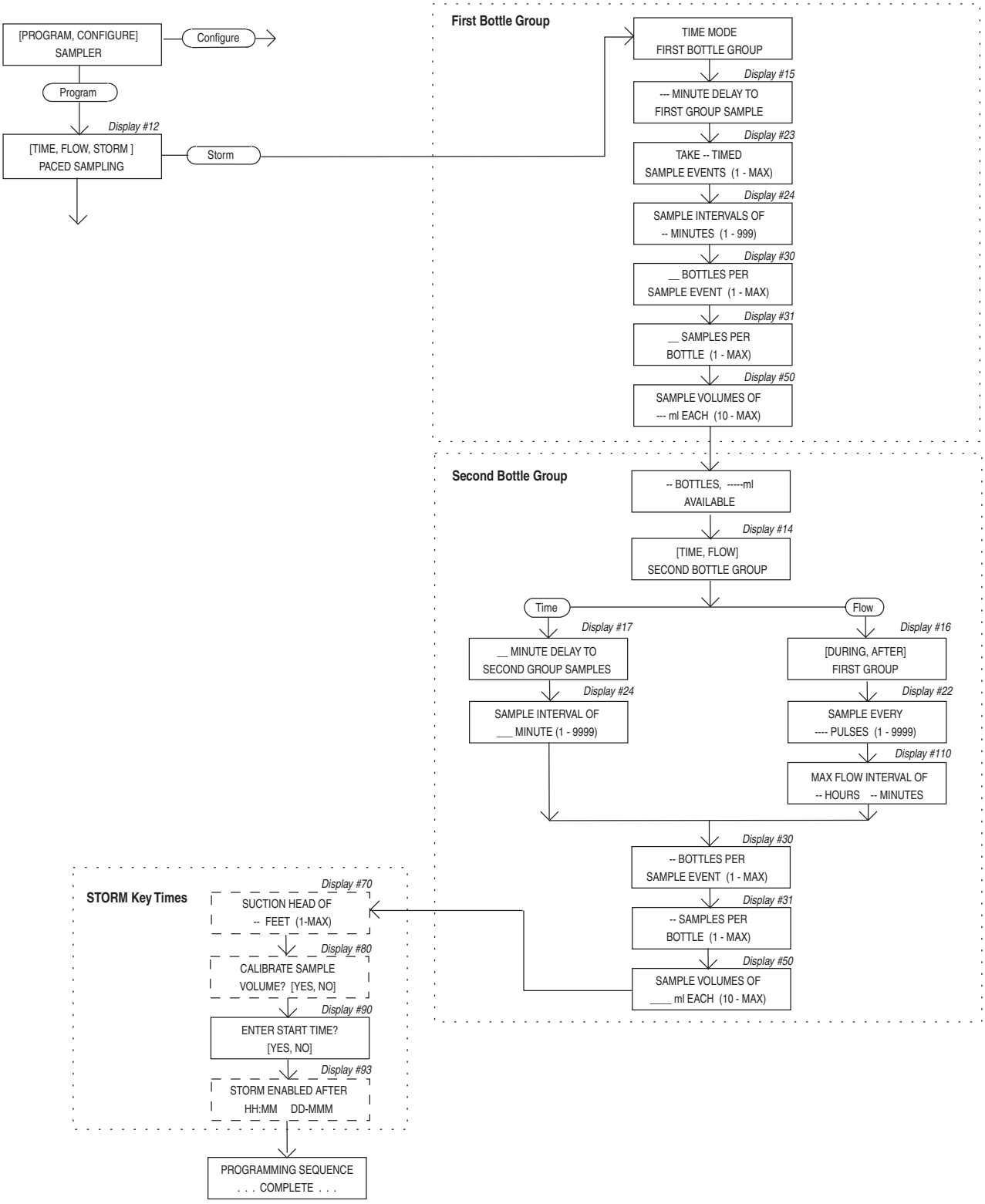


Figure 27 Extended Programming Mode: STORM Programming



Second Section: Second Bottle Group

The second section contains the input displays for the second bottle group. It includes displays that:

- Set the pacing for the second bottle group.
- Determine when the sampler begins filling the second bottle group: during the same time period as the first bottle group or after it fills the first bottle group.
- Set the maximum flow interval.
- Determine the sample distribution for the second bottle group: samples-per-bottle multiplexing, bottles-per-sample multiplexing, or multiple bottle compositing.

After you've completed the entries for the first bottle group, the sampler will present the message:

```
-- BOTTLES, ----- ml
AVAILABLE
```

This message marks the beginning of the second section. It reports the number of bottles allocated for the second bottle group and the total volume of their combined capacity. The sampler displays this information to help you enter the sample distribution scheme and sample volumes for the second bottle group. If the remaining number of bottles or the capacity is incorrect, reprogram the first section.

Pacing for the Second Bottle Group

The next display, Display #14, allows you to select time or flow pacing for the second bottle group.

```
[TIME, FLOW]
SECOND BOTTLE GROUP
```
Display #14

Depending on your selection, the STORM sequence will follow one of the two paths shown for the second section in **Figure 25**.

Time-Pacing

When you select "TIME" from Display #14, two time-pacing displays (#17 and #24) will follow.

```
____ MINUTE DELAY TO
SECOND GROUP SAMPLES
```
Display #17

```
SAMPLE INTERVAL OF
____ MINUTE (1 - 9999)
```
Display #24

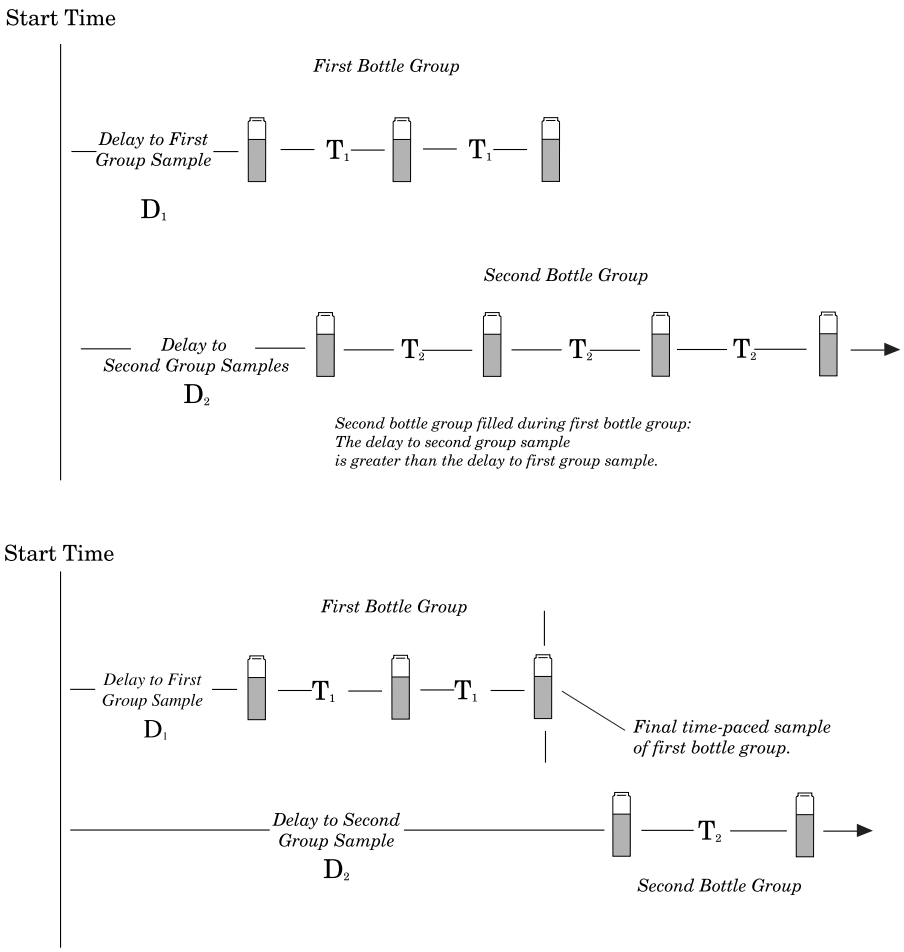
Use Display #17 to set the delay to the second bottle group. Like the delay to the first group sample, the delay to the second group sample determines the period between the time the sampler is enabled and the time the first sample is deposited in the second bottle group. You can use this setting to fill the second bottle group during the same time the sampler fills the first bottle group or after the sampler fills the first bottle group. **Figure 28** shows a time diagram for a STORM routine that uses time pacing for both the first and second bottle groups.

To fill the second bottle group after the first, be sure amount of time you enter for the delay to second group is equal to (or greater than, if necessary) the delay to the first group plus the total amount of time required to fill the first group. The sampler will begin timing both delays (delay to first and delay to second bottle group) at the same time. Refer to the lower diagram in **Figure 28**.

Entries made in Display #'s 15, 23, and 24 (" --
þMINUTE DELAY TO FIRST GROUP SAMPLE," "TAKE -- TIMED EVENTS," and "SAMPLE INTERVALS OF -- MINUTES") determine the amount of time required to fill the first bottle group. For example, if the delay to the first group were zero and the routine required two timed sample events at 30 minute intervals, the sampler would take 30 minutes to fill the first bottle group. The first sample event would occur after the programmed delay to group sample; the second sample event would occur 30 minutes later.

Use Display #24 to enter the time interval for the second bottle group. You can use any interval; you do not have to use the same time interval for the second bottle group as you used for the first group.

Figure 28 Storm Sampling: Time Pacing for the Second Bottle Group



Flow-Pacing for the Second Bottle Group

If you need a flow-paced sample for the second bottle group, select "FLOW" from Display #14. Three flow pacing displays (#16, #22, and #110) will follow.

[DURING, AFTER] TIME MODE	Display #16
SAMPLE EVERY ---- PULSES (1 - 9999)	Display #22
MAX FLOW INTERVAL OF __ HOURS __ MINUTES	Display #110

Use Display #'16 to determine when the sampler will begin filling the second bottle group. Select "DURING" if you want the second bottle group filled during the same time period as the first bottle group. Select "AFTER" to begin the flow pacing for the second bottle group after the sampler fills the first bottle group. If you select "DURING," the sampler will begin counting flow pulses when it begins timing the delay to first group sample. The sampler will take the first sample of the second bottle group as soon at the sampler counts a full flow pulse interval. If you select "AFTER," the sampler will begin counting flow pulses after the last sample event of the first bottle group. Use Display #22 to enter the flow pulse interval for the second bottle group.

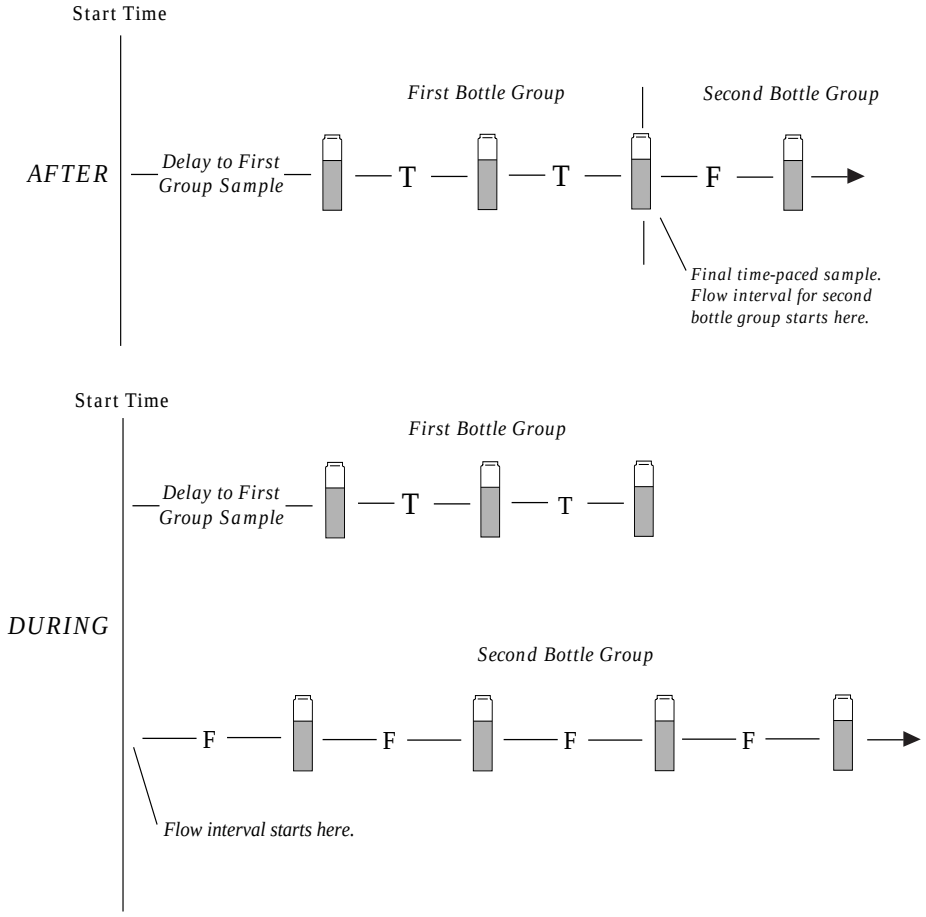
The third flow paced display allows you to enter the maximum flow interval. The acceptable range of values for the maximum flow interval is one minute to 99 hours and 59 minutes.

The sampler will terminate the sampling routine when the amount of time between flow-paced samples exceeds the limit set for the maximum flow interval. The maximum flow interval will terminate the routine even if all bottles of either bottle group have not been filled. Once the sampler terminates a routine, the sampler cannot be reenabled by the flow meter should the flow meter detect enable control conditions again.

Note: If the second bottle group requires flow-paced samples, the sampler may fill the second bottle group before it fills the first bottle group. This can occur when the flow rate monitored by the flow meter is higher than anticipated and the flow pulse interval has not been adjusted to reflect the higher rate. If this occurs, the sampler will continue the first bottle group until all samples have been taken. Adjust the pulse interval by:

- Reprogramming the flow meter to change the number of flow pulses sent to the sampler by the flow meter.
- Reprogramming the sampler to change the flow pulse interval in the flow-pacing segment of the STORM routine.
- Reprogramming both the flow meter and the sampler.

Figure 29 Storm Sampling: Flow Pacing for the second Bottle Group



STORM Key Times

The third section, STORM Key Times, contains the displays used to

- Enter suction head measurements.
- Enable the calibration routine.
- Enter a start time for the STORM routine.

The input displays of the third section of the STORM program sequence vary according to configure option settings. The first two displays ("SUCTION HEAD OF -- FEET" and "CALIBRATE SAMPLE VOLUME") appear only if the sampler is configured to add them to the STORM program sequence. Entries made in the Liquid Detector configure option and the Calibrate Sampler configure option add or exclude these displays from the sequence. **Example 17** on page 86 does not include these displays since they are not normally necessary.

To enter a specific start time for the routine, select "YES" in Display #90 (illustrated in step 19 of Example 17). The sampler will prompt you to enter a start time with Display #93 (step 20). If you select "NO," the start time will be delayed by the amount set in the Start Time Delay configure option. After you've made these entries, the sampler will present the "PROGRAMMING SEQUENCE COMPLETE" message and return to standby.

Programmed Start Times, Start Time Delays, and Delays to Group Sample

Samplers programmed for STORM sampling respond to start-time delays and programmed start times in the same way as samplers programmed for any other basic or extended mode routines. The sampler will delay the STORM routine until the start time entered in the third segment of the STORM sequence. (See Display #93.) If the sampler is enabled by the flow meter at the start time, the sampler will begin to time the delay to the first bottle group. If the sampler is disabled by the flow meter at the start time, the sampler will suspend the routine until it becomes enabled. Once the sampler is enabled by the flow meter, the sampler will begin the delay to first timed sample event and continue the STORM routine.

As you can see, a STORM sampling routine has four delay periods that vary slightly with the programming entries. Every STORM routine will have a delay to start time and delay to first group sample. Depending on whether the second bottle group is time paced or flow paced, the third delay period will be either the delay to second group sample or the "During/After" delay.

- Delay to Start Time. The start time is simply the time the sampler begins the routine. The sampler begins timing the delay to start time when you press the start sampling key. The sampler will not check for an enable or disable signal from a flow meter, Liquid Level Actuator, or another sampler until the start time.

  The delay to start time is the amount of time between the time you press the start sampling key and the start time. The delay to start time is determined by the programmed start time entry for the STORM routine (Display #93) or the Start Time Delay configure option. The Start Time Delay, set in the configure option, can be from 0 to 999 minutes long. A programmed start time can be any date within 30 days of the sampler's current date.
- Delay to First Group Sample. The delay to first group sample is the period between the time the sampler is enabled (not the start time) and the time first sample volume is delivered to the first bottle group. Your entry in Display #15 determines the Delay to First Group.
- Delay to Second Group Samples. The delay to second group sample is the period between the time the sampler is enabled (not the start time) and the time the first sample volume is delivered to the second bottle group. This delay is determined by your entry in Display #17. You can enter a delay to second group sample only for time-paced second bottle groups.
- DURING/AFTER. This delay affects flow-paced second bottle groups. Like the delay to second group sample, the during/after delay determines when the sampler begins sampling for the second bottle group. Because the flow-paced sampling can consume unpredictable amounts of time, the STORM routine must use two specific events to mark the beginning of the flow intervals. These events are the time the sampler is enabled and the time the sampler completes the first bottle group.

  If you want the sampler to fill the second bottle group during the first bottle group, select "DURING" from Display #16. The sampler will begin counting flow pulses when the sampler is enabled. (If the sampler is enabled at the start time, the sampler starts counting flow pulses at the start time.)

  If you want the sampler to fill the second group after the sampler fills the first bottle group, select "AFTER." The sampler will begin counting flow pulses after it fills the first bottle group.

PROGRAMMING EXAMPLES

The following examples demonstrate the steps used to program the sampler for several different sampling routines in the extended programming mode.

Each programming example concludes with the run state displays that appear for that routine. The examples assume you are familiar with the functions of the keys as discussed in *Keypad Description,* on page 23 and *Displays,* on page 25.

Note: Before programming a sampler in the extended programming mode, the sampler must be configured for extended programming. Refer to *Programming Mode,* on page 45 for a discussion of the Programming Mode configure option. **Example 1** on page 29 shows the steps required to access the Programming Mode option.

FOREIGN LANGUAGES AND METRIC UNITS OF MEASURE

The 3700FR Sampler provides displays in French, Spanish, and German. Additionally, the software supports entries in metric units of measure. Metric units include volumes in milliliters, suction head and suction line length in decimeters, and suction line ID in millimeters.

Samplers using French, Spanish, and German language displays support metric units for suction line and suction head measurements. Samplers operating with English displays support either English or metric units for suction line and suction head measurements. (Sample volumes are always entered in milliliters, regardless of the language).

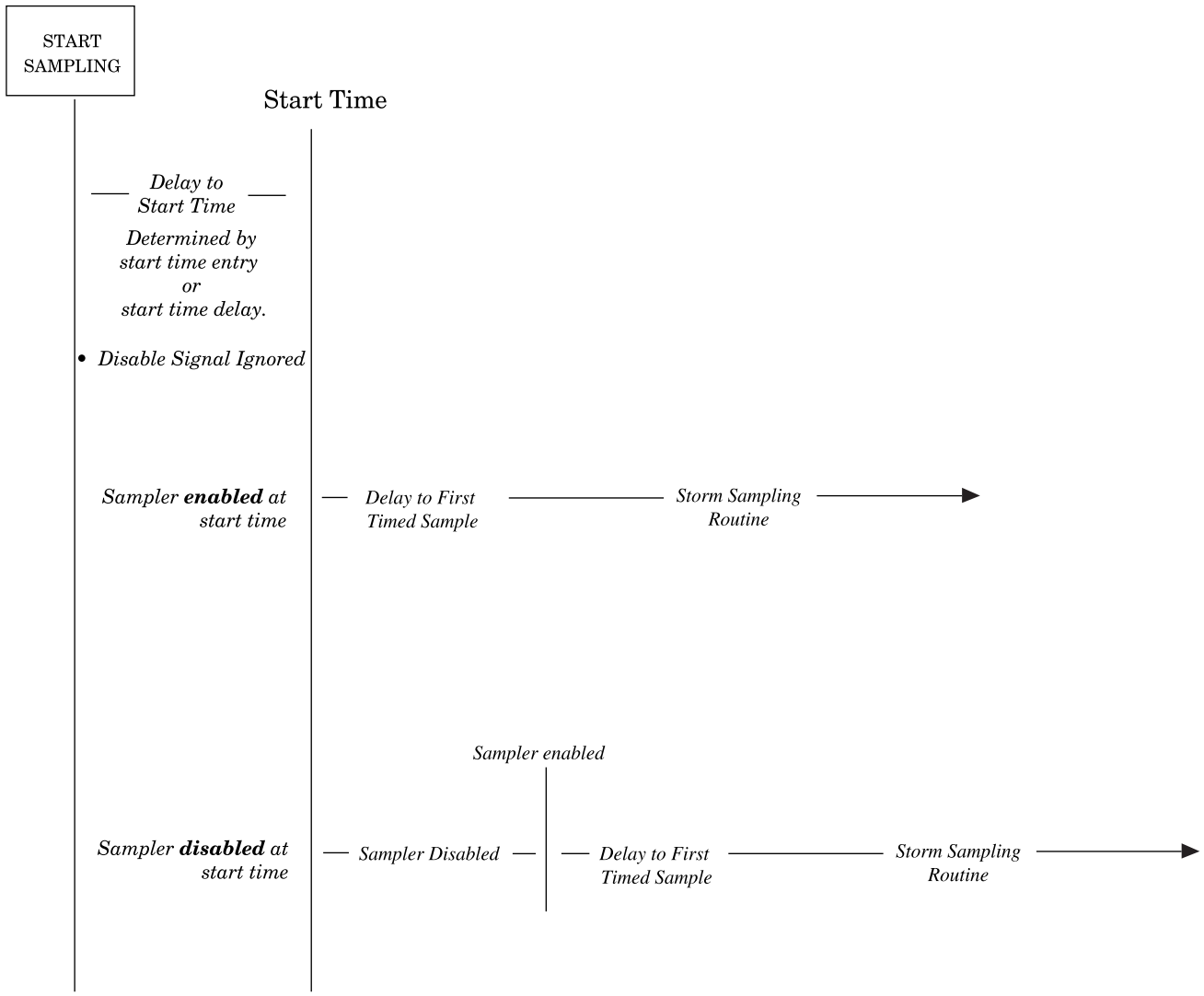
To program the sampler for foreign language displays, begin by placing the sampler in standby. Then, be sure the sampler is configured for extended programming. Access the language programming sequence by pressing the stop key five times. The standby display will be replaced by the input display illustrated below.

```
[English, German,
Spanish, French]
```

Select the preferred language from this display. If you select French, Spanish, or German, the sampler will automatically convert English units of measure to metric units and return to standby. If you select English, a second input display (shown below) will appear. Select the units of measure from this display. After you've made the selection, the sampler will convert the units of measure as required and return to standby.

```
[U.S., Metric]
Units
```

Figure 30 Start Time Diagram for STORM Routines



Example 10 Extended Time-paced Sequential Sampling

The following example programs the sampler to take time-paced samples at uniform time intervals of 30 minutes starting at 8:00 am, tomorrow morning. One 500 ml sample is to be placed in each bottle.

Step No.	Display	Procedure
1	**. . . STANDBY . . . 10:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE] SAMPLER**	Access the program sequence by selecting "PROGRAM."
3	**[*TIME*, FLOW, STORM] PACED SAMPLING**	Select "TIME."
4	**[*UNIFORM*, NONUNIFORM] TIME INTERVALS**	Select "UNIFORM."
5	**SAMPLE EVERY *0* HOURS, 10 MINUTES**	Enter "0" to set the hours at zero. Press ENTER/PROGRAM to store the number "0" and move to the minutes entry.
6	**SAMPLE EVERY 0 HOURS, *30* MINUTES**	Enter "30" to set the minutes entry to 30.
7	***1* BOTTLES PER SAMPLE EVENT (1 - 24)**	Enter "1" to set the number of bottles per sample event to 1.
8	**CHANGE BOTTLES BASED ON [TIME, *SAMPLES/BTL*]**	Select "SAMPLES/BTL."
9	**CHANGE BOTTLES EVERY *1* SAMPLES (1 - 8)**	Enter "1" to set the number of samples per bottle to 1.
10	**SAMPLE VOLUMES OF *500* ml (10 - 1000)**	Enter "500" to set the sample volume at 500 ml.
11	**ENTER START TIME? [*YES*, NO]**	Select "YES."
12	**TAKE FIRST SAMPLE AT *8*:00 20-JUN**	Enter the start time and date: 8:00 tomorrow morning.
13	**PROGRAMMING SEQUENCE COMPLETE . . .**	After this message is displayed briefly, the sampler will automatically return to the standby state.
14	**. . . STANDBY . . . 10:37:23 19-JUN-91**	When the sampler is properly installed, press the START SAMPLING key to run the program.
15	**START SAMPLING BOTTLE *1* (1-24)**	To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.

Step No.	Display	Procedure
16	**BOTTLE 1** **AT 8:00 10:38:07**	This display appears as the sampler counts down the time remaining to the start time. The first line reports the bottle which will receive the next sample volume. The second line reports the start time at the left and the current time on the right.
17	**BOTTLE 1**	When the start time occurs, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge. During the purge, the display indicates the bottle number which will receive the sample volume.
	BOTTLE 1 **PUMPING 500 ml**	As soon as the pump runs forward to deliver the sample volume, the message on the second line appears and remains through the post-sample purge.
18	**BOTTLE 2** **AT 8:30 8:01:11**	This display appears when the post-sample purge from the previous sample event is completed. It indicates the bottle number which is to receive the sample at the upcoming sample event. The second line displays the scheduled time for the next event on the left. The current time is displayed on the right.
19	↓ ↓	The cycle of displays is repeated for each bottle until the sampling routine is done.
20	**DONE . . . 24 SAMPLES** **8:10:35 21-JUN-91**	When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

Example 11 Time-paced Multiplexed (Samples-Per-Bottle) Sampling

The following example programs the sampler to take time-paced samples at uniform time intervals of 15 minutes. At each sample event, one bottle will receive a sample volume of 75 ml. The bottles are to be switched every hour so that four sample volumes have been deposited into each bottle. The sampling routine is to start according to the programmed start time delay set in the Start Time Delay configure option.

Step No.	Display	Procedure
1	**. . . STANDBY . . .** **5:37:23 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE]** **SAMPLER**	Access the program sequence by selecting "PROGRAM."
3	**[*TIME*, FLOW, STORM]** **PACED SAMPLING**	Select "TIME."
4	**[*UNIFORM*, NONUNIFORM]** **TIME INTERVALS**	Select "UNIFORM."
5	**SAMPLE EVERY** ***0* HOURS,30 MINUTES**	Enter "0" to set the hours at zero. Press ENTER/PROGRAM to store the number "0" and move to the minutes entry.
6	**SAMPLE EVERY** **0 HOURS,*15* MINUTES**	Enter "15" to set the minutes entry to 15.

Step No.	Display	Procedure
7	***1*** **BOTTLES PER SAMPLE EVENT (1 - 24)**	Enter "1" to set the number of bottles per sample event to 1.
8	**CHANGE BOTTLES BASED ON [TIME, *SAMPLES/BTL*]**	Select "SAMPLES/BTL." We recommend bottle set changes be based on samples for time-paced sampling routines.
9	**CHANGE BOTTLES EVERY *4* SAMPLES (1 - 8)**	Enter "4" to set the number of samples per bottle to 4.
10	**SAMPLE VOLUMES OF *75* ml (10 - 250)**	Enter "75" to set the sample volume at 75 ml.
11	**ENTER START TIME? [YES, *NO*]**	Select "NO."
12	**PROGRAMMING SEQUENCE COMPLETE . . .**	After this message is displayed briefly, the sampler will automatically return to the standby state.
13	**. . . STANDBY . . . 5:39:25 20-JUN-91**	After the sampler is properly installed, press the START SAMPLING key to run the program.
14	**START SAMPLING AT BOTTLE *1* (1-24)**	To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.
15	**1 OF 4, BOTTLE 1 AT 5:41 5:39:33**	This display is used with samples-per-bottle multiplexing. The first line indicate the number of the upcoming sample and the total number of samples each bottle is to receive. It also indicates the current bottle number. Thus, this display indicates that the upcoming sample is the first of four samples and bottle one is to receive the next sample. The second line indicates the scheduled time of the sample. The current time is shown in the right corner as the sampler counts down to the next sample event time.
16	**1 OF 4, BOTTLE 1**	When the scheduled sample event time arrives, the second line will disappear while the sampler completes the pre-sample purge.
	1 OF 4, BOTTLE 1 PUMPING 75 ml	When the pump begins to pump forward to deliver the sample, the second line will indicate the sample delivery by displaying the word "PUMPING" and the sample volume being delivered. The message remains during the sample delivery and post-sample purge.
17	**2 OF 4, BOTTLE 1 AT 6:15 6:00:26**	When the sampling cycle is completed, the display will indicate the upcoming sample, shown here. This display indicates that the upcoming sample is the second of four samples; the current sample bottle is bottle 1. The sample event is scheduled for 6:15. The current time is just after 6:00.
18	**2 OF 4, BOTTLE 1**	The next displays illustrated here, in steps 18 through 19, show the displays as the sample volumes are deposited in bottle 1.
	2 OF 4, BOTTLE 1 PUMPING 75 ml	

Step No.	Display	Procedure
19	**3 OF 4, BOTTLE 1 AT 6:30 6:15:27**	
	↓ ↓	
20	**1 OF 4, BOTTLE 2 AT 7:00 6:45:25**	When the final sample has been deposited in the first bottle, the display changes to indicate the new sample bottle. This display indicates that the upcoming sample event will place the first of four sample volumes in bottle 2 at 7:00.
21	**1 OF 4, BOTTLE 2**	This display appears as the pump delivers the first sample to bottle 2.
	1 OF 4, BOTTLE 2	PUMPING 75 mL
22	↓ ↓	The cycle of displays is repeated for each bottle until the sampling routine is done.
23	**DONE . . . 96 SAMPLES 6:10:35 21-JUN-91**	When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

Example 12 Extended Flow-paced Multiplexed (Bottles-Per-Sample) Sampling

This example programs the sampler to take samples at intervals of 10 pulses. Samples will be multiplexed: 800 ml sample volumes will be placed into two bottles at each sample event. Each bottle is to receive only one sample volume. The routine will use the start time delay.

Step No.	Display	Procedure
1	**. . . STANDBY . . . 10:35:23 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE] SAMPLER**	Access the program sequence by selecting "PROGRAM."
3	**[TIME, *FLOW*, STORM] PACED SAMPLING**	Select "FLOW."
4	**SAMPLE EVERY *10* PULSES (1 - 9999)**	Enter "10" to set the pulse interval to 10 pulses.
5	***2* BOTTLES PER SAMPLE EVENT (1 - 24)**	Enter "2" to set the number of bottles per sample event to 2.
6	**CHANGE SETS BASED ON [TIME, *SAMPLES*]**	Select "SAMPLES."

Step No.	Display	Procedure
7	**CHANGE SETS EVERY *1* SAMPLES (1 - 8)**	Enter “1” to set the number of samples per bottle to 1.
8	**SAMPLE VOLUMES OF *800* ml (10 - 1000)**	Enter “800” to set the sample volume at 800 ml.
9	**ENTER START TIME? [YES, *NO*]**	Select “NO.”
10	**PROGRAMMING SEQUENCE COMPLETE . . .**	After this message is displayed briefly, the sampler will automatically return to the standby state.
11	**. . . STANDBY . . . 10:37:23 19-JUN-91**	When the sampler is installed, press the START SAMPLING key to run the program.
12	**START SAMPLING AT BOTTLE *1* (1-23)**	To start the sampling routine with the first bottle, accept the blinking “1” by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.
13	**START FLOW COUNT AT 10:38 20-JUN**	This display appears after you press the START SAMPLING key to start the routine. It reports the scheduled start time on the first line. The second line reports the current time and date.
14	**BOTTLES 1- 2 AFTER 10 PULSES**	When the scheduled start time arrives, the sampler will begin to count flow pulses. This display indicates the bottles which will receive sample volumes at the upcoming sample event. (If the bottle set consisted of four bottles, the first line of the display would read, “BOTTLES 1 - 4.”) The number of flow pulses remaining to the sample event is displayed on the second line.
15	**BOTTLES 1- 2 AFTER 9 PULSES**	The second line of the display changes as each flow pulse is received.
16	↓ ↓	
17	**BOTTLES 1- 2 AFTER 1 PULSES**	This display shows one pulse remaining until the sample event.
18	**BOTTLE 1**	When the tenth pulse is received, the display will display the current bottle number, only.
	BOTTLE 1 PUMPING 800 ml	When the pump begins to run forward to deliver the sample volume, the second line appears. After the pump completes the sample delivery, it reverses to purge the liquid from the pump tube past the liquid detector. The suction line is not completely purged; instead, the liquid is pumped just past the liquid detector. At the end of the pump tube purge, the distributor moves to the next bottle of the set. The display remains unchanged until the distributor relocates to the next bottle of the set.

Step No.	Display	Procedure
19	**BOTTLE 2 PUMPING 800 ml**	As the distributor moves to the next bottle, the bottle number reported in the display changes to indicate the bottle number. The message, "PUMPING 800 ml," will remain on the display. When the distributor reaches the correct position over the current bottle, the pump runs forward to deliver the sample volume. When the delivery is completed, the pump reverses to complete the post-sample purge.
20	**BOTTLES 3- 4 AFTER 10 PULSES**	At the end of the post-sample purge, the display changes to indicate the bottle numbers of the next bottle set. The display will change as it receives each flow pulse.
21	↓ ↓	The cycle is repeated until the sampling routine is completed.
22	**DONE . . . 12 SAMPLES 6:10:35 21-JUN-91**	When the routine is complete, the display will indicate the status of the routine ("DONE"), the number of sample events, and the current time and date.

Example 13 Extended Flow-paced Multiplexed (Multiple Bottle Compositing) Sampling

In this example, 100 ml samples are taken every 1000 flow pulses and deposited into two bottles. To avoid missing samples, the routine starts immediately. To place the bottle-set changes at the top of the hour, the routine samples until 12:00, the time of the first bottle-set change. Then, bottle sets change occur every two hours. The number of samples in each bottle set vary as the flow rate varies. If at least one sample is desired in each bottle, the sampler should take a sample at the start and switch times. See *Flow Mode Sampling*, on page 49.

Step No.	Display	Procedure
1	**. . . STANDBY . . . 10:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE] SAMPLER**	Access the program sequence by selecting "PROGRAM."
3	**[TIME, *FLOW*, STORM] PACED SAMPLING**	Select "FLOW."
4	**SAMPLE EVERY *1000* PULSES (1 - 9999)**	Enter "1000" to set the pulse interval to 1000 pulses.
5	***2* BOTTLES PER SAMPLE EVENT (1 - 24)**	Enter "2" to set the bottles per sample event to 2. Each bottle set will consist of two bottles.
6	**CHANGE SETS BASED ON [*TIME*, SAMPLES/BTL]**	Select "TIME."
7	**CHANGE SETS EVERY *2* HOURS 0 MINUTES**	Enter "2" to switch bottle sets every two hours. Press the ENTER/PROGRAM key to advance to the minutes entry.
8	**CHANGE SETS EVERY 2 HOURS *0* MINUTES**	Press ENTER/PROGRAM to accept an entry of "0" for minutes.

Step No.	Display	Procedure
9	**SAMPLE VOLUMES OF *100* ml (10 - 330)**	Enter “100” to set the sample volume at 100 ml.
10	**ENTER START TIME? [YES, *NO*]**	Select “NO.
11	**ENTER FIRST SWITCH TIME? [*YES*, NO]**	Select “YES.”
12	**FIRST SET CHANGE AT *12*:00 19-JUN**	Enter the time at which you want the sampler to move to the second bottle set. At the first bottle set change, 12:00, the bottle set changes will be placed on schedule.
13	**PROGRAMMING SEQUENCE COMPLETE . . .**	After this message is displayed briefly, the sampler will automatically return to the standby state.
14	**. . . STANDBY . . . 10:37:23 19-JUN-91**	When the sampler has been correctly installed, press the START SAMPLING key to run the program.
15	**START SAMPLING AT BOTTLE *1* (1-23)**	To start the sampling routine with the first bottle, accept the blinking “1” by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.
16	**START FLOW COUNT AT 10:39 19-JUN**	This display appears after you press the START SAMPLING key to start the routine. The scheduled start time is reported on the first line. The second line reports the current time and date.
17	**SAMPLE 1, BTLS 1- 2 AFTER 1000 PULSES**	This display alternates with the display illustrated below. The first line indicates the sample event number and the bottle numbers of the current bottle set. The second line is used to indicate the number of flow pulses remaining until the sample event is initiated.
	NEXT SET CHANGE AT 12:00 19-JUN	This display indicates the time and date of the next bottle set change.
18	**SAMPLE 1, BOTTLE 1**	This display appears when the sample event is initiated. It reports the sample number and the receiving bottle number on the first line during the pre-sample purge.
	SAMPLE 1, BOTTLE 1 PUMPING 100 ml	When the pump begins to run forward to deliver the sample, the second line appears; it reports the sample volume.
19	**SAMPLE 1, BOTTLE 2 PUMPING 100 ml**	When the sample delivery has been completed for the first bottle of the set, the distributor moves to the second bottle.
20	**SAMPLE 2, BTLS 1- 2 AFTER 1000 PULSES**	After the bottles of the set have each received a sample volume, the alternating pair of displays re-appear.
21	**NEXT SET CHANGE AT 12:00 19-JUN**	

Step No.	Display	Procedure
22	**SAMPLE 2, BOTTLE 1**	When the next sample event occurs, this display reports the current sample event and the current bottle. When the sample delivery is completed, the distributor will move to the next bottle of the set and the following display will appear.
	SAMPLE 2, BOTTLE 1 **PUMPING 100 ml**	
23	**SAMPLE 2, BOTTLE 2** **PUMPING 100 ml**	This cycle will be repeated, as samples are deposited in the bottles of the set. The sample number will increase with each sample deposited until the set change.
24	**SAMPLE 1, BTLS 3- 4** **AFTER 1000 PULSES**	When the bottle sets are changed, the sample event number is reset to one. The bottle numbers of the new current set is reported.
	NEXT SET CHANGE **AT 2:00 19-JUN**	
25	↓ ↓	The cycle of displays is repeated for each bottle until the sampling routine is done.
26	**DONE . . . 96 SAMPLES** **6:10:35 21-JUN-91**	When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

Example 14 Nonuniform Time-paced Sequential Sampling

The following example programs the sampler to take time-paced samples at nonuniform time intervals. This example assumes the sampler is configured for extended programming and that it connected to a Liquid Level Actuator. The Actuator will inhibit the sampler until the liquid level rises to contact the Actuator probe.

The sampler is to take 24 samples: the first samples are to occur at 10 minute intervals for an hour, the following samples at 20 minute intervals for an hour, and the remaining samples at 30 minute intervals. One 500 ml sample is to be placed in each bottle. Although this example assumes that nonuniform times are being used with the Actuator, uniform time intervals or flow intervals can be used with the Actuator as well.

Step No.	Display	Procedure
1	**. . . STANDBY . . .** **10:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE]** **SAMPLER**	Access the program sequence by selecting "PROGRAM."
3	**[*TIME*, FLOW, STORM]** **PACED SAMPLING**	Select "TIME."
4	**[UNIFORM, *NONUNIFORM*]** **TIME INTERVALS**	Select "NONUNIFORM."
5	**MODIFY SEQUENCE?** **[*YES*, NO]**	Select "YES" to modify the sequence of nonuniform time entries.

Step No.	Display	Procedure
6	**TAKE *24* SAMPLES (1-999)**	Enter the total number of samples: "24." This entry should always include the sample taken at the start time.
7	**QUANTITY AT INTERVAL 1. *5* AT 10 MINUTES**	Enter the number of samples to occur at the first interval. The sampler is to take samples at 10 minute intervals for an hour or 6 samples in the first hour. Since the first sample is taken at the start time, the remaining five samples will occur at the 10 minute interval.
8	**1. 5 AT 10 MINUTES 2. *3* AT 20 MINUTES**	When you have completed the first entries, the display will "roll" to move the first interval entries to the first line, and add the second line entries for the next series of samples and intervals. Enter the next entries: "3" samples at "20" minutes.
9	**2. 3 AT 20 MINUTES 3. *15* AT 30 MINUTES**	Enter the third set of samples and intervals, "15" samples at "30" minutes.
10	***1* BOTTLES PER SAMPLE EVENT (1 - 24)**	Enter "1" to set the number of bottles per sample event to 1.
11	**CHANGE BOTTLES BASED ON [TIME, *SAMPLES*]**	Select "SAMPLES."
12	**CHANGE BOTTLES EVERY *1* SAMPLES (1 - 50)**	Enter "1" to set the number of samples per bottle to 1.
13	**SAMPLE VOLUMES OF *500* ml (10 - 1000)**	Enter "500" to set the sample volume at 500 ml.
14	**ENTER START TIME? [YES, *NO*]**	Select "NO."
15	**PROGRAMMING SEQUENCE COMPLETE . . .**	After this message is displayed briefly, the sampler will automatically return to the standby state.
16	**. . STANDBY . . . 10:37:23 19-JUN-91**	Press the START SAMPLING key to run the program.
	Run State Displays	**Comment**
17	**START SAMPLING BOTTLE *1* (1-24)**	To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.
18	**SAMPLER INHIBITED! 10:35 20-JUN-91**	This display appears while the Actuator is inhibiting the sampler. The second line indicates the current time and date.
19	**BOTTLE 1 AT 11:26 11:25:47**	This display appears when the sampler becomes enabled and counts down the time remaining to the start time. The first line reports the bottle which will receive the next sample volume. The second line reports the start time at the left and the current time on the right.

Step No.	Display	Procedure
20	**BOTTLE 1**	When the start time occurs, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge. During the purge, the display indicates the receiving bottle number.
	BOTTLE 1 **PUMPING 500 ml**	As soon as the pump runs forward to deliver the sample volume, the message on the second line appears. This message remains through the post-sample purge.
21	**BOTTLE 2** **AT 11:36: 11:26:11**	This display appears when the post-sample purge from the previous sample event is completed. It indicates the bottle number which is to receive the sample at the upcoming sample event. The second line displays the scheduled time for the next event on the left; the current time is displayed on the right.
22	↓ ↓	The cycle of displays is repeated for each bottle until the sampling routine is done.
23	**DONE . . . 24 SAMPLES** **8:10:35 21-JUN-91**	When the routine is completed, this message appears. It reports the status of the routine, "DONE;" the total number of sample events; and the current time and date.

Example 15 Entering Nonuniform times as Specific Clock Times

Nonuniform times can be entered in either the method shown above, in **Example 14** on page 81, or by specifying a clock time and date for each sample. The abbreviated example below shows the displays used to enter the clock times. The type of display, clock time or minutes, used in the program sequence is controlled by the settings in the Nonuniform Times configure option; you must specify either clock time or minutes in that configure option.

Step No.	Display	Procedure
1	**TAKE SAMPLES AT** **1. 06:00 19-JUN**	Enter the time and date for the first sample event. Times and dates are entered on the second line of the display.
2	**1. 06:00 19-JUN** **2. 07:00 19-JUN**	Enter the time and date for the second sample event. The controller will guess a time at the hour succeeding the previously entered time.
3	**2. 06:30 19-JUN** **3. 07:00 19-JUN**	Enter the time and date for the third sample event.
4	↓ ↓	Continue to enter times and dates for each sample event. After all sample event times have been entered, the sample distribution section of the programming sequence will appear.

Example 16 Extended Time-paced Sequential Sampling Using Stops and Resumes

The following example programs the sampler for time-paced samples at intervals of 15 minutes, starting at 6:00 am on the following day and placing one 500 ml sample in each bottle. The sampling continues from 6:00 am until 8:00 am, resumes at 11:00 am, and continue until 1:30 pm. It pauses until 4:00 pm, continuing until 6:00 pm. When sampling stops, less than 24 samples may have been taken. Note: See *Sampling Stop / Resume,* on page 49.

Step No.	Display	Procedure
1	**. . . STANDBY . . . 10:34:50 19-JUN-91**	Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE] SAMPLER**	Access the program sequence by selecting “PROGRAM.”
3	**[*TIME*, FLOW, STORM] PACED SAMPLING**	Select “TIME.”
4	**[*UNIFORM*, NONUNIFORM] TIME INTERVALS**	Select “UNIFORM.”
5	**SAMPLE EVERY *0* HOURS, 10 MINUTES**	Enter “0” to set the hours at zero. Press ENTER/PROGRAM to store the number “0” and move to the minutes entry.
6	**SAMPLE EVERY 0 HOURS, *15* MINUTES**	Enter “15” to set the minutes entry to 15.
7	**_1_ BOTTLES PER SAMPLE EVENT (1 - 24)**	Enter “1” to set the number of bottles per sample event to 1.
8	**CHANGE BOTTLES BASED ON [TIME, *SAMPLES/BTL*]**	Select “SAMPLES/BTL.”
9	**CHANGE BOTTLES EVERY *1* SAMPLES (1 - 8)**	Enter “1” to set the number of samples per bottle to 1.
10	**SAMPLE VOLUMES OF *500* ml (10 - 1000)**	Enter “500” to set the sample volume at 500 ml.
11	**ENTER START TIME? [*YES*, NO]**	Select “YES.”
12	**TAKE FIRST SAMPLE AT *06*:00 19-JUN**	Enter the start time and date of the sampling program: 6:00 am tomorrow.
13	**_5_ STOP or RESUME TIMES (0-24)**	Enter “5.” There are three stop times and two resume times.
14	**STOP SAMPLING AT 1. *08*:00 19-JUN**	Enter the time and date of the first stop time: 8:00 am.

Step No.	Display	Procedure
15	RESUME SAMPLING AT 1. *11*:00 19-JUN	Enter the time and date the program should resume: 11:00 am.
16	STOP SAMPLING AT 2. *13*:30 19-JUN	
17	RESUME SAMPLING AT 2. *16*:00 19-JUN	Enter the time and date the program should resume: 4:00 pm or 16:00 in military time.
18	STOP SAMPLING AT 3. *18*:00 19-JUN	Enter the final stop time: 6:00 pm or 18:00 in military time.
19	PROGRAMMING SEQUENCE COMPLETE . . .	After this message is displayed briefly, the sampler will automatically return to the standby state.
20	. . . STANDBY . . . 10:37:23 19-JUN-91	Press the START SAMPLING key to run the program.
21	START SAMPLING BOTTLE *1* (1-24)	To start the sampling routine with the first bottle, accept the blinking "1" by pressing the ENTER/PROGRAM key. If you want to start the routine with another bottle, enter the starting bottle number here.
	Run State Displays	**Comment**
22	BOTTLE 1 AT 6:00 10:38:07	This display appears as the sampler counts down the time remaining to the start time. The first line reports the bottle which will receive the next sample volume. The second line reports the start time at the left and the current time on the right.
23	BOTTLE 1	When the start time arrives, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge. During the purge, the display indicates the bottle number which will receive the sample volume.
	BOTTLE 1 PUMPING 500 ml	As soon as the pump runs forward to deliver the sample volume, the message on the second line appears. This message remains through the post-sample purge.
24	BOTTLE 2 AT 6:15 8:01:11	This display appears when the post-sample purge from the previous sample event is completed. It indicates the bottle number which is to receive the sample at the upcoming sample event. The second line displays the scheduled time for the next event on the left. The current time is displayed on the right.
25	↓ ↓	The cycle of displays is repeated for each bottle until the sampling routine is done.
26	DONE . . . 18 SAMPLES 18:10:35 21-JUN-91	When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

Example 17 Storm Water Run Off Sampling

The following example programs a 24 bottle sampler to allocate six bottles to the first bottle group. The remaining 18 bottles, allocated to the second bottle group, will be used for flow-weighted samples. The sampler will delay the first group 25 minutes after it is enabled. For the first bottle group, the sampler will take two samples with a 5 minute interval between each sample event. At the first sample event, bottles 1 through 3 will each receive 900 ml each (bottles-per-sample multiplexing). At the second timed event, bottles 4 through 6 will receive 900 ml each. The distribution scheme used in this program is illustrated in **Figure 17,** on page 19. The sampler will fill the second bottle group with flow-paced samples during the same time as the first bottle group. At each sample event, a single bottle in the second bottle group will receive a 400 ml sample. Each bottle will receive samples from two sample events (samples-per-bottle multiplexing).

Step No.	Display	Disp No.	Procedure
1	**. . . STANDBY . . . 10:34:50 12-JUN-92**		Press ENTER/PROGRAM to access the interactive state.
2	**[*PROGRAM*, CONFIGURE] SAMPLER**	#1	Access the program sequence by selecting “PROGRAM.”
3	**[TIME, FLOW, *STORM*] PACED SAMPLING**	#12	Select “STORM.”
4	**TIME MODE FIRST BOTTLE GROUP**		After displaying this message briefly, the sampler will automatically advance to the next display.
5	***25* MINUTE DELAY TO FIRST GROUP SAMPLE**	#15	Enter “25” to delay the first group sample 25 minutes. (Acceptable range of values: 0 to 999.)
6	**TAKE *2* TIMED EVENTS (1 - 50)**	#23	Enter “2” to take two timed samples.
7	**SAMPLE INTERVALS OF *5* MINUTES (1 - 999)**	#24	Enter “5” to set the time interval between samples to five minutes.
8	***3* BOTTLES PER SAMPLE EVENT (1-23)**	#30	Enter the number of bottles per sample event: “3.”
9	***1* SAMPLES PER BOTTLE (1 - 2)**	#31	Enter “1” to place one sample in each bottle.
10	**SAMPLE VOLUMES OF *900* ml (10 - 1000)**	#50	Enter the sample volume of “900” ml.
11	**18 BOTTLES, 18000 ml AVAILABLE**		The sampler will display this message before automatically advancing to the next display.
12	**[TIME, *FLOW*] SECOND BOTTLE GROUP**	#14	Select “FLOW.”
13	**[*DURING*, AFTER] TIME MODE**	#16	Select “DURING” to fill the second bottle group at the same time as the first bottle group.

Step No.	Display	Disp No.	Procedure
14	**SAMPLE EVERY *5* PULSES (1-9999)**	#22	Enter "5" as the flow pulse interval. The sampler will take a sample every fifth flow pulse.
15	**MAX FLOW INTERVAL OF *2* HOURS 0 MINUTES**	#110	This display requires two entries. Enter "2" hours and "0" to set the maximum amount of time between flow-paced sample events.
16	***1* BOTTLES PER SAMPLE EVENT (1-22)**	#30	Enter the number of bottles filled at each sample event: "1."
17	***2* SAMPLES PER BOTTLE (1 - 50)**	#31	Enter "2" to set the number of samples delivered to each bottle.
18	**SAMPLE VOLUMES OF *400* ml (10 - 990)**	#50	Enter the sample volume of "400" ml.
19	**ENTER START TIME: [*YES*, NO]**	#90	Select "YES" to enter a start time in the following step.
20	**STORM ENABLED AFTER 06:00 20-*06***	#93	This display requires two entries. Enter a time of "06:00" and a date of "20-06" to start the STORM routine at 6:00 am on June 20.
21	**PROGRAMMING SEQUENCE COMPLETE . . .**		After displaying this message, the sampler will automatically return to the standby state
	Run State Displays		**Comment**
	START STORM PROGRAM AT 6:00 5:33:07		This display appears when you press START SAMPLING.
22	**BOTTLE 1 AT 6:25 5:38:07**		The displays shown in step 22 alternate as the sampler's clock approaches the start time. The first line reports the bottles which will receive the first sample volumes for each bottle group.
	1 of 2, BOTTLE 3 AFTER 5 PULSES		
23	**BOTTLE 1 PUMPING 900 ml**		As soon as the pump runs forward to deliver the sample volume, the message on the second line appears. This message remains through the post-sample purge.
24	**BOTTLE 2 AT 6:30 6:26:11**		The sampler will continue to alternate displays until the routine terminates
	1 of 2, BOTTLE 3 AFTER 5 PULSES		
25	↓ ↓		The cycle of displays is repeated for each bottle until the sampling routine is done.
26	**DONE . . . 42 SAMPLES 18:10:35 25-JUN-92**		When the routine is completed, this message appears. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

STANDBY STATE

A sampler in the standby state is waiting for your instructions. From standby, you can start or resume a sampling program, access the program or configure sequences, take manual samples, and use the display status key to review program settings or the results of a sampling routine.

A sampler in standby uses a number of displays to communicate its status. Some of these displays are associated with the function of a specific key; other displays are used to notify you that a sampling program is done, halted, or has encountered a problem. The standby state displays and valid keys are discussed below. (Most standby displays do not have numbers.)

Standby Display

When you first turn the sampler on, the sampler "wakes up" in the standby state. The standby display, illustration *a*, simply informs you that the sampler is in standby and reports the current time and date.

```
. . . STANDBY . . .
10:37:23   19-JUN-91
```

a

At this point, the following keys are operable: ON/OFF, PUMP REVERSE, PUMP FORWARD, enter/program, start sampling, manual sample, NEXT BOTTLE, and display status.

Program Halted

A sampling program can be halted with either the STOP or exit program key; if this occurs, the sampler will display the halt message shown in illustration *b*. If you halt the program to take a manual sample or to change a setting in the program or configure sequence, the sampler will return to standby. If this is the case, you will not be able to use the resume sampling key.

```
. . . PROGRAM HALTED . . .
10:37:33   19-JUN-91
```

b

Each operable key is listed and discussed below.

On/Off- When in the standby state, this key simply shuts the sampler off.

Pump Forward and Pump Reverse - The PUMP FORWARD and PUMP REVERSE keys run the pump forward or in reverse until you interrupt it with the STOP key. While the pump is running, the message illustrated in *c* or D is displayed, depending on the pumping direction.

```
PUMPING FORWARD . . .
```

c

```
PUMPING REVERSE . . .
```

d

When you press the STOP key, the sampler will display a message similar to the one illustrated in e. This message indicates the total number of pump counts that occurred while the pump was running. This information can be used to set the desired number of purge counts in *Purge Counts,* on page 52. Press any key, except STOP and ON/OFF, to return to the standby display.

```
311 COUNTS FORWARD
```

e

Manual Sample - You can take manual samples in standby by pressing the MANUAL SAMPLE key. After you press the MANUAL SAMPLE key, the sampler will deliver the programmed sample volume to the bottle currently under the distributor. A manual sample delivers the sample volume currently entered as a programmed setting, and includes the pre-sample and post-sample purges. It will also include any programmed rinses and retries. The sampling process can be stopped with the STOP key at any time. If you press the MANUAL SAMPLE key while a sampling program is in progress, the manual sample will be counted as one of the programmed samples.

While the sample is being delivered, the sampler displays a message similar to that illustrated in *f*. The second line will not appear until the pump begins to pump forward to deliver the sample. The display will revert to standby after the manual sample has been delivered.

```
. . . MANUAL SAMPLE . . .
PUMPING  200 ml
```

f

Next Bottle - If you want to reposition the distributor, use the NEXT BOTTLE key. The sampler will advance the distributor to the next bottle position. (The sampler determines the bottle positions by referring to the Bottle Number configuration setting. See *Bottles and Sizes,* on page 42.) The sampler will display the distributor's location as illustrated in g. After a short time, the display will revert to standby. If the distributor is over the last bottle position when you press NEXT BOTTLE, it will move to Bottle 1.

NOW ON BOTTLE 2

g

Start Sampling - Once you have programmed and configured the sampler, use the start sampling key to run the sampling program. The first display you'll see after pressing the START SAMPLING key is illustrated in *h*. If you want to have the sampling program begin with a bottle other than bottle one, enter the first bottle number here. If "1" is acceptable, press the ENTER/PROGRAM key to place the sampler into the run state. If you do not press a key within 60 seconds, the sampler will automatically enter the run state and will begin the sampling routine with bottle 1.

START SAMPLING AT BOTTLE 1 (1 - 24)

h

There are three instances where the sampler will not be able to run the program immediately. These occur when the program has been started after: the programmed start time, the first switch time, one or more programmed stop times. The sampler responds to these situations as discussed in **Examples 18** through **20**.

Resume Sampling - To resume or restart the program, press the RESUME SAMPLING or START SAMPLING key. When you press the RESUME SAMPLING key, the program will resume at the point it was halted. The display must read "PROGRAM HALTED" for the RESUME SAMPLING key to be active. If any samples were missed during the time the program was halted, the sampler will inform you with the message illustrated in *i*. The sampler will initiate one sample event if one or more sample events were missed.

2 SAMPLES WILL BE SKIPPED

i

Example 18 Program Started Later than Programmed Start Time

Display	Display No.	Procedure
PAST START TIME . . .		This display informs you of the expired start time. The sampler will present this display for a short time, then advance to the next display.
1 SAMPLES WILL BE SKIPPED		This display reports the number of samples which will be skipped if you do not change the start time; it appears only if more than one sample event time has passed. (See *Source of Sample Event,* on page 93.)
CHANGE START TIME? [*YES*, NO]	142	Select "YES" if you want to change the start time. Select "NO" if missed samples are acceptable.
TAKE FIRST SAMPLE AT *12*:30 19-JUN	93	This display appears when you select "YES" in display #142 and a sample event is to occur at the start time. Enter the new start time.
START FLOW COUNT AT *12*:30 19-JUN	94	This display appears when you select "YES" in display #142 and no sample is to occur at the start time for a flow-paced sampling routine. Enter the new start time.

Example 19 Program Started Later than Programmed First Switch Time

Display	Display No.	Procedure
PAST SWITCH TIME . .		This display informs you of the expired switch time. The sampler presents this display for a short time, then advances to the next display.
CHANGE SWITCH TIME? [*YES*, NO]	143	Select "YES" to change the switch time. Select "NO" to continue the routine.
FIRST BOTTLE CHANGE AT *5*:30 19-JUN	46	This display appears when you select "YES" in display #143 and the bottles per sample event is set at "1." Enter the new switch time.
FIRST SET CHANGE AT *5*:30 19-JUN	47	This display appears when you select "YES" in display #143 and the bottles per sample event is set to a number greater than one. Enter the new switch time.

Example 20 Program Started Later than Programmed Stop Time

Display	Display No.	Procedure
PAST STOP TIME . . . PLEASE REPROGRAM		This display informs you of the expired stop time. The sampler presents this display for a short time, then reverts to standby.
. . . STANDBY . . . 10:22:34 21-JUN-91		You must access the program sequence to change the expired stop and resume times. Once you've made the changes, start the routine again with the START SAMPLING key.

Start Sampling - When you press the START SAMPLING key after a program has been halted, the sampler will give you the choice between resuming the program and starting the program by presenting the display illustrated in *j*.

[START, RESUME]? SAMPLING PROGRAM

j

Select "START" to start the program from the beginning. Select "RESUME" to resume the program at the point at which it halted. If you do not make a selection from this display within 60 seconds, the sampler will automatically select the currently blinking response. START will re-initialize the display status memory.

Additional Displays

There are three additional displays used in the run state. These displays are discussed below.

Done

The sampler will inform you it has completed a program by displaying the message illustrated in *k*. This message is displayed until you press any key, at which time the display will return to the standby message.

DONE . . . 24 SAMPLES 10:37:33 19-JUN-91

k

Problem Occurred

You will be informed that a problem was encountered during the sampling routine with the message illustrated in *l*. This display will alternate with the "DONE" display at approximately three second intervals until you press any key. The sampler tracks missed samples and logs the probable cause in memory. This information is available through the display status procedure discussed in *Display Status*, on page 91.

PROBLEM OCCURRED . . . PRESS DISPLAY STATUS

l

DISPLAY STATUS

You can access a summary of the current program settings and the results of the most recent sampling routine with the DISPLAY STATUS key. This key is valid in both the run and standby states. The summary of the program settings consists of a number of informational displays describing the settings. The results of the sampling program include information about each sample event and reports problems encountered during the program. This information remains in memory until you start another program.

You can retrieve this information with Isco's Field Printer or a laptop computer running Isco's SAMPLINK software. Both methods produce two reports which contain the sampler ID, current status, program settings, and sampling results.

If a sampling routine is in progress when you press the DISPLAY STATUS key, the sampling routine will be suspended. No samples will be taken until you exit Display Status.

If the pump count reaches the number entered for the Tubing Life Warning setting, the Pump Tubing Warning will be displayed. An illustration of the warning is shown below.

WARNING: REPLACE PUMP TUBING!

DISPLAY STATUS AND REVIEWING OR PRINTING PROGRAM INFORMATION

The sampler tracks and reports the following items:

- program start time and date
- sample volume
- source of each sample event
- cause of any missed samples
- start time of each sample event,
- number of pump counts to liquid detection for each event
- time the routine was completed
- sampler ID
- current time and date
- program settings.

Each of these items is illustrated in **Example 21** on page 92.

When you press DISPLAY STATUS, the display shown below, follows the pump tubing warning. It allows you to review the program settings or sampling results.

[REVIEW, PRINT] PROGRAM INFORMATION

Display # 148

Select "REVIEW" to review the program settings and sampling results. The sampler will present the display shown below. Use this display to leave the display status procedure or to review the program settings or sampling results.

REVIEW PROGRAM [NO, SETTINGS, RESULTS]

Display # 150

Select "NO" to return to the previous operating state. If you entered display status from standby, the standby message will reappear. If you entered display status from the run state, the sampling routine will resume.

Select "SETTINGS" to review the program settings. Use the LEFT ARROW, RIGHT ARROW, and the enter/program keys to move through the sampling settings. When the RIGHT ARROW or the ENTER/PROGRAM key is pressed at the last settings display, the "REVIEW PROGRAM" display will reappear.

Select "RESULTS" to review the results of the sampling routine. The first display reports the time and date the sampling program started. Use the LEFT ARROW, RIGHT ARROW, and ENTER/PROGRAM keys to move through the results. If the routine was finished at the time you pressed the DISPLAY STATUS key, the last display will report the time and date the routine ended. Use the LEFT ARROW, RIGHT ARROW, and the ENTER/PROGRAM keys to move through the sampling results. When the RIGHT ARROW or the ENTER/PROGRAM key is pressed at the last results display, the "REVIEW PROGRAM" display will reappear.

Select "PRINT" from Display #148 to send the current status, program settings, or sampling results to the Isco Field Printer. For information on the reports produced by the Field Printer, refer to the *Field Printer Instruction Manual.*

Example 21 Display Status: Results of Sampling Program

Step No.	Display	Procedure
1	**DONE . . . 24 SAMPLES 12:34:50 20-JUN-91**	Press DISPLAY STATUS to view the results of the sampling program.
2	**[*REVIEW*, PRINT] PROGRAM INFORMATION**	Select "REVIEW."
3	**REVIEW PROGRAM [NO, SETTINGS, *RESULTS*]**	Select "RESULTS."
4	**PROGRAM STARTED AT 5:30 19-JUN-91**	This display reports the start time and date of the program. Press ENTER/PROGRAM to advance to the next display.
5	**200 ml SAMPLES**	200 ml SAMPLES? This display reports the nominal sample volume. Press ENTER/PROGRAM to advance to the next display.
6	**SAMPLE: 1, BOTTLE: 1 SOURCE: START**	This display reports the bottle number(s) for each sample event. It also reports the source of the event; in this case, the sample was taken at the start time. Press ENTER/PROGRAM to advance to the next display.
7	**TIME: 5:30 19-JUN-91 COUNTS: 280**	This display reports the initiation time of the sample and the number of pump counts to liquid detection in the sample delivery cycle. Variations in the pump count indicate changes in the sampling conditions – head changes, example. Press ENTER/PROGRAM to advance to the next display.
8	↓ ↓	Press ENTER/PROGRAM to continue to review the information for the remaining sample events.
9	**PROGRAM FINISHED AT 12:00 20-JUN-91**	Press ENTER/PROGRAM to return to the "REVIEW PROGRAM" display.
10	**REVIEW PROGRAM [*NO*, SETTINGS, RESULTS]**	Select "NO" to return to standby.
11	**. . . STANDBY . . . 15:39:50 19-JUN-91**	

When you select "PRINT," Display #149 appears. Use this display to select the settings or results report. (The sampler will interrupt the reports to take a sample, if necessary.) Select "NO" to return to standby.

PRINT PROGRAM [NO, SETTINGS, RESULTS]

Display # 149

The sampler will display one of two messages as it sends the data to the printer. The first message informs you that the transmission is in progress. The second message is a warning which informs you that the sampler is unable to detect the printer. If you see the warning message, check the cable connections between the printer and the sampler.

. . . PRINTING . . . PROGRAM INFORMATION

PRINT ABORTED NO PRINTER DETECTED!

SOURCE OF SAMPLE EVENT

The display illustrated in step 5 of **Example 21** on page 92 shows the sample event number, the bottle(s) used, and the source of the sample event. Source refers to the programmed or configured setting that initiated the sample event. For example, the sampler will report "TIME" as a source if the sample was taken as one of the program's time-paced samples. Nine sources are tracked and reported:

Time - The sample event was one of the program's time-paced samples.

Flow - The sample event was one of the program's flow-paced samples.

Start - The sample event was initiated at the program's start time.

Resume - The sample event was initiated to compensate for a missed sample which should have occurred while the sampler was halted. If more than one sample event was missed, only one sample will be taken.

Power - The sample event was initiated to compensate for a missed sample which should have occurred while the sampler was without power. If more than one sample was missed, only one sample will be taken.

Enable - The sample event was initiated when the sampler became enabled by a device connected to pin F of the flow meter connector, generally a Liquid Level Actuator. This source is also reported when the sample was initiated at a programmed resume time. Two different configure option settings control this event: the Sample Upon Enable setting in the Enable Pin configure option and the Sample at Resume setting in the Sampling Stop/Resume configure option.

Manual - The sample event was initiated with the MANUAL SAMPLE key and was counted as one of the programmed sample events.

Time Switch - The sample event was initiated at the programmed switch time. This event is controlled by the Sample at Time Switch setting in the Flow Mode Sampling configure option. This option is available for flow-paced sampling only.

Disable - The sample event was initiated when the sampler became disabled by a device connected to pin F of the flow meter connector, generally a Liquid Level Actuator. This source is also reported when the sample was taken at a programmed stop time. Two different configure option settings control this event: the Sample Upon Disable setting in the Enable Pin configure option and the Sample at Stop setting in the Sampling Stop/Resume configure option.

ERROR MESSAGES AND MISSED SAMPLES

The probable cause of any missed sample is reported after the sample number/source display. A missed sample display is illustrated below.

SAMPLE MISSED: NO LIQUID DETECTED!

Eleven causes are tracked and reported:

Pump "STOP" Key Hit! - The sampler was halted with the STOP key during the sample event.

Pump Jammed! - The sampler was unable to take the sample because the pump jammed.

Started Too Late! - The sampling routine was started after the programmed start time for the first sample. This message is reported for all samples skipped because of an expired start time.

Program Halted! - The sampling routine was interrupted by the STOP or exit PROGRAM KEY when the sample event was to occur.

Power Lost! - The sampler was unable to take the sample because the sampler's power source was disconnected.

Sampler Inhibited! - The sampler was prevented from taking the sample by an inhibit signal sent to the sampler by the Liquid Level Actuator, or other inhibiting device.

Distributor Jammed! - The sampler was unable to take the sample because the distributor jammed.

Probable Overflow! - Overflow is determined by comparing the bottle volume to the product of the sample volume and the number of samples. If the product exceeds the bottle volume, the sampler will not pump a sample for that sample event and will record the "Probable Overflow!" message.

No More Liquid! - The sampler was unable to deliver a full sample volume because the sampler pumped all liquid from the flow stream.

No Liquid Detected! - The sampler was unable to take the sample because no liquid was detected.

Sampler Shut "OFF"! - The sampler was unable to take the sample because it was halted with the ON/OFF key during the sample event.

RUN STATE

A sampler in the run state is executing the sampler's instructions according to the settings you've entered in the program and configure sequences.

To start a sampling program and place the sampler into the run state, press the START SAMPLING key. While running the sampling program, the sampler will present a number of displays which allow you to monitor the sampler's progress. The displays are listed with a brief explanation in **Tables 9** through **11.**

If a problem is encountered while running a sampling routine which has resulted in missed samples, an asterisk will appear in the lower right corner of the display, as illustrated below.

```
BOTTLE 11
AT  6:00        5:42:33 *
```

There is one instance where the refrigerated sampler will enter the run state after the START SAMPLING key is pressed, but will not begin the sampling program. If the sampler is interfaced with a flow meter, a Liquid Level Actuator, or other equipment capable of transmitting an inhibit signal, the sampler will not begin the program until the inhibit signal is suspended. The sampler will use the following display to inform you of this conditions.

```
SAMPLER INHIBITED!
10:32       19-JUN
```

Sampler Inhibited Display

Table 9 Run State Displays: Time-paced Sampling

	Display	Explanation
1	**BOTTLE 5** **AT 5:44 5:42:33**	Indicates the bottle number of the next sequential sample. The second line reports the scheduled sample event time followed by the current time.
2	**BOTTLES 1- 4** **AT 6:00 5:55:33**	Indicates the scheduled time and receiving bottle numbers for an upcoming sample event. The sampling program requires four bottles per sample event.
3	**1 OF 4, BOTTLE 1** **AT 6:00 5:55:33**	Indicates the number of the upcoming sample, the total number of samples each bottle is to receive, and the current bottle number. The program requires four samples per bottle.
4	**1 OF 4, BTLS 1- 4** **AT 6:00 5:55:33**	Indicates the sample and bottle numbers of the next sample event. The bottle set consists of four bottles. The sampling program requires that four samples be placed in each bottle of the set.
5	**SAMPLE 3, BOTTLE 1** **AT 6:00 5:42:33**	Indicates the sample and bottle number of the next sample event The current time is shown in the lower right corner. The sampling program requires one bottle per sample event and that the bottles be switched on a time basis. This display alternates at three second intervals with the display illustrated in item 6.
6	**NEXT BOTTLE CHANGE** **AT 10:00 19-JUN**	Indicates the time of the next bottle switch.
7	**SAMPLE 2, BTLS 1 - 4** **AT 6:00 5:42:33**	Indicates the sample and bottle numbers of the next sample event. The current time is shown in the lower right corner. The sampling program requires four bottles per sample event and that the bottle sets be switched on a time basis. This display alternates at three second intervals with the display illustrated in item 8.
8	**NEXT SET CHANGE** **AT 8:00 19-JUN**	Indicates the time of the next bottle set switch.
9	**BOTTLE 1** **PUMPING 200 ml**	Indicates a sample in progress.

Table 10 Run State Displays: Flow-paced Sampling

	Display	Explanation
1	START AT 6:00 19-JUN 5:42:43 19-JUN	Indicates the programmed start time of a flow-paced sampling program when no sample is to be taken at the start time. The first line reports the programmed start time and date, the second line reports the current time and date.
2	BOTTLE 1 AT 6:00 5:42:33	Indicates the programmed start time of a flow-paced sampling program when a sample is to be taken at the start time. The current time is shown in the lower right corner. The sampling program requires one bottle per sample event.
3	BOTTLE 1 AFTER 5 PULSES	Indicates the bottle number of the next sequential sample. The second line reports the number of flow pulses remaining until the next sample event.
4	BOTTLES 5- 7 AFTER 25 PULSES	Indicates the bottles which will receive samples at the next sample event. The second line reports the pulses remaining until the next sample event. The sampling program requires three bottles per sample event.
5	1 OF 4, BOTTLE 1 AFTER 10 PULSES	Indicates the number of the upcoming sample, the total number of samples each bottle is to receive, and the current bottle number. This display indicates that four samples are to be deposited in each bottle.
6	1 OF 4, BTLS 1- 4 AFTER 1000 PULSES	Indicates the sample and bottle numbers of the next sample event. The bottle set consists of four bottles. The sampling program requires that four samples be placed in each bottle of the set.
7	SAMPLE 2, BOTTLE 1 AFTER 10 PULSES	Indicates the sample and bottle number of the next sample event. The sampling program requires one bottle per sample event and that the bottles are switched on a time basis. Alternates at three second intervals with the display illustrated in item 8.
8	NEXT BOTTLE CHANGE AT 10:00 19-JUN	Indicates the time of the next bottle switch.
9	SAMPLE 2, BTLS 1 - 4 AFTER 10 PULSES	Indicates the sample and bottle numbers of the next sample. The sampling program requires four bottles per sample event and that the bottle sets be switched on a time basis. This display alternates at three second intervals with the display illustrated in item 10.
10	NEXT SET CHANGE AT 10:00 19-JUN	Indicates the time of the next bottle set switch.
11	BOTTLE 1 PUMPING 200 ml	Indicates a sample in progress.

Table 11 Run State Displays: Composite Sampling

	Display	Explanation
1	SAMPLE 1 OF 12 AT 6:00 5:43:33	Indicates the sample number of the next sample and the total number of samples for time-paced routines. The current time is shown in the lower right corner.
2	SAMPLE 1 OF 12 AFTER 10 PULSES	Indicates the sample number of the next sample and the total number of samples for flow-paced routines.
3	BOTTLE 1 PUMPING 200 ml	Indicates a sample in progress.

Chapter 4 Routine Maintenance

Routine Maintenance

The 3700FR/3720, although ruggedly built to withstand difficult field operating conditions, will maintain maximum reliability when these simple maintenance procedures are followed. As with any piece of field-operated equipment, a certain amount of preventive maintenance is necessary to keep it functioning properly.

Weather and Corrosion Resistance

The 3700FR/3720 is designed to be operated in relatively hostile environments. It may be directly exposed to wet environments and still function properly. The refrigerator's mechanical and electrical components, and the sampler controller are protected from rain, accidental spray, etc.

The refrigerator's base, exterior, and controller cover are constructed of a fiberglass reinforced polyester with an ultraviolet-resistant gel coat. The exterior metal parts are either anodized or Iridited™ aluminum, or stainless steel. The control box is made of Noryl (polyphenylene oxide) and is rated at NEMA 4X, 6. The interior of the refrigerator is made of a food grade ABS plastic which will not support bacterial growth or leach plasticizers into the sample. The evaporator is a roll-bonded aluminum plate with a special refrigeration powder coated epoxy finish. The power supply and solid state thermostat are enclosed in a sealed aluminum enclosure inside the refrigerator's base.

Cleaning

The following sections present information on cleaning the sample bottles and pump tubing. Information is also included for cleaning the refrigerator's interior, exterior, condenser coil, and bottle locating base.

Tubing

The suction line and pump tubing can be cleaned by placing the end of the suction line in a cleaning solution and pumping this solution through the tubing system using the PUMP FORWARD and PUMP REVERSE keys. Follow with a clean water rinse.

Sample Bottles

The sample bottles have a wide mouth to facilitate cleaning and can be washed with a brush and soapy water or washed in a dishwasher. The glass bottles can be autoclaved; however, the plastic lids and bottles should **not** be autoclaved.

Cleaning Protocols for Priority Pollutants

The following sections are excerpted from U.S. Environmental Protection Agency Publications EPA-600/4-77-039 (“Sampling of Water and Wastewater” by Dr. Phillip E. Shelley) to provide an example of sampler cleaning procedures for priority pollutants.

Proper Cleaning

Proper cleaning of all equipment used in the sampling of water and wastewater is essential to ensuring valid results from laboratory analysis. Cleaning protocols should be developed for all sampling equipment early in the design of the wastewater characterization program. Here also, the laboratory analyst should be consulted, both to ensure that the procedures and techniques are adequate, as well as to avoid including practices that are not warranted in view of the analysis to be performed.

Cleaning Examples

As an example, Lair (1974) has set down the standard operating procedures for the cleaning of sample bottles and field procedures equipment used by USEPA Region IV Surveillance and Analysis field personnel engaged in NPDES compliance monitoring. They are reproduced as follows for a typical automatic sampler and related sampling equipment.

Isco Glass Sample Bottles:

1. One spectro-grade acetone rinse.
2. Dishwasher cycle (wash and tap water rinse, no detergent).
3. Acid wash with at least 20 percent hydrochloric acid.
4. Dishwasher cycle, tap and distilled water rinse cycles, no detergent.
5. Replace in covered Isco bases.

Suction Line (1/4 or 3/8 Vinyl):

1. Do not reuse sample tubing. No cleaning required. New sample tubing is to be used for each new sampling setup.
2. Use Teflon tubing where samples for organics are to be collected.

Isco Pump Tube:

1. Rinse by pumping hot tap water through tubing for at least 2 minutes.

2. Acid wash tubing by pumping at least a 20 percent solution of hydrochloric acid through tubing for at least 2 minutes.
3. Rinse by pumping hot tap water through tubing for at least 2 minutes.
4. Rinse by pumping distilled water through tubing for at least 2 minutes.

Teflon Tubing:

1. Rinse twice with spectro-grade acetone.
2. Rinse thoroughly with hot tap water using a brush if possible to remove particulate matter and surface film.
3. Rinse thoroughly three times with tap water.
4. Acid wash with at least 20 percent hydrochloric acid.
5. Rinse thoroughly three times with tap water.
6. Rinse thoroughly three times with distilled water.
7. Rinse thoroughly with petroleum ether and dry by pulling room air through tubing.
8. Dry overnight in warm oven (less than 150° F), if possible.
9. Cap ends with aluminum foil.

⚠ CLEANING THE REFRIGERATOR

The refrigerator's exterior may be periodically cleaned with soapy water using a sponge or non-metallic brush to keep it free from corrosive solutions, grease, oil, etc. The thermal-formed, high impact ABS refrigerator interior may also be cleaned with soapy water. Do not direct a hose spray toward the underside or into the front grille of the refrigerator.

After cleaning, wipe the refrigerator dry. To maintain the appearance of the refrigerator's exterior, apply an automotive or marine wax that is recommended for fiberglass treated with an ultraviolet gel coat.

Because the refrigerator uses a forced-air system for cooling the compressor and condenser coil; dust, lint, and other debris will be pulled into the unit and will eventually accumulate on the filter.

⚠ CAUTION

If the filter is not cleaned periodically, damage due to overheated components may result.

⚠⚠ WARNING

Removing the front or back panel exposes electrical and mechanical hazards. Disconnect power before performing any service activities.

In order to prevent damage due to overheated components, the filter should be cleaned every three months; more frequently under severe operating conditions. To clean,

1. Remove the thumbscrews holding on the refrigerator's grille.
2. Remove the grille and filter then steam clean or wash in hot soapy water. After washing, treat the filter with a standard filter coat.

The condenser coil and surrounding areas should be cleaned annually; more frequently under severe operating conditions. To clean,

1. Remove the screws that hold the back panel on to the refrigerator and remove the panel.
2. Vacuum the fan, compressor, and surrounding areas.
3. Check the fan for freedom of movement. Oiling the fan motor is not necessary because the motor bearings are sealed. If the fan motor does not rotate freely, it should be replaced.
4. Replace the back panel.
5. Remove the front grille and filter. Vacuum the condenser coil and surrounding areas.
6. Replace the filter and grille.

Cleaning the Bottle Locating Base and Sample Bottles

The bottle locating base may be cleaned with soapy water and a sponge.The sample bottles have a wide mouth to facilitate cleaning. The 2.5-gallon glass bottle may be washed with a brush and soapy water then washed in a dishwasher or autoclaved. The 2.5, 4, and 5.5-gallon polyethylene bottles may be washed with a brush and soapy water or washed in a dishwasher, but not autoclaved.

REPLACEMENT OF PUMP TUBING

The pump tube serves two functions: it is a pump tube in the peristaltic pump and a distribution tube, routing the sample liquid from the pump outlet to the sample bottle. The pump tube consists of a single 39.5 inch (101 cm) piece of medical grade Silastic™ silicone rubber tubing. Medical grade tubing is used because of its superior mechanical properties and because it does not contain any organic materials.

Non-medical grade silicone rubber tubing can contain organic vulcanizing agents. During the vulcanizing process, these agents are converted into other compounds which can be leached into the sample. The medical grade silicone rubber tubing supplied by Isco for use with the 3700FR Sampler will **not** contribute any organic material to the sample.

⚠ Inspection of Pump Tubing

The pump tubing is extremely durable. However, the constant mechanical strain placed on the tubing by the peristaltic action of the pump will eventually cause the tubing to fatigue and fail.

⚠ CAUTION

Pump may actuate without warning. To avoid injury, sampler must be off when pump housing cover is removed for inspection or tubing replacement.

Inspect the pump tubing periodically for wear inside the pump by removing the cover. Check the tubing for cracks where the pump roller compresses the tubing. Replace it with a new pump tube, if necessary.

The inspections should be frequent when the liquid being sampled contains a high percentage of suspended solids. If the liquid is relatively free of solids, the inspections can be less frequent. The Tubing Life configure option reports the number of pump counts elapsed during the life of the tube.

The amount of tubing (13.5 inches) used in the pump is less than half the total length of the pump tube (39.5 inches). In some cases, when the tube has not been damaged to the point of leaking, the tube can be used twice by simply turning it around.

Note: The black bands used to assist you in correctly positioning the tubing in the pump and detector are placed on one end only. If you turn the tubing around, you will not be able to use the bands for reference.

⚠ Removing the Pump Tubing

To remove the tubing:

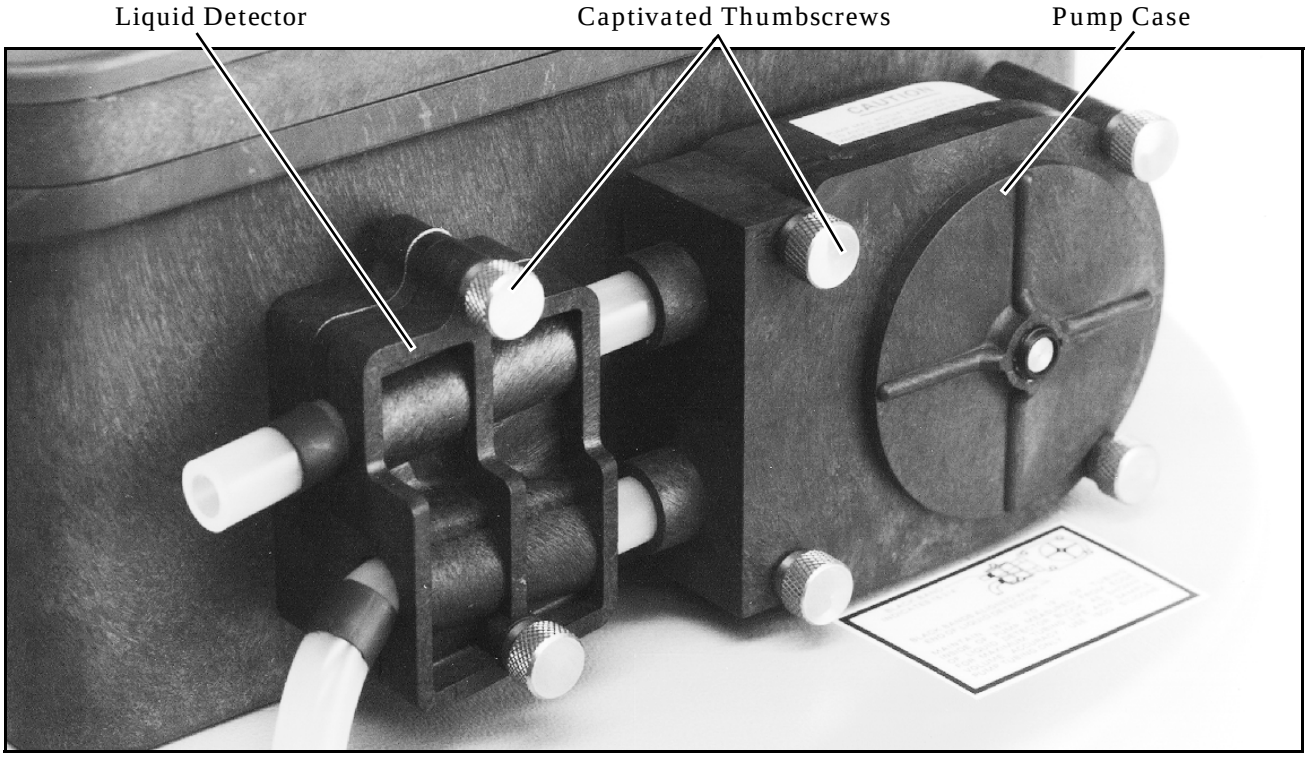
1. Disconnect power from the unit.

⚠ CAUTION

Pump may actuate without warning. To avoid injury, sampler must be off when pump housing cover is removed for inspection or tubing replacement.

2. Detach the outer cases of the liquid detector and pump by loosening the captivated thumbscrews shown in **Figure 31**. This will expose the pump tubing as shown in **Figure 32**.

Figure 31 Liquid Detector and Pump Case



3. Pull the tubing away from the detector. Extract the tubing from the pump. The pump rollers can be rotated manually to facilitate the removal of the tubing. After the tubing is removed, clean the interior of the pump case thoroughly.
4. Remove the suction line, if attached, and pull the pump tubing from the pump tube port.

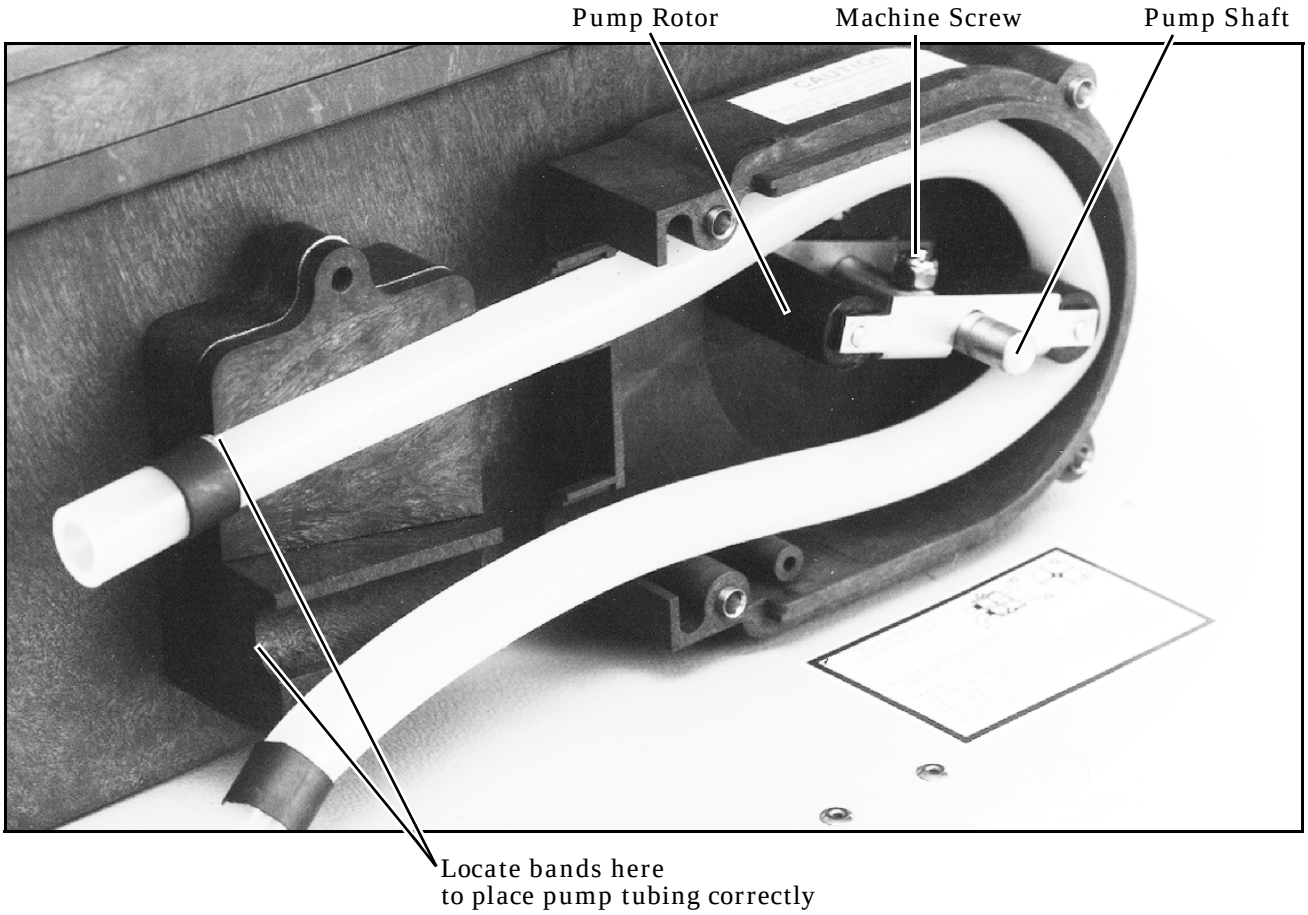
⚠ INSTALLING A NEW PUMP TUBE

The steps below outline the procedure needed to install a new pump tube.

> ⚠ **CAUTION**
>
> Pump may actuate without warning. To avoid injury, sampler must be off when pump housing cover is removed for inspection or tubing replacement.

1. The pump tube is marked with two black bands. These bands are used to correctly locate the tubing in the detector and pump. Correct placement will prolong the life of the pump tube and assures efficient operation and accurate sample volumes. Facing the liquid detector, place the inner edge of the end band against the upper left inlet of the liquid detector. Place the inner band at the lower outlet of the liquid detector. See **Figure 32**.
2. Slip the pump tubing under the rollers so that the pump tubing does not interfere with the installation of the outer pump lid.
3. Replace the outer pump lid and tighten the four thumbscrews.
4. Re-check the position of the marker bands and adjust the tubing if the position of the bands indicate the tubing has slipped.
5. Replace the outer case of the liquid detector and tighten the two thumbscrews. The thumbscrews must be tightened securely for the liquid detector to operate correctly.
6. Feed the free end of the tube down through the pump tube port.
7. Re-install the suction line, as described in *Attaching the Suction Line* on page 8.
8. Reset the Pump Tube count to zero. Refer to the discussion of the Tubing Life configure option in **Chapter 3**.

Figure 32 Interior of Liquid Detector and Pump Tube



Replacement of Suction Line

It may be desirable to replace the suction line for one of several reasons. The suction line may be worn, cut, contaminated, or otherwise damaged; it should be periodically inspected for damage. In critical sampling, it may be necessary to replace the suction line between sampling programs to avoid cross contamination. When sampling site conditions change, it may be necessary to replace the suction line with a different diameter or type of line (vinyl or Teflon). The vinyl suction line contains a very low PPM (parts per million) level of phenols. If this affects your samples, use the Teflon line.

Cleaning Suction Line

The suction line and the remainder of the pump tube system should be cleaned occasionally as described in *Tubing* on page 98.

Replacement Vinyl Line

Replacement vinyl suction lines are available from Isco in two forms. First, a complete suction line, with weighted strainer and tube coupling, is available in 10 ft and 25 ft lengths for each of the 1/4-inch and 3/8-inch ID (Inside Diameter) vinyl suction lines. Second, bulk suction line in the 1/4-inch ID and 3/8-inch ID vinyl tube is available in 100- and 500-foot rolls see *Appendix A Accessories List*, on page 140.

Replacement Teflon Line

The 3/8-inch ID Teflon suction line is available from Isco in line lengths of 10 and 25 feet.

1/4 and 3/8 Inch ID Vinyl Suction Line

The following sections discuss the replacement of the complete suction line-strainer assemblies, the sizing of the suction line, and the assembly and installation of the bulk tubing. The suction line is removed from the pump tubing by detaching the tube coupling, as described in *Attaching the Suction Line* on page 8. If a complete new suction line-strainer assembly of the standard 10- or 25-foot length is used, it should be installed as described in *Placement of the Suction Line and Intake* on page 9.

Bulk Suction Line

If you are using bulk suction line to replace the old line, detach the old line from the tube coupling. Remove the strainer by loosening the hose clamp which secures the strainer to the line. Cut the new suction line to the desired length in one foot increments. The line must be between 3 and 99 feet long. To insure accurate sample volumes, it is important that the line is cut in 1-foot increments and that the line length is correctly entered in the Suction Line configure option. Install the strainer on the new suction line and tighten the hose clamp. The new suction line can now be installed in the pump as described in *Attaching the Suction Line* on page 8.

3/8 Inch ID Teflon Suction Line

The suction line is removed from the pump by loosening the clamp; which secures the line to the pump tube and pulling the suction line out of the pump tube. If a new suction line (either with or without the optional stainless steel strainer) is to be used, it is installed as described in *Attaching the Suction Line* on page 8. To install the optional stainless steel strainer, carefully slip the strainer's tapered connector inside the suction line and tighten the hose clamp supplied with the strainer.

Changing the Internal Desiccant

A humidity indicator, labeled “INTERNAL CASE HUMIDITY,” is located in the lower left corner of the control panel. It indicates the amount of moisture present inside the control box. The paper indicator is blue in a dry state.

The control box is a completely sealed unit. (The control box does not need to be opened during normal operation.) The desiccant should absorb any moisture which may accumulate in the control box. Thus, the humidity indicator should remain blue under normal conditions. If moisture does accumulate, the numbered areas on the indicator will turn light pink or white, starting with the area numbered “20.” This indicates that the relative humidity inside the control box exceeds 20%. As more moisture accumulates, the areas numbered “30” and “40” will turn light pink or white, indicating relative humidities of 30% and 40%.

If the 30% area of the humidity indicator turns light pink or white, the control unit should be opened, inspected for leaks, and the desiccant renewed. To do this, unscrew the 10 screws around the outer rim of the control box bezel, and carefully lift the cover off the control box and bezel. The control box contains electronic circuitry that may be damaged by static discharge. Open the control box only in a static-free environment.

Renewing the Desiccant

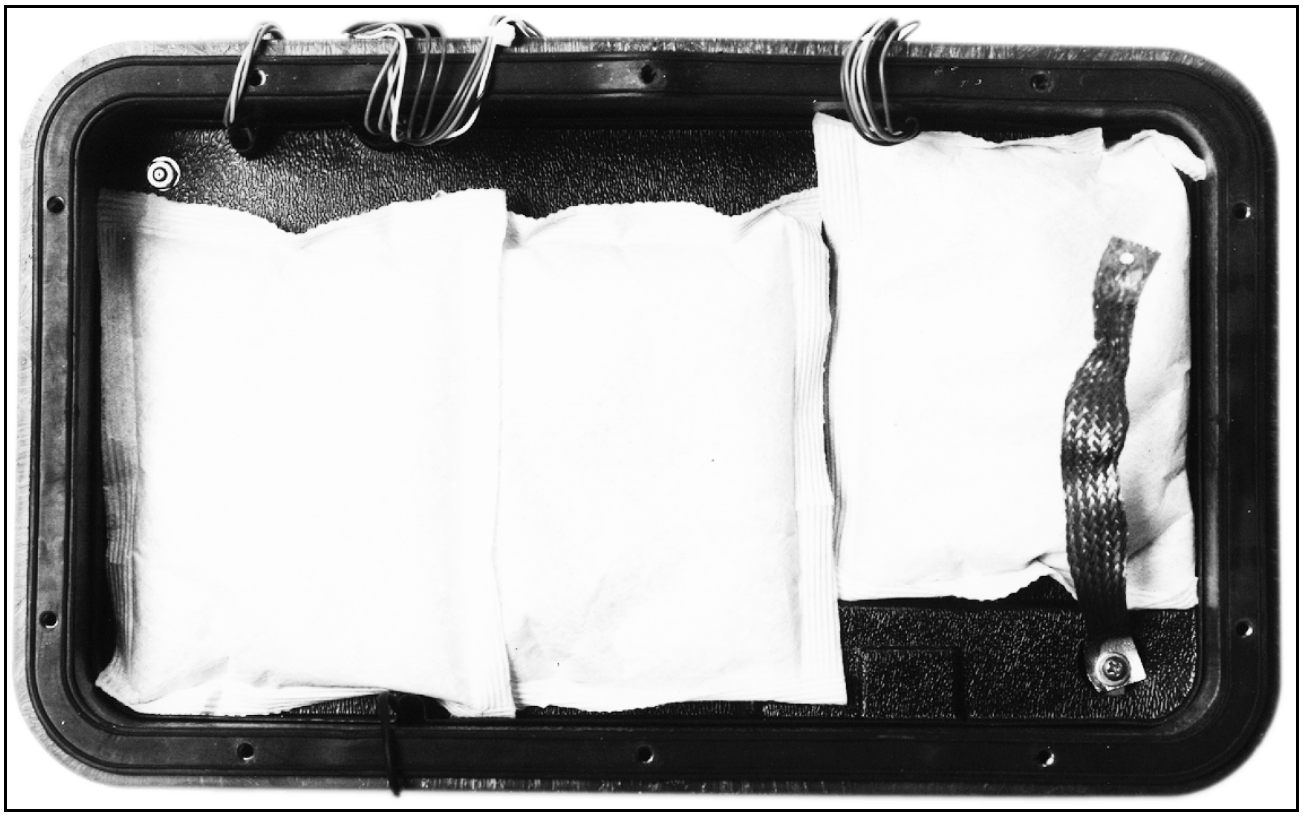
The desiccant is renewed by first removing the bags of desiccant from the control box, as shown in **Figure 33**. Then place a sheet of brown paper on a flat metal sheet. You can use a brown grocery bag and a typical cookie sheet. Place only the bags on the sheet. Do not stack the bags on top of each other or allow them to touch. Place in a vented, circulating forced air, convection oven in a well ventilated room. Allow two inches of air space between the top of the bags and the next metal tray above the bags. Keep the tray a minimum of 16 inches from the heating element. Heat the bags at a temperature of 240° to 250° F (116° to 121° C) for 12 to 16 hours. At the end of the time period, the bags should be immediately removed and placed in an airtight container for cooling. The desiccant will be recharged to approximately 80% to 90% of its previous capacity.

After repeated recharging, the desiccant bag may require replacement. Replacement bags of desiccant are available from Isco; refer to the *Replacement Parts List* in the back of this manual.

Some bags will have the temperature and time for recharging printed on the bag. If they differ, use the temperature and time printed on the bag.

To reassemble the controller, place the renewed desiccant in the tray as shown in **Figure 33**. If you have disconnected any wiring or the grounding strap between the control box and the panel, reconnect them. Before reinstalling the cover, coat the cover's gasket with a light film of silicone grease to seal the control box. Tighten the ten screws which hold the control box cover and bezel in place using an even cross-torquing pattern.

Figure 33 Control Box Internal Desiccant



Chapter 5 Options and Interfacing Equipment

INTRODUCTION

This chapter presents information regarding the major options available with the 3700FR Sampler. The following sections present a general description of the options.

Connection to Isco and non-Isco flow meters is discussed in *Flow Meter Connections*.

Interface devices are discussed in *Interface Devices,* on page 105.

The Model 1640 Liquid Level Actuator is discussed in *Model 1640 Liquid Level Actuator,* on page 105.

FLOW METER CONNECTIONS

The 3700FR can collect samples on a flow proportional basis using flow inputs from an external flow meter or flow logger. The 3700FR Sampler requires a 5 to 15 VDC pulse of at least 25 millisecond duration to register a flow pulse. Flow meters are connected to the sampler by attaching a flow meter connect cable to the flow meter connector. **Figure 6,** on page 10 shows the connector.

NOTE

If a connect cable is not attached to the flow meter or printer connectors, be sure that the protective covers are tightly fastened in place

The sampler has an additional connector, labeled "PRINTER," used to connect the sampler to an Isco Field Printer or laptop computer. **Figure 34** shows the pin location diagram for the printer connector. (Note: Both the flow meter connector and the printer connector use the same 6-pin configuration.) The printer cable connector accepts both the connector from the Isco Field Printer and a cable from a laptop computer running the SAMPLINK software. **Table 12,** on page 105, shows the pinouts for the printer connector.

Isco Flow Meters and Flow Loggers

Connect cables to connect the 3700FR Sampler to an Isco flow meter are available. Refer to the *Appendix A Accessories List,* on page 140 for details. To make the connection, attach the appropriate cable connector to the flow meter or flow logger according to directions in the instrument's instruction manual, and attach the other connector to the 6-pin flow meter connector on the thermostat/wiring housing assembly, shown in **Figure 6,** on page 10.

Non-Isco Flow Meters

Certain non-Isco flow meters can be directly interfaced with the 3700FR Sampler. These are flow meters with an isolated contact closure type output of at least 25 millisecond duration. The frequency of the contact closures must be directly proportional to total flow.

The isolated contact closure from the flow meter should be connected to pins A and C of the 6-pin connector. **Table 13,** on page 105 shows the pinouts required for connecting a flow meter to the sampler. **Figure 34** shows a diagram of the pin locations on the 6-pin connector. Refer to the instruction manual of the flow meter being used for further details.

A connector and cable clamp to connect a non-Isco flow meter to the 3700FR Sampler are available from Isco. To wire the connector for contact closures, use pins A and C. To wire the connector for pulses, use pin C. When appropriately wired, attach the non-Isco connector to the flow meter connector on the rear of the sampler.

A connector pre-wired to a 22 ft. (6.7 m) cable terminating in two wires is also available. The black wire is connected to pin A, the white wire to pin C.

Figure 34 Pin Location Diagram for 6-pin Connector

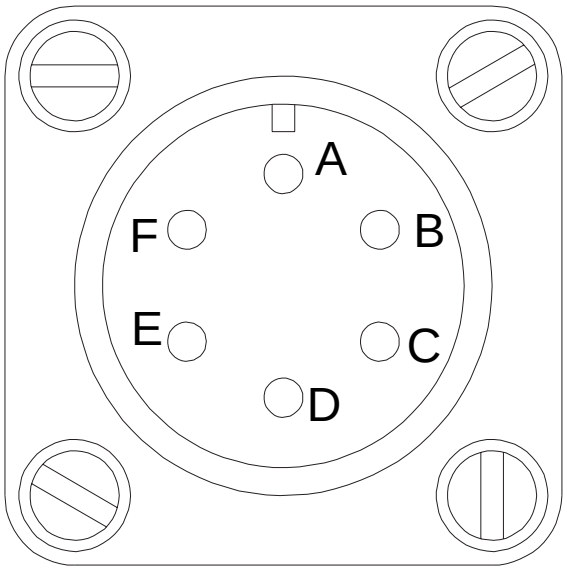


Table 12 6-Pin Printer Connector Wiring

Pin	Signal
A	+12 VDC
B	Common
C	Printer Sense
D	Transmit
E	Receive
F	NC

Table 13 6-Pin Flow Meter Connector Wiring

Pin	Signal
A	+12 VDC
B	Common
C	Flow Pulses In
D	Bottle Number Out
E	Event Mark Out
F	Inhibit In

INTERFACE DEVICES

The 3700FR Sampler can also be used with flow meters having other types of outputs, for example, a 4 to 20 mA output directly proportional to flow rate. However, these flow meters require a special interface device to convert their output signal into one compatible with the 3700FR Sampler. Two interfaces are available: the Type A Interface and the 4 - 20 mA Sampler Input Interface. Each interface connects to the flow meter connector. Consult the factory for assistance in interfacing the sampler with non-Isco flow meters.

Type A Interface - Converts flow pulse duration output from non-Isco flow meters to acceptable flow pulses. The Type A interface is shown in **Figure 35,** on page 106.

4-20 mA Sampler Input Interface -Converts 4 to 20 mA output signals from non-Isco flow meters to acceptable flow pulses. The 4-20 mA Sampler Input Interface is shown in **Figure 36,** on page 106.

MODEL 1640 LIQUID LEVEL ACTUATOR

The Liquid Level Actuator is a device used to begin a sampling routine when the liquid level of the sample flow stream reaches a predetermined height. The actuator is used to inhibit sampling according to flow levels; i.e., if the level of the flow stream falls below the actuator's probe, the actuator will inhibit sampling until the level again rises to contact the probe.

The actuator can be set to control the sampler in two modes.

Latch Mode - The sampler continues the sampling routine even though the liquid level has receded and liquid no longer contacts the sensor.

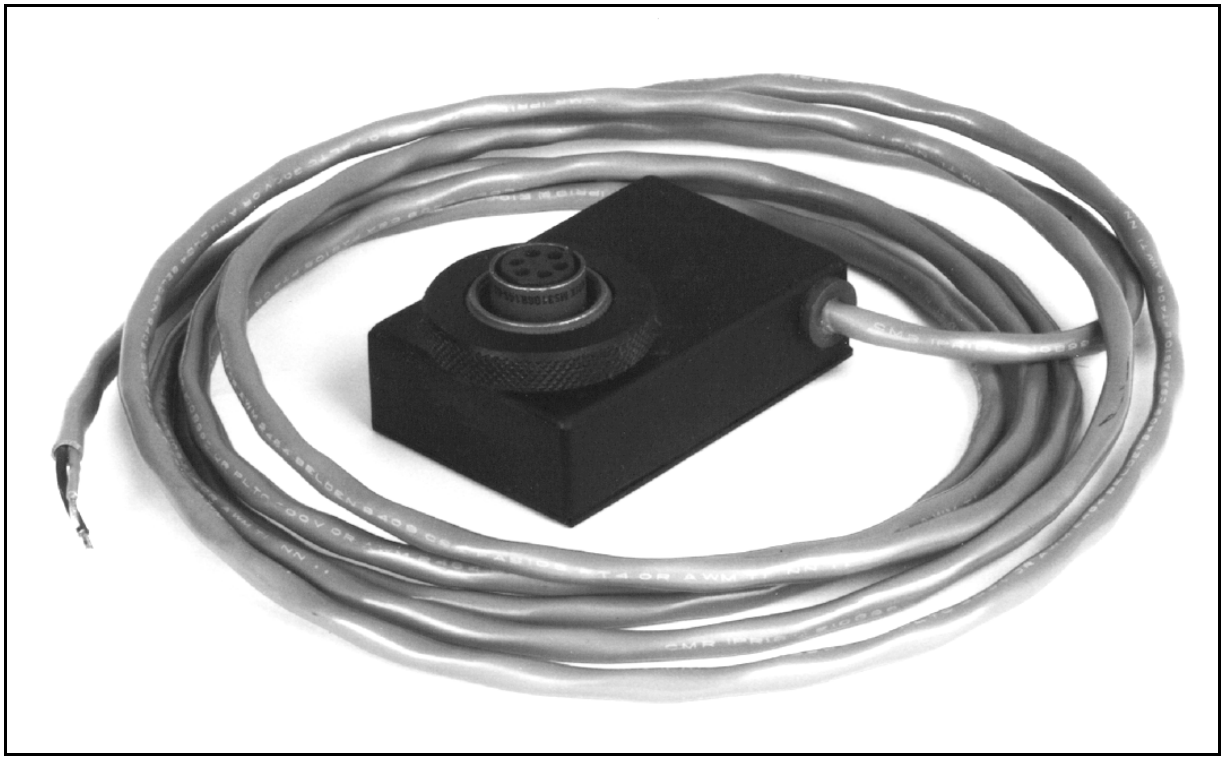
Toggle Mode - The sampler will halt the routine when the liquid ceases to contact the sensor.

To connect the actuator to the sampler, attach the actuator cable to the flow meter connector on the rear of the sampler. Refer to **Figure 34,** on page 104 for the location of the flow meter connector. Refer to the Liquid Level Actuator Instruction Manual for additional information.

The sampler must be configured to respond to the actuator. Refer to *Enable Pin*, on page 50.

Figure 35 Type A Interface

Figure 36 4-20 mA Sampler Input Interface



Chapter 6 Servicing

SERVICING INFORMATION

This chapter presents refrigerator servicing information to assist you in correcting malfunctions which may occur. Included are sections providing information on the electrical and refrigeration systems, and on servicing the sampler's controller. An illustrated list of common replacement parts is also included.

The electrical system is discussed in *Electrical System*, on page 107.

The refrigeration system is discussed in *Refrigeration System*, on page 111.

A troubleshooting guide appears in *Troubleshooting Guide*, on page 111.

Servicing information for the electronic components in the control box is discussed in *Servicing the 3700 Controller*, on page 111.

An illustrated **Replacement Parts List** and a list of **Accessories** available for the 3700FR Sampler appear at the end of the chapter.

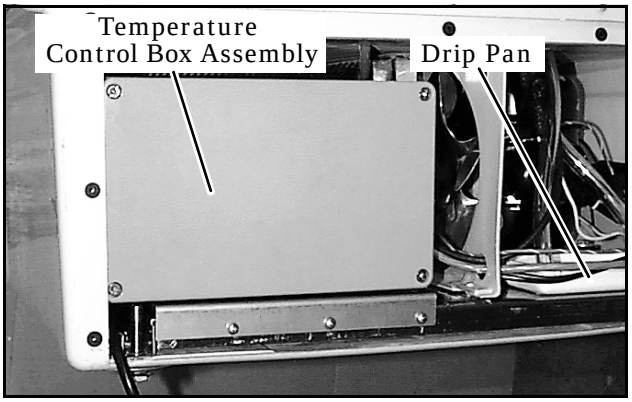
⚠⚠ ELECTRICAL SYSTEM

Access to the electrical and refrigeration components can be gained by removing the nine screws on the back of the refrigerator. Refer to **Figure 36**.

⚠⚠ WARNING

Removing the back panel exposes electrical and mechanical hazards. Disconnect power before performing any service activities.

Figure 36 Rear View of the 3700FR/3720



The temperature control box assembly which houses the thermostat logic circuit board, the transformer, and the solid state relay, is located on the left-hand side of the refrigerator base as shown in **Figure 36**. Access to these components can be gained by removing the four screws securing the lid of the temperature control box. See **Figure 37**.

You can remove the temperature control box from the refrigerator by removing the screws from its mounting plate and disconnecting the wires from the backside of the box. See **Figures 38** and **39**.

Figure 37 Thermostat Logic Cicuit Board

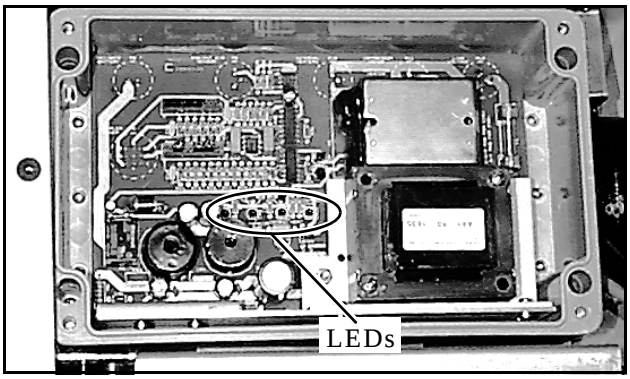


Figure 38 Control Box Wiring

Figure 39 Control Box Connections

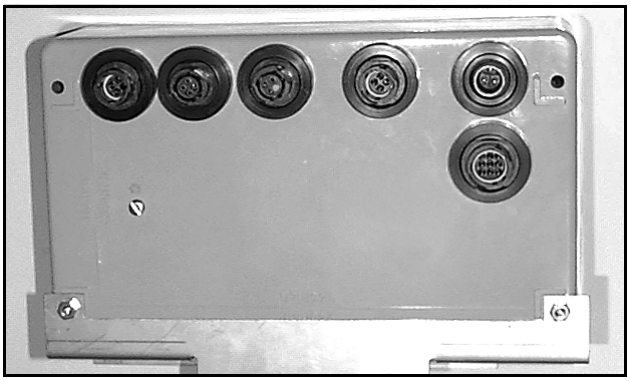


Figure 41 is a wiring diagram for the refrigerator. The diagram shows where all the connections are made within the refrigerator and the color of wires. It also points out the location of the various components within the refrigerator.

The refrigerator schematic showing the refrigerator's 12 V⎓ power supply and temperature control circuitry is shown in **Figure 40**. The refrigerator circuit board is equipped with light emitting diode (LED) indicators showing the various functions of the thermostat circuitry and power supply. Because the indicators are helpful in identifying malfunctions, they are described in detail in the circuit description below.

Refer to the refrigerator schematic in **Figure 40**. The barrier block on the circuit board contains all the 120 V∿ (230 V∿) circuit connections. A fuse, F1, is placed on the primary side of T1 for current protection. F1 is a 1½ amp slow-blow fuse for 120 V∿ systems, 230 V∿ systems use a ¾ amp slow-blow fuse. Refer to the Replacement Parts Listing for replacement fuse part numbers. The power is then rectified and passes through the switching regulators U7 and U8 to create the 12 V⎓ supply for the logic and sampler controller.

The signals from the ambient air temperature sensor, the internal refrigerator thermistor, the evaporator plate thermistor and the temperature control potentiometer come into the circuit board on connector P10.

The ambient air sensor samples the air temperature outside the refrigerator. It is located in the temperature assembly located on the right of the refrigerator grille. If the ambient temperature is cold, three heaters will be turned on by the circuitry.

Two of the heaters are located on the sides of the evaporator plate inside the refrigerator and one heater is located on the compressor.

The fuse, F2, is included on the supply side of the heaters to prevent an electrical hazard in the event of a fault in either heater. Refer to the Replacement Parts Listing for replacement fuse part numbers.

The heaters prevent the sample from freezing when the outside air temperature falls below freezing. The compressor will cycle approximately the same amount of times at cold temperatures as at room temperatures.

The ambient air temperature signal comes from the sensor into the circuit board on pins 7 and 8 of connector P10. The signal is then sent to pin 2 of U1, which is an oscillator. Depending on the temperature, the voltage at pin 2 of U1 will vary. This varies the duty cycle of the oscillator, which in turn, varies the duty cycle of the heaters. This circuitry is linear; at 65°F the heaters will begin to come on and at -35°F the heaters will be on continuously. When the heaters are on, the internal heat LED indicator will be lit.

The internal temperature sensor is a thermistor that samples the internal air temperature of the refrigerator. It is mounted at the top of the refrigerator's interior. The internal temperature signal comes from the sensor, through the plug in the thermostat/wiring housing assembly, and into the board across pins 1 and 3 of P10. The setting on the temperature control knob comes from the potentiometer, through the plug in the thermostat/wiring housing assembly and into the board across pins 3 and 4 of connector P10. The signals are compared in comparator U2. If the interior of the refrigerator is warmer than the temperature control potentiometer setting, the internal temperature LED indicator will be lit. The temperature control potentiometer is located in the thermostat/wiring housing assembly.

The evaporator temperature sensor is mounted on the front of the evaporator plate. The signal from the sensor comes through the connector in the thermostat/wiring housing assembly and into the circuit board across pins 1 and 2 of connector P10. The signal is compared with a calibrated setting in comparator U2. The evaporator temperature LED indicator will be lit if the evaporator temperature is warm (and all the frost has been melted).

Connectors P4 and P5 are used for calibration purposes only. They are used at the factory to set up the correct resistances so the internal temperature and evaporator temperature indicators are “on” at the proper temperatures. It is not recommended that the user try adjusting these settings. The operation of the compressor and the compressor run LED indicator is determined by the temperature control potentiometer setting, the internal refrigerator temperature, and the evaporator temperature.

Below is the operation of a compressor cycle assuming that the compressor is already running.

As the compressor runs, the temperature of the evaporator will fall below 32°F (0°C) and the evaporator temperature indicator, located on the circuit board, will go out. The internal temperature and the compressor run indicators will both be lit. The compressor will continue running until the internal air temperature of the refrigerator reaches the temperature set on the temperature control knob. Once this temperature is reached the internal temperature indicator will go off, the compressor run indicator will go off, and the compressor will shut off. After the compressor shuts off, the refrigerator melts the frost that accumulated on the evaporator while the compressor was running. Once the evaporator temperature has warmed to the calibrated temperature (approximately 2°C) the evaporator temperature LED indicator will turn on.

Figure 40 3700FR/3720 Schematic Diagram

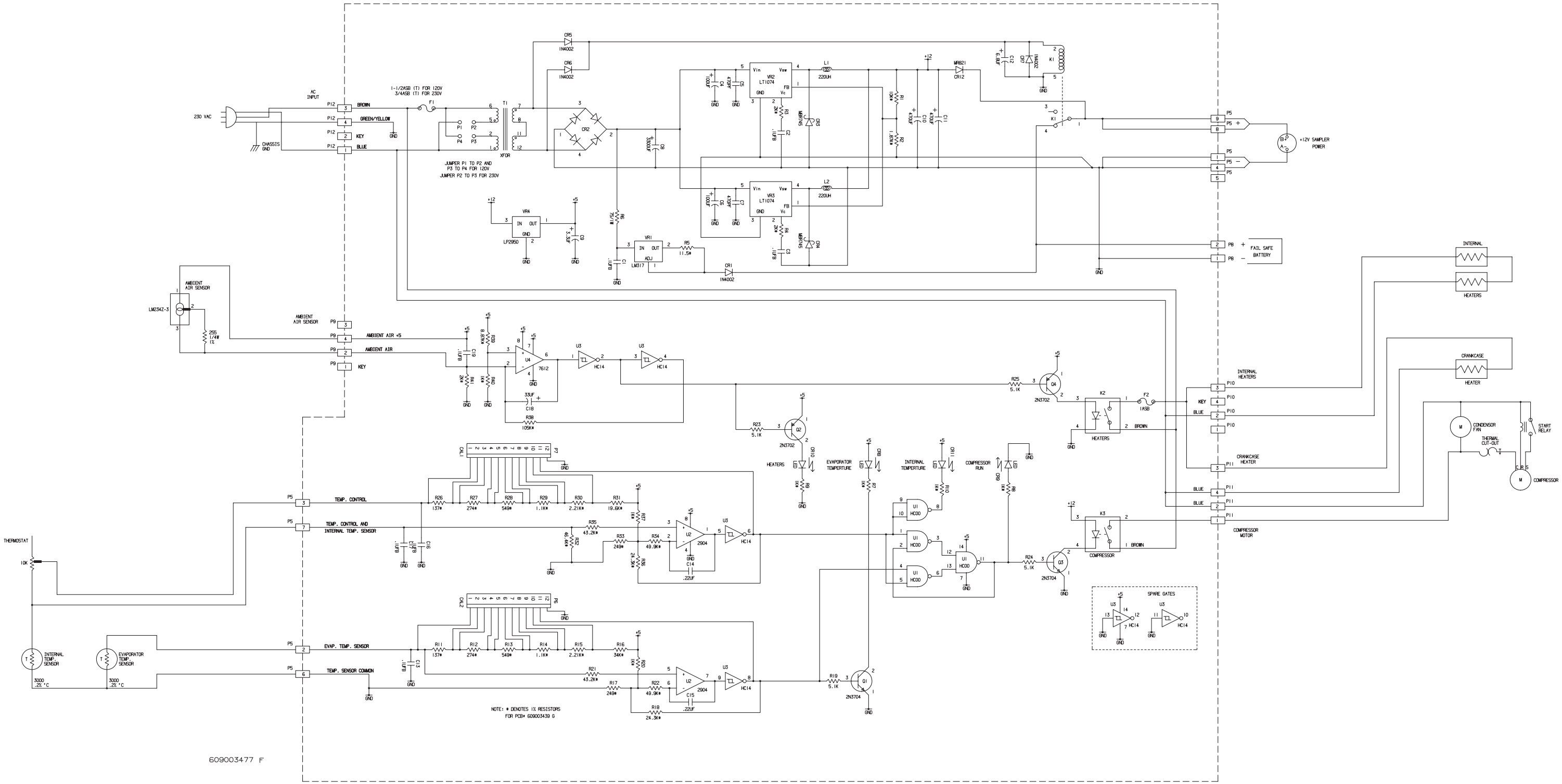
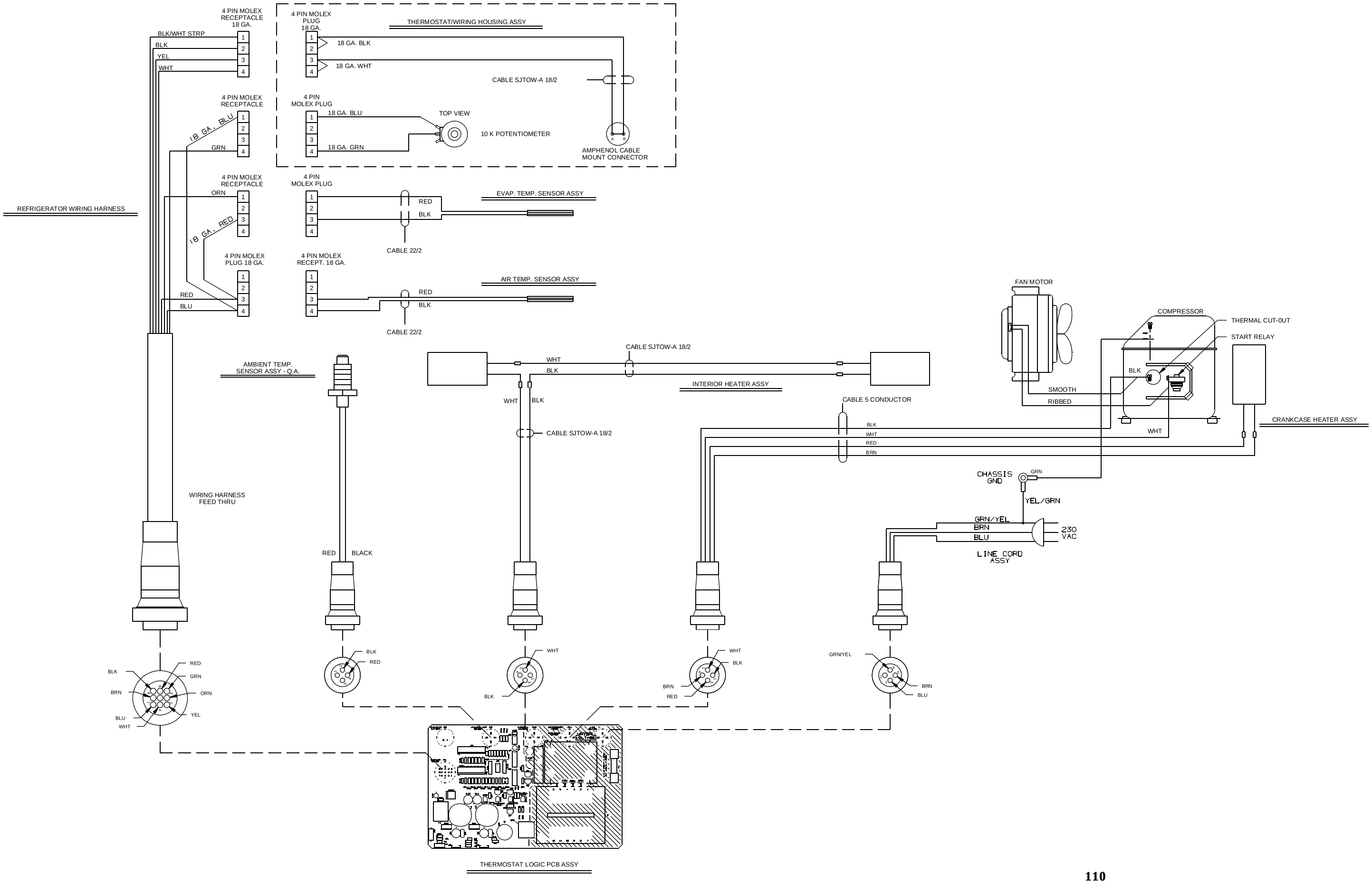


Figure 41 3700FR/3720 Refrigerator Wiring Diagram



When the refrigerator's internal temperature gets warmer than the temperature setting, the internal temperature indicator will light. When both the evaporator temperature and the internal temperature indicators are lit, a signal is sent through connectors P2 and P3 to the solid state relay. This activates the refrigerator's compressor and turns on the compressor run indicator. The compressor will continue to run until the internal temperature indicator goes out.

If it is suspected that there is a problem with the circuitry, remember that the compressor shuts off when the internal temperature sensor reaches the setting on the temperature control knob. But, to turn the compressor on, both the internal temperature sensor and the evaporator temperature sensor must be warm. The compressor/fan solid state relay may be replaced but do not attempt to replace any other components. Otherwise, the calibration of the circuitry will be disturbed. It is suggested that the entire board be replaced or the board be returned to the factory for repair.

⚠ Refrigeration System

The refrigeration system is shown schematically in **Figure 42**. The refrigerant-charge capacity of the system varies according to the age and AC power requirements of the refrigerator. When recharging the refrigeration system, refer to the following chart.

Before Serial Number 11901-001	R-12, 8.5 oz
After Serial Number 11901-001	R134a, 7.52 oz

⚠ CAUTION

All refrigeration repair work must be performed by a qualified refrigeration technician.

Always purge the system with nitrogen. NEVER USE AIR to purge the system.

Always recover the refrigerant.

When recharging, do not leave a line tap in the refrigeration system because of possible corrosion or leakage problems

Equipped with external overtemperature and overload protection, the compressor may fail to start immediately when power is momentarily interrupted or when the thermostat setting is changed. The overload relay normally trips repeatedly until the refrigerant pressure equalizes. This does not indicate a malfunction.

Troubleshooting Guide

A troubleshooting flow chart appears in **Figure 43.** This is meant as a general guide and is not intended to cover problems in detail.

Servicing the 3700 Controller

The controller's solid-state electronic circuitry is highly reliable. If the unit fails to operate properly, check the power-cable or wiring harness connections. If problems persist, call the Isco Customer Service department for information on returning the sampler to the factory for repair.

Figure 42 Refrigeration Schematic Diagram

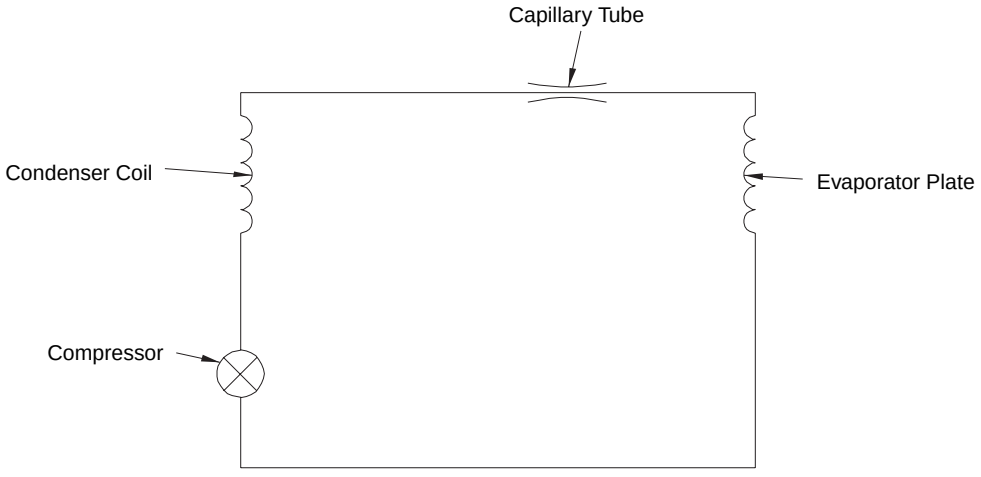


Figure 43 Refrigerator Troubleshooting Chart

WARNING

Removing the front and back panel exposes electrical and mechanical hazards. Troubleshooting and repair activities should be performed by a qualified refrigeration technician.

Problem: Refrigerator will not cool.

1. Make sure the operating voltage (120 or 230 V~) is present across pins 1 and 3 of circuit board connector P12.
2. Is the compressor running?

NO
a. Is the compressor-run LED (on the circuit board) lit?
NO – Check the circuit board for a malfunction.
YES – Continue.
b. Is there 12 V⎓ across pins 4 and 4 of the compressor fan relay?
NO – Check the circuit board for a malfunction.
YES – Continue.
c. Is there 120 or 230 V~ across pins 1 and 2 of the circuit board connector P11?
NO – Replace the compressor/fan relay.
YES – Continue.
d. Is there 120 or 230 V~ across the start relay and compressor common?
NO – Check to see if the thermal cutout relay is open or the start relay is defective.
YES – Check the compressor for an open winding.

YES
a. Is the fan running?
NO – Replace the fan.
YES – Continue.
b. Check the refrigerant in the refrigeration system.

Problem: Samples freezing.

1. Is the Heaters LED (on the circuit board) lit?

NO – Check the circuit board for a malfunction. If the board is good, replace the ambient air sensor.
YES – Continue.

2. Is there 5 V⎓ across pins 3 and 4 of heater relay K2?

NO – Check Q4 on the circuit board for a malfunction.
YES – Continue.

3. Is there 120 or 230 V~ across pins 1 and 2 of heater relay K2?

NO – Replace heater relay.
YES – Continue.

4. Is there 120 or 230 V~ across pins 2 and 3 on PCB connector P10?

NO – Replace heater fuse F2. Refer to the replacement parts listing for the correct part number.
YES – Check heater wiring.

Problem: Sampler has no power.

1. Is there 12 V⎓ at the sampler connector?

NO – Continue.
YES – Troubleshoot the sampler controller.

2. Is there 12 V⎓ between pins 1 and 8 on PCB connector P5?

NO – Check F1. If open, replace fuse. Refer to the replacement parts listing for the correct part number.
YES – Check the power supply circuit for malfunction.

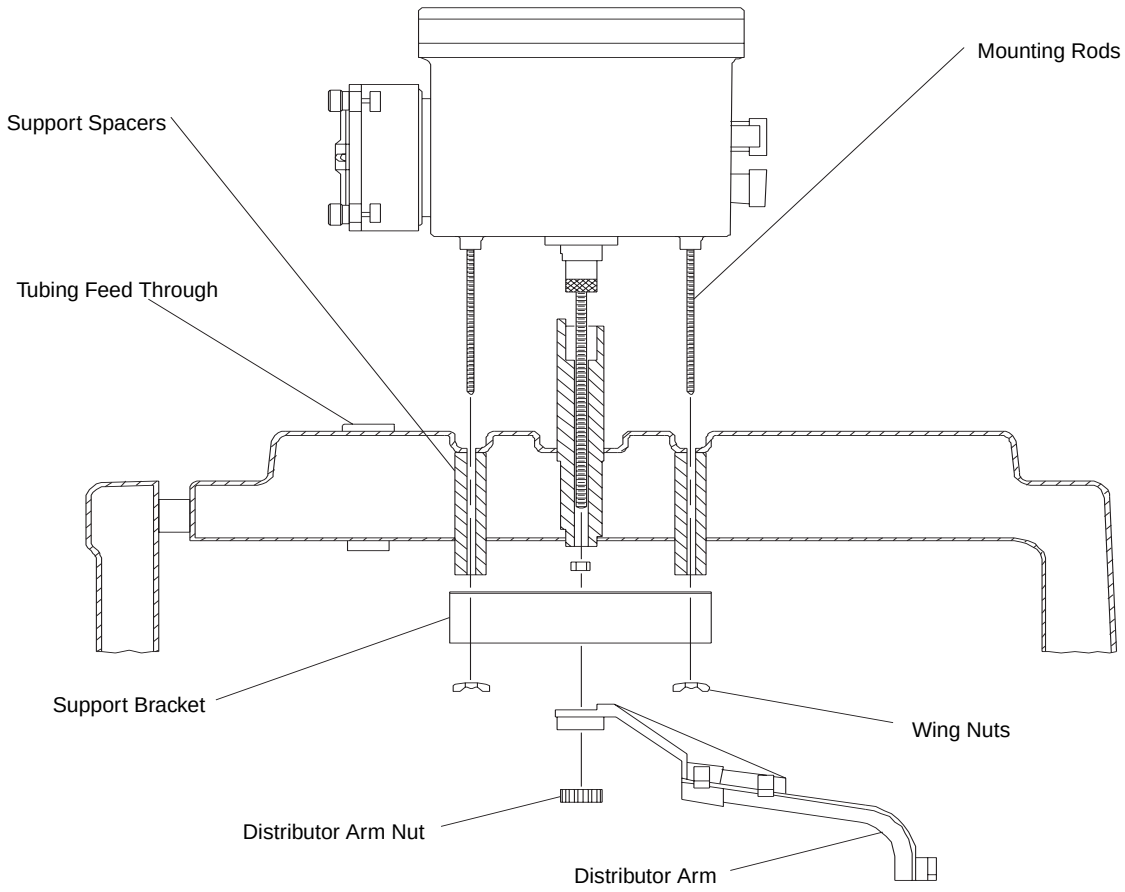
INSTALLING A 3700 SERIES CONTROLLER ON THE 3720 REFRIGERATOR

The 3720 Sampler Refrigerator is available to convert a 3700 Portable Sampler into a 3700FR Refrigerated Sampler. To do this, remove the control box from the portable sampler following the instructions in **Chapter 7** of the *3700 Portable Sampler Instruction Manual*. Because of the longer distance between the pump discharge and the sample bottle in the refrigerator, the standard 42 inch (107 cm) pump tube must be replaced with the 46 inch (117 cm) pump tube supplied in the mounting kit. The new pump tube may be installed following the instructions in *Installing a New Pump Tube,* on page 101.

Once the new pump tube is installed, use the parts supplied in the controller mounting kit and follow the instructions below to prepare and mount the controller on the refrigerator. Refer to **Figure 44** Turn the controller upside down and screw the four threaded mounting rods into the four corner feet of the controller. The two middle feet are not used. The controller is now ready to be installed on the refrigerator.

1. Open the controller cover on the top of the refrigerator and orient the controller on the top of the unit so the peristaltic pump and liquid detector face the front of the refrigerator.
2. Carefully insert the threaded rods into the four mating holes on the refrigerator and push the controller down so it is against the refrigerator.
3. Working inside the refrigerator, install the spacers and wing nuts on the threaded rods.
4. Feed the pump tube down through the tube guide port into the interior of the refrigerator and route the pump tube into the distributor arm.
5. Connect the two-pin connector on the power cable to the 12 V⎓ plug on the controller and the six-pin connector on the flow meter cable to the flow meter connector on the rear of the controller.

Figure 44 Mounting the Control Box



⚠ Access to Electronic Components

To gain access to the electronic components housed in the control box:

CAUTION

Disconnect power from the refrigerator and controller when working on the unit.

Keep yourself grounded when handling disassembled equipment.

1. Remove the ten screws around the outer edge of the control box bezel.
2. Lift the cover and bezel off the control box and turn the cover over, as shown in **Figure 45**.
3. The control box cover assembly may be disconnected from the control box lower section by disconnecting the five connectors (see **Figure 45**) and the grounding strap (see **Figure 33**).
4. The main circuit board assembly of the 3700 Sampler is protected by an aluminum shield. To remove this shield, unscrew the stop nut that holds the short grounding strap and unscrew the four screws located in each corner of the shield. Lifting the shield off will then reveal the main circuit board shown in **Figure 46**.
5. To remove the circuit board assembly from the control box cover, unscrew the four hex threaded stand-offs and the phillips head screw, indicated in **Figure 46**. The circuit board may now be pulled away from the control box cover.
6. To completely disconnect the circuit board assembly from the cover, disconnect the connector shown in **Figure 46**.

The controller can be reassembled by reversing these steps. Ensure that all hardware and connections are secure.

Figure 45 Underside of the Control Box Cover

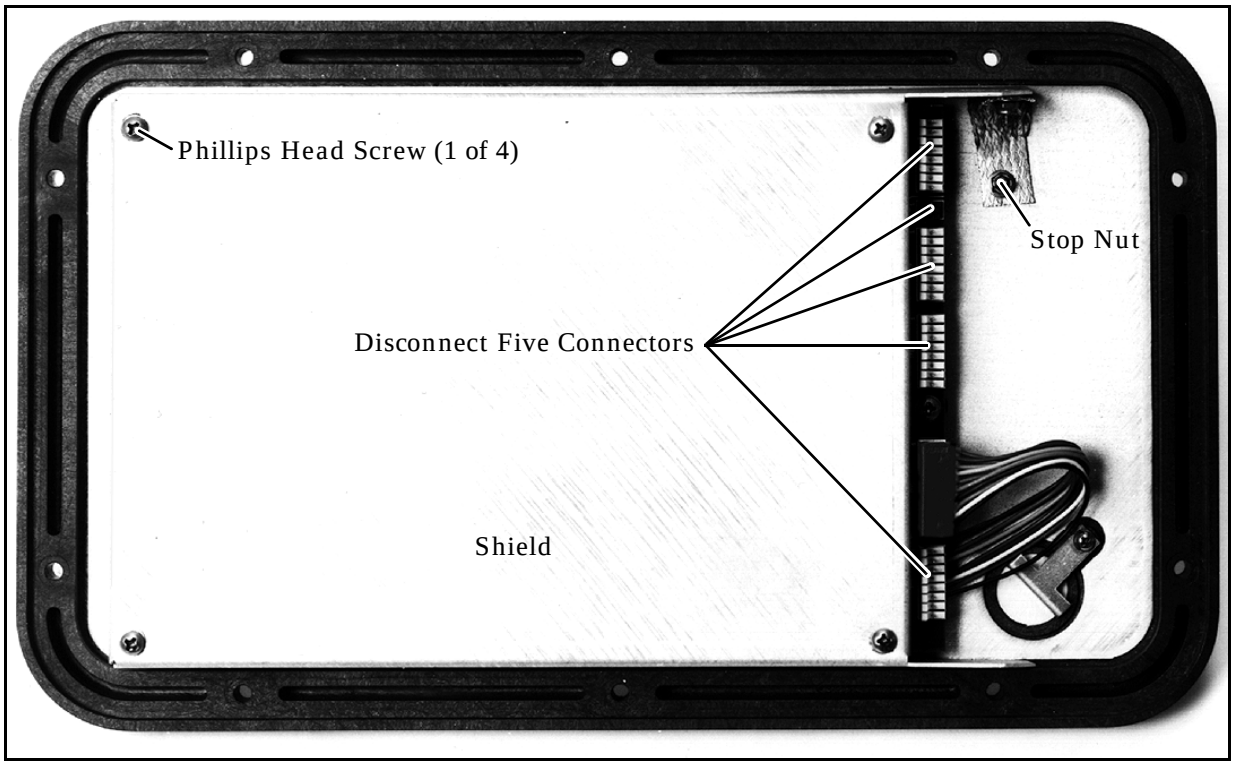


Figure 46 Main Circuit Board

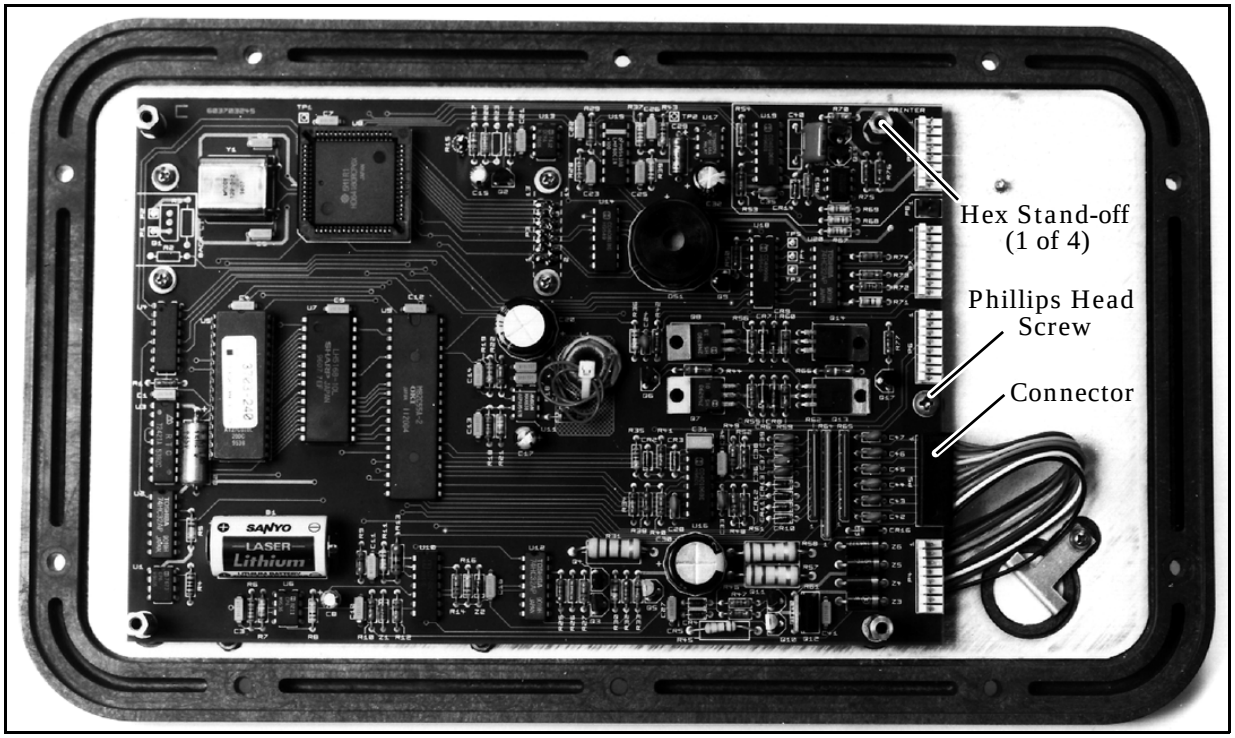
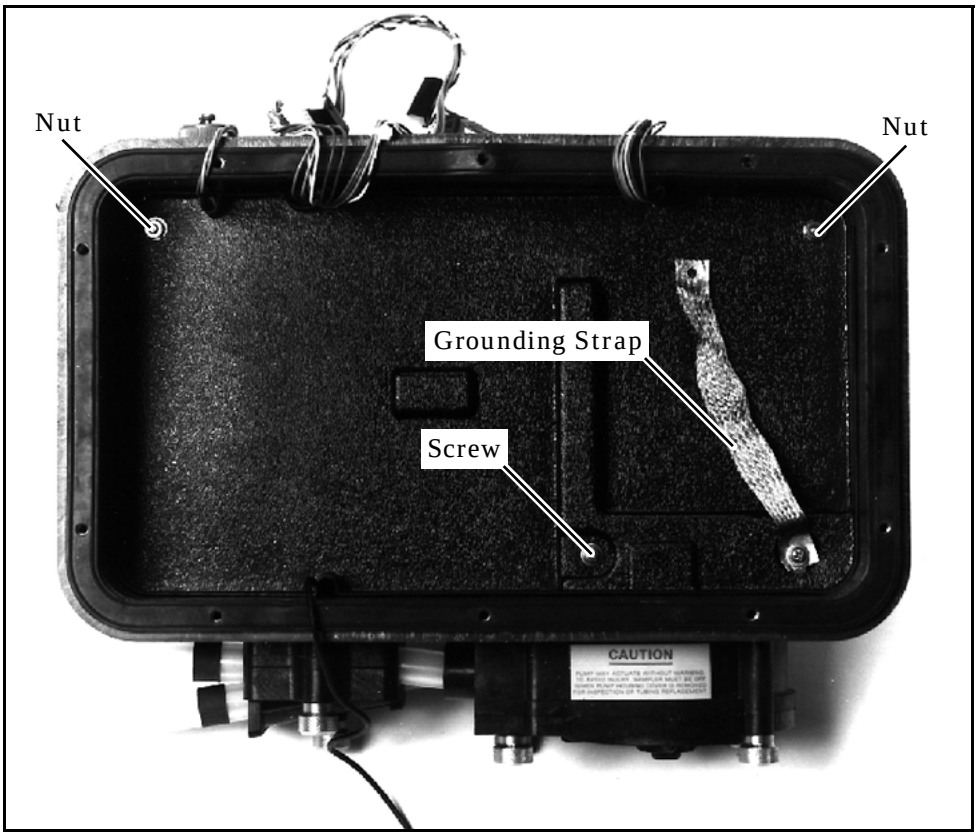


Figure 47 Control Box Tray Removal



⚠ Removal of the Distributor Gear Case Assembly

The distributor gear case assembly is located in the lower section of the control box. To gain access to the lower section of the control box, follow the instructions in *Access to Electronic Components*, on page 114. Use the steps below to gain access to these and other components in the control box lower section:

⚠ CAUTION

Disconnect power from the refrigerator and controller when working on the unit.

Keep yourself grounded when handling disassembled equipment.

1. Remove the two nuts, the screw, and the grounding strap indicated in **Figure 47**.
2. Lift the plastic tray straight up out of the control box.
3. The distributor gear case can be removed from the control box by unscrewing the four screws at the base of the distributor, and disconnecting the two grounding straps.

The distributor can be replaced by reversing these steps. Ensure that all hardware and connections are secure.

⚠ Removal of the Pump Gear Case Assembly

The pump gear case assembly is located in the lower section of the control box. To gain access to the lower section of the control box, follow the instructions in *Access to Electronic Components*, on page 114. Use the following steps to remove the pump gear case.

⚠ CAUTION

Disconnect power from the refrigerator and controller when working on the unit.

Keep yourself grounded when handling disassembled equipment.

1. Remove the two nuts, the screw, and the grounding strap indicated in **Figure 47**.
2. Lift the plastic tray straight up out of the control box.
3. Remove the liquid detector lid and the pump lid by loosening the captivated thumbscrews on the pump exterior. **Figure 31,** on page 100 shows the location of the thumbscrews.
4. Remove the pump tubing from the interior of the pump.
5. Remove the pump rotor by loosening the machine screw and locknut attaching the rotor to the pump shaft. **Figure 32,** on page 101 shows the location of the machine screw. Rotate the rotor until you can reach the screw with a screwdriver inserted through the pump case inlet sleeve.
6. Slide the rotor off the pump shaft.
7. Remove the pump case by unscrewing the four screws on the back of pump's inner case.
8. Lift the pump gear case assembly out of the control box.

The pump gear case can be replaced by reversing these steps. Ensure that all hardware and connections are secure.

⚠ Precautions for Servicing CMOS Circuitry

Most of the circuitry in the 3700 Sampler is made up of CMOS components. Because of the oxide gate structure of these devices, they are extremely susceptible to destruction caused by the discharge of static electricity through their inputs.

⚠ CAUTION

Disconnect power from the refrigerator and controller when working on the unit.

Keep yourself grounded when handling disassembled equipment.

Preliminary Electronics Troubleshooting Steps

Following are suggested areas to check before attempting to service the microprocessor CPU and associated circuitry. These checks should be made before looking at the CPU and memory.

1. Supply voltage is correct.
2. Wiring harnesses, connectors, and solder joints are in good condition.
3. Appearance of physical damage, such as burned or broken components, overly hot components, or evidence of water damage.
4. Shorted or open diodes and transistors, especially drive transistors.
5. Voltage regulators working properly.
6. Excessive current draw in the circuitry.
7. Correct input signals to unit.
8. Crystal oscillator operating at proper frequency.
9. Reset circuitry working properly.

CIRCUIT BOARDS

The following is a general description of the 3700 electronic circuitry. While reading this description, refer to the main circuit board schematic diagram (**Figure 48**), the case schematic diagram (**Figure 50**), and the pictorial views of the circuit boards (**Figures 49** and **51**).

The 3700FR Sampler is a microprocessor-based device which executes a program stored in ROM. The program (software) is a series of instructions that tell the microprocessor what to do in order to accomplish the various functions which the sampler must perform. The software is discussed only as is necessary to describe the operation of the circuitry (hardware). The hardware is discussed below.

A connector on the side of the control box is used to connect to an external 12 V⎓ source. A 3.75 Amp PTC device provides circuit protection.

The 3700FR Sampler contains two printed circuit boards: the main board and the pump control board. The display module (attached to the main circuit board) also contains a small circuit board. This module is purchased assembled and does not contain any user-serviceable parts. Unless it is being replaced, the module should not be disturbed.

Main Board

Power is supplied to the circuitry through P4 – pin 1 is ground and pin 2 is 12 V. A 5 V switching regulator (IC U11) is used to obtain a 5 V rail from the 12 V supply. All of the ICs used in the 3700FR Sampler get their operating power from the 5 V rail. IC U11 is also used as a low voltage detector – it constantly monitors the 12 V supply. IC U17, a voltage converter, provides a -5 V supply which is needed for some components.

IC U8 is the microprocessor, IC U5 is the ROM, and IC U7 is the RAM. These three ICs make up the "brains" of the 3700FR Sampler. The microprocessor executes the program stored in ROM. While executing, information (program settings, sample data, etc.) is retrieved from and stored in RAM. A 4.608 MHz crystal oscillator (Y1) sets the microprocessor's execution speed. The 3700FR Sampler keeps track of time with a real time clock (IC U3). Both the RAM and IC U3 are battery-backed with a lithium battery (B1). IC U1 is a switch which selects between battery and system power.

Three devices allow the microprocessor to communicate with the outside world: the 2 line, 20 characters per line LCD, IC U9, and IC U18. The LCD allows for communication with the user and is connected through P3. IC U13, transistor Q2, thermistor R15, and other components provide the LCD with a temperature compensated driver voltage. By providing temperature compensation, the display quality is optimized over a wide temperature range. However, when the operating temperature drops below freezing, the LCD may become difficult to read, particularly if the text is blinking. The display will return to normal when the temperature rises above freezing.

IC U9 and IC U18 are I/O devices which allow the microprocessor to: read the keypad, sound the beeper, advance the distributor, count pump counts, and so on.

A 24 position keypad, connected at P5, is used to direct the microprocessor through the program. Many discrete components along with IC U9 are used to decode pressed keys. All user-originated instructions to the 3700FR Sampler enter the system through the keypad.

The 3700FR Sampler is supplied with a liquid detection system that gives it the ability to accurately deliver specified sample volumes. The liquid detection system consists of a piezoelectric sensor and filtering circuitry. The sensor, mounted on the exterior of the control box, produces a signal proportional to an induced strain on the pump tubing. This signal is routed through P8 to IC U15 and its associated circuitry where it is massaged into a YES or NO indication of liquid presence. IC U15, containing a switched capacitor low pass filter and two Op Amps, is the main circuit component of the detection system.

A collection of transistors, resistors, and diodes are used to control the distributor motor. The motor control circuitry connects to the distributor through P6 and can drive the distributor in either direction. As the distributor moves, its position is monitored by an optical device mounted to the distributor assembly. IC U20 supplies the necessary current for the optical device.

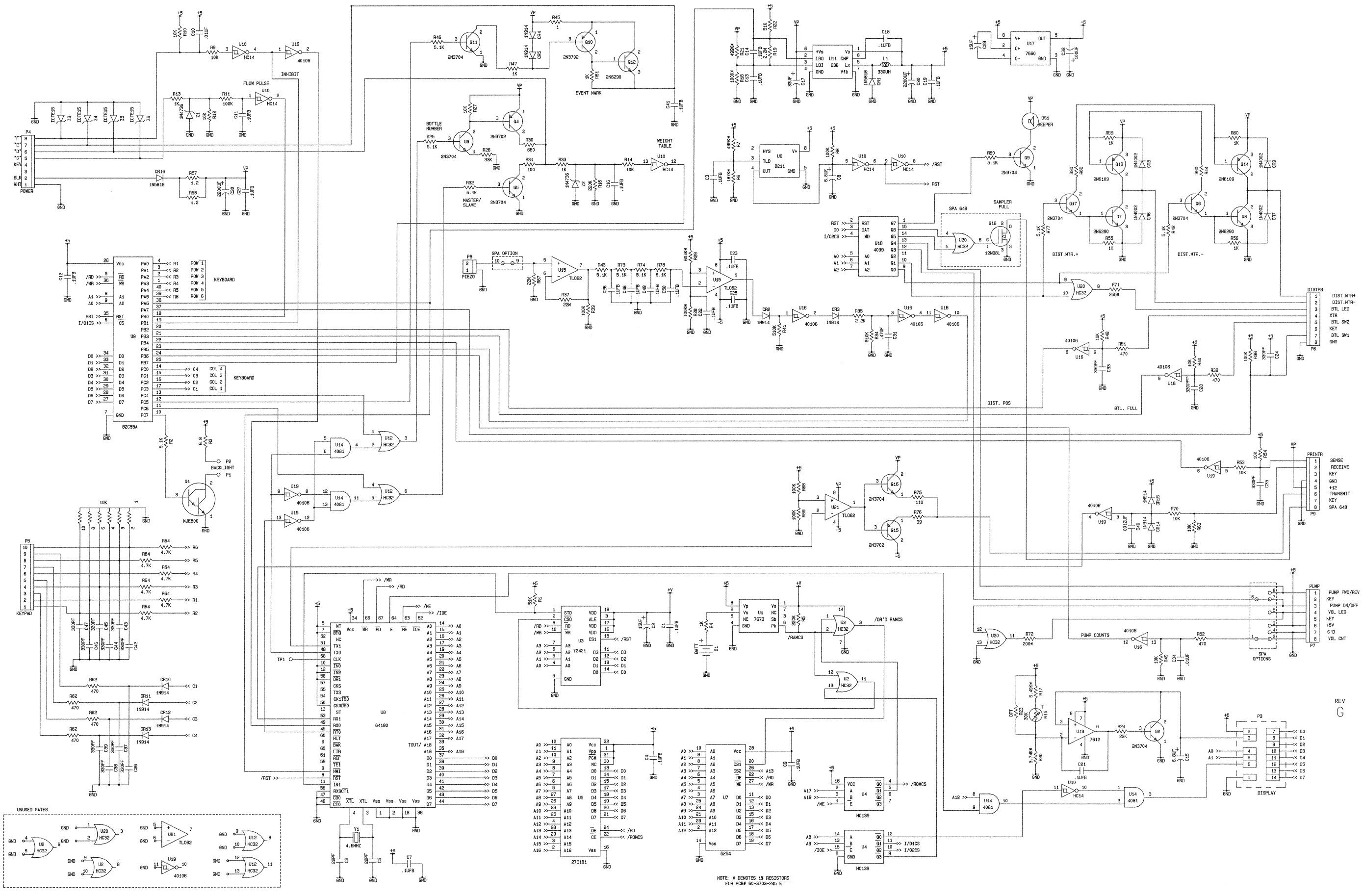
An RS-232 serial communications port is connected to the system at P9. This port is used to output sampler status, program settings, and sampling results to a printer or an interrogator. IC U21, IC U19, and a handful of discrete components are used to transmit serial information, receive serial information, and sense the externally connected device.

Pump Control Board

The pump control board is an integral part of the pump assembly and serves two functions: control the pump motor and sense pump revolutions. The pump motor control consists of a 2-pole double-throw relay (K201) and transistor switches (Q201, Q202 and Q203). The relay is used to change the pumping direction and will run the pump in the reverse direction when in the rest state. Each time the pump runs, the microprocessor sends the

pumping direction signal through pin 1 of P7, waits for the relay to change state, then starts the pump by sending a high signal through pin 3 of P7. Waiting for the relay to change state before applying power prevents arcing at the relay contacts.

Figure 48 3700 Controller Main Circuit Board Schematic



REV G

60-3703-253

Figure 49 Main Circuit Board Component Layout

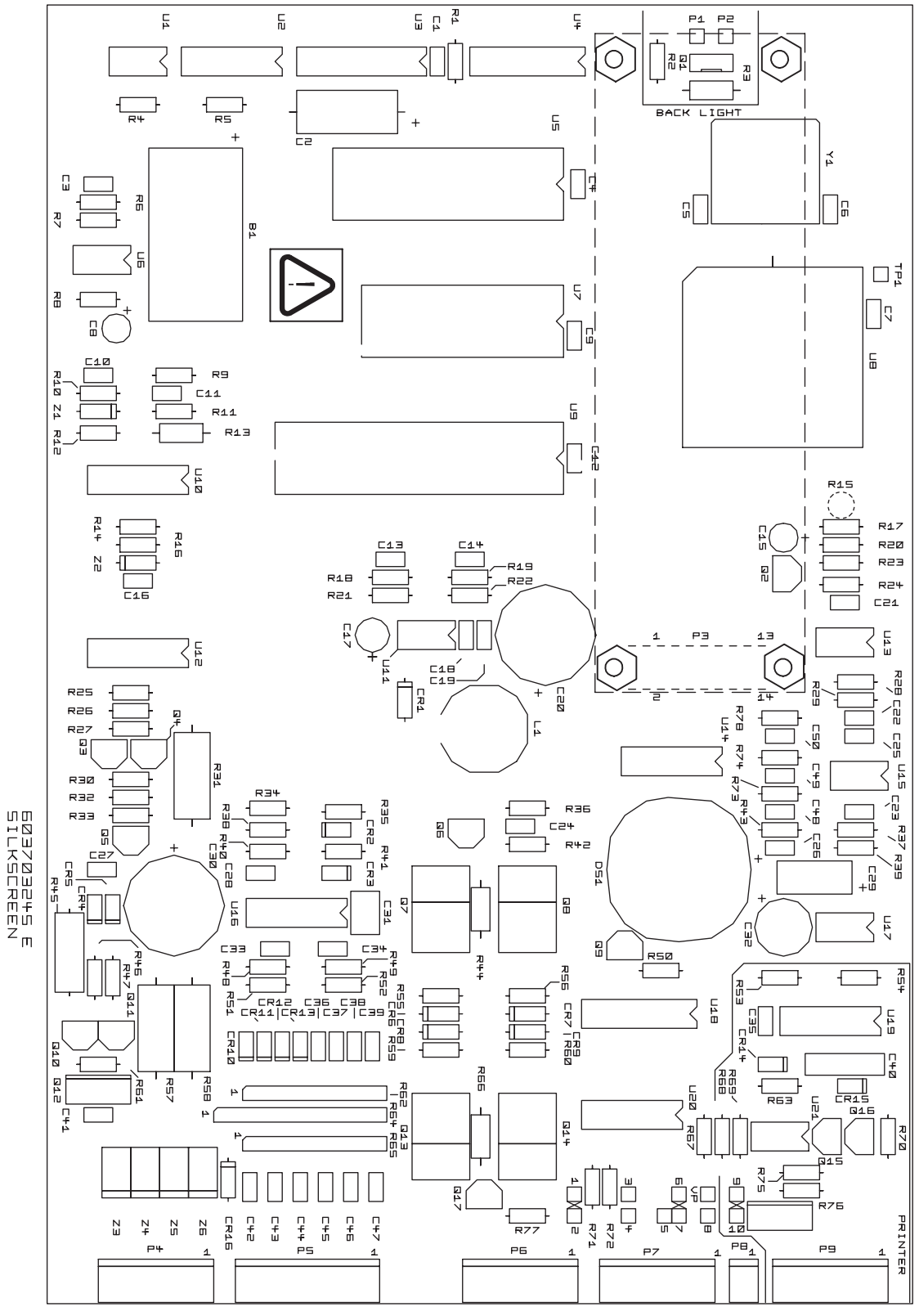


Figure 50 Case Schematic Diagram

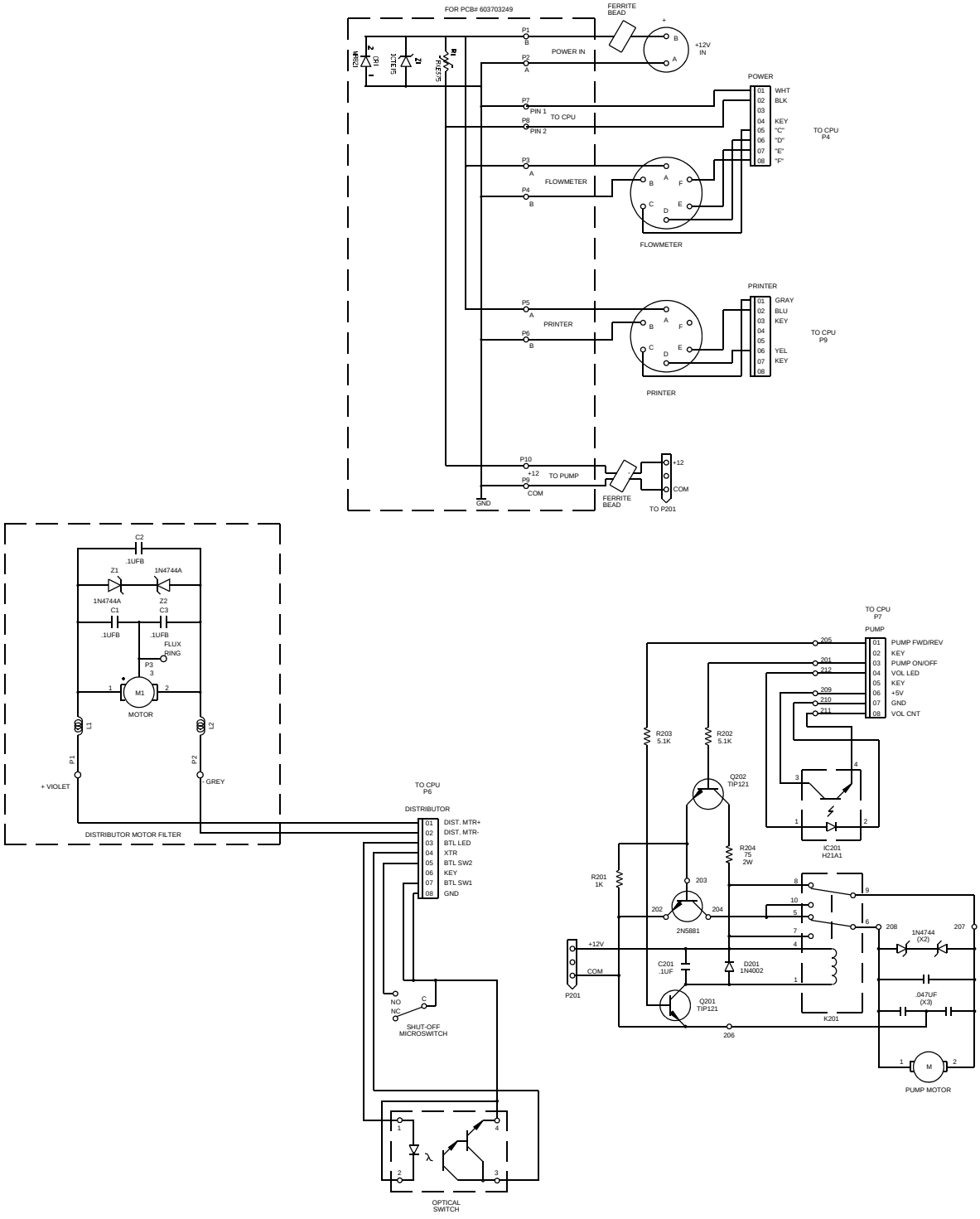
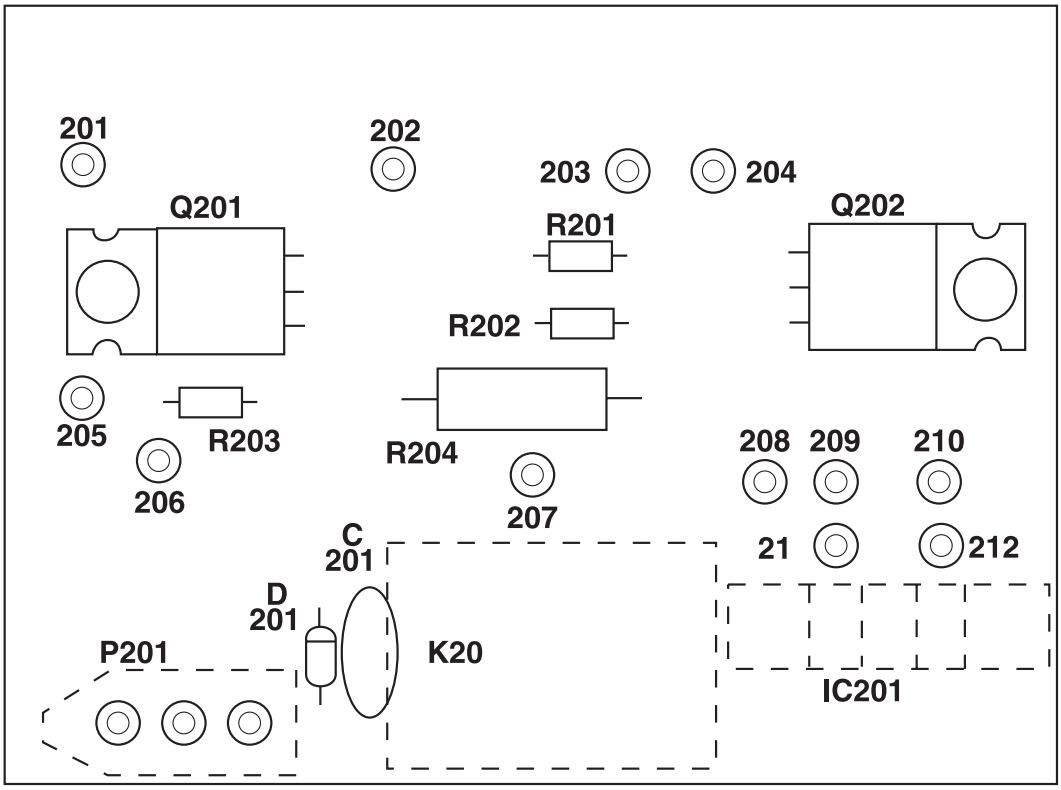


Figure 51 Optical Counter PCB Component Layout



A key element of the pump revolution count sensor is the LED-phototransistor device (IC201). Whenever the pump is running, power is supplied to IC201. A rotating disk positioned between the LED and phototransistor periodically interrupts the transmitted signal. These interruptions create pulses which are sent back to the main board at pin 8 of P7 to be counted. The microprocessor uses these counts to determine the pumped volume.

Sample Event Cycle and Delivery of Sample Volumes

The sequence of steps in a typical sequential sample event is described below. Should you suspect a malfunction in the delivery of the sample volumes, this information will assist you in determining the point at which the problem occurs.

1. A sample event is initiated.
2. The pump rotates in the reverse direction to air purge the suction line inlet of any debris.
3. The pump direction changes, pumping in the forward direction to fill the suction line.
4. After the suction line has been filled to the pump inlet, the sample volume measuring portion of the sampling cycle begins. The pump continues to rotate in the forward direction until the programmed sample volume is delivered.
5. The pump direction again changes, pumping in the reverse direction to air purge the suction line to avoid cross-contamination of samples. The pump then shuts off.
6. The sampler waits until another sample event is initiated and the cycle begins again at step 1.

Peristaltic Pump

The following is a brief description of the method by which the sample volume is determined. The 3700 Sampler uses a peristaltic pump to transport the sample from the source to the sample bottle. When compared with other suction lift sample gathering methods, a peristaltic pump has numerous advantages: simplicity, reliability, no metering chamber required, easily cleaned, etc.

Volumetric Determination

The 3700 Sampler determines the volumetric delivery of its peristaltic pump by electronically counting revolutions of the pump rotor. Each revolution of the pump rotor corresponds to a fixed number of "pump counts" and a certain volume of sample liquid. However, the volume of liquid delivered by one revolution of the pump rotor changes with the suction head and the type of suction line. At each sample event, the 3700 liquid detection system automatically compensates for changes in suction head and adjusts the volume delivered for each revolution of the pump. Thus, for a given type of suction line, each revolution of the pump rotor results in the delivery of a known amount of sample volume.

Sample Delivery

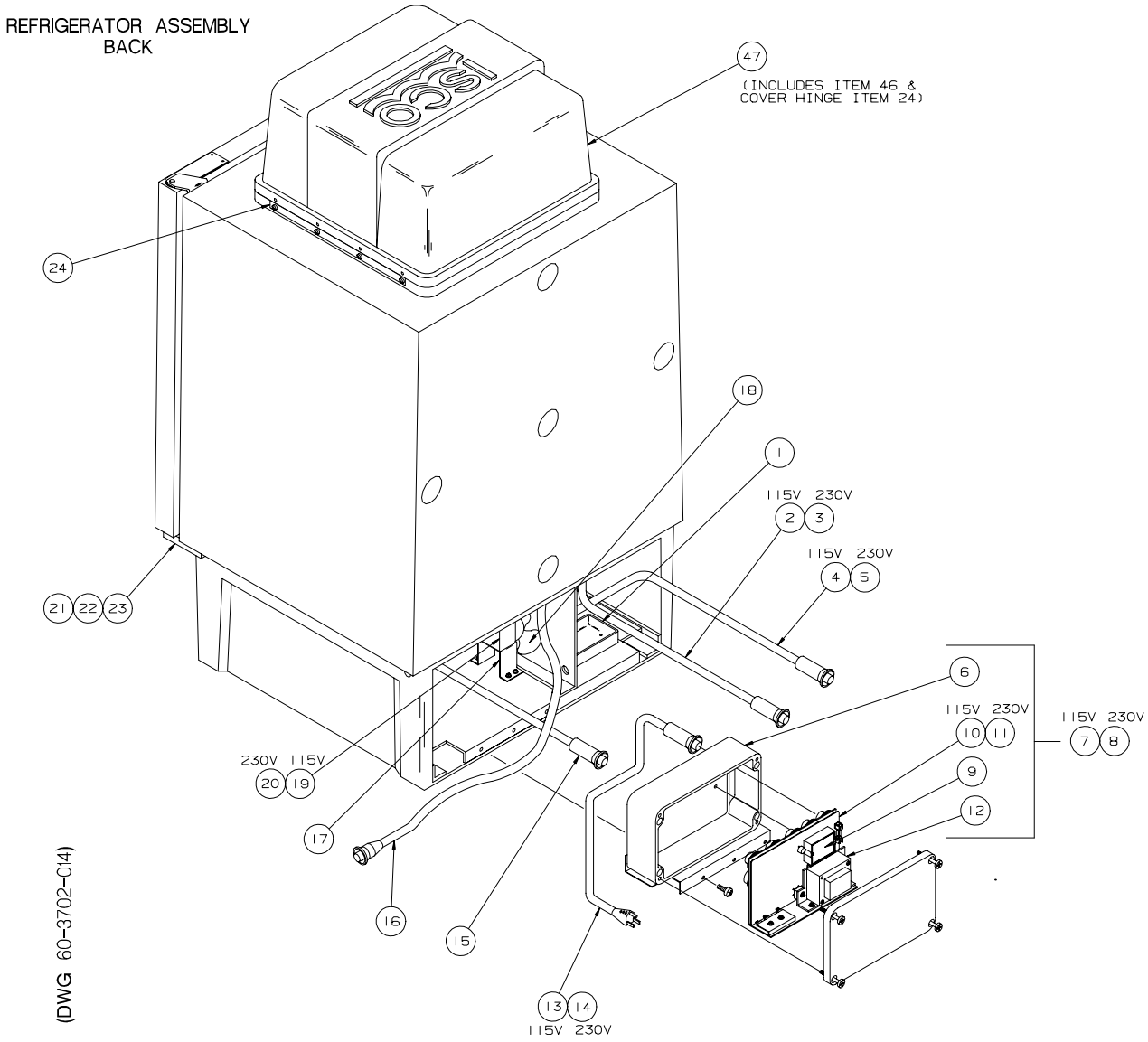
The sample pumping portion of a sample event consists of three parts: suction line fill, liquid detection, and sample volume delivery. The sampler counts the number of pump revolutions as the suction line fills. At liquid detection, the controller uses that count to determine the proper number of pump revolutions required to deliver the programmed sample volume. It is important to note that the volume delivered by a peristaltic pump can be influenced by a number of factors other than those discussed above. Thus, even with the sophistication of the sample volume measuring functions of the 3700 Sampler, the volume of sample deposited in the sample bottle may vary from the programmed value. The repeatability of a sample volume from sample to sample (which normally is the most important consideration) will typically be within the ± 10 ml specification stated in **Table 1,** on page 6.

Replacement Parts List

An illustrated list of common replacement parts for the 3700FR/3720 follows. When ordering a replacement part, be sure to include the Isco part number, a complete description, and the serial number of the unit on which the part is to be used. The controller and the refrigerator are serialized separately. The controller serial number is located on the side of the unit and the refrigerator serial number is located on the inside of the door.

Accessory Parts List

A list of options and accessory parts described throughout this manual can be found in the *Appendix A Accessories List*, on page 140. When ordering an option or accessory, include the part description and the Isco part number.

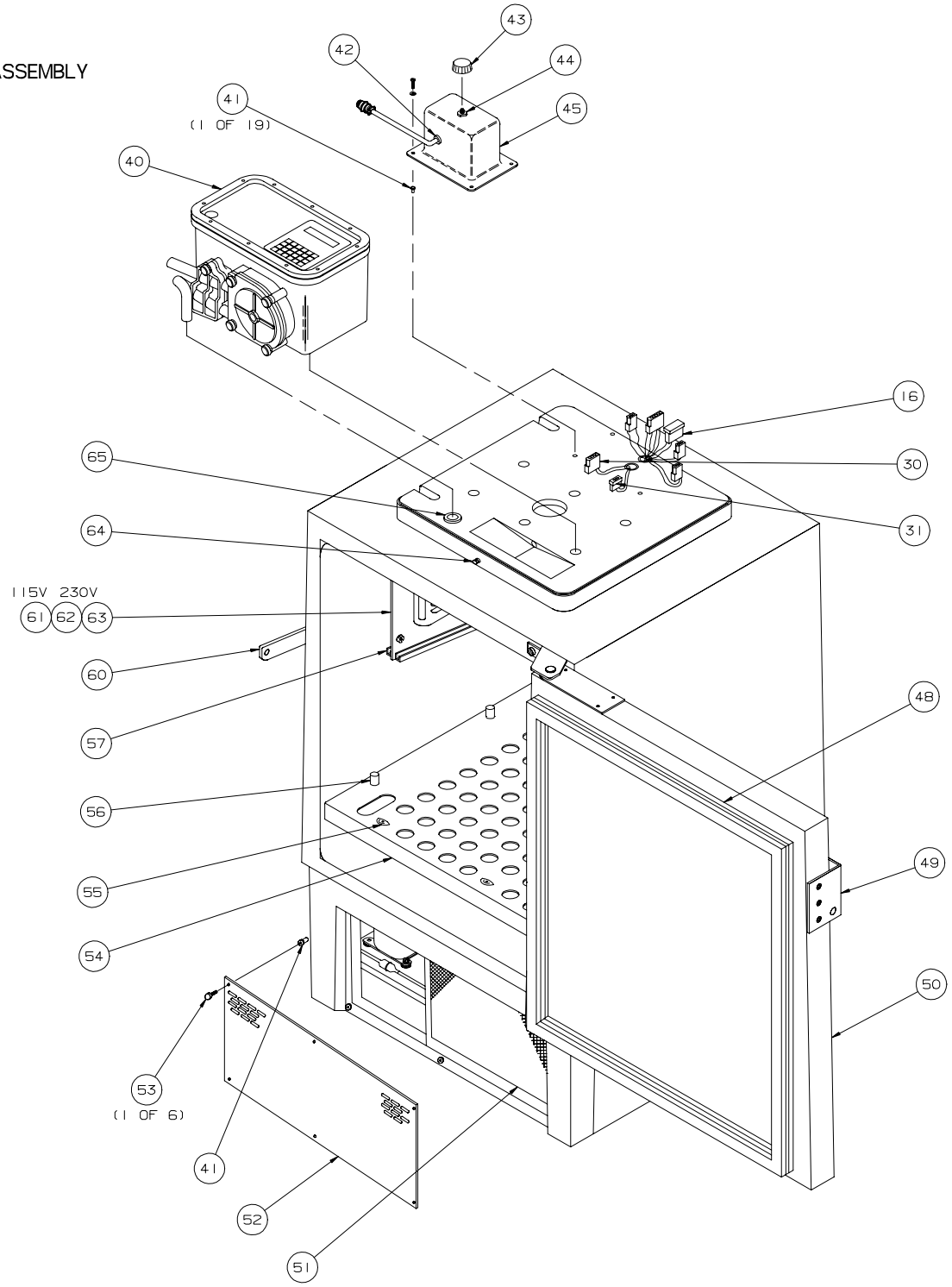

REFRIGERATOR ASSEMBLY
BACK
47
(INCLUDES ITEM 46 &
COVER HINGE ITEM 24)
24
18
1
115V 230V
2 3
115V 230V
4 5
21 22 23
6
115V 230V
10 11
115V 230V
7 8
9
12
230V 115V
20 19
17
16
15
13 14
115V 230V
(DWG 60-3702-014)

ITEM	INVENTORY NO.	DESCRIPTION
1	60-2723-068	DRIP PAN
2	60-9004-260	EVAPORATOR HEATER ASSY. 115 VAC
3	60-9004-204	EVAPORATOR HEATER ASSY. 230 VAC
4	60-9004-256	CRANKCASE HEATER ASSY. 115 VAC
5	60-9004-228	CRANKCASE HEATER ASSY. 230 VAC
6	60-9003-479	TEMPERATURE CONTROL BOX
7	60-9004-208	TEMPERATURE CONTROL BOX ASSY 115 VAC
8	60-9004-225	TEMPERATURE CONTROL BOX ASSY 230 VAC
9	366-0001-00	SOLID STATE RELAY
10	60-9004-257	PCB ASSY, 115 VAC
11	60-9004-217	PCB ASSY, 230 VAC
12	442-4899-03	TRANSFORMER
13	60-9004-242	LINE CORD ASSY 115 VAC
14	60-9004-230	LINE CORD ASSY 230 VAC
15	60-9004-241	AMBIENT AIR TEMP. SENSOR
16	60-9004-224	SAMPLER POWER WIRING ASSY
17	60-2723-133	FAN MOUNT
18	209-0195-03	FAN BLADE
19	304-2300-09	MOTOR FAN 115 VAC
20	304-2300-19	MOTOR FAN 230VAC
21	60-2724-066	DOOR HING ASSY BOTTOM
22	231-0149-12	SCREW 1/4-20 X 3/4
23	60-2723-007	HINGE BUSHING
24	60-2723-085	COVER HINGE
*25	432-0000-00	HEATER FLEX (CRANKCASE) 115 VAC
*26	432-0000-01	HEATER FLEX (CRANKCASE) 230 VAC
*27	099-0002-00	DESICCANT (BAG 8 oz)
*28	60-9003-498	REFRIGERATOR BACK COVER
*29	239-0906-32	WELL-NUT FASTNER (FOR AIR TEMP SENSOR)
*30	60-9004-226	AIR TEMP. SENSOR WIRING ASSY
*31	60-9004-240	EVAP. TEMP. SENSOR
*32	60-2723-134	FAN SHROUD MOUNT
*33	210-0003-01	COMPRESSOR 600 BTU/hr 115VAC
*34	210-0004-01	COMPRESSOR 600 BTU/hr 230VAC
*35	210-0003-02	OVERLOAD FOR COMPRESSOR 115 VAC
*36	210-0001-08	OVERLOAD FOR COMPRESSOR 230 VAC
*37	210-0003-03	RELAY FOR COMPRESSOR 115 VAC
*38	210-0001-07	RELAY FOR COMPRESSOR 230 VAC
*39	60-2724-058	CONDENSING COIL

NOTE: * ITEM IS NOT SHOWN IN ILLUSTRATION

(DWG 60-3702-014)

REFRIGERATOR ASSEMBLY
FRONT



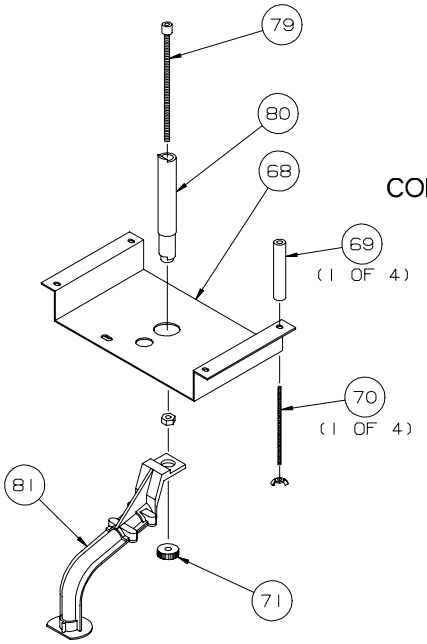
(DWG 60-3702-014)

(DWG 60-3702-014)

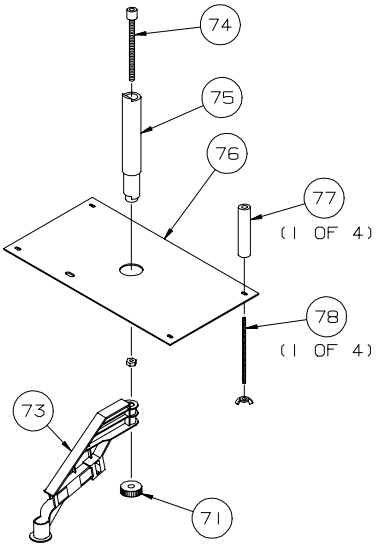
ITEM	INVENTORY NO.	DESCRIPTION
40	60-3704-001	MODEL 3700 CONTROLLER
41	239-0908-32	WELL-NUT FASTNER 8-32
42	209-0075-05	BSHG SR NYL
43	180-0012-01	KNOB PKG-100B-1/4
44	380-9510-70	POT 10K 2W 3/4 TURN
45	60-2723-150	THERMOSTAT HOUSING
*46	109-0800-00	OVER CENTER DRAW LATCH
47	60-2724-063	TOP COVER
48	60-2723-005	GASKET, REFRIGERATOR DOOR
49	61-2723-042	DOOR HANDEL POWDER COATED
50	60-2724-062	REFRIGERATOR DOOR
51	60-9003-182	FILTER FOR REFRIGERATOR
52	60-2723-032	GRILLE FOR REFRIGERATOR
53	60-2724-021	THUMBSCREW ASSY
54	60-2723-028	WIRE RACK PLATE
55	60-2723-041	WIRE RACK STOP
56	60-2724-065	ADJ POST REPLACEMENT KIT
57	60-9003-487	DRIP RAIL (LEFT)
*58	60-9003-489	DRIP TRAY (RIGHT)
*59	60-2723-034	DRIP TRAY
60	60-2723-043	DOOR LATCH POWDER COATED
61	60-9004-259	EVAPORATOR PLATE, COP. TUBING, & HTR. ASSY 115 VAC
62	60-9004-222	EVAPORATOR PLATE, COP. TUBING, & HTR. ASSY 230 VAC
63	60-2723-035	EVAPORATOR PLATE MOD.
64	60-2723-054	KEEPER, TOP COVER LATCH
65	60-2723-165	TUBE FEED THRU

NOTE: * ITEM IS NOT SHOWN IN ILLUSTRATION

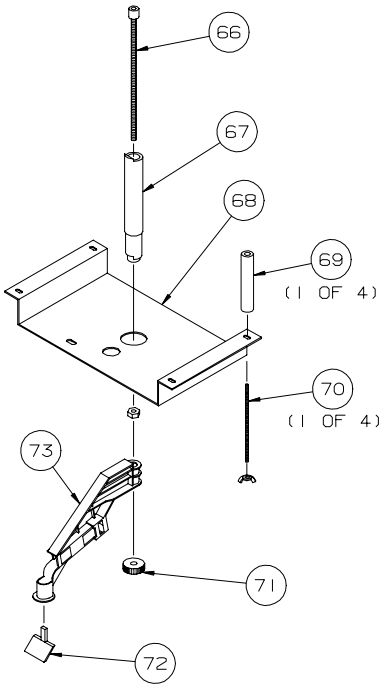
CONTROLLER MOUNTING KIT
1 OR 24 BOTTLE



CONTROLLER MOUNTING KIT
2 BOTTLE



CONTROLLER MOUNTING KIT
8 BOTTLE

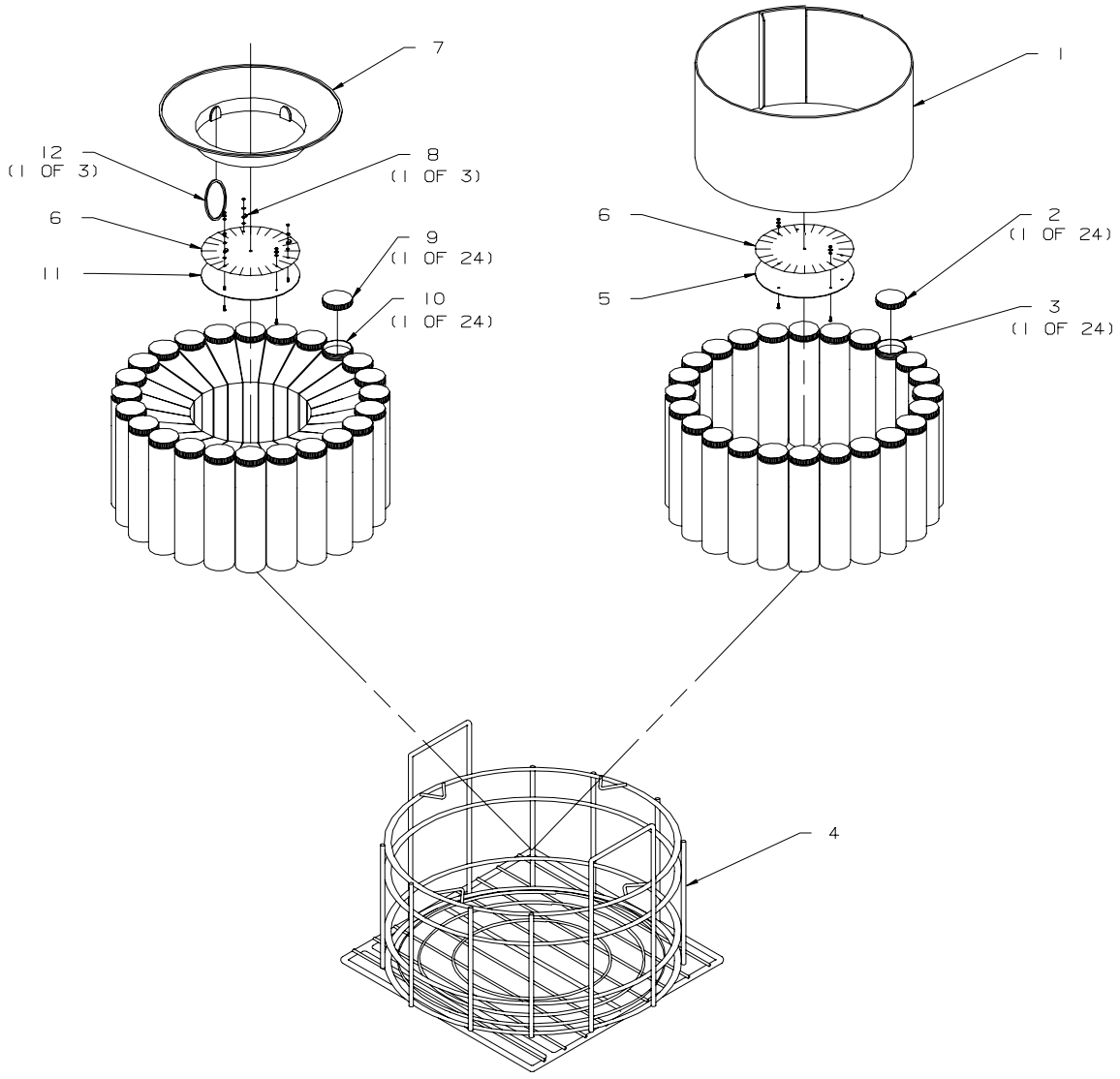


ITEM	INVENTORY NO.	DESCRIPTION
66	60-2724-041	DRAW BOLT ASSY, 8 BTL
67	60-2723-098	DIST SHAFT EXTENSION, 8 BTL
68	61-2743-009	SUPPORT BRACKET CLR ANDZD
69	60-2723-064	SPCR 3/4 RND DELRN .191D X 3-9/16
70	60-2723-065	THD ROD SST 8-32 X 4-3/4LG
71	60-2923-007	DISTRIBUTOR ARM NUT
72	61-2743-039	LIQUID DEFLECTOR PTFE COATED
73	60-2903-008	DISTRIBUTOR ARM
74	60-2724-040	DRAW BOLT ASSY, 2 BTL
75	60-2723-097	DIST SHAFT EXTENSION, 2 BTL
76	61-2743-037	SUPPORT BKT 2 BTL CLR ANDZD
77	60-2733-010	SPCR 3/4RND DELRIN .191D X 2-3/4
78	60-2733-009	CONTROLLER MOUNTING ROD
79	60-2724-019	DRAW BOLT ASSY, 24 BTL
80	60-2723-057	DIST SHAFT EXTENSION, 24 BTL
81	60-2744-028	DISTRIBUTOR ARM ASSY

(DWG 60-3702-014)

BOTTLE RACK ASSEMBLY
24 PLASTIC BOTTLES

BOTTLE RACK ASSEMBLY
24 GLASS BOTTLES

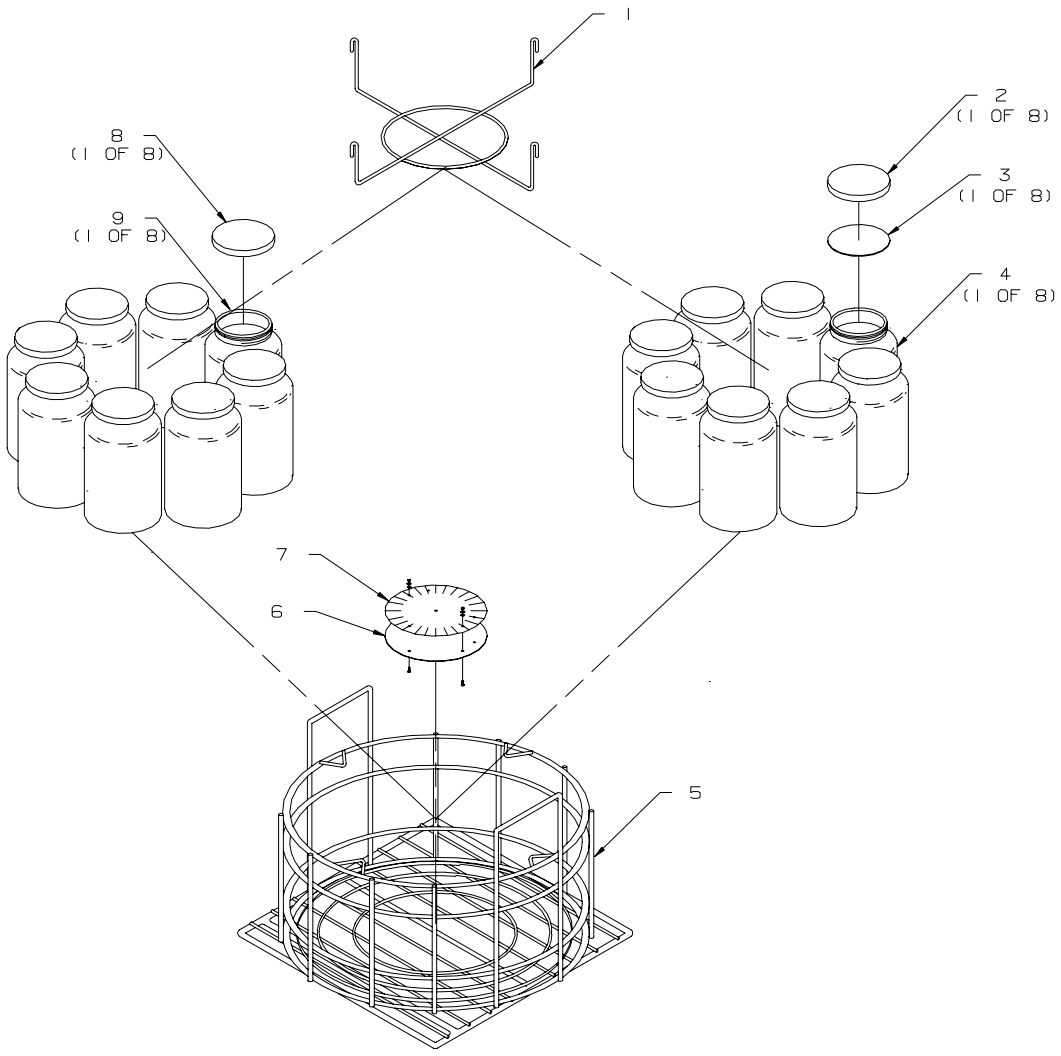


ITEM	INVENTORY NO.	DESCRIPTION
1	602724020	EXPANDER ASSY GLS BTL
2	299048406	CAP POLYPRO 48MM W/TEF LINER
3	601683132	BOTTLE GLS 2100/2700
4	602723006	BOTTLE WIRE RACK
5	612723009	WIRE RACK PLATE IRR
6	602723010	LABEL BOTTLE LOCATION
7	609003242	RETAINING RING 24 IL BTL
8	489000200	CLAMP CBL .25 NYL
9	299048407	CAP W/POLYETHYLENE FOAM LINER
10	602103095	IL BOTTLE POLYPROPYLENE
11	602724022	BASE PLATE ASSY
12	603704111	BOTTLE HOLD DOWN CORD ASSY

(DWG 60-3703-266 Rev B)

BOTTLE RACK ASSEMBLY
8 PLASTIC BOTTLES

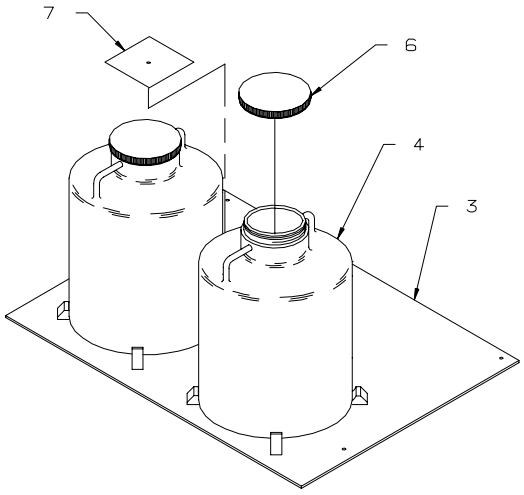
BOTTLE RACK ASSEMBLY
8 GLASS BOTTLES



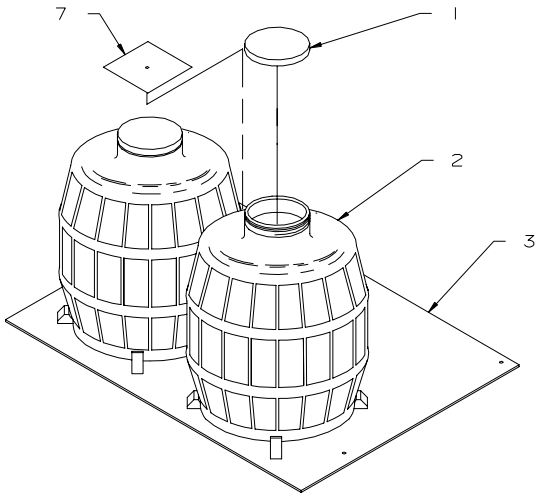
(DWG 60-3703-266 Rev B)

ITEM	INVENTORY NO.	DESCRIPTION
1	602743024	EIGHT BOTTLE ADAPTER
2	291000002	CAP POLYPRO LNRLS 83MM
3	299008900	LNR - TEF 83MM X .020 THK
4	291000800	JAR GLS 1/2 GAL BALL
5	602723006	BOTTLE WIRE RACK
6	612723009	WIRE RACK PLATE IRR
7	602723010	LABEL BOTTLE LOCATION
8	291000003	CAP POLYPRO LNRLS 100MM
9	299001902	JAR POLYETH 4 PT JAR WD MOUTH

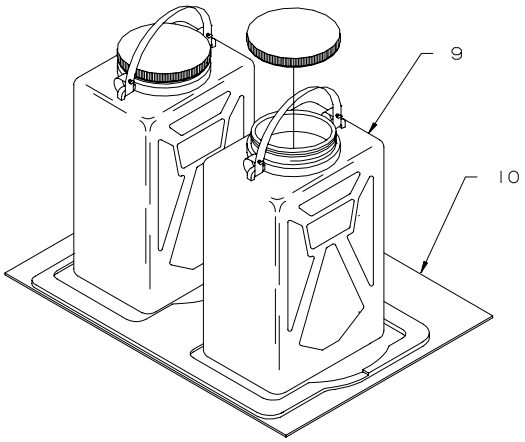
BOTTLE RACK ASSEMBLY
2 PLASTIC BOTTLES
(3700R ONLY)



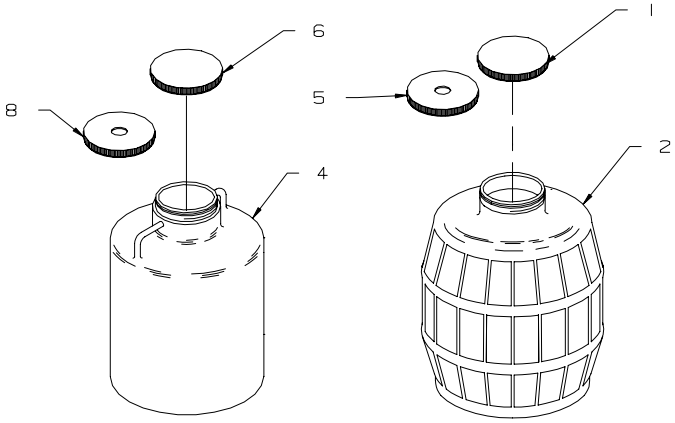
BOTTLE RACK ASSEMBLY
2 GLASS BOTTLES



BOTTLE RACK ASSEMBLY
2 PLASTIC BOTTLES
(3700FR ONLY)

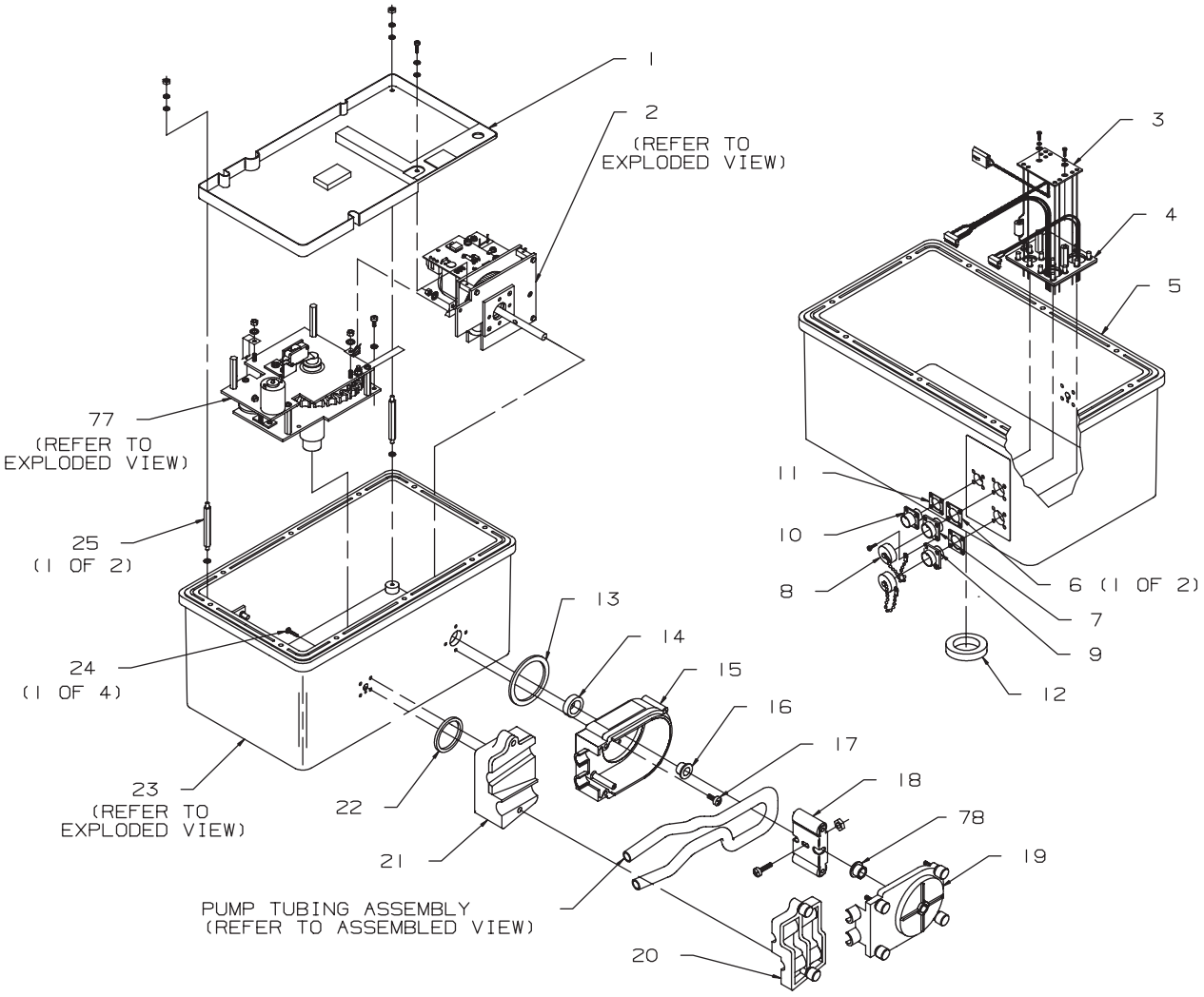


SINGLE BOTTLE SAMPLING
PLASTIC OR GLASS



(DWG 60-3703-266 Rev B)

ITEM	INVENTORY NO.	DESCRIPTION
1	603004193	LID & LINER ASSY
2	291000000	BTL GLS 2-1/2 GAL W/CAP BALE
3	602743038	LOCATING BASE - 2 BOTTLE
4	299001304	BTL NALGENE 2-1/2 GAL W/CAP
5	603004184	LID & LINER MOD ASSY 120MM
6	299001303	CAP BOTTLE LID
7	602743040	LOCATING BASE RETAINER - 2 BOTTLE
8	601623027	LID MOD PLS BTLS
9	299001307	BTL NALGENE 2 GAL REC W/CAP
10	602723102	LOCATING BASE, 2 BTL

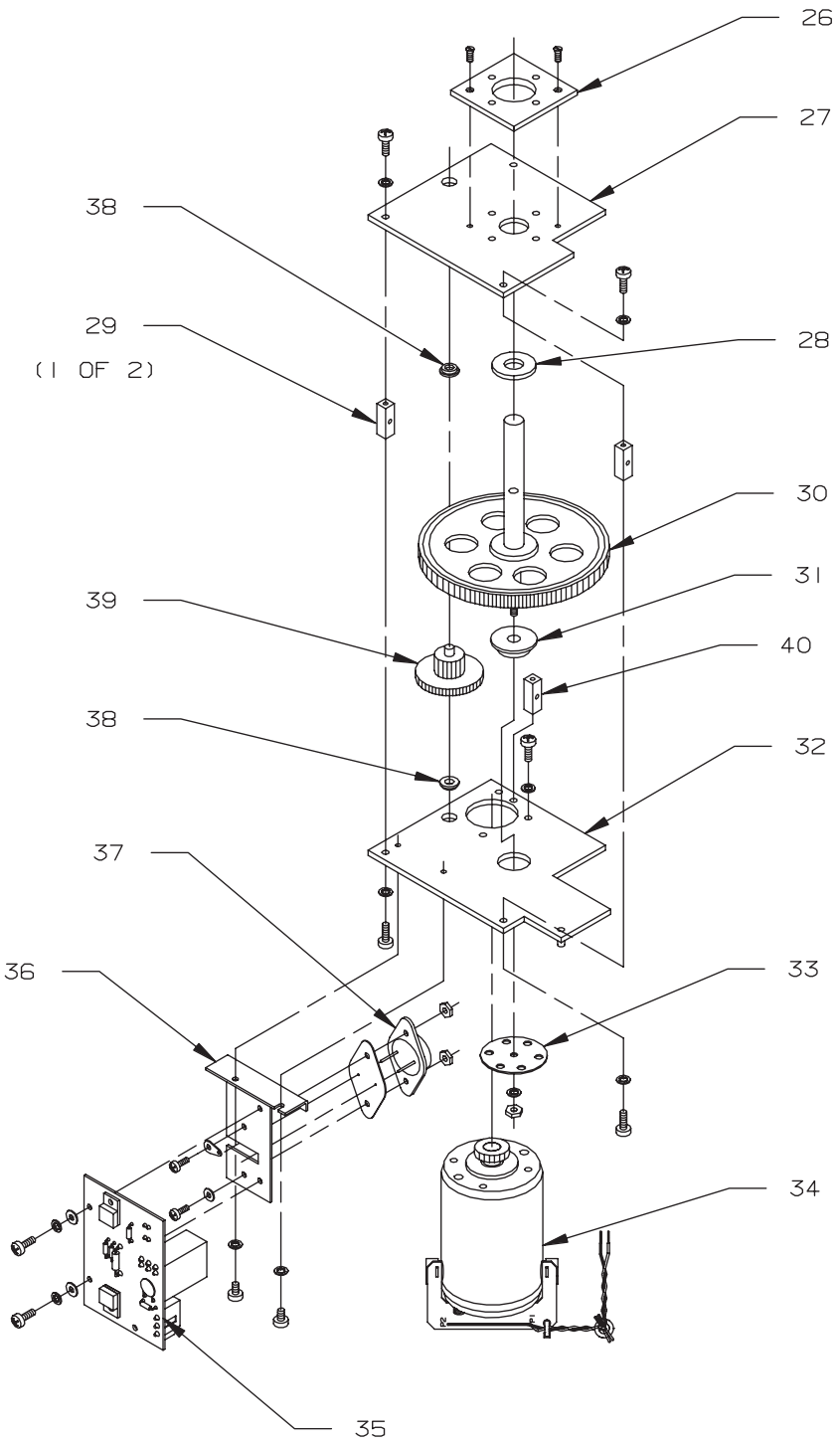


60-3703-268
REV. D

DRAWING NO: 60-3703-268
REVISION: D
SHEET 2 OF 8
EFFECTIVE DATE: 01283

REPLACEMENT PARTS LIST

ITEM NUMBER	PART NUMBER	DESCRIPTION
1	60-3703-252	DESICCANT TRAY, CE
2	60-3704-154	PUMP GEAR CASE ASSEMBLY, CE
3	60-3704-151	CIRCUIT BOARD ASSEMBLY, POWER SUPPLY CONNECTIONS
4	60-3704-156	BACK PLATE ASSEMBLY WITH GASKET, CE
5	60-3704-089	CONTROL BOX MODIFICATION ASSEMBLY
6	60-1473-057	SEAL GASKET, 6 PIN AMP
7	140-1006-00	PLUG, PANEL MOUNT, 6 PIN
8	149-1001-00	DUST COVER #14
9	60-3704-091	PRINTER CONNECTOR ASSEMBLY
10	140-1002-01	PLUG, PANEL MOUNT, 2 PIN
11	60-1393-082	SEAL GASKET, 2 PIN AMP
12	202-9999-04	LIP SEAL, 1.000 ID X 1.500 OD
13	202-1001-35	O RING, 1.925 ID, .103 CROSS SECTION, BUNA-N
14	202-9999-03	LIP SEAL, .375 ID X .750 OD
15	60-3704-019	PUMP HOUSING ASSEMBLY, INSIDE
16	60-3703-012	PUMP HOUSING BUSHING
17	231-9145-12	SCREW, MACHINE, 8-32 X ¾, SELF SEAL, STAINLESS STEEL
18	60-2704-019	PUMP ROTOR ASSEMBLY
19	60-3704-017	PUMP HOUSING ASSEMBLY, OUTSIDE (INCLUDES ITEM 78)
20	60-3704-021	DETECTOR LID ASSEMBLY
21	60-3704-022	DETECTOR BASE ASSEMBLY
22	202-4012-37	O RING, 1.237 ID, .103 CROSS SECTION
23	60-3704-152	CONTROL BOX SUB-ASSEMBLY, CE
24	231-0195-08	SCREW, MACHINE, 8-32 X ½, SELF-SEAL, STAINLESS STEEL
25	60-2703-170	STANDOFF, 6-32 X .25 HEX X 3.00 LONG, MALE, SST
77	60-3704-173	DISTRIBUTOR DRIVE ASSEMBLY, CE
78	60-3703-278	PUMP HOUSING BUSHING

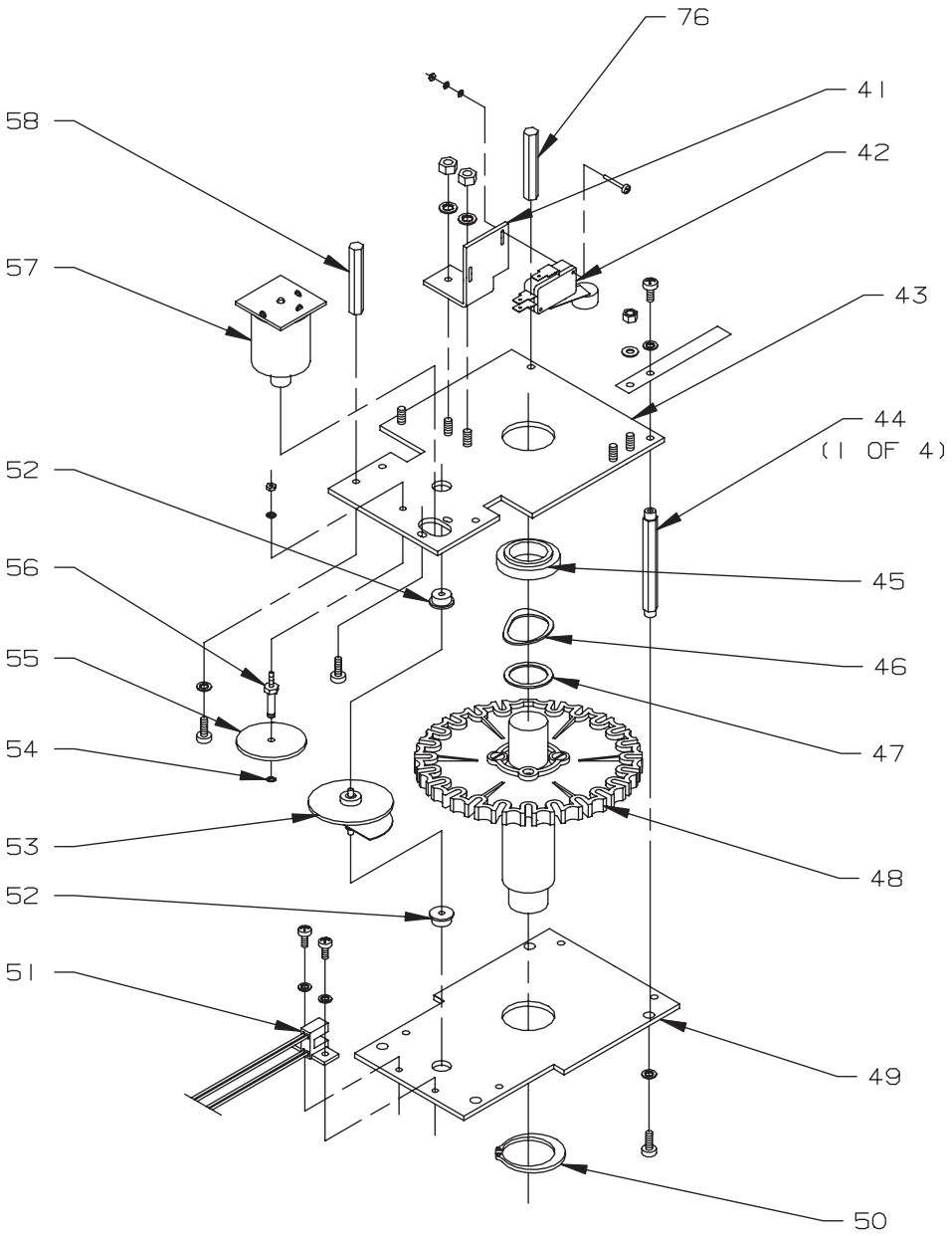


60-3703-268
REV. D

DRAWING NO: 60-3703-268
REVISION: D
SHEET 4 OF 8
EFFECTIVE DATE: 01283

REPLACEMENT PARTS LIST

ITEM NUMBER	PART NUMBER	DESCRIPTION
26	60-2703-037	PUMP SHAFT SPACER PLATE
27	60-2703-050	PUMP PLATE
28	60-2703-058	SPACER, .380 ID X 1.00 OD X .060 LONG
29	60-2703-096	STANDOFF, 6-32 X .25 SQUARE X .75 LONG
30	60-2704-010	PUMP SHAFT ASSEMBLY
31	60-2703-076	FLANGED BEARING, .275 ID X .625 OD X .31 LONG
32	60-3704-160	MOTOR PLATE ASSEMBLY, CE
33	60-2703-063	PUMP SHAFT OPTICAL DISK
34	60-3704-172	PUMP MOTOR WITH FILTER ASSEMBLY
35	60-2704-039	CIRCUIT BOARD ASSEMBLY, COUNTER
36	60-2704-048	MOUNTING PLATE ASSEMBLY, OPTICAL COUNTER
37	402-0258-01	TRANSISTOR, 2N5881/2N5882
38	201-3112-00	FLANGED BEARING, .189 ID X .314 OD X 1/8 LONG
39	60-2704-008	PUMP GEAR SHAFT ASSEMBLY
40	237-1150-00	STANDOFF, 6-32 X 3/16 ROUND X ¾ LONG

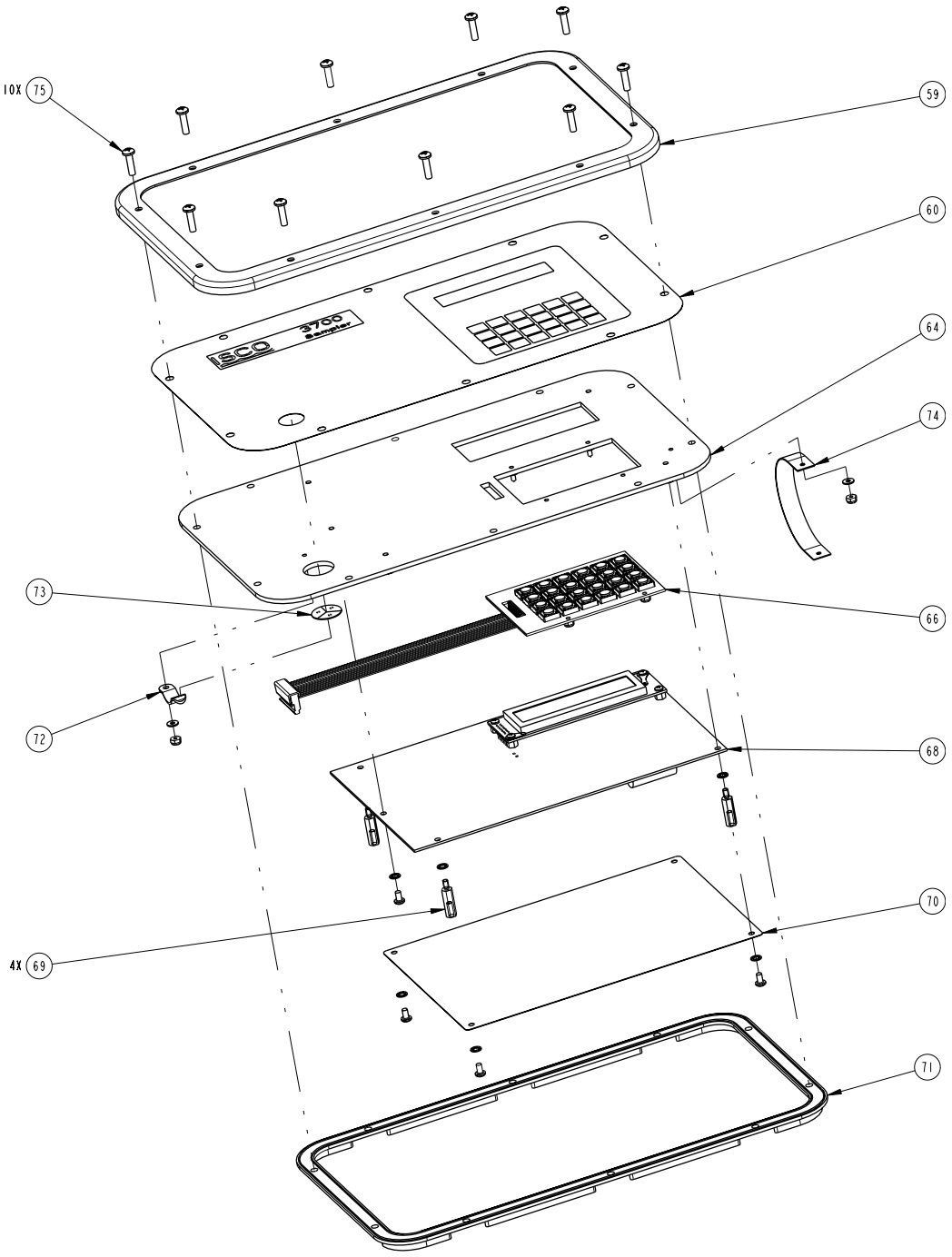


60-3703-268
REV. D

DRAWING NO: 60-3703-268
REVISION: D
SHEET 6 OF 8
EFFECTIVE DATE: 01283

REPLACEMENT PARTS LIST

ITEM NUMBER	PART NUMBER	DESCRIPTION
41	60-3703-016	MICROSWITCH MOUNTING PLATE
42	60-1484-033	MICROSWITCH ASSEMBLY, SHUTOFF
43	60-3704-163	DISTRIBUTOR TOP PLATE ASSEMBLY, CE
44	60-3703-038	DISTRIBUTOR DRIVE STANDOFF
45	60-3703-009	TOP SUPPORT BUSHING
46	233-6090-00	FINGER SPRING WASHER, .81 ID X 1.10 OD
47	233-0190-00	WASHER, FLAT, .770 ID X .969 OD, SST
48	60-3704-174	DISTRIBUTOR SHAFT ASSEMBLY
49	60-3703-250	DISTRIBUTOR BASE PLATE, CE
50	209-0017-10	RETAINING RING, EXTERNAL, 1.00 SHAFT, STEEL
51	60-3704-164	DISTRIBUTOR WIRING HARNESS, CE
52	201-3113-00	FLANGED BEARING, .127 ID X .315 OD X .250 LONG
53	60-3704-011	GENEVA DRIVE SHAFT ASSEMBLY
54	209-0005-01	RETAING RING, EXTERNAL, .125 SHAFT, SST
55	60-2703-062	GEAR MODIFICATION, COMBINATION
56	60-2703-151	IDLER SHAFT
57	60-3704-165	DISTRIBUTOR MOTOR ASSEMBLY, CE
58	60-3703-036	STANDOFF, 6-32 X .25 HEX X 1.560 LONG, ALUMINUM
76	60-3703-260	STANDOFF, 6-32 X .25 HEX X 1.500 LONG, ALUMINUM



60-3703-268
REV-D

603703268

REPLACEMENT PARTS LIST

SHEET: 8 OF 8

Isco, Inc.

REV: D | DATE: 02015

ITEM NO.	PART NUMBER	DESCRIPTION
59	693703282	RING TRIM
60	603703032	LABEL CONTROL PANEL
64	603708003	CONTROL PANEL STUD ASSEMBLY
66	693704003	WIRING ASSEMBLY KEYPAD
68	603704189	CIRCUIT BOARD ASSEMBLY, 3700 CPU, CE
69	603703028	STANDOFF 1/4 HEX, SST 6-32M/F X .781
70	693703008	ELECTROSTATIC DISCHARGE SHIELD
71	602703010	CONTROL BOX GASKET
72	209902138	TENSION CLIP 3/8 DIA.
73	490001300	HUMIDITY INDICATOR CARD
74	603703256	STRAP INTERCONNECT 5.5"
75	231514510	SCREW CAP SST 8-32 X 5/8

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

Appendix A Accessories List

General Accessories

Extra Silastic pump tubing, 46" length 60-3704-044
Model 3700FR Sampler controller 68-3720-025
Extra Pocket Guide, Model 3700R/3700FR 60-3703-178
Plastic graduated cylinder, 1000 ml, for sample volume calibration 299-0020-00

Bottles and Caps

Sample bottles, 1000 ml polypropylene without caps, case of 100 68-2100-008
Caps for 1000 ml polypropylene bottles, with polyethylene foam liners, case of 100 68-2100-010
Sample bottles, 350 ml glass without caps, case of 100 68-2100-002
Caps for 350 ml glass bottles with Teflon liners, case of 100 68-2100-003
1000-ml polypropylene sample bottles Set of 24, includes polyethylene foam lined caps 68-2100-007
350-ml glass sample bottles Set of 24, includes Teflon lined caps 68-2100-001
2.5 gallon polyethylene container with cap 299-0013-04
2.5 gallon glass container with cap and Teflon liner 68-2700-005
4 gallon polyethylene container with cap 299-0013-05

Suction Lines, Pump Tubing, and Strainers

1/4" ID x 10' vinyl suction line with weighted polypropylene bodied strainer 60-3704-067
1/4" ID x 25' vinyl suction line with weighted polypropylene bodied strainer 60-3704-068
3/8" ID x 10' vinyl suction line with weighted polypropylene bodied strainer 60-3704-071
3/8" ID x 25' vinyl suction line with weighted polypropylene bodied strainer 60-3704-072
3/8" ID x 10' Teflon suction line with protective coating, without strainer 60-1683-146
3/8" ID x 25' Teflon suction line with protective coating, without strainer 60-2703-114
1/4" ID vinyl tubing, bulk 100' 68-1680-055
1/4" ID vinyl tubing, bulk 500' 68-1680-056
1/4" ID vinyl tubing, bulk 1000' 68-1680-057
3/8" ID vinyl tubing, bulk 100' 68-1680-058
3/8" ID vinyl tubing, bulk 500' 68-1680-059
1/4" Vinyl suction line accessory kit (required for 1/4" suction lines) 68-3700-006
3/8" Vinyl suction line accessory kit (required for 3/8" suction line) 68-3700-007
Weighted strainer only, 1/4", polypropylene body 60-1394-070
Low flow strainer only, 1/4", all stainless steel 60-2903-081
Weighted strainer only, 3/8", all stainless steel 60-1684-110
Weighted strainer only, 3/8", polypropylene body 60-1394-071
Low flow strainer only, 3/8", all stainless steel (not recommended for use with Teflon suction line) 60-2903-079
Weighted strainer only, 3/8", all plastic 60-3704-066
Extra Silastic pump tubing, bulk 15' length 68-1680-061
Extra Silastic pump tubing, bulk 50' length 68-1680-065

POWER SOURCES

Model 913 High Capacity Power Pack (120-volt) 60-1684-088
Model 914 Battery-Backed Power Pack (120-volt) 60-3004-130
Model 923 High Capacity Power Pack (240-volt) 60-1684-093
Model 924 Battery-Backed Power Pack (240-volt) 60-3004-160
Model 934 Nickel-Cadmium Battery 60-1684-040
Model 946 Lead-Acid Battery 60-3004-106
Model 948 45-Amp-Hour Battery 68-3000-948
Portable 12-volt DC, 6-Amp Battery Charger for 948 Battery 341-0118-12
Model 961 Battery Charger (120-volt) 60-3004-059
Model 965 Five Station Battery Charger 68-3000-965
Model 954 Solar Panel Battery Charger 68-3000-027
Additional Solar Panel 68-3000-028
Solar Panel Cable (25-foot Length) 60-3004-097
Solar Panel “Y” Cable 60-3004-098
Solar Panel/Interrogator. Extension Cable 60-2544-028
Connect cable, for external 12 VDC power source; terminates in heavy duty battery clips 60-1394-023

INTERFACING EQUIPMENT

Model 1640 Liquid Level Actuator 60-1644-000
Extra Instruction Manual, Model 1640 60-1644-009
Sampler to flow meter cable, 6-conductor 60-3004-107
Connector only, without cable, for use with non-Isco flow meters having an isolated contact closure proportional to flow 68-1680-060
Same as above, with 22' cable terminating in two wires 60-1394-077
Type A Interface (converts pulse duration flow meter output proportional to flow into pulses acceptable to Isco samplers) 60-1784-007
4-20 mA Sampler Input Interface (converts analog signal flow meter output as specified by user into pulses acceptable to Isco samplers) 60-3704-037
Isco Field Printer 60-3774-001
FLOWLINK3 Software 68-2544-043
SAMPLINK Sampler Interrogation Software 60-3774-043
Computer connect cable, 9-pin 60-2544-044
Computer connect cable, 25-pin 60-2544-040
Interrogator communications line kit - 9 pin (connects laptop computer with 9 pin serial port to sampler) 68-3770-001
Interrogator communications line kit - 25 pin (connects laptop computer with 25 pin serial port to sampler) 68-3770-002

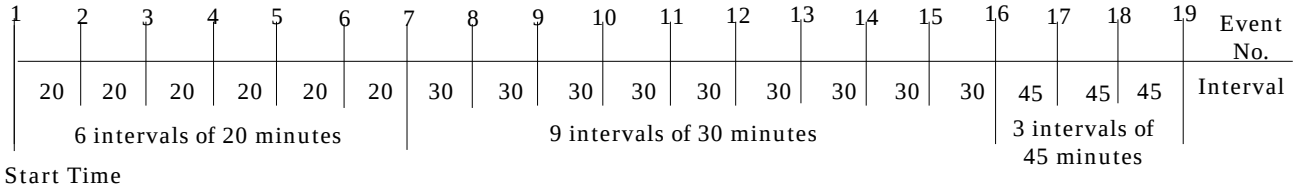
Appendix B Display Index

Note: To access the display number, press the STOP key while the sampler displays the screen in question. The display numbers are available in the Standby and Program states.

Disp. No.	Display	Description
1	[PROGRAM, CONFIGURE] SAMPLER	This display appears after you press the ENTER/PROGRAM key while in standby. Select "PROGRAM" to access the program sequence. Select "CONFIGURE" to access the configure sequence.
3	----- COUNTS FORWARD	This informational display appears when you stop the pump with the STOP key after having pressed the PUMP FORWARD key. It reports the number of pump counts detected while the pump was in operation. Exit this display by pressing any key except STOP and ON/OFF.
3	----- COUNTS REVERSE	This informational display appears when you stop the pump with the STOP key after having pressed the PUMP REVERSE key. It reports the number of pump counts detected while the pump was in operation. Exit this display by pressing any key except STOP and ON/OFF.
10	[TIME, FLOW] PACED SAMPLING	This display appears after you select "PROGRAM" in Display #1. Select "TIME" for time-paced sampling, "FLOW" for flow-paced sampling.
11	[UNIFORM, NONUNIFORM] TIME INTERVALS	This display appears only in the extended programming mode and follows Display #10 when you have selected "TIME." Select "UNIFORM" for uniform time intervals, "NONUNIFORM" for nonuniform time intervals.
12	[TIME, FLOW, STORM] PACED SAMPLING	This display appears after you select "PROGRAM" in Display #1. It appears only when the sampler is configured for the extended programming mode and for 2, 4, 8, 12, or 24 bottles. Select "TIME" for time-paced sampling. Select "FLOW" for flow-paced sampling, and "STORM" for storm sampling.
14	[TIME, FLOW] SECOND BOTTLE GROUP	This display appears after you select "STORM" in Display #12. Use to select time- or flow-pacing for the second bottle group of a storm routine. Select "TIME" for time-pacing or "FLOW" for flow-pacing.
15	___ MINUTE DELAY TO FIRST GROUP SAMPLE	This display appears after you select "STORM" in Display #12. Enter the amount of time between the time the sampler is enabled and the first sample event for the first bottle group.
16	[DURING, AFTER] FIRST GROUP	This display is the first input display of the flow segment of a storm program. Select "DURING" to collect samples for the first and second bottle groups concurrently. Select "AFTER" to collect samples for the second bottle group after the sampler has filled the first bottle group.
17	___ MINUTE DELAY TO SECOND GROUP SAMPLE	This display appears after you select "STORM" in Display #12. Enter the amount of time between the time the sampler is enabled and the first sample event for the second bottle group.
20	MODIFY SEQUENCE? [YES, NO]	This display follows Display #11 when you have selected "NONUNIFORM." Select "YES" to modify the existing nonuniform intervals. Select "NO" to leave the nonuniform intervals unchanged.

Disp. No.	Display	Description
21	**SAMPLE EVERY -- HOURS -- MINUTES**	In the basic programming mode, this display appears after you have selected "TIME" in Display #10. In the extended programming mode, this display appears when you have selected "UNIFORM" in Display #11. Enter the uniform time interval. Two entries are required: the first entry sets the hours, the second sets the minutes.
22	**SAMPLE EVERY ---- PULSES (1 - 9999)**	This display follows Display #10 when you have selected "FLOW." Enter the flow pulse interval.
23	**TAKE -- TIMED SAMPLE EVENTS (1 - MAX)**	This display follows Display #15. Use this display to enter the number of timed sample events in a storm program.
24	**SAMPLE INTERVALS OF -- MINUTES (1 - 99)**	This display follows Display #23. Enter the time interval between time-paced sample events in a storm program.
25	**TAKE --- SAMPLES (1 -** *MAX***)**	This display follows Display #20 when you have selected "YES" to modify the nonuniform time interval sequence. Enter the number of sample events to occur at nonuniform time intervals. *MAX* varies according to the bottle size entered in Display #223.
26	**TAKE SAMPLES AT 1.** *HH:MM DD-MMM*	This display follows Display #25. Enter the nonuniform clock times and dates for each sample event.
27	**QUANTITY AT INTERVAL 1. -- AT --- MINUTES**	Enter the number of samples to be taken at each interval. The total quantity entered will be one less than the total number of samples because the first sample, taken at the start time, counts as one. For example, if 19 samples are to be taken (the first 6 at 20 minute intervals, the next 9 at 30 minute intervals, and the remaining 3 at 45 minute intervals); first enter a quantity of 6 at 20 minutes, a quantity of 9 at 30 minutes, and then 3 at 45 minutes. **Figure 52.** shows a time line for the sampling routine.
30	**-- BOTTLES PER SAMPLE EVENT (1 -** ***MAX*****)**	This display appears for samplers configured for 2, 4, 8, 12, and 24 bottles (*Display #'s 221 or 222*). It does not appear for samplers configured for a single bottle. In the basic programming mode, it follows Display #36. In the extended programming mode, it follows one of the four sample interval entry displays (*Display #'s 21, 22, 26, 27*). Enter the number of bottles to receive a sample volume at each sample event.

Figure 52. Time Line



Disp. No.	Display	Description
31	**-- SAMPLES PER BOTTLE (1 - *MAX*)**	In the basic programming mode, this display appears when you have selected “SAMPLES PER BOTTLE” in Display #36. In the extended programming mode, it appears when the sampler is configured for 2, 4, 8, 12, or 24 bottles and there is only one bottle set. Enter the number of samples you want deposited in each bottle.
31	**-- SAMPLES PER BOTTLE (1 - *MAX*)**	In the basic programming mode, this display appears when you have selected “SAMPLES PER BOTTLE” in Display #36. In the extended programming mode, it appears when the sampler is configured for 2, 4, 8, 12, or 24 bottles and there is only one bottle set. Enter the number of samples you want deposited in each bottle.
35	**MULTIPLEX SAMPLES? [YES, NO]**	Select “YES” if you want the routine to perform bottles-per-sample or samples-per-bottle multiplexing. Select “NO” if you want the routine to perform sequential sampling.
36	**[BOTTLES PER SAMPLE, SAMPLES PER BOTTLE]**	This display appears when you have selected “YES” in Display #35. Select “BOTTLES PER SAMPLE” if you want the sampler to perform bottles-per-sample multiplexing. Select “SAMPLES PER BOTTLE” if you want the sampler to perform samples-per-bottle multiplexing.
40	**CHANGE BOTTLES BASED ON [TIME, SAMPLES]**	This display appears only in the extended programming mode when you have set the number of bottles per sample event to “1” in Display #30. Select “TIME” if you want the bottles to be switched after a specified period of time. Select “SAMPLES” if you want the bottles to be switched after a specified number of samples have been placed in a bottle. We recommend using “SAMPLES” for time-paced sampling routines.
41	**CHANGE SETS BASED ON [TIME, SAMPLES/BTL]**	This display appears when the number of bottles per sample event is set to a number greater than one and less than half the number of bottles in the tub. Select “TIME” to switch bottle sets after a specified period of time. Select “SAMPLES/BTL” to switch bottle sets after a specified number of samples have been placed in a set of bottles. We recommend using “SAMPLES/BTL” for time-paced sampling routines.
42	**CHANGE BOTTLES EVERY -- HOURS -- MINUTES**	This display appears after you select “TIME” in Display #40. Enter the amount of time each bottle is to receive samples.
43	**CHANGE SETS EVERY -- HOURS -- MINUTES**	This display appears after you select “TIME” in Display #41. Enter the amount of time each bottle set is to receive samples.
44	**CHANGE BOTTLES EVERY -- SAMPLES**	This display appears after you select “SAMPLES” in Display #40. Enter the number of samples each bottle is to receive.
45	**CHANGE SETS EVERY -- SAMPLES**	This display appears after you select “SAMPLES/BTL” in Display #41. Enter the number of samples each bottle set is to receive.
46	**FIRST BOTTLE CHANGE AT *HH:MM MM/DD***	This display appears when you have selected “YES” in Display #95. Enter the time of the first bottle switch. The remaining bottle changes will occur according to settings entered in Display #42. The display will also appear if you have started the routine after the programmed switch time.

Disp. No.	Display	Description
47	**FIRST SET CHANGE AT *HH:MM MM/DD***	This display appears when you have selected "YES" in Display #95. Enter the time of the first bottle set switch. The remaining bottle set changes will occur according to settings entered in Display #43. The display will also appear if you have started the routine after the programmed switch time.
48	**SAMPLE CONTINUOUSLY? [YES, NO]**	This display appears when the sampler is configured for 2, 4, 8, 12, or 24 bottles, under uniform time, flow, or nonuniform time modes of sample pacing. Select "YES" to sample continuously. Select "NO" to stop the sampling routine after the sampler fills the last set of bottles.
50	**SAMPLE VOLUMES OF --- ml EACH (10 - *MAX*)**	Enter the size of the sample volume. *MAX* will vary according to the number of samples per bottle and bottle size.
60	**---COMPOSITE SAMPLES (0 - MAX)**	This display appears when you have configures the controller for composite sampling by selecting "1" in Display #'221 or 222. Enter the number of composite samples. An entry of "0) will instruct the sampler to take samples until a float shutoff terminates the sampling routine.
70	**SUCTION HEAD OF --FEET (1 - MAX)**	This display appears when you have selected "YES" in Display #242 or have selected "Disable" in Display #240. Enter the measured suction head. *MAX* will be the smaller of the suction line length or "20".
80	**CALIBRATE SAMPLE VOLUME? [YES, NO]**	This display appears in the program sequence when you have selected "ENABLE" in Display #290. Select "YES" to use the calibration sequence, "NO" to omit the calibration sequence.
81	**PRESS MANUAL SAMPLE KEY WHEN READY . . .**	This display is part of the calibration sequence. Press the MANUAL SAMPLE key when a collection bottle is underneath the distributor and the suction line is in place.
82	**--- ml VOLUME DELIVERED**	This display is part of the calibration sequence. When it first appears, it reports the programmed sample volume. If the measured volume differs from the reported volume, enter the measured volume here.
83	**---ml! ARE YOU SURE? [YES, NO]**	This display is part of the calibration sequence and appears if the measured volume and the programmed volume differ by a factor of two or more. Select "YES" to confirm the number entered in Display #82. Select "NO" to return to Display #82.
90	**ENTER START TIME? [YES, NO]**	Select "YES" to enter a start time. Select "NO" to begin the sampling routine according to the delay set in Display #310.
91	**TAKE FIRST SAMPLE AT HH:MM DD-MMM**	This display appears when you have selected "YES" in Display #90. Enter the start time and date for the first sample event. This display will also appear if you have initiated the routine after a programmed start time so that you can reprogram the start time.
92	**START FLOW COUNT AT *HH:MM DD-MM***	This display appears when you have selected "YES" in Display #90. Enter the start time and date for the flow pulse countdown. This display will also appear if you have initiated the routine after a programmed start time so that you can reprogram the start time.

Disp. No.	Display	Description
93	**STORM ENABLED AFTER HH:MM DD-MM**	This display is the last display of the storm branch. It appears when you select "YES" in display #90. Enter the start time for the storm sampling routine. The sampler will disregard enable or disable signals from the flow meter until the start time you enter here.
95	**ENTER FIRST SWITCH TIME? [YES, NO]**	This display appears when you have selected "TIME" in either Display #40 or 41. Select "YES" if you want to specify a clock time for the first bottle or bottle set switch. Select "NO" if you want to begin the switch interval at the routine's start time.
100	**-- STOP or RESUME TIMES (0 - 24)**	This display appears when you have selected "ENABLE" in Display #300. Enter the number of stop and resume times.
101	**STOP SAMPLING AT 1.*HH:MMDD-MMM***	This display appears when the setting in Display #100 is greater than zero. Enter the appropriate stop time.
102	**RESUME SAMPLING AT 1.*HH:MMDD-MMM***	This display appears when the setting in Display #100 is greater than one. It follows Display #101. Enter the appropriate resume time.
110	**MAX FLOW INTERVAL OF -- HOURS, -- MINUTES**	This display follows Display #22. Enter the maximum amount of time you want between flow-paced sample events in a storm program. If the time between flow pulses exceeds this entry, the sampler will terminate the sampling routine.
140	**[START, RESUME] SAMPLING PROGRAM**	This display appears when a routine is halted and you press the START SAMPLING key. Select "START" to start the sampling program at the beginning, "RESUME" to continue the sampling program at the point at which it was halted.
141	**START SAMPLING AT BOTTLE -- (1 - *MAX*)**	This display appears after you start a routine and the sampler is configured for 2, 4, 8, 12, or 24 bottles. Enter the starting bottle location for the sampling routine. *MAX* varies according to number of bottles (Display #'s 221 or 222) and the number of bottles per sample event (Display #30).
142	**CHANGE START TIME? [YES, NO]**	This display appears when you have started a routine after the programmed start time. Select "YES" to enter a new start time. Select "NO" to start the routine immediately; some sample events may be missed or late.
143	**CHANGE SWITCH TIME? [YES, NO]**	This display appears when you have started a routine after the programmed first switch time. Select "YES" to enter a new switch time. Selecting "NO" will switch one bottle set and start the routine.
148	**[REVIEW, PRINT] PROGRAM INFORMATION**	This display appears after you press the DISPLAY STATUS key. Select "REVIEW" to view the summary of the current program settings and for sampling results. Select "PRINT" to send the current status, program settings, and sampling results to an Isco Field printer. The printed results include data for sample events completed at the time you pressed the DISPLAY STATUS key.
149	**PRINT PROGRAM [NO, SETTINGS, RESULTS]**	This display appears after you select "Print" in Display #148. Select "NO" to return to standby. Select "Settings" to print the settings report. Select "RESULTS" to print the results report.

Disp. No.	Display	Description
150	**REVIEW PROGRAM [NO, SETTINGS, RESULTS]**	This display appears after you select "REVIEW" in display #148. Select "NO" to return to the previous operating state. Select "SETTINGS" to view the summary of the current program settings. Select "RESULTS" to view the sampling results for sample events completed at the time you pressed the DISPLAY STATUS key.
151	***SETTINGS DISPLAYS***	Display #151 is used to identify the displays used to summarize the current program settings which appear when you select "SETTINGS" in Display #150.
152	***RESULTS DISPLAYS***	Display #152 is used to identify sampling results displays which appear when you select "RESULTS" in Display #150.
200	**SELECT OPTION (← →)** *NAME OF CONFIGURE OPTION*	Display #200 is used to identify the displays which locate each configure option in the configure sequence. Press ENTER/PROGRAM to access the input displays for each option. Use the LEFT ARROW and the RIGHT ARROW keys to move through the options.
210	**HH:MM DD/MM/YY** ***HH:MM DD/MM/YY***	Set Clock configure option. Enter the time and date to set the controller's clock. Use military time. Enter two digits each for the day (DD), month (MM), and year (YY).
220	**[PORTABLE, REFRIG.] SAMPLER**	Bottles and Sizes configure option. Select "PORTABLE" when you are using a 3700 Portable Sampler. Select "REFRIG." when you are using a 3700 refrigerated sampler.
221	[**1, 2, 4, 8, 12, 24**] **BOTTLES**	Bottles and Sizes configure option. This display appears when you have selected "REFRIG." in Display #220. Select the number of bottles in the bottle base.
222	**[1, 4, 12, 24]** **BOTTLES**	Bottles and Sizes configure option. This display appears when you have selected "PORTABLE" in Display #220. Select the number of bottles in the base.
223	**BOTTLE VOLUME IS** **----- ml**	Bottles and Sizes configure option. Enter the bottle volume in milliliters.
224	**---- ml . . . ARE YOU SURE? [YES, NO]**	Bottles and Sizes configure option. This display appears when you have entered a bottle volume, in Display #223, that exceeds a standard Isco bottle size.
230	**SUCTION LINE ID IS** [**1/4**, **3/8**] **INCH**	Suction Line configure option. Select "1/4" if you are using 1/4 inch suction line, "3/8" if you are using 3/8 inch suction line.
231	**SUCTION LINE IS** **[VINYL, TEFLON]**	Suction Line configure option. This display appears when you have selected "3/8" in Display #230. Select "VINYL" if you are using vinyl suction line, "TEFLON" if you are using Teflon suction line.
232	**SUCTION LINE LENGTH IS -- FEET (3 - 99)**	Suction Line configure option. Enter the length of the suction line. The length should not include the tube coupling or the strainer.
240	**[ENABLE, DISABLE]** **LIQUID DETECTOR**	Liquid Detector configure option. Select "ENABLE" to turn the Liquid Detector on, "DISABLE" to turn the Liquid Detector off. If you turn the detector off, you will be required to enter the suction head (Display #70) in the program sequence.

Disp. No.	Display	Description
241	- RINSE CYCLES (0 - 3)	Liquid Detector configure option. This display appears when you have selected "ENABLE" in Display #240. Enter the number of rinse cycles. Rinse cycles condition the suction line to reduce cross contamination.
242	ENTER HEAD MANUALLY? [YES, NO]	Liquid Detector configure option. This display appears when you have selected "ENABLE" in Display #240. Select "YES" to add the suction head setting (Display #70) to the program sequence. Select "NO" to omit the setting.
243	RETRY UP TO - TIMES WHEN SAMPLING (0 - 3)	Liquid Detector configure option. This display appears when you have selected "ENABLE" in Display #240. Enter the number of retries: the number of times the sampler will try to detect the presence of liquid for each sample event.
250	[BASIC, EXTENDED] PROGRAMMING MODE	Programming Mode configure option. Select "BASIC" if you want to use the basic programming mode. Select "EXTENDED" if you want to use the extended programming mode.
255	LOAD PROGRAM [#1, #2, #3, NONE]	Load Stored Program configure option. Select the sampling program you want to use. Select "NONE" to exit the display without loading a program.
260	SAVE PROGRAM AS [#1, #2, #3, NONE]	Save Current Program configure option. Select the number you want to use to identify the current program with when saved. Select "NONE" to exit the display without saving a program.
270	TAKE SAMPLE AT START TIME? [YES, NO]	Flow Mode Sampling configure option. This setting affects flow-paced sampling routines. Select "YES" to take the first sample at the start time, "NO" to take the first sample at the end of the first flow pulse interval.
271	TAKE SAMPLE AT TIME SWITCH? [YES, NO]	Flow Mode Sampling configure option. This setting affects flow-paced, time-switched sampling routines only. Select "YES" to take a sample at switch times. Select "NO" if no sample event is desired at the switch times.
280	ENTER INTERVALS IN [CLOCK TIME, MINUTES]	Nonuniform Time configure option. Select "CLOCK TIME" to enter the nonuniform time intervals as clock times (Display #26). Select "MINUTES" to set the nonuniform intervals in minutes (Display #27).
290	[ENABLE, DISABLE] CALIBRATE SAMPLER	Calibrate Sampler configure option. Select "ENABLE" to add calibration displays to the program sequence. Select "DISABLE" to omit the calibration displays.
300	[ENABLE, DISABLE] SAMPLING STOP/RESUME	Sampling Stop/Resume configure option. Select "ENABLE" to add the Sampling Stop and Resume settings to the program sequence. Select "DISABLE" to omit the settings.
301	SAMPLE AT STOP? [YES, NO]	Sampling Stop/Resume configure option. This display appears when you have selected "ENABLE" in Display #300. Select "YES" to take a sample at stop times. Select "NO" if no sample event is desired at the stop times.

Disp. No.	Display	Description
302	SAMPLE AT RESUME? [YES, NO]	Sampling Stop/Resume configure option. This display appears when you have selected "ENABLE" in Display #300. Select "YES" to take a sample at the resume times. Select "NO" if no sample event is desired at the resume times.
310	---- MINUTE DELAY TO START (0 - 9999)	Start Time Delay configure option. Enter the amount of time, in minutes, you want to delay the start time. This entry affects programs that do not have a programmed start time.
321	SAMPLE UPON DISABLE? [YES, NO]	Enable Pin configure option. Select "YES" to take a sample at the time the sampler becomes disabled. Select "NO" if no sample event is desired when the sampler becomes disabled.
322	SAMPLE UPON ENABLE? [YES, NO]	Enable Pin configure option. Select "YES" to take a sample at the time the sampler becomes enabled; i.e., ceases to receive an inhibit signal from a Flow Meter or a Liquid Level Actuator. Note: No sample will be taken if the enable signal is used to initiate the start time delay countdown. Select "NO" if no sample event is desired when the sampler becomes enabled.
323	RESET SAMPLE INTERVAL? [YES, NO]	Enable Pin configure option. Select "YES" to restart the sample interval countdown at the time the sampler becomes enabled. If "NO" is selected, the interval countdown is determined by the setting in Display #324.
324	INHIBIT COUNTDOWN? [YES, NO]	Enable Pin configure option. This display appears when "NO" was selected in Display #323. Select "YES" to freeze the sample interval when the sampler becomes disabled. The interval countdown will continue from the point at which it was stopped when the sampler is enabled. Select "NO" to allow the sample interval countdown to continue while the sampler is disabled.
330	[CONTINUOUS SIGNAL, PULSE]	Event Mark configure option. Select "CONTINUOUS SIGNAL" to send a variable duration event mark signal out pin E of the flow meter connector. Select "PULSE" to send a 3 second event mark signal.
331	DURING [PUMP CYCLE, FWD PUMPING ONLY]	Event Mark configure option. This setting appears when you have selected "CONTINUOUS SIGNAL" in Display #330. Select "PUMP CYCLE" to transmit the event mark signal during the entire pump cycle, including any programmed rinses and retries. Select "FWD PUMPING ONLY" to send the signal when the pump is delivering a sample volume only.
332	AT THE BEGINNING OF [PURGE, FWD PUMPING]	Event Mark configure option. This setting appears when you have selected "PULSE" in Display #330. Select "PURGE" to transmit an event mark signal to a flow meter at the beginning of the pre-sample purge. Select "FWD PUMPING" to transmit a signal when the pump switches forward to deliver the sample volume.
340	--- PRE-SAMPLE COUNTS (0 - 9999)	Purge Counts configure option. Enter the number of pre-sample pump counts needed to purge the suction line. This value is set to 150 when the controller is re-initialized.
341	--- POST-SAMPLE COUNTS (0 - 9999)	Purge Counts configure option. Enter the number of post-sample pump counts needed to purge the suction line. The number that initially appears in this display is derived by the controller from the suction line ID and length entered in Display #'s 230 and 232.

Disp. No.	Display	Description
350	------ PUMP COUNTS, WARNING AT ------	Tubing Life configure option. This informational display is used to communicate the number of pump counts elapsed since the last reset and the number of counts required to trigger the Pump Tubing Warning. Exit this display by pressing any key.
351	RESET PUMP COUNTER? [YES, NO]	Tubing Life configure option. After changing the pump tube, select "YES" to reset the pump counter to zero. Select "NO" to leave the counter unchanged.
352	------ PUMP COUNTS TO WARNING	Tubing Life configure option. Enter the number of pump counts required to trigger the pump count warning if the factory setting is not suitable. This value is set to 500,000 when the controller is re-initialized.
360	[ENABLE, DISABLE] PROGRAM LOCK	Program Lock configure option. Select "ENABLE" to turn the program lock on. If you enable the program lock, input displays are protected by a pass-number: 3700. The controller will not allow you to make any changes to a program or configure sequence setting until you enter the pass-number when requested. Select "DISABLE" to turn the program lock off.
365	SAMPLER ID NUMBER IS ----------	Sampler ID configure option. Enter the sampler ID (identification) here. The sampler will accept up to ten characters, including periods (press RESUME SAMPLING), dashes (press MANUAL SAMPLE), and spaces (press START SAMPLING).
370	TEST DISTRIBUTOR? [YES, NO]	Run Diagnostics configure option. Select "YES" to run the distributor test. Select "NO" to skip the test. The distributor is tested by moving it to position 24 then back to position 1.
371	RE-INITIALIZE? [YES, NO]	Run Diagnostics configure option. Select "YES" to re-initialize the controller: the entire RAM – with the exception of the configure option settings for current pump count total, number of bottles, bottle size, suction line length, and sampler ID – will be re-initialized to factory settings. Select "NO" the leave the settings unchanged.

Appendix C Calculating Flow Increment Between Samples

Calculating Flow Increment Between Samples

The 3700FR will accept flow proportional inputs of a certain specific nature from an external flow meter. These electronic flow input signals are transmitted to the sampler at fixed increments of total flow, for example every 10,000 gallons. That is, each time 10,000 gallons of liquid has flowed past the flow meter, a signal is sent to the sampler, which registers it as a single flow pulse. The Sampler can be programmed to totalize any number of flow pulses from 1 to 9999 before a sampling event is initiated. For example, if the sampler were programmed to totalize 5 flow pulses and each flow pulse represented 10,000 gallons of total flow, a sample would be collected each time 50,000 gallons (5 flow pulses of 10,000 gallons each) had passed the flow meter.

Time Interval Known

If the desired average time interval between individual samples is known, the flow increment between samples can be determined by calculating how much flow (based on the average flow rate) occurs during that time interval. For example, assume that the average flow is 2.5 MGD and it is desired to collect a sample every 30 minutes. The flow increment between samples is calculated:

2.5 MGD = 2,500,000 gal/day.

2,500,000 gal/day × 1 day/24 hrs × 1 hr/60 min = 1736 gal/min.

1736 gal/min × 30 min/sample = 52,080 gal/sample.

Thus, the desired flow increment between samples is approximately 52,000 gallons.

Number of Samples Known

Alternatively, if the total number of samples to be collected over the total sampling period is known, the flow increment between samples can be determined by calculating how much total flow will occur during the sampling period, and dividing this by the total number of samples to be collected. For example, assume that the average flow is 1.75 MGD, that the composite sampling period is 2 days, and that it is desired to collect 100 individual samples. The flow increment between samples is calculated:

1.75 MGD = 1,750,000 gal/day.

1,750,000 gal/day × 2 days = 3,500,000 gallons.

3,500,000 gal ÷ 100 samples = 35,000 gal/sample.

Thus, the desired flow increment between samples is approximately 35,000 gallons.

Once the desired flow increment between samples is known, the number of flow pulses to be programmed into the sampler may be calculated, assuming that the volume of the flow pulses from the flow meter is known. The number of flow pulses is calculated by dividing the flow increment between samples by the volume of each flow pulse. Using the first example above, the flow increment between samples was calculated as 52,000 gallons; assume that each flow pulse represents 10,000 gallons of flow. The number of flow pulses to be programmed into the sampler is calculated:

52,000 gal ÷ 10,000 gal/flow pulse = 5.2 flow pulses.

Rounding this to an even number results in 5 flow pulses to be programmed into the sampler. This in turn results in a flow increment between samples of 50,000 gallons (5 flow pulses × 10,000 gallons/flow pulse).

To calculate the total number of samples to be collected, three quantities must be known: the average flow rate, the flow increment between samples (calculated above), and the total time over which the composite sample is to be collected. The total number of samples to be collected is determined by first calculating the total flow volume over the sampling period, and then dividing this by the flow increment between samples. For example, assume that the average flow is 2.5 MGD, the flow increment between samples is 50,000 gallons, and the composite sample is to be collected over a 24 hour period. The total flow volume over a 24 hour period is:

2.5 MGD = 2,500,000 gal/day.

2,500,000 gal/day × 1 day = 2,500,000 gallons.

The total number of samples to be collected in this 24 hour period is then calculated:

2,500,000 gal ÷ 50,000 gal/samples = 50 samples.

Thus, based on an average flow of 2.5 MGD, 50 samples will be collected.

To calculate the volume of each individual sample, the volume of the composite sample container being used and the total number of samples to be collected (calculated above) must be known. Isco provides two different size composite sample containers for use with the 3700FR:

2.5 gallon = 9,400 ml.

4 gallon polyethylene = 15000 ml.

The individual sample volume is calculated by simply dividing the volume of the composite sample container being used by the total number of samples to be collected. For example, assume that a 2.5 gallon plastic container is being used, and that a total of 50 samples are to be collected in it. The individual sample volume is then calculated:

9400 ml ÷ 50 samples = 188 ml.

Thus, a sample volume of 188 ml will result in the desired composite sample. Because of the basic uncertainty of the delivered sample volume exactly matching the programmed nominal sample volume and the 10 ml sample repeatability, it is good practice to select a nominal sample volume which is slightly smaller than the calculated sample volume. This is to prevent overfilling of the sample container. In the example, an individual nominal sample volume of 125 ml might be a prudent choice. For critical applications, calibration of the sample volume can be used. It is important to select an individual sample volume which will not result in an overfilled sample container under worst-case conditions.

The nominal volume of the composite sample may be calculated by multiplying the programmed nominal sample volume by the total number of samples to be collected. In the example:

125 ml/sample × 50 samples = 6,250 ml.

This calculated total volume may vary from the actual total volume because of variations in the actual volume of each individual sample. The total time needed to collect the 50 individual samples may vary from the desired 24 hour period because of variations in the average flow rate from the 2.5 MGD figure used in these calculations.

Appendix D Glossary

Bottle set - A bottle set is the collection of bottles defined by the number of bottles per sample in Index #30. For example, if the bottles per sample event setting is "4," a 24 bottle tub would contain six bottle sets. A bottle set can consist of only one bottle.

Bottles per sample - Bottles per sample is the number of bottles receiving sample volumes at each sample event.

Composite sampling - Composite sampling is a process in which multiple sample volumes are placed in bottle sets. Typically, composite sampling uses a single container. A composite sample represents an average of the characteristics of the flow stream for the elapsed time of sampling.

Controller - The controller is a collection of electronic components which governs the actions of the sampler. It includes the microprocessor, RAM (Random Access Memory), ROM (Read Only Memory) and its imbedded software, the LCD (Liquid Crystal Display), and the keypad.

Cross contamination - Cross contamination occurs when portions of previous samples are mixed with the current sample. For example, cross contamination will result when residual amounts of sample remain in the suction line or pump tube from a previous sample event.

Event mark - An event mark is a signal sent by the sampler to a flow meter or other device at each sample event. Each time an event mark pulse is received by the flow meter, a mark is placed on the flow meter's recording chart. Marking the recording chart cross-references the charted flow with the sample events.

Multiplexing - There are two types of multiplexing: samples per bottle and bottles per sample. In samples per bottle multiplexing, a bottle receives samples from more than one sample event. In bottles per sample multiplexing, equal sample volumes are placed in more than one bottle at each sample event.

Multiple bottle compositing - A type of composite sampling where samples per bottle multiplexing and bottles per sample multiplexing are combined to create multiple composite samples. Multiple bottle compositing allows you to use the sequential bottle sets to acquire composite samples.

Post-sample purge - Post-sample purge refers to the suction line purge that follows the delivery of the sample volume(s). It is also called "post-purge."

Pre-sample purge - Pre-sample purge refers to the suction line purge that precedes the delivery of the sample volume(s). It is also called "pre-purge."

Real time clock - A clock which can be set to the actual time and date.

Sample event - A sample event consists of the complete sampling cycle resulting in the collection and distribution of one or more equal sample volumes. A sample event includes pre-sample and post-sample purges, line rinses, liquid detection retries, and deliveries of sample volumes. No more than one sample volume is placed in any one bottle during a sample event.

Sample volume - The sample volume is the discrete, programmed amount of sample delivered to each bottle. A single sample event may deliver several sample volumes.

Samples per bottle - Samples per bottle is the number of discrete sample volumes placed in each bottle.

Sampling program - See sampling routine.

Sampling routine - A sampling routine, also called a sampling program, is the process of taking samples according to the program settings you enter when programming and configuring the controller. The program settings define the sample pacing, distribution, volume, and key clock times.

Selection - A selection is represented by a blinking word or number in an input display. The blinking selection indicates the current choice or value. Selections are accepted and stored by pressing the ENTER/PROGRAM key.

Sequential sampling - Sequential sampling is the process in which discrete, programmed sample volumes are placed in separate, identifiable sample bottles. Sequential sampling represents a series of "snap shots" of the flow stream.

Suction head - Suction head is the vertical distance from the surface of the flow stream to the pump inlet.

DECLARATION OF CONFORMITY

CE
ISM1-A

Application of Council Directive:	89/336/EEC – The EMC Directive
Manufacturer's Name:	Isco, Inc.
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501
Equipment Type/Environment:	Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No:	Model FR Sampler 6700FR, 3700FR, 3710FR
Operating Voltage:	230 VAC 50Hz 1ϕ
Year of Issue:	1996
Standards to which Conformity is Declared:	EN 50082-1 Generic Immunity for Commercial, Light Industrial Environment EN 55011 Limits and methods of radio disturbance characteristics EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

Standard	Description	Severity Applied	Performance Criteria
IEC 801.2	Electrostatic Discharge	Level 3 - 4kV contact discharge Level 2 - 8kV air discharge	B B
IEC 801.3	Radiated RF Immunity	27 MHz to 500MHz Level 2 - 3 V/m	A
IEC 801.4	Electrical Fast Transient	Level 2 - 1kV on ac lines	B
CISPR11/ EN 55011	RF Emissions	Group 1, Class A Industrial, Scientific, and Medical Equipment	

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of April 23, 1996.

Bill Foster
USA Representative

Isco

Bill Foster
Director of Engineering
Isco, Inc.
4700 Superior Street
Lincoln, Nebraska 68504

Phone: (402) 464-0231
Fax: (402) 464-4543

Michael Teutscher
European Authorized Representative

Isco
STIP

Contact: Dr. Dirk Köppenkastrop
Geschäftsführer Managing Director
STIP ISCO GmbH

Siemensstraße 2
64823 Groß-Umstadt

Telefon: 06078 7 86-82
Telefax: 06078 7 86-88

60-9003-421
Rev C

One Year Limited Warranty *

Factory Service

Isco instruments covered by this warranty have a one-year limited warranty covering parts and labor.

Any instrument that fails during the warranty period, due to faulty parts or workmanship, will be repaired at the factory at no charge to the customer. Isco's exclusive liability is limited to repair or replacement of defective instruments. Isco is not liable for consequential damages.

Isco will pay surface transportation charges both ways within the 48 contiguous United States if the instrument proves to be defective within 30 days of shipment. Throughout the remainder of the warranty period, the customer will pay to return the instrument to Isco, and Isco will pay surface transportation to return the repaired instrument to the customer. Isco will not pay air freight or customer's packing and crating charges.

The warranty for any instrument is the one in effect on date of shipment. Warranty period begins on the shipping date, unless Isco agrees in writing to a different date.

Excluded from this warranty are normal wear; expendable items such as charts, ribbon, tubing, and glassware; and damage due to corrosion, misuse, accident, or lack of proper maintenance. This warranty does not cover Isco on-line Process Analyzers and certain Isco SFE instruments, which are covered under different warranty terms, nor does it cover products not sold under the Isco trademark or for which any other warranty is specifically stated in sales literature.

This warranty is expressly in lieu of all other warranties and obligations and Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose. Any changes in this warranty must be in writing and signed by a corporate officer.

The warrantor is Isco, Inc. 4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to USA customers. Customers in other countries should contact their Isco dealer for warranty service.**

Before returning any instrument for repair, please call, fax, or e-mail the Isco service department for instructions. Many problems can often be diagnosed and corrected over the phone, or by e-mail, without returning the instrument to the factory.

Instruments needing factory repair should be packed carefully, preferably in the original carton, and shipped to the attention of the service department. Small, non-fragile items can be sent by insured parcel post. **PLEASE BE SURE TO ENCLOSE A NOTE EXPLAINING THE DEFECT.**

Return instruments to: Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

Mailing address: Isco, Inc.
PO Box 82531
Lincoln NE 68501 USA

Phone: Repair service: (800)775-2965 (lab instruments)
(800)228-4373 (samplers & flowmeters)
Sales & General Information (800)228-4373 (USA & Canada)

Fax: (402) 465-3001

Email: service@isco.com

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Isco, Inc.
www.isco.com