

## GARANTÍA LIMITADA

El Fabricante garantiza, al comprador y el propietario subsiguiente durante el período de garantía, que cada producto nuevo está libre de defectos en materiales y mano de obra bajo condiciones de uso y servicio normales, cuando se usa y mantiene correctamente, durante un período de tres años a partir de la fecha de fabricación original del producto. Las partes que fallen durante el período de garantía, un año a partir de la fecha de compra por parte del usuario final, lo que ocurra primero, cuyas inspecciones determinen que presentan defectos en materiales o mano de obra, serán reparadas, reemplazadas o remanufacturadas a opción del Fabricante, con la condición sin embargo de que por hacerlo no estemos en la obligación de reemplazar un ensamblaje completo, el mecanismo entero o la unidad completa. No se dará concesión alguna por costos de envío, daños, mano de obra u otros cargos que pudieran surgir por falla, reparación o reemplazo del producto.

Esta garantía no aplica a y no se ofrecerá garantía alguna por ningún material o producto que haya sido desarmado sin aprobación previa del Fabricante, o que haya sido sometido a uso indebido, aplicación indebida, negligencia, alteración, accidente o acto fortuito; que no haya sido instalado, usado o mantenido según las instrucciones de instalación del Fabricante; que haya sido expuesto a sustancias foráneas que incluyen pero no se limitan a lo siguiente: arena, grava, cemento, lodo, alquitrán, hidrocarburos, derivados de hidrocarburos (aceite, gasolina, solventes, etc.), u otras sustancias abrasivas o corrosivas, toallas para lavar o productos sanitarios femeninos, etc. en todas las aplicaciones de

bombeo. La garantía presentada en el párrafo anterior deja sin efecto cualquier otra garantía expresa o implícita; y no autorizamos a ningún representante u otra persona para que asuma por nosotros ninguna otra responsabilidad con respecto a nuestros productos.

Comuníquese con el Fabricante en 3649 Cane Run Road, Louisville, KY 40211 EE.UU., Attention: Customer Service Department, para obtener cualquier reparación necesaria o reemplazo de partes o información adicional sobre nuestra garantía.

**EL FABRICANTE EXPRESAMENTE RECHAZA RESPONSABILIDAD POR DAÑOS ESPECIALES, EMERGENTES O INCIDENTALES O POR INCUMPLIMIENTO DE LA GARANTÍA EXPRESA O IMPLÍCITA; Y CUALQUIER GARANTÍA IMPLÍCITA DE IDONEIDAD PARA UN FIN PARTICULAR Y DE COMERCIALIZACIÓN SE LIMITARÁ A LA DURACIÓN DE LA GARANTÍA EXPRESA.**

Algunos estados no permiten limitaciones en la duración de una garantía implícita, de forma que la limitación anterior podría no aplicar a usted. Algunos estados no permiten la exclusión o limitación de daños incidentales o emergentes, de forma que la limitación o exclusión anterior podría no aplicar a usted.

Esta garantía le otorga a usted derechos legales específicos y podría tener otros derechos que varían de un estado a otro.

## LO QUE DEBE Y NO DEBE HACER PARA INSTALAR UNA BOMBA DE SUMIDERO

1. LEA completamente todo el material sobre la instalación provisto con la bomba.
2. INSPECCIONE la bomba para ver si hay cualquier daño visible causado durante el envío. Comuníquese con el vendedor si la bomba está dañada.
3. RETIRE todos los escombros del sumidero. Asegúrese de que la bomba se apoyará sobre una superficie dura, plana y estable. **NO LA INSTALE** sobre arena, grava o tierra.
4. ASEGÚRESE de que el sumidero sea suficientemente grande para permitir el funcionamiento correcto de los interruptores de control de nivel.
5. SIEMPRE desconecte la bomba de la fuente de alimentación eléctrica antes de manipularla.  
SIEMPRE conecte la bomba a un circuito protegido separadamente y con puesta a tierra adecuado.  
JAMÁS corte, empalme o dañe el cable de alimentación eléctrica. (Empalme únicamente cuando hay una caja de conexión hermética.)  
JAMÁS transporte o levante la bomba por su cable de alimentación eléctrica.  
JAMÁS use un cable de extensión con una bomba de sumidero.
6. INSTALE una válvula de retención y una unión en la tubería de descarga.  
JAMÁS use una tubería de descarga de menor tamaño que la descarga de la bomba.

7. JAMÁS use una bomba de sumidero como una bomba excavadora o para zanjas, ni para bombear aguas cloacales, gasolina u otros líquidos peligrosos.
8. PRUEBE la bomba inmediatamente después de su instalación para asegurarse de que el sistema funciona correctamente.
9. CUBRA el foso con una tapa adecuada para sumidero.
10. EXAMINE todos los códigos nacionales y locales aplicables y verifique que la instalación esté de acuerdo a cada uno de ellos.
11. CONSULTE con el fabricante si necesita aclaraciones o tiene preguntas.
12. CONSIDERE un sistema de dos bombas con alarma en donde la instalación puede sobrecargarse o la falla de una bomba primaria causaría daños a la propiedad.
13. CONSIDERE un sistema de apoyo de CD en donde una bomba de achique o sumidero es necesaria para prevenir daños a la propiedad debido a inundación causada por interrupciones en el suministro de energía eléctrica, problemas mecánicos o eléctricos, o sobrecarga del sistema.
14. INSPECCIONE y pruebe el funcionamiento del sistema por lo menos cada 3 meses.

## LISTA DE VERIFICACIÓN DE SERVICIO



**▲ ADVERTENCIA** PRECAUCIONES ELÉCTRICAS - Antes de proporcionar algún servicio a la bomba, desactive siempre el interruptor principal de suministro de energía eléctrica y desenchufe la bomba. Asegúrese de usar zapatos protectores con suelas aislantes y de no estar parado en el agua. Bajo condiciones de inundación, llame a su compañía eléctrica local o a un técnico electricista calificado para desconectar el servicio eléctrico antes de quitar la bomba.



**▲ ADVERTENCIA** Las bombas sumergibles contienen aceites que se presurizan y calientan bajo condiciones operativas. Deje que pasen 2½ horas después de apagarla antes de proceder con el servicio.

CONDICIÓN	CAUSAS COMUNES
A. La bomba no arranca o no funciona.	Verifique el fusible, voltaje bajo, protección contra sobrecarga abierta, cableado abierto o incorrecto, interruptor abierto, impulsor o sello trabado mecánicamente, capacitor o relé defectuoso, motor o cableado eléctrico en corto circuito. Conjunto del flotador enganchado. Interruptor defectuoso, dañado o fuera de punto.
B. El motor se sobrecalienta y activa la protección contra sobrecarga o desconecta el fusible.	Voltaje incorrecto, carga negativa (descarga abierta menos de lo normal), impulsor o sello trabado mecánicamente, capacitor o relé defectuoso, motor en corto circuito.
C. La bomba se enciende y se apaga muy a menudo.	El flotador está apretado en la varilla, la válvula de retención está atascada o no hay una instalada en una línea de larga distancia, protección contra sobrecarga abierta, interruptores defectuosos, foso del sumidero demasiado pequeño.
D. La bomba no se apaga.	Hay escombros debajo del conjunto del flotador, el flotador o la varilla del flotador están trabados por los lados del foso u otros, interruptor defectuoso, dañado o fuera de punto.
E. La bomba funciona pero sin o con poca agua.	Verifique la caja del filtro y la tubería de descarga, o si se usa una válvula de retención, el agujero de ventilación debe estar abierto. La carga de descarga excede la capacidad de la bomba. Voltaje bajo o incorrecto. Rotación incorrecta del motor. Capacitor defectuoso. El agua de entrada contiene aire o hace que el aire entre en la bomba.
F. Caída en la carga y/o capacidad después de un período de uso.	Aumento de fricción en la tubería, línea o válvula de retención atascada. Material abrasivo o productos químicos adversos podrían haber deteriorado el impulsor o el cárter de la bomba. Revise la línea. Quite la base e inspeccione.

Si la lista de verificación arriba mencionada no revela el problema, consulte con la fábrica. No intente proporcionar algún servicio o desarmar la bomba. Las Estaciones de servicio autorizadas por Zoeller deberán proporcionar dicho servicio.

Visite el sitio [www.zoellerpumps.com/servicestations](http://www.zoellerpumps.com/servicestations) para encontrar la estación de servicio autorizada para su zona.



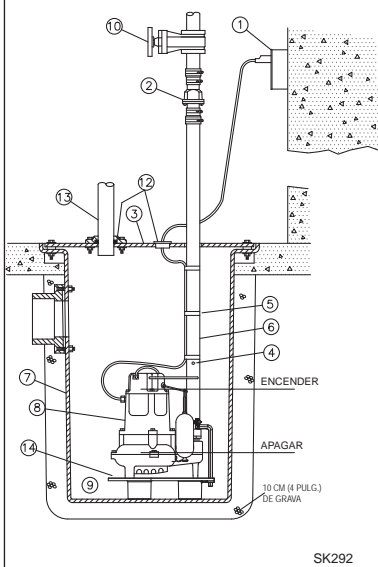
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- El cableado y la protección eléctrica deben estar de acuerdo con el Código Eléctrico Nacional y todos los otros requisitos eléctricos locales y estatales aplicables.
- Instale el "Unicheck" (combinación de unión y válvula de retención) apropiado de Zoeller, luego arriba del estanque para que se pueda quitar fácilmente la bomba para su limpieza o reparación. Si los sistemas para aguas cloacales, efluentes o achique requieren instalación de carga elevada o por debajo de la tapa, use 30-0164 en tubería de 38 mm (1½ pulg.), 30-0152 en tubería de 51 mm (2 pulg.) y 30-0160 en tubería de 76 mm (3 pulg.). Vea el número 4 más abajo.
- Todas las instalaciones requieren una tapa para prevenir que escombros caigan dentro del estanque y prevenir lesiones accidentales.
- Cuando instale un "Unicheck", perforo un agujero de 5 mm (3/16 pulg.) de diámetro en la tubería de descarga al mismo nivel de la parte superior de la bomba. **NOTA: EL AGUJERO TAMBIÉN DEBERÁ ESTAR POR DEBAJO DE LA TAPA DEL ESTANQUE Y SE DEBE LIMPIARLO PERIÓDICAMENTE.** (Para unidades de carga elevada, ver el número 3 de la lista de "Precauciones" en la página 1.) Se verá un chorro de agua saliendo del agujero durante los períodos de bombeo.
- Fije firmemente el cable de alimentación eléctrica al tubo de descarga con cinta o abrazadera.
- Use tubería de descarga de tamaño completo.
- El estanque debe estar de acuerdo con los códigos y las especificaciones aplicables.
- La bomba debe estar nivelada y el mecanismo del flotador libre de los lados del estanque antes de encender la bomba.
- El estanque debe estar limpio y libre de escombros después de la instalación.
- El instalador deberá suministrar una válvula de paso directo o una válvula de bola y instalarla de acuerdo con cualesquiera y todos los códigos.
- La ubicación de los interruptores de flotador es como se muestra en el esquema a la izquierda. El punto "off" (apagado) debe estar por encima del cárter del motor y a 180° de la entrada. **NOTA: PARA BOMBAS AUTOMÁTICAS, UTILICE EL ESQUEMA PARA LA INSTALACION PARA ACHIQUE MÁS ABAJO.**
- Los sellos herméticos contra gases son necesarios en todas las instalaciones de aguas cloacales a fin de contener los gases y olores.
- Ventile los gases y olores a la atmósfera a través del tubo de ventilación. (sólo para cloaca y achique).
- Instale el soporte para bomba Zoeller (Modelo 10-2421) debajo de la bomba para proporcionar un sumidero de decantación (sólo para efluente y achique).

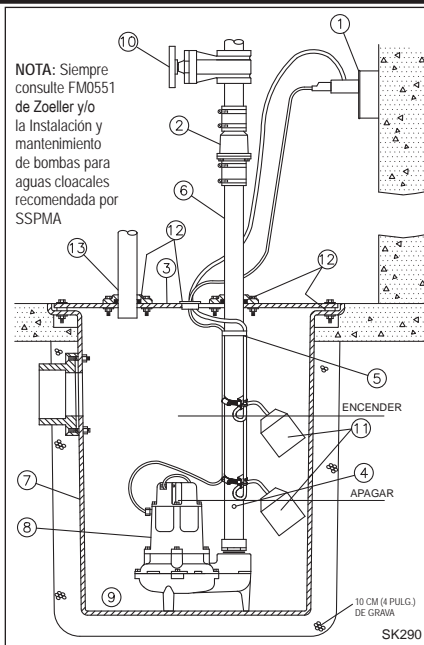
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- La conexión del cableado de la bomba a la fuente de alimentación eléctrica debe hacerse a través de una caja de conexión hermética Zoeller o un empalme hermético. **NOTA: La caja hermética es obligatoria en áreas húmedas.** Vea FM0732. Vea el número 8 en la página 1.
  - Consulte el Manual sobre tamaños de efluentes del SSPMA para determinar la posición de los interruptores "on-off" (encendido-apagado).
  - Se debe usar tubos verticales en el tanque séptico para tener fácil acceso a la bomba y al filtro.
- NOTA:** Las bombas de sello doble ofrecen protección adicional contra los daños causados por falla del sello.

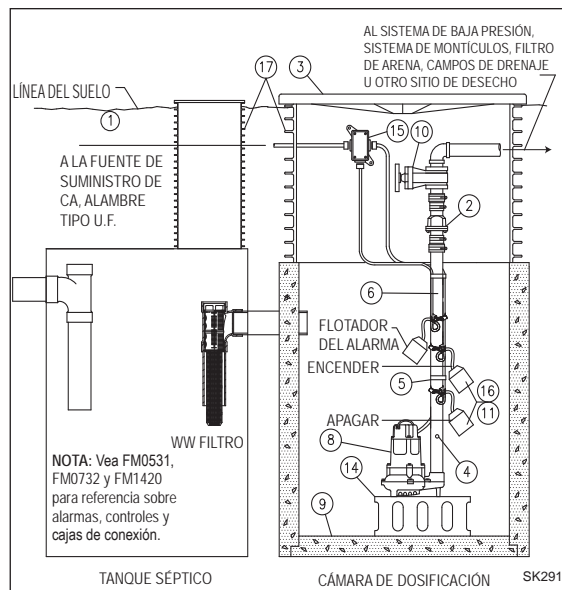
NOTA: Vea FM0531, FM0732 y FM1420 para referencia sobre alarmas, controles y cajas de conexión.



INSTALACIÓN TÍPICA PARA ACHIQUE



INSTALACIÓN TÍPICA PARA AGUAS CLOACALES



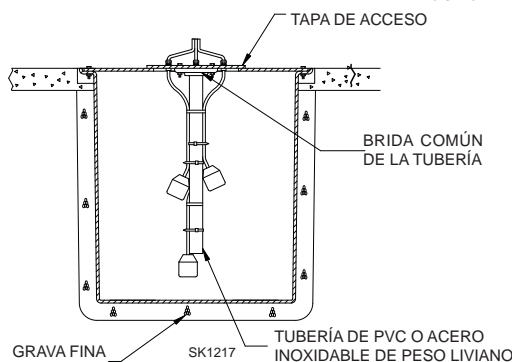
INSTALACIÓN TÍPICA PARA EFLUENTES

Todas las instalaciones deben cumplir con todos los códigos eléctricos y de instalación sanitaria aplicables, incluyendo, pero sin limitarse al Código Eléctrico Nacional, los códigos locales, regionales y/o los códigos estatales de instalación sanitaria, etc. No se debe usar las instalaciones en lugares peligrosos.

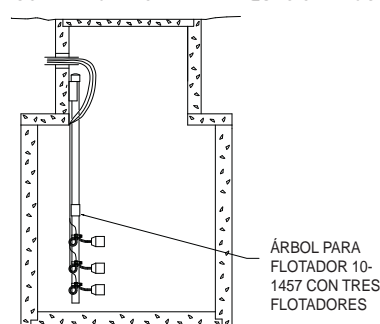
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En algunas instalaciones es deseable instalar un soporte colgante independiente para los interruptores de control de nivel para evitar posibles enganches en las bombas, tubería, válvulas, etc. Los soportes colgantes del flotador se pueden comprar de Zoeller Company según la Hoja de catálogo FM0526, o fabricarse de tubería y empalmes comunes.

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# INSTRUCCIONES PARA LA INSTALACIÓN DE LOS MODELOS WD Y WH

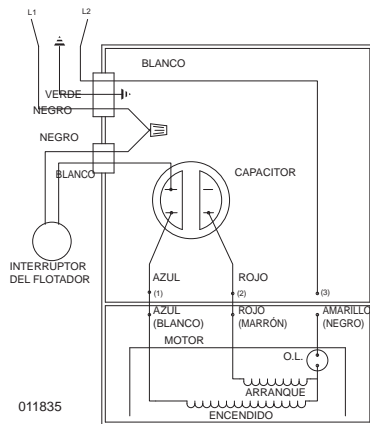


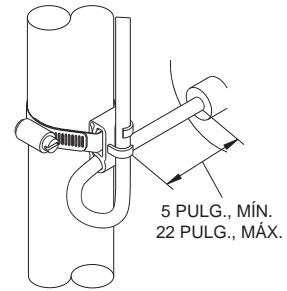
DIAGRAMA DE CABLEADO PARA LOS MODELOS:  
WD-230V, 1 FASE, 60 CICLOS  
WH-200/208V, 1 FASE, 60 CICLOS

## Determinación del rango de bombeo en pulgadas (1 pulg. = 2,5 cm)

Longitud de la atadura	5	10	15	20	22
	min.				máx.
Rango de bombeo	9	13.5	18	22	24

Usar solamente como guía. Debido al peso del cable, el rango de bombeo sobre la horizontal no es igual al rango de bombeo debajo de la horizontal. Los rangos se basan en pruebas en condiciones no turbulentas. El rango puede variar debido a la temperatura del agua y a la forma del cable. A medida que aumenta la longitud de la atadura, también aumenta la variación en el rango de bombeo.

Los modelos WD y WH son completamente automáticos. Se incluye un interruptor de flotador con cableado de fábrica en el circuito de la bomba para proveer una operación automática una vez que el interruptor de flotador se haya atado correctamente a la tubería de salida. Use el diagrama de arriba para asegurar correctamente el interruptor de flotador y obtener la atadura apropiada para adecuar el ciclo de encendido-apagado a cada aplicación.



SK305

INTERRUPTOR DE 20 AMPERIOS  
(MODELOS WD Y WH)

Nota: No tener en cuenta los límites adecuados de la atadura podría alterar el funcionamiento seguro del interruptor.

Nota: El cable debe ser instalado en posición horizontal.

## INSTRUCCIONES PARA EL CABLEADO MONOFÁSICO



**▲ ADVERTENCIA** PARA SU PROTECCIÓN, SIEMPRE DESCONECTE LA BOMBA DE LA FUENTE DE ALIMENTACIÓN ELÉCTRICA ANTES DE MANIPULARLA. Las bombas monofásicas se suministran con enchufes de 3 patillas con puesta a tierra para ayudar a protegerle contra la posibilidad de choque eléctrico. NO RETIRE BAJO NINGUNA CIRCUNSTANCIA LA CLAVIJA DE PUESTA A TIERRA. Los enchufes de 3 patillas se deben introducir en un tomacorriente para 3 patillas apropiado. Si la instalación no posee un tomacorriente de este tipo, se debe cambiar por uno apropiado, cableado y con puesta a tierra de acuerdo al Código Eléctrico Nacional y a todas las ordenanzas y códigos locales aplicables.

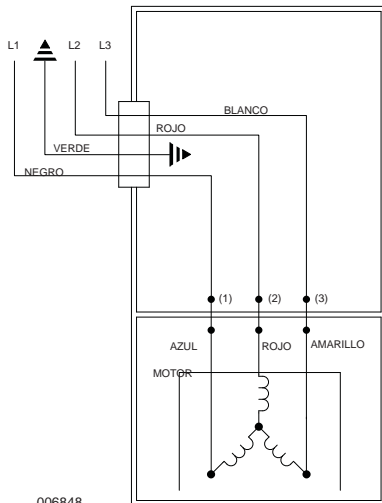


**▲ ADVERTENCIA** "Riesgo de choque eléctrico". No quite el cable de alimentación eléctrica ni el dispositivo de alivio de tensión y no conecte un conductor directamente a la bomba.

**▲ ADVERTENCIA** La instalación y verificación de los circuitos eléctricos y del equipo deberán llevarse a cabo por un técnico electricista calificado.

**▲ ADVERTENCIA** A las unidades que se suministran sin enchufe (monofásico y trifásico) y a las unidades monofásicas no automáticas que poseen un enchufe de 20 amperios se les debe conectar un control de motor y un control de nivel de líquidos durante la instalación. Los niveles de voltaje, amperaje, frecuencia, puesta a tierra y potencia del dispositivo de control deben ser apropiados para la bomba a la cual se conecta.

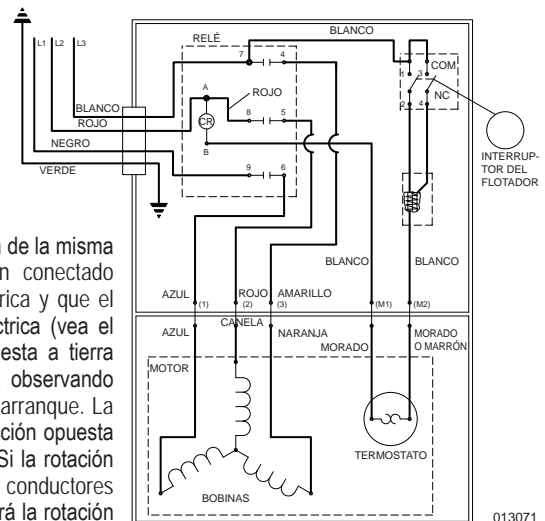
## INSTRUCCIONES PARA EL CABLEADO TRIFÁSICO



006848

Las bombas trifásicas no son automáticas. Para operarlas automáticamente se requiere un panel de control. Siga las instrucciones provistas con el panel para completar el cableado del sistema. Para bombas trifásicas automáticas, ver el diagrama de cableado para bombas trifásicas automáticas a la derecha.

Antes de instalar una bomba, verifique la rotación de la misma para asegurarse de que los cables se hayan conectado correctamente a la fuente de alimentación eléctrica y que el conductor verde del cable de alimentación eléctrica (vea el diagrama de cableado) está conectado con puesta a tierra adecuada. Active momentáneamente la bomba, observando la dirección del retroceso debido a la torsión de arranque. La rotación es correcta si el retroceso está en dirección opuesta a la flecha de rotación en la caja de la bomba. Si la rotación no es correcta, cambiar dos de cualquiera de los conductores eléctricos, excepto el con puesta a tierra, proveerá la rotación apropiada.



013071



**▲ ADVERTENCIA** PARA SU PROTECCIÓN, SIEMPRE DESCONECTE LA BOMBA DE LA FUENTE DE ALIMENTACIÓN ELÉCTRICA ANTES DE MANIPULARLA.

Todas las bombas trifásicas requieren dispositivos de arranque del motor con protección contra sobrecarga. Vea FM0514 para instalaciones simplex o FM0486 para instalaciones duplex. Las bombas se deben instalar de acuerdo al Código Eléctrico Nacional y a todas las ordenanzas y códigos locales aplicables. Las bombas no se deben instalar en sitios clasificados como peligrosos según el Código Eléctrico Nacional ANSI/NFPA 70.

**AVISO IMPORTANTE:** Ciertas pólizas de seguro, tanto comerciales como residenciales, extienden la cobertura a los daños causados por la falla del producto. En la mayoría de los casos, usted deberá conservar el producto para respaldar su reclamo. Zoeller Pump Co. reemplazará la unidad o reembolsará el precio de compra original una vez que la compañía de seguros liquide el reclamo, en el caso de que usted necesite conservar el producto para respaldar un reclamo por daños que le haya presentado a su compañía de seguros.



Que vous dormiez en paix est notre priorité®

Les renseignements présentés ici reflètent les conditions au moment de la publication. Consulter l'usine en cas de contradiction ou d'inconsistance.



Zoeller Family of Water Solutions™

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AVIS : TROU D'ÉVENT POUR  
LE CLAPET DE SÉCURITÉ  
VOIR N° 3 CI-DESSOUS ET  
N° 4 PAGE 3.

## INSTRUCTIONS D'INSTALLATION MODÈLES RECOMMANDÉS

DATE D'INSTALLATION :

NUMÉRO DE MODÈLE :

EFFLUENTS* / PUISARD / ASSÈCHEMENT	ÉGOUT
Série 49 / 53 / 57	Série 264
Série 137, Série 151 / 152 / 153	Série 266 / 267 / 268

### LISTE DE VÉRIFICATIONS AVANT L'INSTALLATION - TOUTES LES INSTALLATIONS

1. Inspecter la pompe. De temps en temps, la pompe est endommagée en cours d'expédition. Si la pompe est endommagée, contacter le distributeur avant de l'utiliser. **NE PAS** enlever les bouchons test du couvercle ni du compartiment moteur.
2. Il faut lire attentivement tous les documents fournis pour se familiariser avec les détails spécifiques de l'installation et de l'utilisation. Il faut conserver ces documents pour pouvoir les consulter ultérieurement.



#### AVERTISSEMENT

VOIR PLUS BAS POUR LA  
LISTE DES AVERTISSEMENTS

1. Il faut vérifier que la prise est à portée du cordon d'alimentation de la pompe. **NE PAS UTILISER DE RALLONGE.** Les rallonges trop longues ou de trop faible capacité ne fournissent pas la tension nécessaire au moteur de la pompe, mais, encore plus important, elles peuvent être dangereuses si l'isolant est endommagé ou si l'extrémité avec le branchement tombe dans un endroit humide ou mouillé.
2. **Vérifier que le circuit d'alimentation de la pompe est équipé de fusibles ou de disjoncteurs de capacité appropriée.** Il est recommandé d'installer un circuit indépendant de capacité suffisante, conforme aux codes électriques nationaux pour la capacité indiquée sur la plaque d'identification de la pompe.
3. **Vérification de la mise à la terre.** Pour des raisons de sécurité, il faut vérifier la terre de chaque prise électrique en utilisant un analyseur de circuit sur la liste d'Underwriters Laboratory qui indique si les fils de phase, de neutre et de terre de la prise sont branchés correctement. S'ils ne sont pas branchés correctement, appeler un électricien agréé qualifié.
4. Pour des raisons de sécurité, les pompes et autre équipement équipés d'un fil à trois broches, avec mise à la terre, doivent être branchés sur une prise à trois broches. Pour des raisons de sécurité, la prise doit être protégée par un disjoncteur différentiel. Quand la pompe est branchée dans un boîtier de branchement étanche, il est possible d'enlever la fiche et de faire le branchement directement sur l'alimentation avec mise à la terre appropriée. Pour des raisons de sécurité, ce circuit peut être protégé par un disjoncteur différentiel. L'installation doit être conforme au code national d'électricité et tous les règlements locaux.
5. **POUR DES RAISONS DE SÉCURITÉ, IL FAUT TOUJOURS DÉBRANCHER L'ALIMENTATION DE LA POMPE AVANT DE LA MANIPULER.** Les pompes monophasées sont équipées d'un cordon avec fiche à trois broches de mise à terre pour protéger contre les électrocutions. **IL NE FAUT JAMAIS ENLEVER LA BROCHE DE MISE À TERRE.** Il faut brancher la fiche à trois broches dans une prise à trois broches de mise à terre. Si le circuit n'est pas équipé d'une telle prise, il faut en installer une en respectant le code national d'électricité et toute la législation et réglementation locales en vigueur. Les pompes triphasées doivent être équipées d'un dispositif de mise en marche avec protection thermique du moteur. Consulter la norme FM0486 pour les installations duplex.
6. La ventilation du réservoir doit être conforme au code de plomberie local. Les pompes doivent être installées conformément au code national d'électricité et à toute la législation et réglementation locales en vigueur. Les pompes ne doivent pas être installées dans des endroits classifiés à risque, conformément à la norme ANSI/NFPA 70 du Code national américain de l'électricité.
7. **Risque d'électrocution.** Ne pas enlever le cordon d'alimentation ni le distributeur de tension mécanique, ni brancher le conduit directement à la pompe.
8. L'installation et la vérification de l'équipement électrique doivent être faites par un électricien qualifié.
9. L'installation et la vérification de la pompe doivent être faites par une personne qualifiée.
10. **Risque d'électrocution.** L'usage de ce type de pompe dans une piscine de natation et des zones marines n'a pas été étudié.
11. Ce produit contient des produits chimiques dont l'état de la Californie a déterminé comme étant la cause de cancer et de déficiences à la naissance ou autres dommages reproductifs.



#### MISE EN GARDE

VOIR PLUS BAS POUR LA  
LISTE DES MISES EN GARDE

1. Vérifier que le circuit d'alimentation a une capacité suffisante pour alimenter le moteur, comme indiqué sur la pompe ou sur la plaque d'identification de l'appareil.
2. L'installateur est responsable de l'installation des pompes automatiques avec des interrupteurs à niveau variable ou des pompes non-automatiques utilisant des interrupteurs auxiliaires à niveau variable et il doit s'assurer que l'interrupteur à flotteur est installé fermement pour qu'il n'accroche pas à la pompe ni au puits pour permettre l'arrêt de la pompe. Il est recommandé d'utiliser du tuyau et des raccords rigides et le puits doit avoir un diamètre supérieur à 45 cm (18").
3. **Renseignements sur le trou d'évent.** Il est nécessaire que la pompe submersible, les pompes à effluents et d'égout capables de passer des solides de différentes tailles aient leur alimentation à la base pour réduire le colmatage et la défaillance des joints. Si l'installation comprend un clapet de sécurité, il faut percer un trou d'évent d'environ 5 mm (3/16") dans le tuyau de refoulement au-dessous du clapet de sécurité et le couvercle pour purger l'air de l'appareil. L'air emprisonné est causé par l'agitation et / ou un puits sec. Il faut vérifier périodiquement que le trou d'évent n'est pas colmaté. Les carter de pompe de la série 53 / 57 et 98 sont équipés d'un trou d'évent à l'opposé du flotteur, près du goujon du carter, du goujon du carter, mais un trou d'évent est recommandé. Le trou d'évent de l'application à une hauteur de refoulement dynamique élevée peut causer une turbulence trop élevée. Il peut être désirable de ne pas le percer. S'il est décidé de ne pas percer de trou d'évent, il faut s'assurer que le carter et le rotor de la pompe sont couverts de liquide avant de brancher le tuyau sur le clapet anti-retour et qu'aucune conduite d'aspiration n'amène de l'air à l'admission de la pompe. **REMARQUE - LE TROU DOIT AUSSI ÊTRE AU-DESSOUS DU COUVERCLE DU PUIS ET IL FAUT LE NETTOYER RÉGULIÈREMENT.** Un jet d'eau sera visible de cette orifice durant les périodes de fonctionnement de la pompe.
4. Il faut vérifier fréquemment qu'il n'y a pas de débris ni d'accumulation pouvant interférer avec le déplacement du flotteur de marche / arrêt. Les réparations ne doivent être faites que par un centre de réparation agréé par Zoeller Pump Company.
5. Les pompes d'assèchement mécanique et d'effluents sont conçues pour pompage d'eau usée non traitée dans un puits.
6. La température de fonctionnement maximale d'une pompe standard ne peut pas être plus de 54°C (130°F).
7. Il faut utiliser les pompes modèles 266, 267, et 137 en position verticale. Il ne faut pas essayer de mettre la pompe en marche quand elle est inclinée ou couchée sur le côté.
8. Il ne faut pas faire fonctionner la pompe dans une application où la hauteur de refoulement dynamique est inférieure à la hauteur de refoulement dynamique minimale donnée dans les courbes de refoulement et de capacité.

**REMARQUE** - Les pompes avec annotations "UL" et "US" sont vérifiées d'après la norme UL778. Les pompes certifiées CSA sont vérifiées d'après la norme C22.2 no 108.

SE RÉFÉRER À LA GARANTIE EN PAGE 2.



## GARANTIE LIMITÉE

Le fabricant garantit à l'acheteur et au propriétaire ultérieur pendant la période de garantie, tout produit neuf contre tout vice de matériel et de main-d'œuvre, en utilisation normale et quand utilisé et entretenu correctement, pendant une période de 3 ans de la date de fabrication initiale. Les pièces devenant défectueuses pendant la période de garantie, et que des inspections prouvent contenir des vices de fabrication ou de main-d'œuvre, seront réparées, remplacées ou renouvelées au choix du Fabricant, à condition qu'en faisant cela nous ne soyons pas obligés de remplacer l'ensemble, le mécanisme complet ou l'appareil complet. Aucune provision n'est faite pour les frais d'expédition, les dégâts, la main-d'œuvre ni d'autres frais causés par la défaillance, la réparation ou le remplacement du produit.

Cette garantie ne s'applique pas et ne couvre aucun matériel ou produit qui a été démonté sans l'autorisation préalable du Fabricant, soumis à un usage abusif, des applications incorrectes, de la négligence, des modifications, des accidents ou un cas de force majeure ; qui n'a pas été installé, utilisé ou entretenu selon les instructions d'installation du Fabricant; qui a été exposé, y compris, mais non de façon limitative, à du sable, des gravillons, du ciment, de la boue, du goudron, des hydrocarbures ou des dérivés d'hydrocarbures (huile, essence, solvants, etc.) ou à d'autres produits abrasifs ou corrosifs, serviettes ou produits d'hygiène féminine etc., dans toutes les applications de pompage. La garantie mentionnée ci-dessus remplace toutes les autres garanties

expresses ou implicites et nous n'autorisons aucun représentant ou autre personne à accepter la responsabilité en notre nom pour nos produits. Prendre contact avec le Fabricant, 3649 Cane Run Road, Louisville, KY 40211, à l'attention du Service à la Clientèle, pour obtenir des réparations, des pièces de remplacement ou des renseignements supplémentaires concernant la garantie.

**LE FABRICANT REFUSE EXPRESSÉMENT TOUTE RESPONSABILITÉ POUR LES DÉGÂTS SPÉCIAUX, INDIRECTS OU SECONDAIRES OU POUR LES RUPTURES DE GARANTIE EXPRESSES OU IMPLICITES; ET TOUTE GARANTIE IMPLICITE D'APPLICABILITÉ À UNE UTILISATION SPÉCIFIQUE OU DE COMMERCIALITÉ EST LIMITÉE À LA DURÉE DE LA GARANTIE EXPRESSE.**

Certaines provinces ne permettent pas les limitations de la durée de la garantie implicite et il est possible que cette limitation ne s'applique pas. Certaines provinces ne permettent pas l'exclusion ou la limitation des dégâts secondaires ou indirects, et il est possible que cette limitation ou exclusion ne s'applique pas.

Cette garantie vous donne des droits spécifiques reconnus par la loi et vous pouvez également avoir d'autres droits qui varient d'une province à l'autre.

## CONSEILS POUR L'INSTALLATION D'UNE POMPE DE PUISARD

1. **IL FAUT** lire toutes les instructions d'installation fournies avec la pompe.
2. **IL FAUT** vérifier que les appareils n'ont pas été endommagés en cours d'expédition. Contacter le distributeur si la pompe a été endommagée.
3. **IL FAUT** nettoyer tous les débris dans le puisard. Vérifier qu'il y a une surface dure et plate à l'emplacement désiré pour la pompe. **NE PAS** installer la pompe sur du sable, du gravier ou de la terre.
4. **IL FAUT** vérifier que le puisard est assez large pour avoir de l'espace suffisant pour le bon fonctionnement des interrupteurs de commande de niveau.
5. **IL FAUT** toujours débrancher l'alimentation de la pompe avant de la manipuler.  
**IL FAUT** toujours brancher la pompe sur un circuit séparé mis à la terre.  
**IL NE FAUT JAMAIS** couper, faire une épissure ou endommager un cordon d'alimentation. (Pour faire une raccordement, il faut utiliser un boîtier de raccordement étanche.  
**IL NE FAUT PAS** utiliser le cordon d'alimentation pour transporter ou soulever la pompe.  
**IL NE FAUT PAS** utiliser de rallonge pour une pompe de puisard.
6. **IL FAUT** installer un clapet de sécurité et un raccord sur la conduite de refoulement.  
**IL NE FAUT PAS** utiliser une conduite de refoulement de diamètre inférieur à celui du refoulement de la pompe.
7. **IL NE FAUT PAS** utiliser une pompe de puisard comme pompe de tranchée ou d'excavation, ou pour pomper des égouts, de l'essence ou tout autre liquide dangereux.
8. **IL FAUT** essayer la pompe immédiatement après l'installation pour être certain que le système fonctionne correctement.
9. **IL FAUT** recouvrir la pompe de puisard d'un couvercle de puisard approprié.
10. **IL FAUT** étudier tous les codes locaux et nationaux applicables et vérifier que l'installation est conforme.
11. **IL FAUT** consulter le fabricant pour obtenir des clarifications ou des réponses aux questions.
12. **IL FAUT** considérer un système à deux pompes avec une alarme quand l'installation peut être surchargée ou si une défaillance de la pompe primaire causait des dégâts importants.
13. **IL FAUT** considérer un système de secours en courant alternatif quand une pompe de puisard ou d'échage mécanique est nécessaire pour éviter des dégâts matériels en cas d'inondation à la suite d'une panne d'alimentation secteur, de problème mécanique ou électrique ou de surcharge du système.
14. **IL FAUT** inspecter le système et vérifier son fonctionnement au moins tous les trois mois.

## LISTE DE VÉRIFICATIONS POUR L'ENTRETIEN



### ⚠️ AVERTISSEMENT

**PRÉCAUTIONS AVEC LE SYSTÈME ÉLECTRIQUE** – Avant de réparer la pompe, il faut toujours ouvrir le circuit et débrancher la pompe, en prenant soin de porter des chaussures à semelle isolante et de ne pas se tenir dans l'eau. En cas d'inondation, contacter la compagnie d'électricité ou un électricien agréé pour couper l'alimentation avant de déposer la pompe.

### ⚠️ AVERTISSEMENT

Les pompes submersibles contiennent de l'huile qui peut être sous pression ou devenir chaude en cours de fonctionnement. **Attendre 2 heures et demi après l'avoir débranchée avant de travailler sur la pompe.**

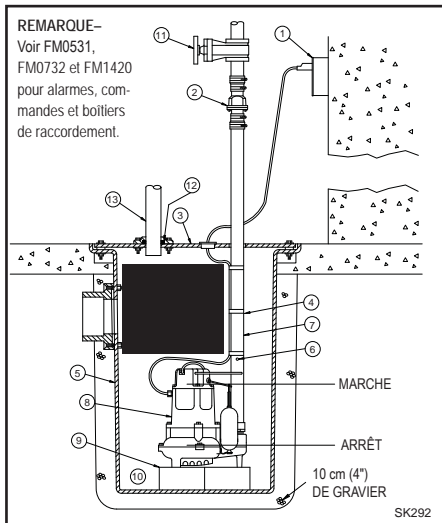
CONDITION	CAUSES FRÉQUENTES
A. La pompe ne démarre pas ou ne fonctionne pas.	Vérifier que le fusible est en bon état, que la tension est normale, que le circuit n'est pas surchargé et que le câblage est correct, que l'interrupteur n'est pas ouvert, que le rotor ou le joint n'est pas bloqué, que le condensateur ou le relais n'est pas défectueux, si installé, qu'il n'y a pas de court-circuit dans le moteur ou le bobinage. Flotteur bloqué en position basse. Interrupteur défectueux, endommagé ou mal réglé.
B. Le moteur surchauffe et déclenche le disjoncteur ou la sécurité thermique.	Mauvaise tension, hauteur de refoulement négative (refoulement ouvert au-dessous de la normale), blocage mécanique du rotor ou du joint, moteur court-circuité.
C. La pompe se met en marche et s'arrête trop fréquemment.	Flotteur grippé sur la tige, clapet de sécurité coincé ou pas de clapet installé sur une conduite longue, clapet de sécurité ouvert, interrupteurs de niveau défectueux, puits trop petit.
D. La pompe ne s'arrête pas.	Débris sous le flotteur, flotteur ou tige du flotteur coincé contre la paroi du puits, interrupteur défectueux, endommagé ou mal réglé.
E. La pompe fonctionne mais son débit est faible ou non existant.	Vérifier le carter de crépine, le tuyau de refoulement ou, si un clapet de sécurité est installé, le trou d'évent. La hauteur de refoulement est supérieure à la capacité de la pompe. Mauvaise tension. Mauvaise direction de rotation de la pompe. Condensateur défectueux. L'eau d'alimentation contient de l'air ou provoque l'entrée d'air dans la chambre de la pompe.
F. Baisse de capacité ou de hauteur de refoulement après une période d'utilisation.	Augmentation de la friction dans le tuyau de refoulement, tuyau ou clapet de sécurité colmaté. Des produits abrasifs ou des produits chimiques peuvent détériorer le rotor et le carter de pompe. Inspecter la conduite. Déposer la base et inspecter.

**Si les vérifications ci-dessus ne résolvent le problème, consulter l'usine. Ne pas essayer de réparer ou de démonter la pompe. Toutes les réparations doivent être faites par un centre de réparation agréé par Zoeller. Visitez le site Web [www.zoellerpumps.com/servicestations](http://www.zoellerpumps.com/servicestations) pour trouver le centre de service agréé le plus proche.**

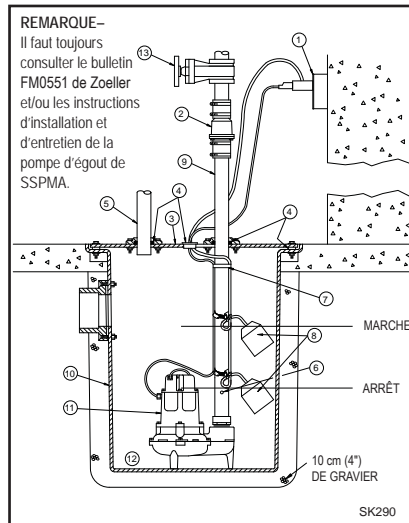


# INSTALLATION RECOMMANDÉE POUR TOUTES APPLICATIONS

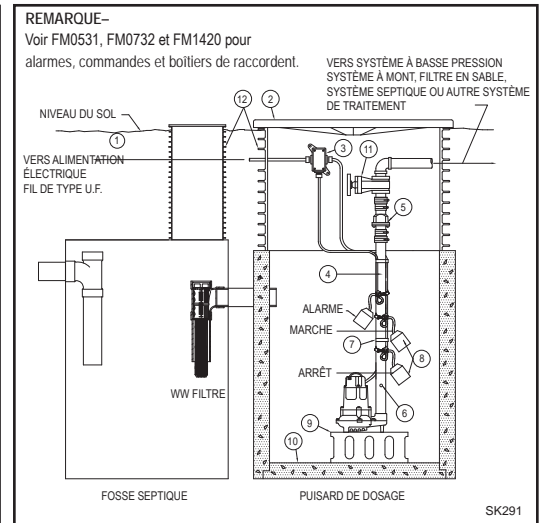
- (1) Les circuits et les protections électriques doivent être conformes aux normes des codes électriques nationaux, provinciaux et locaux.
  - (2) Installer un Unichек (raccord / clapet de sécurité combiné) de Zoeller approprié, de préférence juste au-dessus du puits pour permettre la dépose de la pompe pour le nettoyage ou les réparations. Pour les égouts, les effluents ou les eaux d'assèchement mécanique, utiliser le modèle 30-0164 avec des tuyaux de 1-1/2" (38 mm), modèle 30-0152 avec des tuyaux de 2" (51 mm) et le modèle 30-0160 avec des tuyaux de 3" (76 mm) s'il faut une grande hauteur de refoulement ou en cas d'installation sous un couvercle. Voir (4) ci-dessous.
  - (3) Tous les puits doivent avoir un couvercle pour empêcher les débris d'y tomber et éviter les chutes accidentelles.
  - (4) Quand un Unichек est installé, percer un trou de 5 mm (3/16") dans le tuyau de refoulement, de niveau avec le dessus de la pompe. Les pompes de la série 50 et 90 ont un trou d'évent intégré. **REMARQUE – LE TROU DOIT AUSSI ÊTRE AU-DESSOUS DU COUVERCLE DU Puits ET IL FAUT LE NETTOYER RÉGULIÈREMENT** (pompes à hauteur de refoulement élevée, voir n° 3 de la première page « MISE EN GARDE »). Un jet d'eau sera visible de cette orifice durant les périodes de fonctionnement de la pompe.
  - (5) Attacher fermement le cordon d'alimentation électrique sur le tuyau de refoulement en utilisant du chatterton ou des colliers.
  - (6) Utiliser un tuyau de refoulement de pleines dimensions.
  - (7) Le puits doit être conforme à tous les règlements applicables.
  - (8) Avant la mise en service, la pompe doit être de niveau et le mécanisme du flotteur ne doit pas toucher les bords du puits.
  - (9) Après l'installation, le puits doit être propre et ne doit pas contenir de débris.
  - (10) L'installateur doit fournir la vanne d'arrêt et l'installer en respectant tous les codes.
  - (11) Identifier les interrupteurs à flotteur indiqués dans les illustrations. Le point d'arrêt doit être au-dessus du carter du moteur et à 180° de l'admission. Le point d'arrêt ne se doit trouver jamais au-dessous du refoulement de la pompe (uniquement pour les systèmes d'eaux usées et d'effluent). **REMARQUE - pour les pompes automatiques, utiliser le schéma d'installation pour l'assèchement ci-dessous.**
  - (12) Pour éviter la propagation des gaz et des odeurs, toutes les installations doivent avoir des joints étanches.
  - (13) Les gaz et les odeurs sont évacués à l'atmosphère au moyen d'un tuyau d'évent. (uniquement pour les systèmes d'eaux usées et d'assèchement).
  - (14) Installer la base de pompe Zoeller (modèle 10-2421) sous la pompe pour former un bassin de décantation (uniquement pour les systèmes d'effluent et d'assèchement). **Uniquement pour les systèmes d'effluent :**
  - (15) Brancher l'alimentation de la pompe par l'intermédiaire d'un boîtier étanche Zoeller ou d'une épissure étanche. **REMARQUE – Le boîtier étanche est une nécessité absolue dans un milieu humide. Voir le n° 8 à la première page de FM0732.**
  - (16) Consulter le manuel de dimensions pour les égouts de SSPMA afin de déterminer le modèle d'interrupteur de marche / arrêt à utiliser.
  - (17) Un accès à la fosse septique doit être prévu pour l'entretien du filtre et de la pompe.
- REMARQUE – Les pompes à joint double offrent une protection supplémentaire contre les dommages causés par la défaillance du joint.**



INSTALLATION TYPIQUE  
POUR L'ASSÈCHEMENT MÉCANIQUE



INSTALLATION TYPIQUE  
POUR ÉGOUT

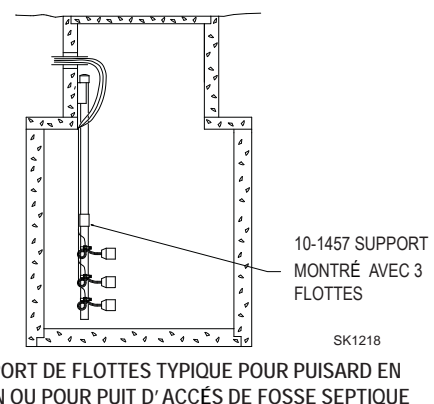
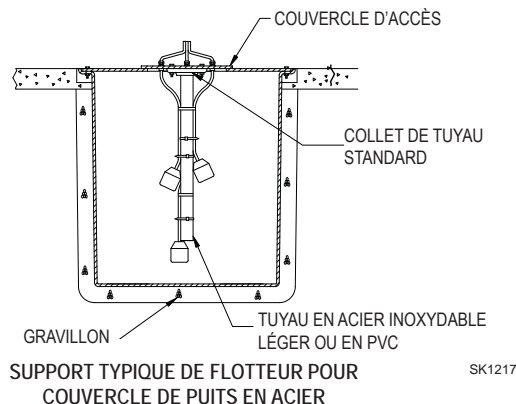


INSTALLATION TYPIQUE  
POUR LES EFFLUENTS

Toutes les installations doivent être conformes aux codes électriques et de plomberie applicables, y compris, mais pas limité aux codes électriques nationaux, locaux, régionaux et aux codes de plomberie provinciaux. Pas conçu pour utilisation dans les endroits dangereux.

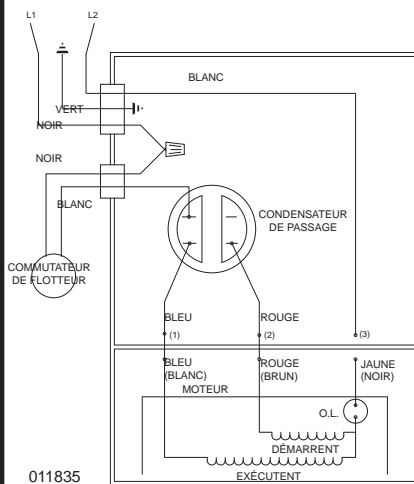
## MÉTHODES SUGGÉRÉES POUR L'INSTALLATION DU FLOTTEUR

Pour certaines installations, il peut être nécessaire d'installer un support indépendant pour les interrupteurs de commande de niveau pour éviter des accrochages possibles sur la pompe, la tuyauterie, les vannes, etc. Il est possible de fabriquer les supports de flotteurs en utilisant des tuyaux et des raccords standard pour faciliter la dépose en cas de réparation. Les supports de flotteurs sont disponibles chez Zoeller tel que décrit au feuillet FM0526 ou peuvent être fabriqués avec de la tuyauterie et des raccords standard.





## Installation des modèles WD et WH



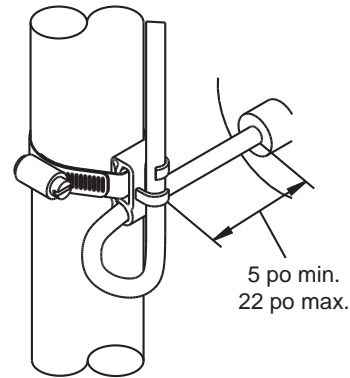
011835  
SCHÉMA ÉLECTRIQUE POUR LES MODÈLES  
WD - 230 V, monophasé, 60 Hz  
WH - 200/208, monophasé, 60 Hz

### Définition de la plage de pompage en pouces (1 pouce = 2,5 cm)

Longueur du bras d'attache	5 min.	10	15	20	22 max.
Plage de pompage	9	13.5	18	22	24

Ce tableau ne doit être utilisé que comme guide. À cause du poids du câble, la plage de pompage au-dessus de l'horizontale n'est pas égale à la plage de pompage au-dessous de l'horizontale. Les plages sont basées sur des essais sans turbulence. La plage peut varier en fonction de la température de l'eau et de la forme du cordon. Plus le bras est long, plus les variations de plage de pompage sont importantes.

Les modèles WD et WH sont entièrement automatiques. Un interrupteur à flotteur est inclus et branché dans le circuit de la pompe pour permettre le fonctionnement automatique après avoir installé l'interrupteur à flotteur correctement sur le tuyau de refoulement. Il faut utiliser le schéma ci-dessus pour attacher correctement l'interrupteur à flotteur et obtenir un bras approprié pour modifier le cycle de marche-arrêt pour chaque application.



SK305

Interrupteur 20 amps (modèles WD et WH)

Remarque – L'interrupteur risque de mal fonctionner si le câble d'attache n'est pas maintenu dans les limites appropriées.  
Remarque – Le câble doit être installé horizontalement.

## Instructions de branchement monophasé



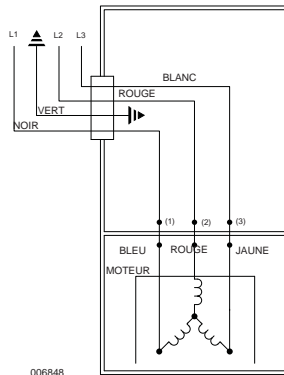
**▲ AVERTISSEMENT** POUR DES RAISONS DE SÉCURITÉ, IL FAUT TOUJOURS DÉBRANCHER L'ALIMENTATION ÉLECTRIQUE DE LA POMPE AVANT L'INTERVENTION. Les pompes monophasées sont fournies avec une fiche à trois broches pour aider à protéger contre les risques d'électrocution. IL NE FAUT JAMAIS ENLEVER LA BROCHE DE TERRE. La fiche à trois broches doit être branchée dans une prise à trois alvéoles correspondantes. Si le circuit d'alimentation n'a pas une telle prise, il faut installer une prise du type approprié, branchée et mise à la terre selon le code national de l'électricité et tous les codes et règlements locaux appropriés.



**▲ AVERTISSEMENT** « Risque d'électrocution ». Il ne faut pas enlever le cordon d'alimentation et le serre-câble ni brancher directement la pompe.  
**▲ AVERTISSEMENT** L'installation et la vérification des circuits électriques et de la quincaillerie doivent être faites par un électricien qualifié.  
**▲ AVERTISSEMENT** Les unités non équipées d'une fiche (monophasée et triphasée) et les unités non automatiques monophasées à fiche de 20 ampères doivent être dotées d'une commande de moteur et d'un régulateur de niveau de liquide lors de l'installation. La tension, l'intensité, la fréquence, la mise à la terre et la puissance du dispositif de commande doivent s'accorder à la pompe sur lequel il est branché.

## Instructions de branchement triphasé

### Pompe non-automatique triphasée



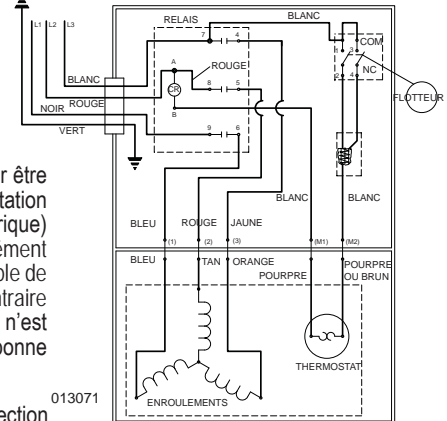
006848

Les pompes triphasées ne sont pas automatiques. Pour qu'elles fonctionnent automatiquement, il faut installer un panneau de commande. Pour brancher le système, suivre les instructions fournies avec le panneau de commande. Pour trois phases automatique les pompes voient le diagramme de câblage automatique de 3 phases situé vers le droit.

Avant d'installer la pompe, vérifier la rotation de la pompe pour être certain que les fils ont été branchés correctement sur l'alimentation et que le fil vert du cordon d'alimentation (voir schéma électrique) est branché sur une bonne terre. Mettre la pompe momentanément sous tension et observer la direction du retour causé par le couple de démarrage. La rotation est correcte si le retour est en sens contraire à la flèche de rotation dans le carter de la pompe. Si la rotation n'est pas correcte, inverser deux des fils de phase pour obtenir la bonne direction de rotation.

Toutes les pompes triphasées doivent être équipées d'un dispositif de démarrage, avec dispositif de protection contre la surcharge. Voir FM0486 pour les installations duplex. La pompe doit être branchée conformément au code national de l'électricité et tous les codes et règlements locaux appropriés. Il ne faut pas installer les pompes dans un endroit classé dangereux conformément au code national de l'électricité, ANSI/NFPA 70.

### Pompe automatique triphasée



013071



**▲ AVERTISSEMENT** POUR DES RAISONS DE SÉCURITÉ, IL FAUT TOUJOURS DÉBRANCHER L'ALIMENTATION ÉLECTRIQUE DE LA POMPE AVANT L'INTERVENTION.

**REMARQUE IMPORTANTE.** – Certaines polices d'assurance commerciales et résidentielles couvrent les dommages résultant d'une défaillance du produit. Dans la plupart des cas, vous devez être en possession du produit pour déposer une réclamation. Zoeller Pump Co. s'engage à remplacer l'appareil ou à rembourser le prix d'achat original après que l'assureur aura réglé la réclamation dans un cas où vous êtes tenu d'être en possession du produit pour documenter une réclamation soumise à votre assureur.



Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

**Zoeller Family of Water Solutions™**

**MAIL TO:** P.O. BOX 16347 • Louisville, KY 40256-0347  
**SHIP TO:** 3649 Cane Run Road • Louisville, KY 40211-1961  
**(502) 778-2731 • 1 (800) 928-PUMP • FAX (502) 774-3624**

**visit our web site:**  
**[www.zoeller.com](http://www.zoeller.com)**

## REPLACEMENT PARTS LIST FOR MODELS:

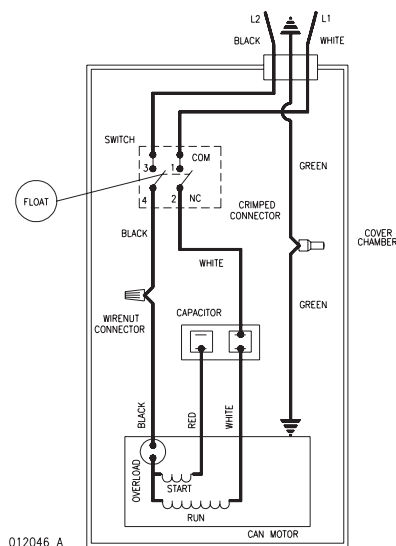
**M72 AUTOMATIC 115V**  
**N72 NONAUTOMATIC 115V**  
**M76 AUTOMATIC 115V**  
**N76 NONAUTOMATIC 115V**

## Consult factory for all other models

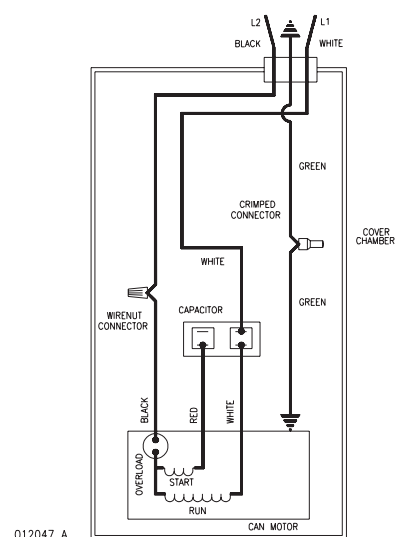
**TO ORDER REPLACEMENT PARTS:**

**PLEASE FURNISH THE FOLLOWING INFORMATION:**

- Model Number.
- Part Number of Pump.
- Part Number and Description of part.



WIRING DIAGRAM FOR MODEL  
M72  
7/99 THRU CURRENT



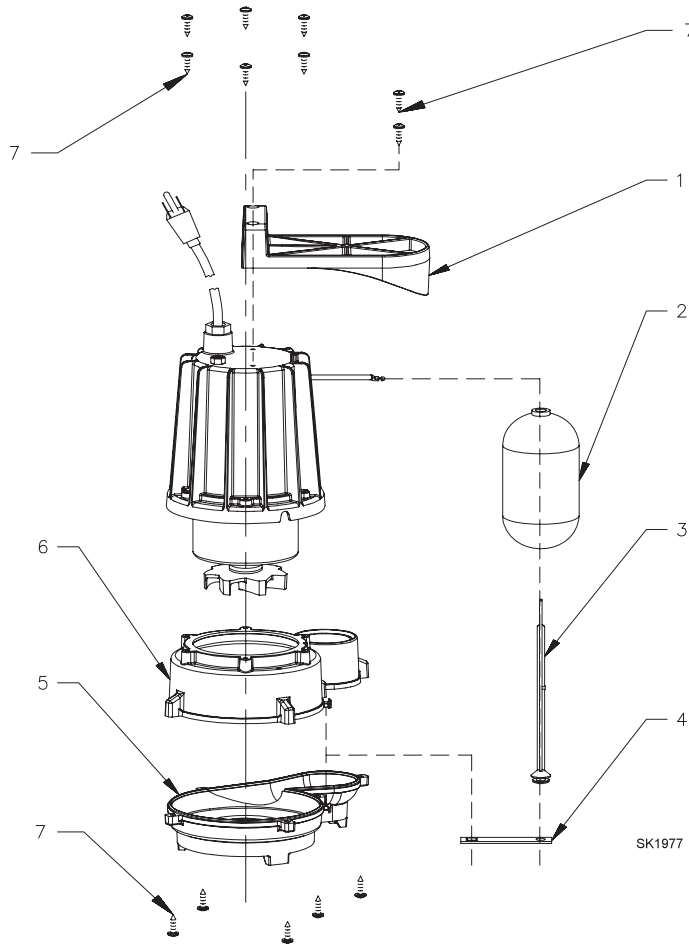
WIRING DIAGRAM FOR MODEL  
N72  
7/99 THRU CURRENT



# **REPLACEMENT PARTS LIST FOR MODELS:** **“M72”, “N72”, “M76” and “N76”.**

MODEL: M72			Rev. A
REF. NO.	DESCRIPTION	QTY	7/99 thru Current
1	Guard/Handle	1	012029
2	Float-Polypropylene	1	034019
3	Float-Rod	1	054062
4	Guide	1	012043
5	Base	1	012028
6	Pump Housing	1	012027
7	Screw	13	012042

MODEL: N72			Rev. A
REF. NO.	DESCRIPTION	QTY	7/99 thru Current
1	Handle	1	012030
2	N/A	N/A	N/A
3	N/A	N/A	N/A
4	N/A	N/A	N/A
5	Base	1	012028
6	Pump Housing	1	012027
7	Screw	13	012042



MODEL: M76			Rev. A
REF. NO.	DESCRIPTION	QTY	02/00 thru Current
1	Guard/Handle	1	012029
2	Float-Polypropylene	1	034019
3	Float-Rod	1	002524
4	Guide	1	012043
5	Base	1	012028
6	Pump Housing	1	012048
7	Screw	13	012042

MODEL: N76			Rev. A
REF. NO.	DESCRIPTION	QTY	02/00 thru Current
1	Handle	1	012030
2	N/A	N/A	N/A
3	N/A	N/A	N/A
4	N/A	N/A	N/A
5	Base	1	012028
6	Pump Housing	1	012048
7	Screw	13	012042



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(502) 778-2731 • 1 (800) 928-PUMP • FAX (502) 774-3624

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**Your Peace of Mind is Our Top Priority®**



## Assembly and operating instructions

DULCOMETER®, Compact Controller  
Measured variable: pH / ORP

ProMinent®

PH-501 - Transmitter, pH, Prominent Dulcometer pH or ORP4-20mA output, 7781499

EN



Please carefully read these operating instructions before use. · Do not discard.  
The operator shall be liable for any damage caused by installation or operating errors.  
The latest version of the operating instructions are available on our homepage.



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## Supplemental instructions

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### General non-discriminatory approach

In order to make it easier to read, this document uses the male form in grammatical structures but with an implied neutral sense. It is aimed equally at both men and women. We kindly ask female readers for their understanding in this simplification of the text.

### Supplementary information


Please read the supplementary information in its entirety.

### Information







*This provides important information relating to the correct operation of the unit or is intended to make your work easier.*

### Safety Information

The safety information includes detailed descriptions of the hazardous situation, see  Chapter 2.1 'Explanation of the safety information' on page 8

The following symbols are used to highlight instructions, links, lists, results and other elements in this document:

### More symbols

Symbol	Description
<b>1.</b> 	Action, step by step
	Outcome of an action
	Links to elements or sections of these instructions or other applicable documents
	List without set order
<i>[Button]</i>	Display element (e.g. indicators) Operating element (e.g. button, switch)
<i>'Display /GUI'</i>	Screen elements (e.g. buttons, assignment of function keys)
CODE	Presentation of software elements and/or texts



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## Identity code

---

### 1 Identity code

DCCa	DULCOMETER® Compact,									
	Mounting type									
	E	Spare part units								
	W	Wall/pipe mounting IP 67								
	S	With fitting kit for control panel mounting IP 54								
	Design									
	00	With ProMinent® logo								
	E1	Spare part unit, controller housing lower part (processor/PCB), fully assembled								
	E2	Spare part unit, controller housing top part (processor/PCB), fully assembled								
	Operating voltage									
	6	90 ... 253 V, 48/63 Hz								
	Measured variable									
	C0	Free chlorine								
	NG	pH/ORP (switchable)								
	L3	Conductive conductivity (designation: COND_C)								
	L6	Inductive conductivity (designation: COND_I)								
	Hardware extension									
	0	None								
	Approvals									
	01	CE (Standard)								
	Certificates									
	0	None								
	Operating instructions language									
	EN	German	KR	Korean						



	Identity code
--	---------------

DCCa	DULCOMETER® Compact,									
							EN	English	LT	Lithuanian
							ES	Spanish	LV	Latvian
							IT	Italian	NL	Dutch
							FR	French	PL	Polish
							FI	Finish	PT	Portuguese
							BG	Bulgarian	RO	Romanian
							ZH	Chinese	SV	Swedish
							CZ	Czech	SK	Slovakian
							EL	Greek	SL	Slovenian
							HU	Hungarian	RU	Russian
							YES	Japanese	TH	Thai



## 2 Introduction

### Data and functions

These operating instructions describe the technical data and functions of the DULCOMETER® Compact Controller, measured variable pH / ORP.

### 2.1 Explanation of the safety information

#### Introduction

These operating instructions provide information on the technical data and functions of the product. These operating instructions provide detailed safety information and are provided as clear step-by-step instructions.

The safety information and notes are categorised according to the following scheme. A number of different symbols are used to denote different situations. The symbols shown here serve only as examples.



#### **DANGER!**

##### **Nature and source of the danger**

Consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger

Danger!

- Denotes an immediate threatening danger. If this is disregarded, it will result in fatal or very serious injuries.



#### **WARNING!**

##### **Nature and source of the danger**

Possible consequence: Fatal or very serious injuries.

Measure to be taken to avoid this danger

Warning!

- Denotes a possibly hazardous situation. If this is disregarded, it could result in fatal or very serious injuries.



#### **CAUTION!**

##### **Nature and source of the danger**

Possible consequence: Slight or minor injuries, material damage.

Measure to be taken to avoid this danger

Caution!

- Denotes a possibly hazardous situation. If this is disregarded, it could result in slight or minor injuries. May also be used as a warning about material damage.



**! NOTICE!**

**Nature and source of the danger**

Damage to the product or its surroundings

Measure to be taken to avoid this danger

Note!

- Denotes a possibly damaging situation. If this is disregarded, the product or an object in its vicinity could be damaged.



***Type of information***

*Hints on use and additional information*

*Source of the information, additional measures*

*Information!*

- *Denotes hints on use and other useful information. It does not indicate a hazardous or damaging situation.*



### 2.2 Users' qualifications



#### **WARNING!**

**Danger of injury with inadequately qualified personnel!**

**The operator of the plant / device is responsible for ensuring that the qualifications are fulfilled.**

If inadequately qualified personnel work on the unit or loiter in the hazard zone of the unit, this could result in dangers that could cause serious injuries and material damage.

- All work on the unit should therefore only be conducted by qualified personnel.
- Unqualified personnel should be kept away from the hazard zone

Training	Definition
Instructed personnel	An instructed person is deemed to be a person who has been instructed and, if required, trained in the tasks assigned to him/her and possible dangers that could result from improper behaviour, as well as having been instructed in the required protective equipment and protective measures.
Trained user	A trained user is a person who fulfils the requirements made of an instructed person and who has also received additional training specific to the system from ProMinent or another authorised distribution partner.
Trained qualified personnel	A qualified employee is deemed to be a person who is able to assess the tasks assigned to him and recognize possible hazards based on his/her training, knowledge and experience, as well as knowledge of pertinent regulations. The assessment of a person's technical training can also be based on several years of work in the relevant field.



Training	Definition
Electrician	<p>Electricians are deemed to be people, who are able to complete work on electrical systems and recognize and avoid possible hazards independently based on his/her technical training and experience, as well as knowledge of pertinent standards and regulations.</p> <p>Electricians should be specifically trained for the working environment in which they are employed and know the relevant standards and regulations.</p> <p>Electricians must comply with the provisions of the applicable statutory directives on accident prevention.</p>
Customer Service department	Customer Service department refers to service technicians, who have received proven training and have been authorised by ProMinent to work on the system.


***Note for the system operator***

*The pertinent accident prevention regulations, as well as all other generally acknowledged safety regulations, must be adhered to!*



### 3 Safety and responsibility

#### 3.1 General Safety Information



##### **WARNING!**

###### **Live parts!**

Possible consequence: Fatal or very serious injuries

- Measure: Disconnect the mains power supply prior to opening the housing
- De-energise damaged, defective or manipulated units by disconnecting the mains plug



##### **WARNING!**

###### **Unauthorised access!**

Possible consequence: Fatal or very serious injuries

- Measure: Ensure that there can be no unauthorised access to the unit



##### **WARNING!**

###### **Operating errors!**

Possible consequence: Fatal or very serious injuries

- The unit should only be operated by adequately qualified and technically expert personnel
- Please also observe the operating instructions for controllers and fittings and any other component groups, such as sensors, measuring water pumps ...
- The operator is responsible for ensuring that personnel are qualified



##### **CAUTION!**

###### **Electronic malfunctions**

Possible consequence: Material damage to destruction of the unit

- The mains connection cable and data cable should not be laid together with cables that are prone to interference
- Measure: Take appropriate interference suppression measures



**! NOTICE!**

**Correct and proper use**

Damage to the product or its surroundings

- The unit is not intended to measure or regulate gaseous or solid media
- The unit may only be used in accordance with the technical details and specifications provided in these operating instructions and in the operating instructions for the individual components

**! NOTICE!**

**Correct sensor operation / Run-in time**

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- It is imperative that the run-in times of the sensors are adhered to
- The run-in times should be allowed for when planning initial operation
- It may take a whole working day to run-in the sensor
- Please read the operating instructions for the sensor

**! NOTICE!**

**Correct sensor operation**

Damage to the product or its surroundings

- Correct measuring and dosing is only possible if the sensor is working perfectly
- Check and calibrate the sensor regularly

**! NOTICE!**

**Compensation of control deviations**

Damage to the product or its surroundings

- This controller cannot be used in control circuits which require rapid compensation (< 30 s)

### 3.2 Correct and proper use

**! NOTICE!**

**Compensation for control deviations**

Damage to the product or its surroundings

- The controller can be used in processes, which require compensation of > 30 seconds



### **! NOTICE!**

#### **Correct and proper use**

The unit is intended to measure and regulate liquid media. The marking of the measured variables is located on the controller and is absolutely binding.

The unit may only be used in accordance with the technical details and specifications provided in this operating manual and in the operating manuals for the individual components (such as, for example, sensors, fittings, calibration devices, metering pumps etc.).

Any other uses or modifications are prohibited.



## 4 Functional description

### Brief functional description

The DULCOMETER® Compact Controller for pH and redox measured variables provides basic functions for water treatment applications. It has a fixed configuration with the following features:

- Measured variables pH and redox (can be switched over on the DULCOMETER® Compact Controller)
- Language independent operation (use of abbreviations, such as *[INPUT]*, *[OUTPUT]*, *[CONTROL]*, *[ERROR]*)
- Illuminated display
- 3 LEDs indicate the operating states (*[f-REL]* active, *[P-REL]* active, error)
- Sensor monitoring of pH
- P or PID control characteristics
- Selectable control direction (raise or lower measured value)
- Impulse frequency relay *[f-REL]* for metering pump control
- Power relay *[P-REL]*, configurable as alarm, limit value or pulse width modulated (PWM) control output for metering pumps
- Analogue output 0/4...20 mA, can be configured as a measured value or correction variable
- Suction function for all actuators
- Digital input to switch off the DULCOMETER® Compact Controller or to process a sample water limit contact by remote control
- Temperature sensor input (Pt 1000) for temperature compensation of the pH value
- Protection class IP67 (wall/pipe mounting), protection class IP54 (control panel mounting)

### Applications:

- Waste water treatment
- Treatment of drinking water
- Swimming pool water treatment



## 4.1 Flow diagram

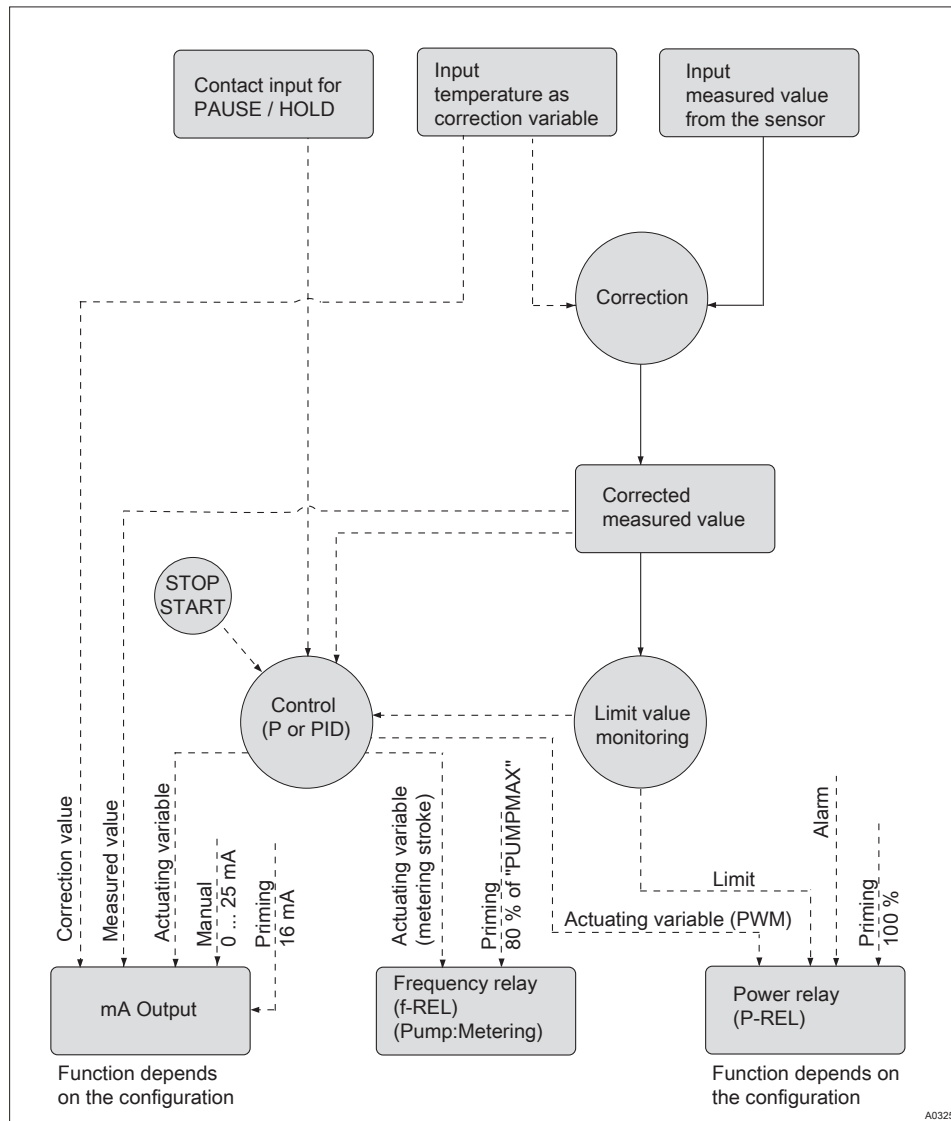


Fig. 1: Flow diagram



## 4.2 Overview of the first level menu

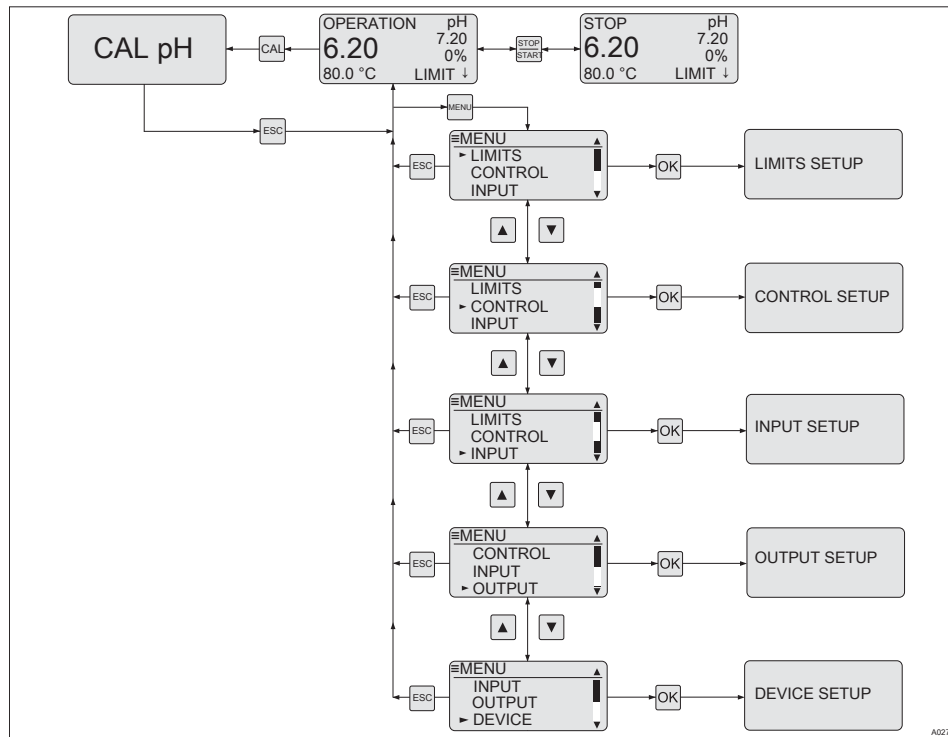
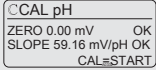

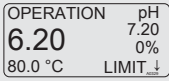



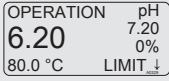

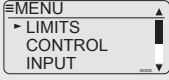


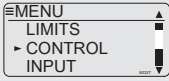




Fig. 2: Overview of the first level menu; shown for pH

Display view	Selection with:	Reference	Function
<div>OPERATION</div> <div>pH</div> <div>6.20</div> <div>7.20</div> <div>0%</div> <div>80.0 °C</div> <div>LIMIT ↓</div>		<a href="#">Chapter 7 'Operating diagram'</a> on page 43	
<div>CAL</div>			Changes to the calibration menu.

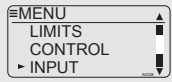


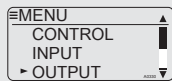


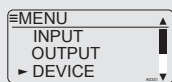



## Functional description

Display view	Selection with:	Reference	Function
		<a href="#">Chapter 8.1 'pH sensor calibration (CAL)' on page 48</a>	The calibration menu enables calibration of controller and sensor.
			
			Stop/Start the control and metering function.
		<a href="#">Chapter 9.2 'STOP/START key' on page 73</a>	By pressing the STOP key, the control is stopped. The STOP key can be pressed independently of the currently displayed menu. However the STOP state is only shown in the continuous display.
		<a href="#">Chapter 7.3 'Continuous display' on page 45</a>	Changes from the continuous display to the setting menu.
		<a href="#">Chapter 8.3 'Setting limit values [LIMITS]' on page 58</a>	Enables the setting of the limit value for limit value monitoring.
			
		<a href="#">Chapter 8.4 'Setting the control [CONTROL]' on page 60</a>	Enables parameter setting for the control.
			



## Functional description

Display view	Selection with:	Reference	Function
		<a href="#">Chapter 8.5</a> <i>'Input setting (INPUT)'</i> on page 63	Enables setting of the measured value input parameter.
			
		<a href="#">Chapter 8.6</a> ' <i>Output setting (OUTPUT)'</i> on page 66	Enables setting of the mA output parameter.
			
		<a href="#">Chapter 8.7</a> <i>'DEVICE setting'</i> on page 70	Enables adjustment of the password and the controller [RESTART] function.



## 5 Assembly and installation

- **User qualification, mechanical installation:** trained qualified personnel, see *Chapter 2.2 'Users' qualifications' on page 10*
- **User qualification, electrical installation:** Electrical technician, see *Chapter 2.2 'Users' qualifications' on page 10*



### CAUTION!

Possible consequence: Material damage.

The hinge between the front and rear part of the housing cannot absorb high levels of mechanical loading. When working on the DULCOMETER® Compact Controller, firmly hold the top section of the controller housing.



### CAUTION!

#### Check band for strain relief

Possible consequence: Material damage.

The ribbon cable and its socket cannot be mechanically loaded. Hence it is essential that when mounting the controller in the control panel mounting, the check strap (part number 1035918) is fitted for strain relief and mechanical securing. Without the check strap, the ribbon cable or its socket could be damaged if they were to fall out of the controller upper housing.



### NOTICE!

#### Mounting position and conditions

- The controller conforms to IP 67 degree of protection (wall/pipe mounting) or IP 54 (control panel mounting) requirements. This degree of protection is only achieved if all seals and cable glands are correctly fitted.
- The (electrical) installation should only take place after (mechanical) installation
- Ensure that there is unimpeded access for operation
- Ensure safe and low-vibration fastening
- Avoid direct sunlight
- Permissible ambient temperature of the controller at the installation location: -10 ... +60 °C at max. 95% relative air humidity (non-condensing)
- Take into consideration the permissible ambient temperature of the sensors and other components connected
- The controller is only suitable for operation in closed rooms. If operated outside, the controller must be protected against the environment by a suitable protective enclosure



#### Read-off and operating position

- *Install the device in a favourable position for reading and operating (preferably at eye level)*





***Mounting position***

- Leave sufficient free space for the cables



***Packaging material***

*Dispose of packaging material in an environmentally responsible way. All packaging components carry the corresponding recycling code ♻️.*



---

## Assembly and installation

---

### 5.1 Scope of delivery

The following parts belong to the standard scope of delivery of a DULCOMETER® Compact Controller.

Description	Quantity
Assembled device	1
Cable connection set DMTa/DXMa (metr.)	1
Operating instructions	1

### 5.2 Mounting (mechanical)

The DULCOMETER® Compact Controller is suitable for mounting on a wall, pipe or control panel.

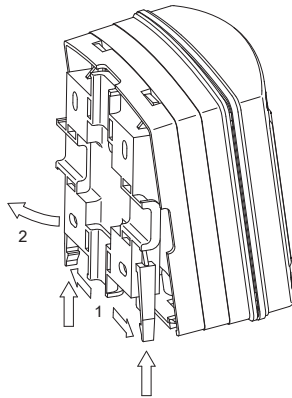
Mounting materials (contained in the scope of supply):

Description	Quantity
Wall/tube retaining bracket	1
Round head screws 5x45 mm	2
Washer 5.3	2
Rawlplug Ø 8 mm, plastic	2

#### 5.2.1 Wall mounting

Mounting (mechanical)

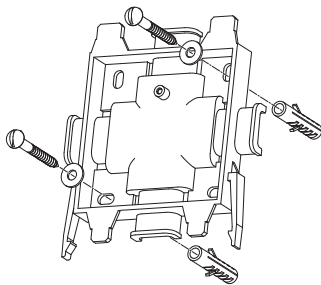




AG273

*Fig. 3: Removing the wall/pipe bracket*

1. ➤ Remove the wall/pipe bracket. Pull the two snap-hooks (1) outwards and push upwards
2. ➤ Fold out the wall/pipe bracket (2) and pull out in a downwards direction
3. ➤ Mark two drill holes diagonal to each other by using the wall/pipe bracket as a drilling template
4. ➤ Drill holes:  $\varnothing$  8 mm, d = 50 mm



AG274

*Fig. 4: Screwing on the wall/pipe bracket using washers*

5. ➤ Screw on the wall/pipe bracket using the washers

6. ➤ Suspend the DULCOMETER® Compact Controller at the top in the wall/pipe bracket and push using light pressure at the bottom against the wall/pipe bracket. Then press upwards until the DULCOMETER® Compact Controller audibly snaps into position.



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## Assembly and installation

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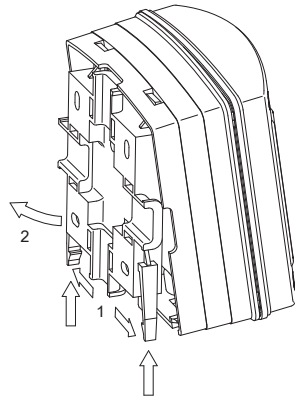
### 5.2.2 Pipe mounting

#### Mounting (mechanical)



#### Pipe diameter

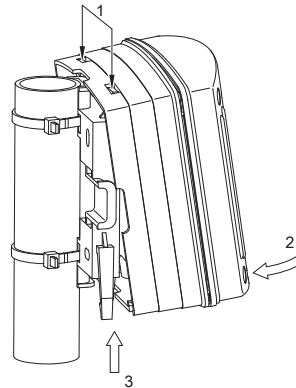
Pipe diameter: 25 mm to 60 mm.



A0273

Fig. 5: Removing the wall/pipe bracket

1. Remove the wall/pipe bracket. Pull the two snap-hooks (1) outwards and push upwards
2. Fold out the wall/pipe bracket (2) and pull out in a downwards direction
3. Secure the wall/pipe bracket using cable ties (or pipe clips) to the pipe



A0275

Fig. 6: Suspend and secure the DULCOMETER® Compact Controller

4. Suspend the DULCOMETER® Compact Controller at the top (1) in the wall/pipe bracket and push using light pressure at the bottom (2) against the wall/pipe bracket. Then press upwards (3) until the DULCOMETER® Compact Controller audibly snaps into position



### 5.2.3 Control panel mounting

Mounting kit for control panel installation of the DULCOMETER® Compact Controller:  
Order number 1037273

Description	Quantity
Drilling template sheet 3872-4	1
PT screw (3.5 x 22)	3
Profile seals	2
Strain relief strip DF3/DF4	1
PT screw (3.5 x 10)	2
Individual parts packed in transparent cover / Mounting kit is not contained in the standard scope of supply	



#### CAUTION!

##### Material thickness of control panel

Possible consequence: material damage

- The thickness of the material of the control panel should be at least 2 mm to ensure secure fixing



*In the mounted state, the DULCOMETER® Compact Controller extends approx. 30 mm from the control panel.*



## Assembly and installation

### Preparing the control panel

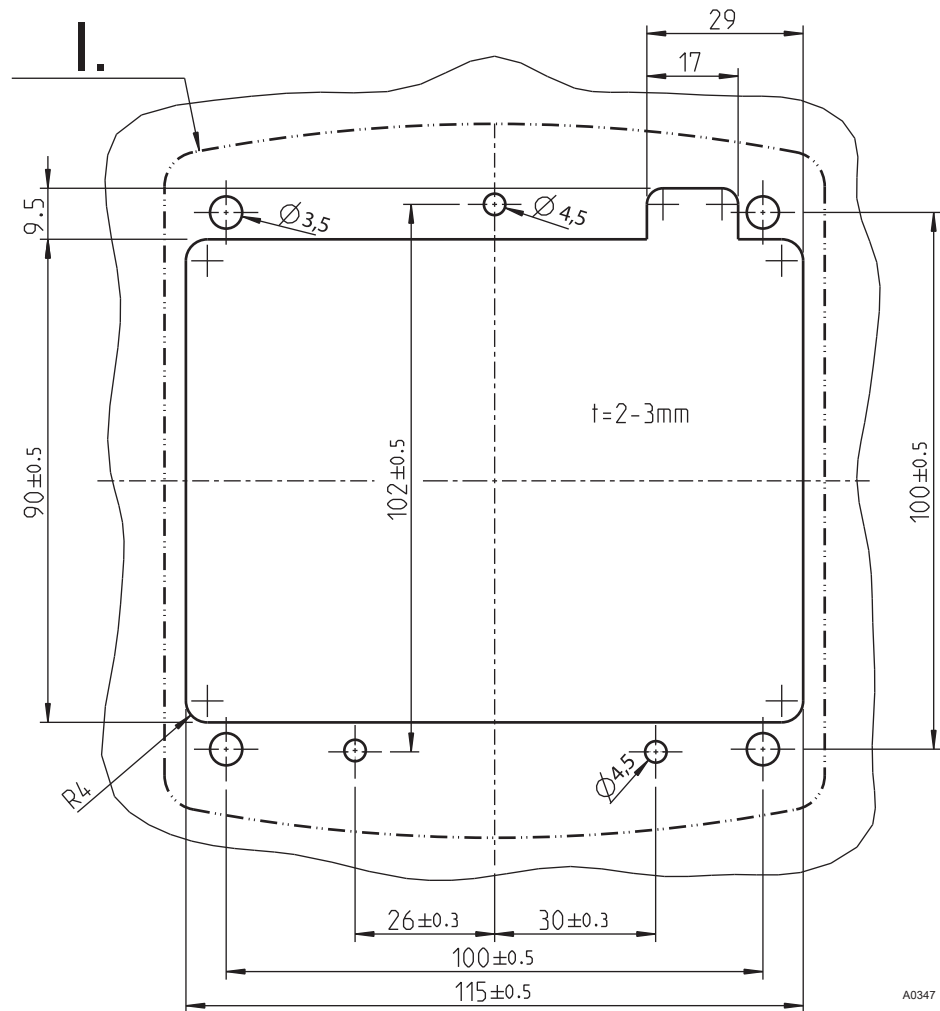


Fig. 7: The drawing is not to scale and is intended for information purposes only.

- I. Outline contour of the DULCOMETER® Compact Controller housing

1. Mark the exact position of the DULCOMETER® Compact Controller on the control panel using the drilling template



2. 



### **Core hole**

*Adhere to the 3.5 mm Ø as the core hole diameter for screwing in the fixing bolts.*

Drill four holes for the bolts for the top section of the controller housing using a 3.5 mm Ø drill bit

3. 

Drill three holes for the bolts for the bottom section of the controller housing using a 4.5 mm Ø drill bit

4. 

Drill four holes using an 8 mm Ø drill bit and use a jigsaw to cut the cut-out

⇒ Deburr all the edges.



---

## Assembly and installation

---

### Fitting the DULCOMETER® Compact Controller into the cut-out in the control panel

#### ! NOTICE!

##### Ribbon cable base

The base for the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 8

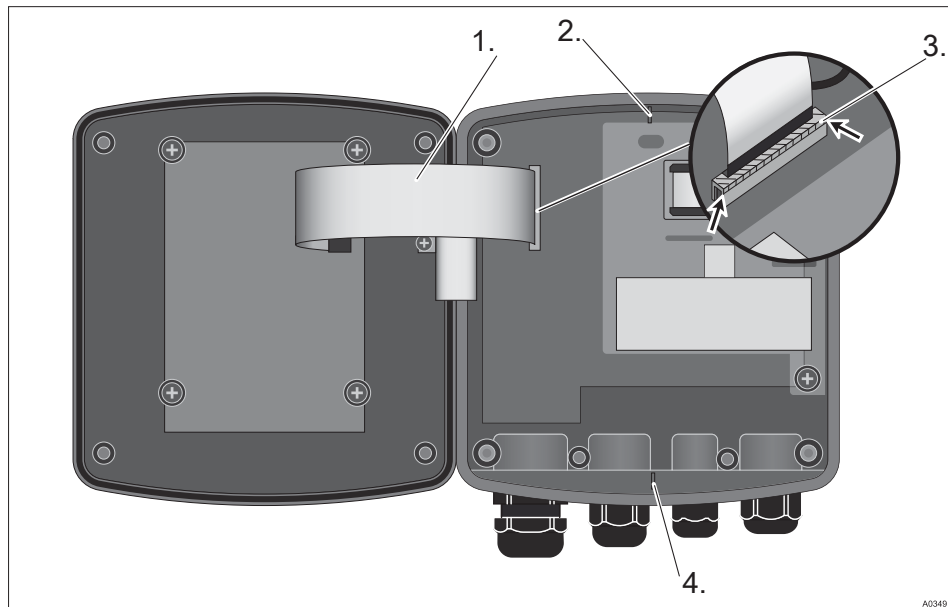
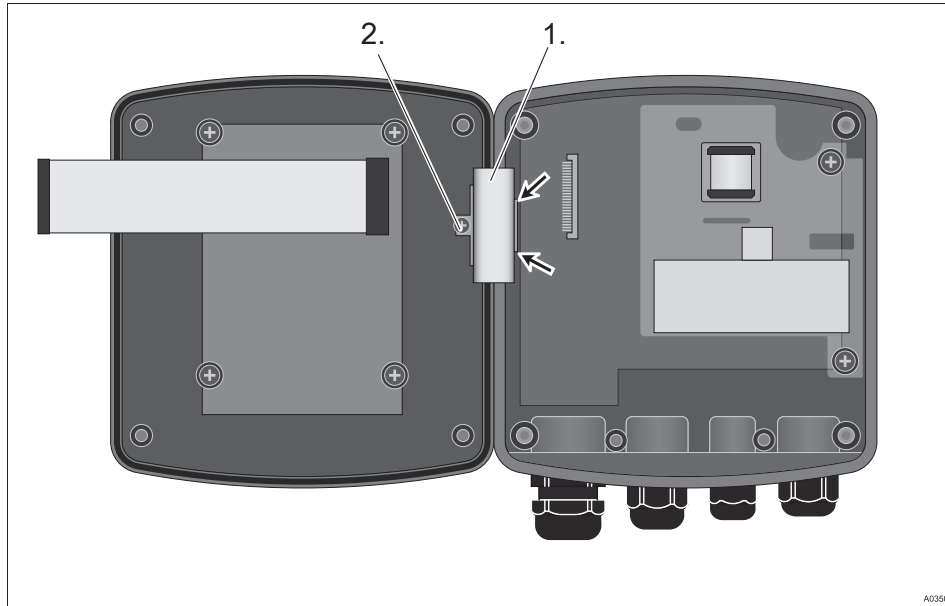


Fig. 8: Loosening the ribbon cable

1. ➤ Undo four screws and open the DULCOMETER® Compact Controller
2. ➤ Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the socket
3. ➤ Use pliers to break off the catches (2 and 4). These are not needed for control panel installation

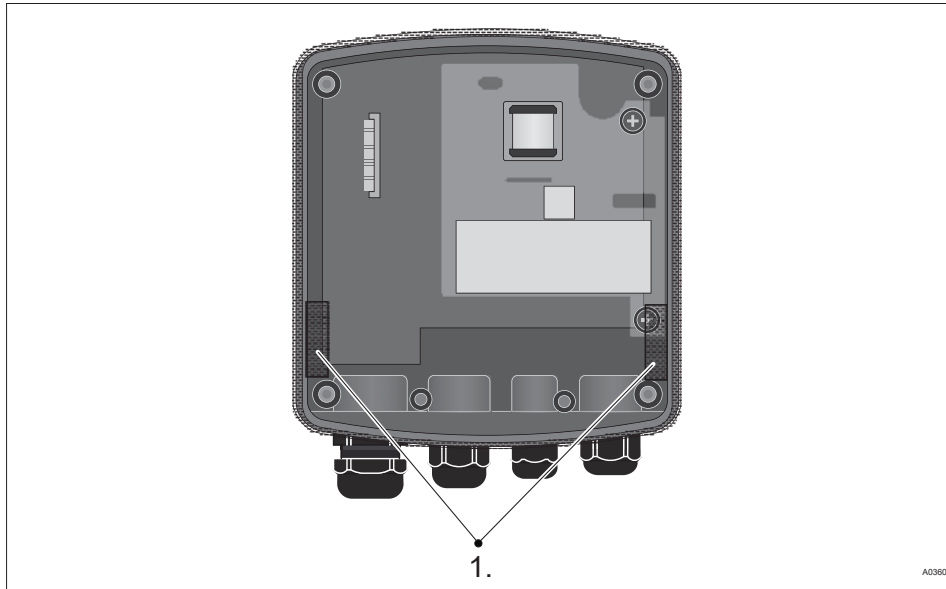




*Fig. 9: Dismantle the hinge*

4. ➡ Remove the screw (2), unclip the hinge (1) on the bottom section of the controller housing (arrows) and remove the hinge

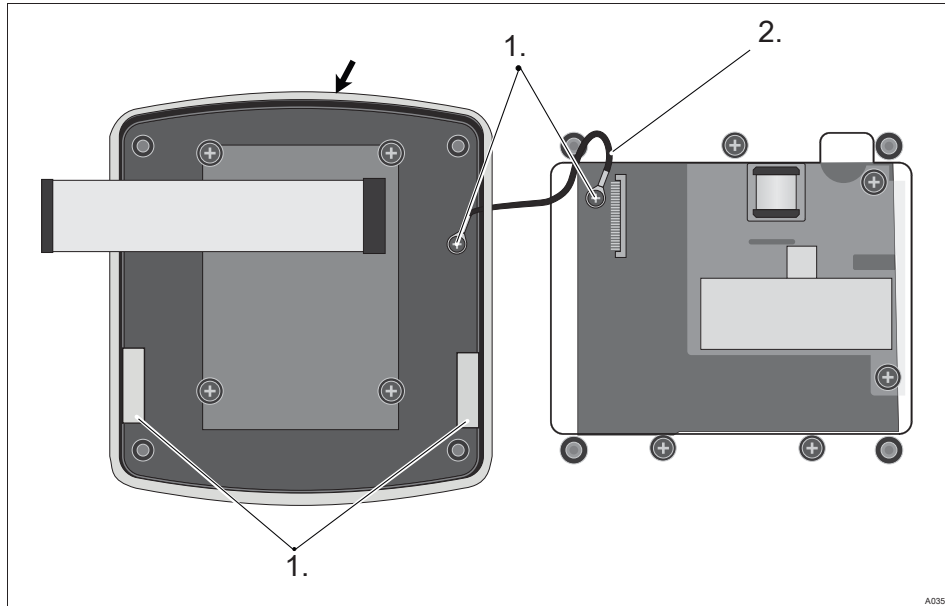




*Fig. 10: Fitting the profile seal on the bottom section of the controller housing*

5. ➔ Position the profile seal evenly around the upper edge of bottom section of the DULCOMETER® Compact Controller housing. Arrange the clips (1) as shown in the figure  
⇒ Ensure that the profile seal evenly surrounds the upper edge of the housing.
6. ➔ Insert the bottom section of the DULCOMETER® Compact Controller housing with the profile seal from behind into the cut-out and use three screws to secure it in place

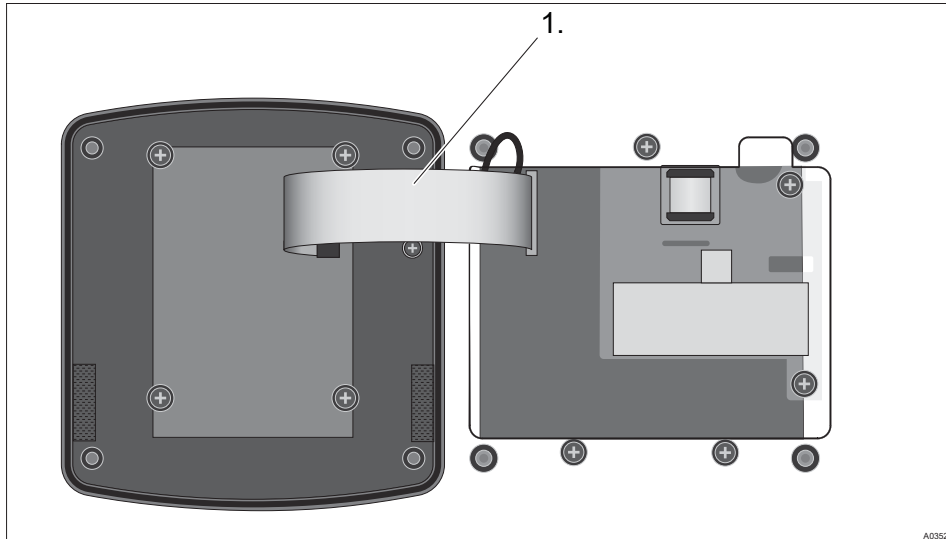




*Fig. 11: Fitting the profile seal onto the top section of the controller housing*

- 7.** ➤ Position the profile seal (arrow) evenly into the groove in the top section of the DULCOMETER® Compact Controller housing. Arrange the clips (3) as shown in the figure
- 8.** ➤ Secure the strain relief (2) using two screws (1)





*Fig. 12: Push and lock the ribbon cable in its base*

- 9.** ➤ Push and lock the ribbon cable (1) in its base
- 10.** ➤ Screw the top section of the controller housing onto the bottom section of the DULCOMETER® Compact Controller housing
- 11.** ➤ Once again check that the profile seals are fitted properly
  - ⇒ IP 54 degree of protection can only be provided if the control panel is mounted correctly



### 5.3 Installation (electrical)



#### **WARNING!**

##### **Live parts!**

Possible consequence: Fatal or very serious injuries

- Measure: Disconnect the electrical power supply to the device before opening the housing and secure to prevent unintentional reconnection
- Disconnect damaged or defective devices or devices that have been tampered with and prevent unintended reconnection
- The provision of a suitable isolating device (emergency-off switch, etc.) is the responsibility of the plant operator



*The signal leads of the DULCOMETER® Compact Controller must not be routed alongside interference-prone cabling. Faults could lead to malfunctions of the DULCOMETER® Compact Controller.*



## Assembly and installation

### 5.3.1 Cable Cross-Sections and Cable End Sleeves

	Minimum cross-section	Maximum cross-section	Stripped insulation length
Without cable end sleeve	0.25 mm <sup>2</sup>	1.5 mm <sup>2</sup>	
Cable end sleeve without insulation	0.20 mm <sup>2</sup>	1.0 mm <sup>2</sup>	8 - 9 mm
Cable end sleeve with insulation	0.20 mm <sup>2</sup>	1.0 mm <sup>2</sup>	10 - 11 mm

### 5.3.2 Installation of coaxial cable to guard terminal XE1



#### CAUTION!

**Maximum length of the coaxial cable 10 m**

Incorrect measured value due to too long a coaxial cable

Possible consequence: Slight or minor injuries, material damage.

The maximum length of the coaxial cable may not exceed 10 m when using redox or pH sensors. The measurement signal can otherwise be falsified by the effects of interference.

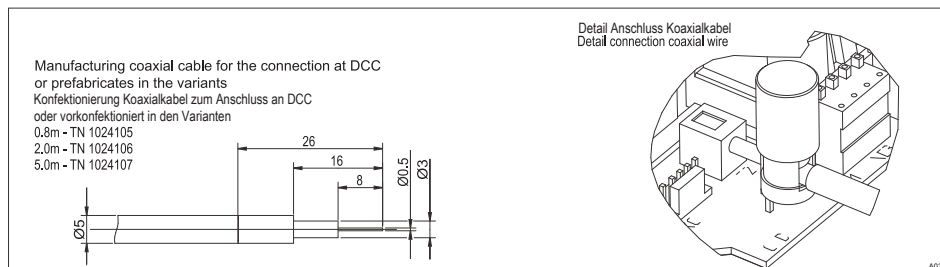


Fig. 13: Installation of Coaxial Cable to Guard Terminal XE1

When installing the coaxial cable for the guard terminal XE 1, the lengths of insulation to be removed from the coaxial cable must be adhered to. The guard terminal *'is tightened'* by hand.



### 5.3.2.1 Terminal diagram / wiring

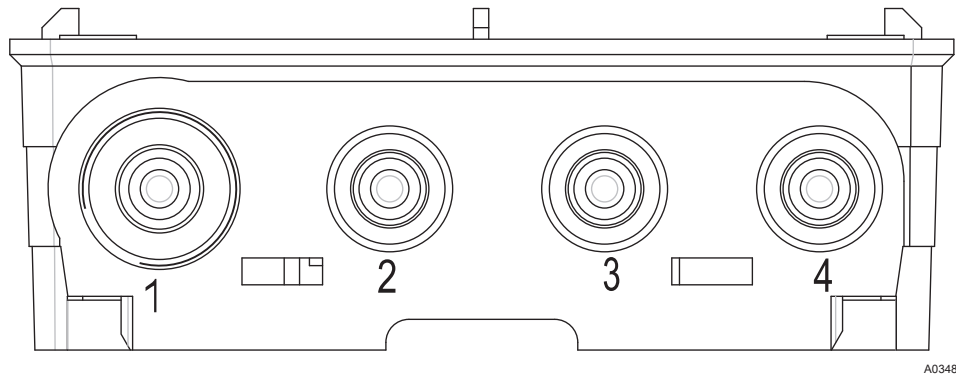


Fig. 14: Threaded connector number

#### Wiring

Threaded connector no. Size	Description	Terminal Description	Terminal number	Pol	Function	Recommended cable ø	Remarks
1 / M20	pH/redox Input 1		XE 1	Ref. El.	pH/ redox sensor	ø 5	Guide cable through multiple M20 / 2x5 mm seal inserts
			XE 2	meas. sig			
	Temp. input Pt 1000	XE 4	1	+	Temp. sensor	ø 5	
			2	-			
2 / M16	Wire jumper or	XE 3			] Short circuit	ø 4,5 *	Guide 4- core cable through multiple M 16 / 2x4,5 mm seal inserts
	potential equaliser	XE 3	1	free	Potential equal- iser***		



## Assembly and installation

Threaded connector no. Size	Description	Terminal Description	Terminal number	Pol	Function	Recommended cable ø	Remarks
	Standard signal output	XA 1	2	Ref. volt.		ø 4,5 *	Guide 4-core cable through multiple M 16 / 2x4,5 mm seal inserts
			1	+ 15 V	e.g. recorder / actuator		
	Contact input	XK 1	2	-			
			1	+	Pause		
	Relay output (f-relay)	XR 2	2	-			
			1		Frequency controlled metering pump		
			2				

\* To achieve protection class IP 67 please use original Prominent cable, part number 1036759

\*\*\* When using as a potential equaliser, the short circuit bridge ] must be removed!

3 / M16	Relay output	XR1	1	COM	Solenoid valve / metering pump **  raise / lower	ø 5	Guide cable through single M16 seal insert
	or		2	NO			
	Relay output						
	or	XR1	1	COM	Limit relay		
	Relay output		2	NO			
	(P-relay)						
	XR1	1	COM	Alarm relay			
		3	NC				



Threaded connector no. Size	Description	Terminal Description	Terminal number	Pol	Function	Recommended cable ø	Remarks
<b>** An RC suppressor must be connected (not part of the scope of delivery)</b>							
4 M16	Mains connection	XP 1	1	N	85 ... 253 V eff.	ø 6,5	Guide cable through single M16 seal insert
			2	L			

Legend to the "Wiring" table

Abbreviation	Meaning
Pol.	Polarity
Ref. El.	Reference electrode
meas sig.	Measurement signal (glass electrode)
Ref. pot.	Internal reference potential
f-relay	Pump frequency relay
P-relay	Power relay
COM	Common relay contact (root)
NO	Contact 'normally opened'
NC	Contact 'normally closed'



## Assembly and installation

### Terminal diagram

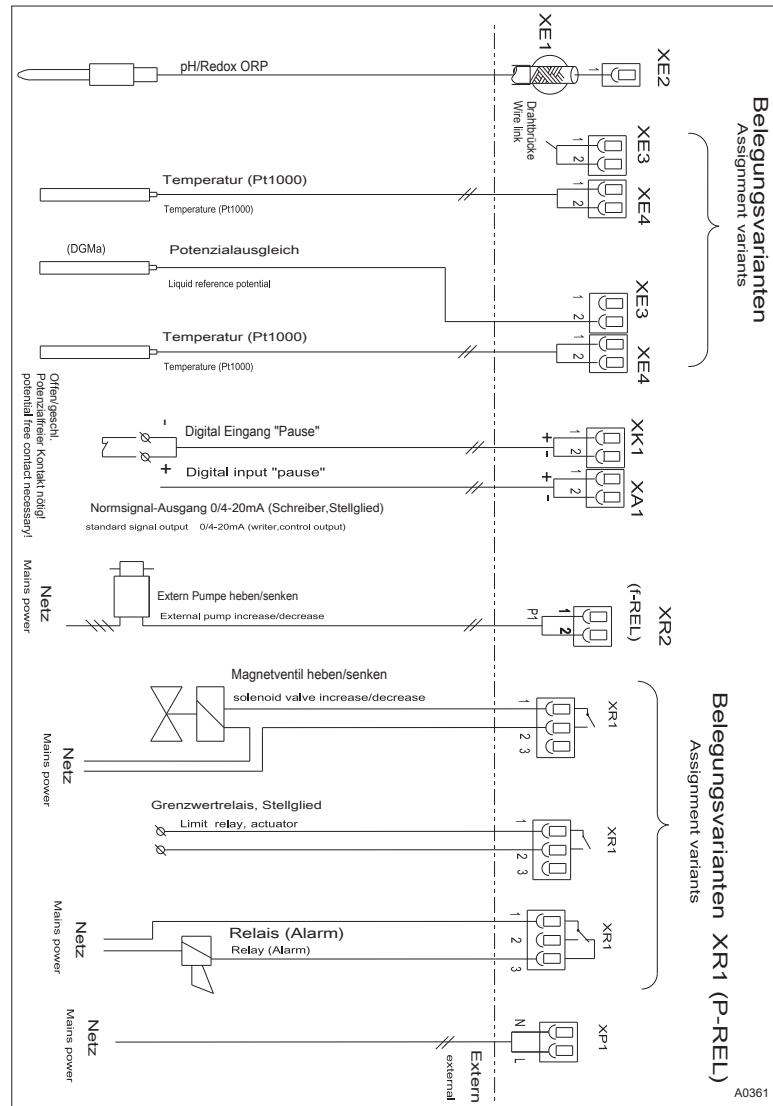


Fig. 15: Terminal diagram

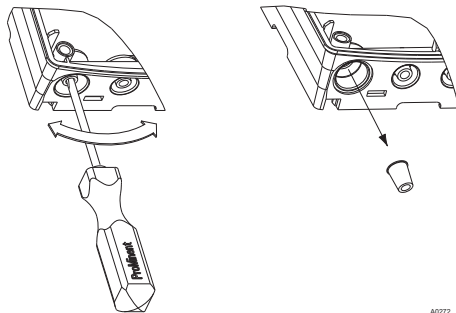


### 5.3.3 Installation (electrical)



*The cable must be routed in a site-provided cable duct to ensure strain relief*

1. Undo the four housing screws
2. Slightly lift the controller housing top section forwards and fold it to the left



A0272

Fig. 16: Punch out threaded holes

- 3.



*Large threaded connection (M 20 x 1.5)*

*Small threaded connection (M 16 x 1.5)*

Punch out as many threaded connections on the bottom side of the controller housing bottom section as required

4. Guide the cable into the respective reducing inserts.

5. Insert the reducing inserts into the threaded connectors
6. Guide the cable into the controller.
7. Connect the cable as indicated in the terminal diagram
8. Screw the required threaded connections in and tighten
9. Tighten the clamping nuts of the threaded connections so that they are properly sealed
10. Click the controller housing top section on to the controller housing bottom section
11. Manually tighten the housing screws
12. Once again check the seating of the seal. Only if the mounting is correct, is protection class IP 67 (wall/pipe mounting) or IP 54 (control panel mounting) achieved

### 5.4 Switching of inductive loads



*If you connect an inductive load, i.e. a consumer which uses a coil (e.g. an alpha motorised pump), then you must protect your controller with a protective circuit. If in doubt, consult an electrical technician for advice.*

The RC member protective circuit is a simple, but nevertheless very effective, circuit. This circuit is also referred to as a snubber or Boucherot member. It is primarily used to protect switching contacts.



## Assembly and installation

When switching off, the connection in series of a resistor and capacitor means that the current can be dissipated in a damped oscillation.

Also when switching on, the resistor acts as a current limiter for the capacitor charging process. The RC member protective circuit is highly suitable for AC voltage supplies.

The magnitude of the resistance R of the RC member is determined according to the following equation:

$$R = U / I_L$$

(Where U = Voltage across the load and  $I_L$  = current through the load)

The magnitude of the capacitor is determined using the following equation:

$$C = k \cdot I_L$$

$k = 0, 1 \dots 2$  (dependent on the application).

Only use capacitors of class X2.

**Units:** R = Ohm; U = Volt;  $I_L$  = Ampere;  
C =  $\mu\text{F}$



*If consumers are connected which have a high starting current (e.g. plug-in, switched mains power supplies), then a means of limiting the starting current must be provided.*

The switching-off process can be investigated and documented using an oscilloscope. The voltage peak at the switch contact depends on the selected RC combination.

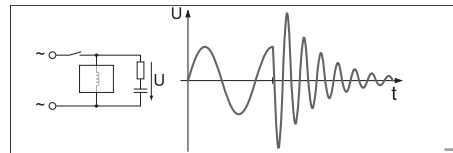


Fig. 17: Switching-off process shown on the oscillogram.

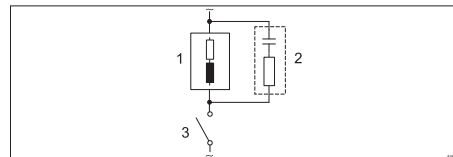


Fig. 18: RC protective circuit for the relay contacts

Typical AC current application with an inductive load:

- 1) Load (e.g. alpha motor-driven pump)
- 2) RC-protective circuit
  - Typical RC protective circuit at 230 V AC:
  - Capacitor [0.22  $\mu\text{F}$ /X2]
  - Resistance [100 Ohm / 1 W] (metal oxide (pulse resistant))
- 3) Relay contact (XR1, XR2, XR3)



## 6 Commissioning

- **Users' qualification:** trained user, see  
↳ *Chapter 2.2 'Users' qualifications' on page 10*



### WARNING!

#### Sensor run-in periods

This can result in hazardous incorrect metering

- Correct measuring and metering is only possible if the sensor is working perfectly
- Please read the operating manual for the sensor
- The sensor must be calibrated after commissioning

Following completion of mechanical and electrical assembly, the DULCOMETER® Compact Controller should be integrated into the measuring point.

### 6.1 Initial commissioning

When first switching on the DULCOMETER® Compact Controller the DULCOMETER® Compact Controller is in a STOP state.

Selection of the measurement variable, controller setting and setting of the various, process-dependent, parameters takes place next. ↳ *Chapter 8 'Operating menus for the measured variables pH and ORP' on page 48.*

### 6.2 Selection of the measured variable

The pH and redox measurement variables are set in the 'INPUT' menu.



### NOTICE!

#### Reset to factory settings

If you set or switch the measurement variable, all parameters in the controller are reset to the factory settings for the selected measurement variable.

You must then reset all the controller functions.

### 6.3 Setting the controller during commissioning



### NOTICE!

#### Reset to factory settings

When switching over the metering direction, all actuators in the DULCOMETER® Compact Controller are reset to the factory settings for the selected metering direction.

For safety reasons, all actuators are deactivated. The base load is reset to 0 %. All parameters relating to the actuator, are reset to the factory setting.

Consequently all parameters relating to the actuator, must be reset.



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## Commissioning

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The DULCOMETER® Compact Controller only controls *'one-way'*. Only one position or one negative control variable can be calculated. The direction of the control variable is set in the *'PUMP'* menu. There is no dead zone. In this sense, control cannot be *'switched off'* (except with *'STOP'* or *'PAUSE'*).

The value of the P-proportion of the control ( $X_p$ ) is specified with the DULCOMETER® Compact Controller in the units of the corresponding measurement variable (e.g. 1.5 pH).

For pure P-control and a separation between the set and actual values, which corresponds to the  $X_p$  value, the calculated control variable is +100 % (with the setting *'raise'*) or -100 % (with the setting *'lower'*).



## 7 Operating diagram

### 7.1 Overview of equipment/Control elements

- **User qualification:** instructed user, see [Chapter 2.2 'Users' qualifications'](#) on page 10

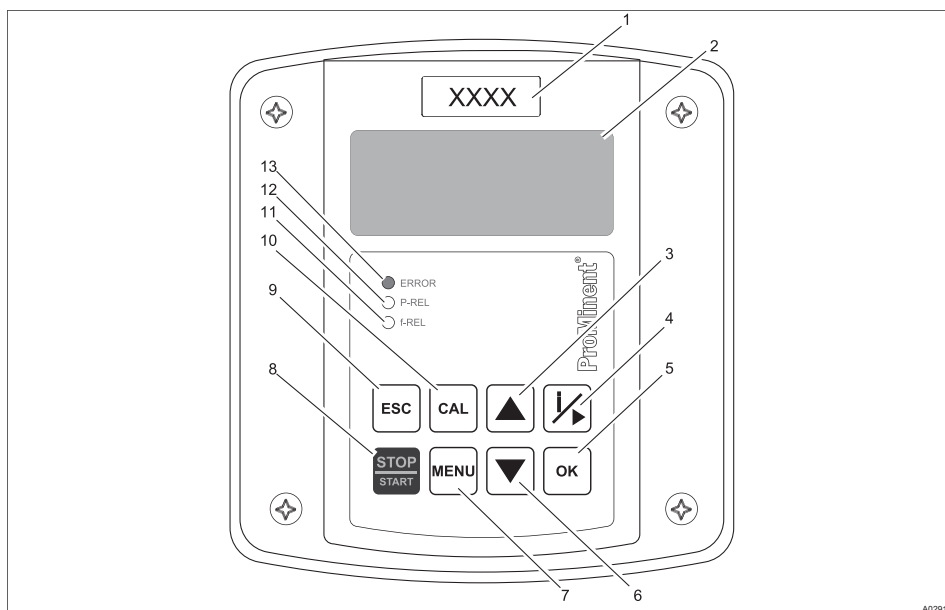


Fig. 19: Overview of equipment/Control elements

Function	Description
1st respective measured variable	Affix the measured variable label here
2. LCD display	
3. UP key	Too increase a displayed number value and to jump upwards in the operating menu
4. INFO/RIGHT key	Opens the info menu or moves the cursor one place to the right



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## Operating diagram

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Function	Description
5. OK key	To apply, confirm or save a displayed value or status or to acknowledge an alarm
6. DOWN key	To decrease a displayed number value and to jump down in the operating menu
7. MENU key	Accesses the controller operating menu
8. STOP/START key	Starts and stops control and metering function
9. ESC key	Jumps a level back in the operating menu, without storage or changing entries or values
10. CAL key	For accessing the calibration menu and navigating within the calibration menu.
11. f-REL LED	Shows the activated state of the f-relay
12. P-REL LED	Shows the activated state of the P-relay
13. ERROR LED	Indicates a controller error state. A text message is displayed simultaneously in the LCD continuous display

### 7.2 Adjusting display contrast

If the DULCOMETER® Compact Controller is set to '*continuous display*', you can set the contrast of the LCD-display. By pressing the ▲ key you can adjust the LCD display contrast so it is darker. By pressing the ▼ key you can adjust the LCD display contrast so it is lighter. Here each key press represents a contrast level. I.e. the key must be pressed once for each contrast level.



### 7.3 Continuous display

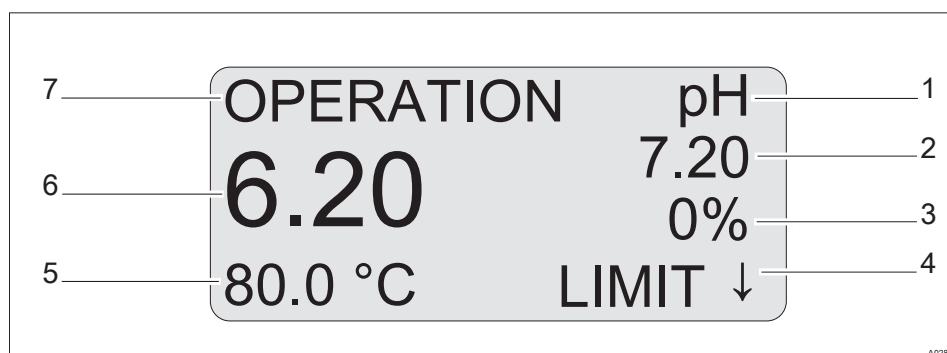





Fig. 20: Continuous display

- |   |  |   |                                   |
|---|--|---|-----------------------------------|
| 1 | Measured variable  | 5 | Temperature (Correction variable) |
| 2 | Setpoint   | 6 | Measured value (actual value)     |
| 3 | Control variable   | 7 | Mode                              |
| 4 | Possible error text: e.g. "Limit ↓"<br>(Direction of the limit value transgression, e.g. here lower limit value transgression) |   |                                   |

### 7.4 Info display

In the info display, the most important parameters for each menu item of the first menu level are displayed.

Access to the info display from the continuous display is by pressing the  key. Pressing the  key again calls the next info display. Pressing the  key recalls the continuous display again.



## Operating diagram

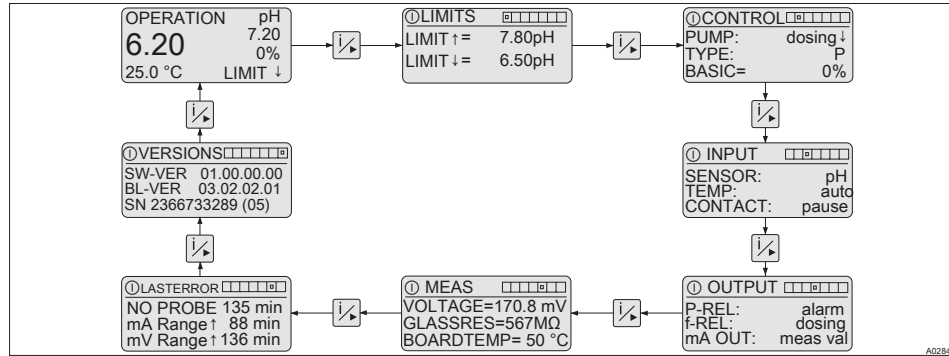


Fig. 21: Info display

Using the **OK** key you can jump from the currently displayed info display directly to the selection menu of this info display.

Using the **ESC** key you can jump back to the info display.

### **i** Info display "MEAS"

The "MEAS" info display shows the following measured values:

- [VOLTAGE]: currently measured sensor mV value
- [GLASSRES]: measured glass resistance of connected pH sensors for media temperatures of 15 °C to 80 °C. The displayed value is only valid when used with ProMinent pH sensors
- [BOARDTEMP]: Current housing interior temperature



## 7.5 Password

Access to the setting menu can be limited using a password. The DULCOMETER® Compact Controller is supplied with the password '5000'. Using the preset password '5000' the DULCOMETER® Compact Controller is setup so that all menus can be accessed without any limitations.

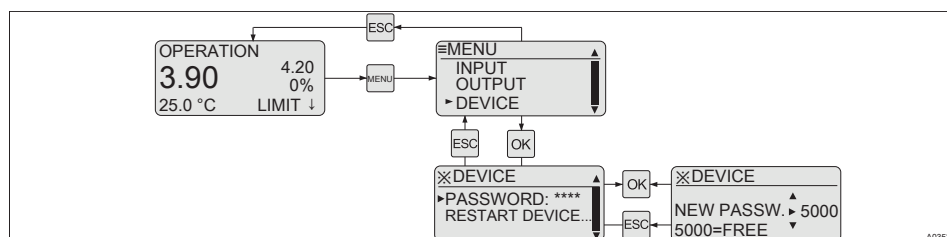


Fig. 22: Password setting

Password	Possible values			
Factory setting	Increment	Lower value	Upper value	Remarks
5000	1	0000	9999	5000 = [FREE]



## 8 Operating menus for the measured variables pH and ORP

- **User qualification:** instructed user, see ↗ Chapter 2.2 'Users' qualifications' on page 10

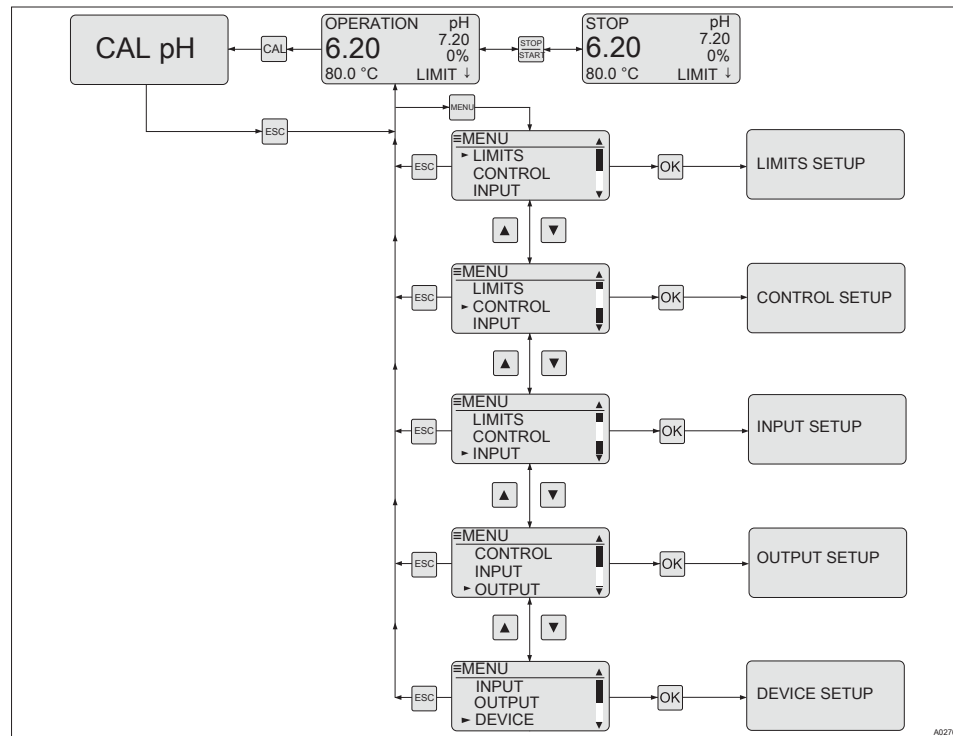


Fig. 23: Operating menu overview

### 8.1 pH sensor calibration (CAL)



#### **Correct sensor operation**

- Correct measuring and metering is only possible if the sensor is working perfectly
- Observe the sensor operating instructions
- The carrying out of a 2-point calibration is strongly recommended and is to be preferred to a single point calibration



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## Operating menus for the measured variables pH and ORP

---

During calibration, the DULCOMETER® Compact Controller sets the control outputs to '0'. Exception to this: a basic load or a manual control variable has been set. This remains active. The mA standard signal output is frozen.

When calibration/testing has been completed successfully, all of the error checks relating to the reading are restarted. The DULCOMETER® Compact Controller saves all the determined data for zero point and slope when the calibration is successful.



### **Used buffer**

*Dispose of the used buffer solution. Related info: see buffer solution safety data sheet.*

Setting	Possible values				Remarks
	Starting value	Increment	Lower value	Upper value	
Buffer temperature	Measured value	0.1 °C	0 °C	120 °C	The temperature can only be adjusted under <i>'TEMP'</i> <i>'auto'</i> or <i>'manual'</i>
Buffer values	Start value = 7.00 pH (ZERO) 4.00 pH (SLOPE)	0.01 pH	0.00 pH	14.00 pH	Limit value ZERO = 6..8 pH  Limit value SLOPE = < 6 pH; > 8 pH



## Operating menus for the measured variables pH and ORP

### 2-Point Calibration

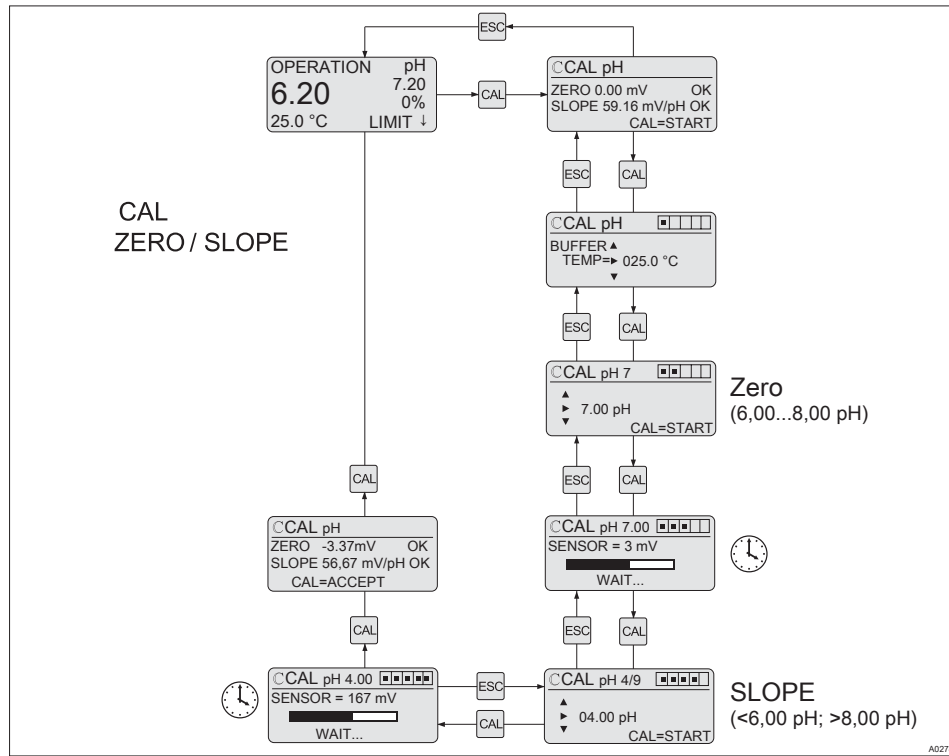


Fig. 24: 2-Point calibration pH sensor





### **Valid calibration values**

*Valid calibration:*

- Zero point -60 mV... +60 mV
- Slope 40 mV/pH... 65 mV/pH

Two test containers with a buffer solution are required for calibration. The pH value of the buffer solutions should be at least 1.5 pH units apart. Thoroughly rinse the sensor with water when changing the buffer solution.

1. Select the calibration menu
2. Start the calibration
3. If temperature has been selected (only if 'TEMP' is set to 'auto' or 'manual'), then set the buffer temperature with the keys , and
4. Confirm the entry by pressing the key
5. Set the pH-value of the buffer 'ZERO' using the keys , and
6. Immerse sensor in the buffer solution containing test container 1 (e.g. pH 7). In so doing, slightly move the sensor
7. Then press
  - ⇒ Calibration is running .
8. Then press to accept the value
  - ⇒ if CAL=ACCEPT is shown in the display and the displayed mV value is stable.
9. Remove the sensor from the buffer solution, rinse thoroughly in water and then dry with a cloth (pad dry, don't rub!)
10. Set the pH-value of the buffer 'SLOPE' using the keys , and
11. Immerse sensor in the buffer solution containing test container 2 (e.g. pH 4). In so doing, slightly move the sensor
12. Then press
  - ⇒ Calibration is running .
13. Then press to accept the value
  - ⇒ if CAL=ACCEPT is shown in the display and the displayed mV value is stable.
14. The determined values for the zero point and slope are displayed



---

## Operating menus for the measured variables pH and ORP

---


- ⇒ The calibration is now saved as successful if the values for 'ZERO' and 'SLOPE' are both 'OK'.



### ***Incorrect calibration***

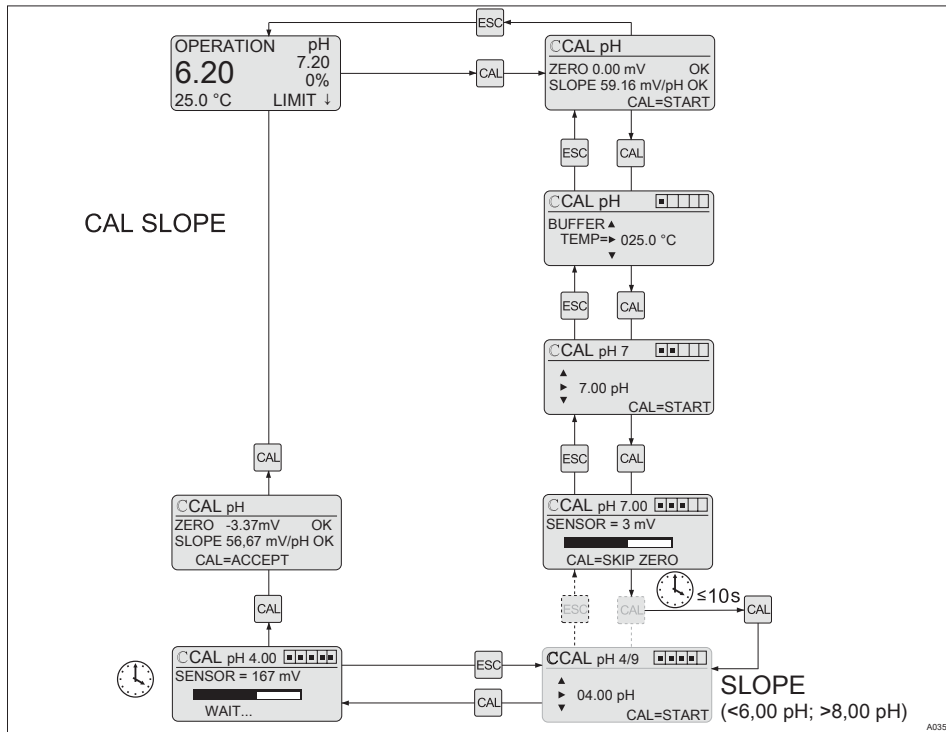
*Should the result of the calibration lie outside the specified tolerance limits, an error message appears 'ERR'. In this case the current calibration will not be applied.*

*Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

- 15.** ➤ Then press  to confirm the result or to terminate the calibration (if necessary, as unsuccessful)



### 1-Point slope calibration



*Fig. 25: Single point slope calibration*

**i** *Valid calibration values*





*Valid calibration:*

- *Slope 40 mV/pH...65 mV/pH*

*Valid calibration:*

- Slope 40 mV/pH...65 mV/pH

One test container with a buffer solution is required for calibration. Again with the single point calibration the buffer values for 'ZERO' and 'SLOPE' must be at least 1.5 pH units apart. If these buffer values are not recognised, then you must carry out a 2-point calibration.

1.  Select the calibration menu 
2.  Start the calibration 



---

## Operating menus for the measured variables pH and ORP

---

3. ➤ If temperature has been selected (only if 'TEMP' is set to 'auto' or 'manual'), then set the buffer temperature with the keys ▲, ▼ and ↵.
4. ➤ Confirm the entry by pressing the OK key or CAL key
5. ➤ Do not set the pH-value of the buffer 'ZERO'. Press the CAL key to confirm and if 'CAL=SKIP ZERO' appears (within no more than 10 s), press the CAL key again
  - ⇒ You have skipped the zero point calibration and are now in the slope calibration screen
6. ➤ Set the pH-value of the buffer 'SLOPE' using the keys ▲, ▼ and ↵.
7. ➤ Immerse sensor in the buffer solution containing test container (e.g. pH 4). In so doing, slightly move the sensor
8. ➤ Then press CAL
  - ⇒ Calibration is running ⌚.
9. ➤ Then press CAL to accept the value
10. ➤ The determined values for the zero point and slope are displayed
  - ⇒ The calibration is now saved as successful if the values for 'ZERO' and 'SLOPE' are both 'OK'.



### **Incorrect calibration**

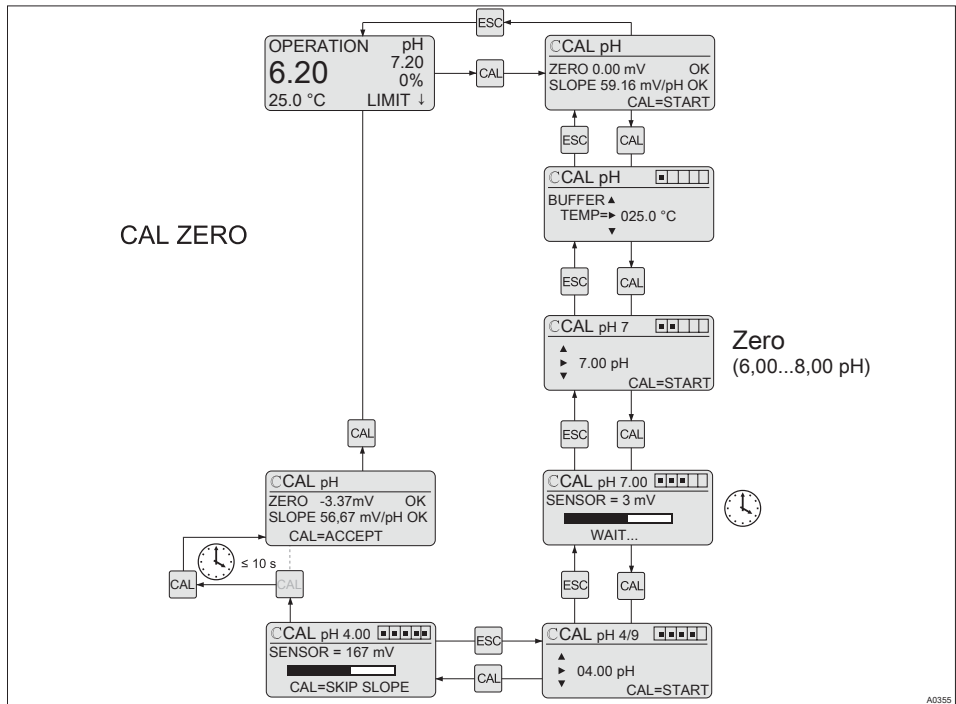
*Should the result of the calibration lie outside the specified tolerance limits, an error message appears 'ERR'. In this case the current calibration will not be applied.*

*Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

11. ➤ Then press CAL to confirm the result or to terminate the calibration (if necessary, as unsuccessful)



## Single point zero point calibration



*Fig. 26: Single point zero point calibration*

**i** *Valid calibration values*



*Valid calibration:*

- *Zero point -60 mV...+60 mV*

*Valid calibration:*

- Zero point -60 mV...+60 mV

One test container with a buffer solution is required for calibration. Again with the single point calibration the buffer values for 'ZERO' and 'SLOPE' must be at least 1.5 pH units apart. If these buffer values are not recognised, then you must carry out a 2-point calibration.













1. Select the calibration menu 
2. Start the calibration 



---

## Operating menus for the measured variables pH and ORP

---


3. ➤ If temperature has been selected (only if 'TEMP' is set to 'auto' or 'manual'), then set the buffer temperature with the keys ,  and 
4. ➤ Confirm the entry by pressing the  key again
5. ➤ Set the pH-value of the buffer 'ZERO' using the keys ,  and 
6. ➤ Immerse sensor in the buffer solution containing test container (e.g. pH 7). In so doing, slightly move the sensor
7. ➤ Then press 
  - ⇒ Calibration is running 
8. ➤ Then press  to accept the value
9. ➤ Do not set the pH-value of the buffer 'SLOPE'. Press the  key to confirm and if 'CAL=SKIP SLOPE' appears (within no more than 10 s), press the  key again
  - ⇒ The calibration is now saved as successful if the values for 'ZERO' and 'SLOPE' are both 'OK'.



### **Incorrect calibration**

*Should the result of the calibration lie outside the specified tolerance limits, an error message appears 'ERR'. In this case the current calibration will not be applied.*

*Check the prerequisites for the calibration and clear the error. Then repeat the calibration*

10. ➤ Then press  to confirm the result or to terminate the calibration (if necessary, as unsuccessful)

## 8.2 Redox sensor calibration (CAL)



### **Redox sensor calibration**

*The redox sensor cannot be calibrated. It is only possible to set an 'OFFSET' of the order of  $\pm 40$  mV and then make a comparison using this value. Should the redox sensor differ by more than  $\pm 40$  mV from the reference value, then it must be checked in accordance with the requirements of the sensor operating instructions.*



## Operating menus for the measured variables pH and ORP



### Correct sensor operation

- Correct measuring and metering is only possible if the sensor is working perfectly
- Observe the sensor operating instructions

During the calibration: the DULCOMETER® Compact Controller sets the control outputs to '0'. Exception to this: a basic load or a manual control variable has been set. This remains active. The mA standard signal output is frozen.



### Used buffer

Dispose of the used buffer solution. Related info: see buffer solution safety data sheet.

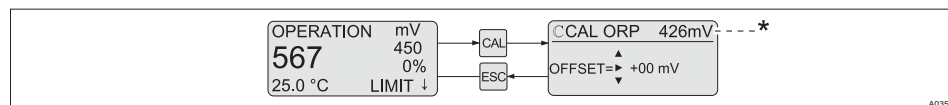


Fig. 27: Redox sensor calibration (CAL) \* corrected value

A container with a redox buffer solution (e.g. 465 mV) is needed for testing.

1. Select the Test menu **CAL**
2. Immerse redox sensor in the redox buffer solution containing test container (e.g. 465 mV)
3. Wait until the mV value has stabilised
4. Adjust the displayed mV values using the keys **▲**, **▼** and **↵** to the mV value of the redox buffer solution in the test container. Confirm the value by pressing **CAL**. The OFFSET value is transferred into the measuring parameters
  - ⇒ **ESC** quits the test menu without transferring the OFFSET value into the measuring parameters.
5. If the redox sensor is unclean or defective, it must be cleaned as described in the redox sensor operating instructions, or alternatively replaced



### 8.3 Setting limit values [LIMITS]

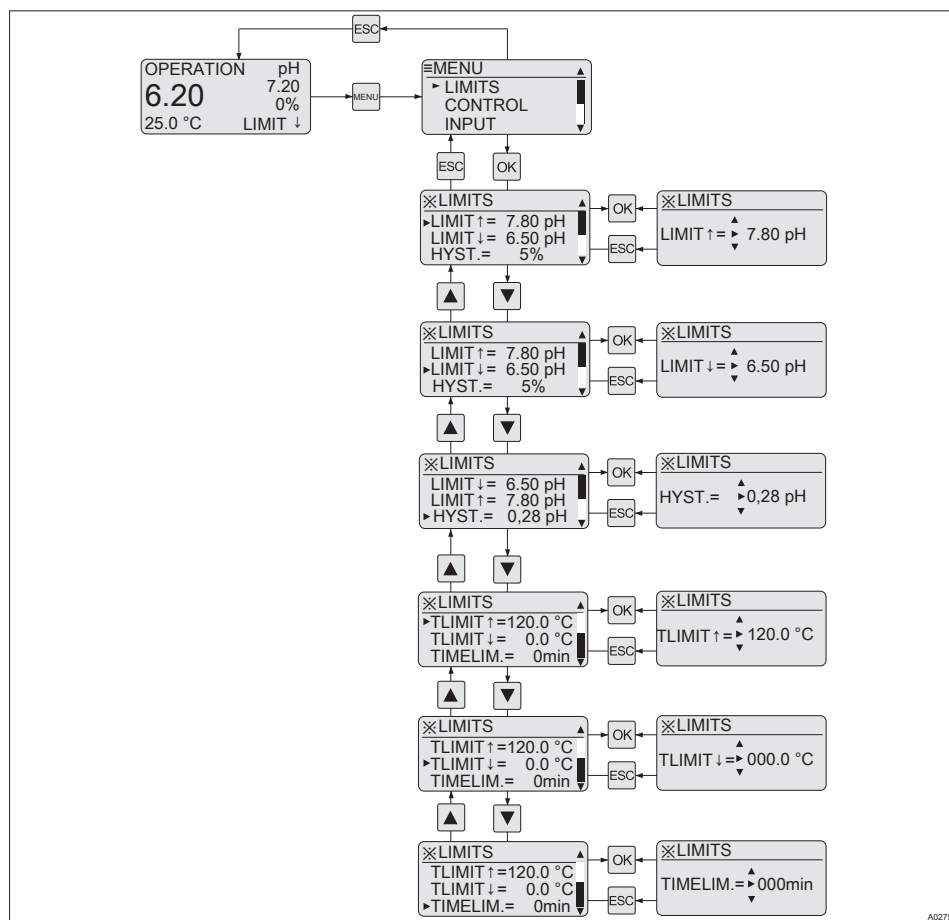


Fig. 28: Setting limit values [LIMITS]



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### Operating menus for the measured variables pH and ORP

---

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remark
[LIMIT ↑ pH]	8.50 pH	0.01 pH	0.00	14.00	upper pH limit value
[LIMIT ↓ pH]	6.50 pH	0.01 pH	0.00	14.00	lower pH limit value
[LIMIT ↑ ORP]	800	1 mV	-1000 mV	1000 mV	upper ORP limit value
[LIMIT ↓ ORP]	600	1 mV	-1000 mV	1000 mV	lower ORP limit value
[HYST.]	0.28 pH	0.01 pH	0.00	14.00	hysteresis for pH
	20 mV	1 mV	-1000 mV	1000 mV	hysteresis for ORP
[TLIMIT ↑ °C]	120.0 °C	0.1 °C	0.0 °C	120.0 °C	upper limit correction value °C
[TLIMIT ↓ °C]	0.0 °C	0.1 °C	0.0 °C	120.0 °C	lower limit correction value °C
[TLIMIT ↑ °F]	248.0 °F	0.1 °F	32.0 °F	248.0 °F	upper limit correction value °F
[TLIMIT ↓ °F]	32.0 °F	0.1 °F	32.0 °F	248.0 °F	lower limit correction value °F
[TIMELIM.]	0 min = OFF	1 minute	0	999	Checktime after a limit value has been exceeded or undershot pH / ORP

#### Hysteresis = [HYST.]

If the value has fallen below a limit value, then the limit value criteria are reset when the measured value has reached the value of the limit value plus hysteresis.

If the value has fallen below a limit value, then the limit value criteria are reset when the measured value has reached the value of the limit value minus hysteresis.

If the limit value criteria no longer exist on expiry of [TIMELIM], then the control is automatically reactivated.



## 8.4 Setting the control [CONTROL]

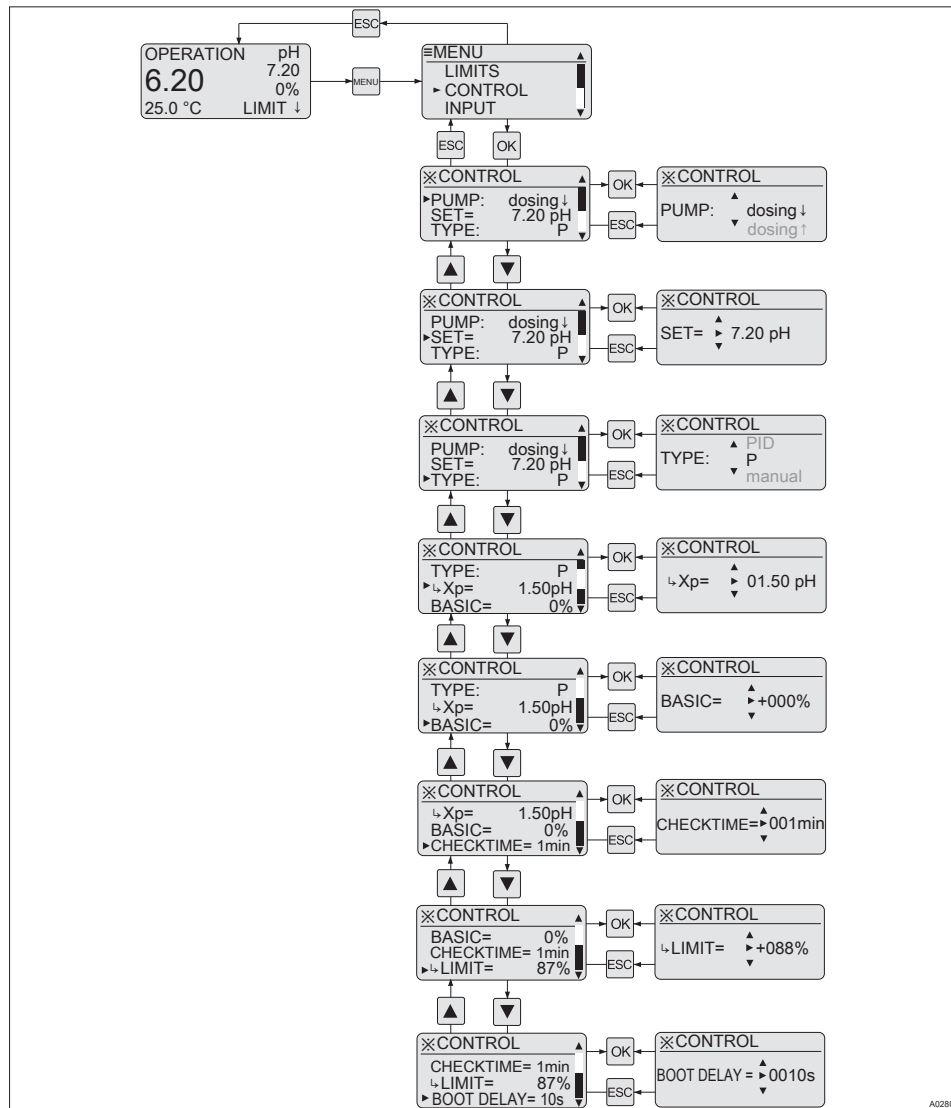


Fig. 29: Setting the control [CONTROL]



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Operating menus for the measured variables pH and ORP

---

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remark
[PUMP]	dosing ↓	dosing ↓ dosing ↑			Mono-directional control direction <sup>2</sup>
[SET]	7.20 pH	0.01 pH	0.00 pH	14.00 pH	pH setpoint
[SET]	750 mV	1 mV	-1000 mV	1000 mV	ORP voltage setpoint
[TYPE]	P	P Manual PID			Controller type
[↪Xp]	1.50 pH	0.01 pH	0.01 pH	70.00 pH	P-proportion of the pH control variable
[↪Xp]	100 mV	1 mV	1 mV	3000 mV	P-proportion of the ORP control variable
[↪Ti]	0 s	1 s	0 s	9999 s	PID control integral action time (0 seconds = no I-proportion)
[↪Td]	0 s	1 s	0 s	2500 s	PID control derivative action time (0 seconds = no D-proportion)
[BASIC] <sup>1</sup>	0%	1%	- 100%	100%	Basic load
[↪MANUAL] <sup>1</sup>	0%	1%	- 100%	100%	Manual control value
[CHECK-TIME]	0 min	1 min	0 min	999 min	Control checktime 0 minutes = off



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## Operating menus for the measured variables pH and ORP

---

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remark
<i>[↗LIMIT]<sup>1</sup></i>	0%	1%	- 100%	100%	Checktime limit. No basic load, only PID control value
<i>[BOOT DELAY]</i>	0 s	1 s	0 s	9999 s	Control delay period after the start of the measuring point. After it is switched on, the unit only measures but does not control during this period.

1 = in an upwards direction with mono-directional control: 0 .. +100% (setting with PUMP: dosing ↑), in a downwards direction: -100..0% (setting with PUMP: dosing ↓).

2 = When switching over the metering direction, all actuators in the DULCOMETER® Compact Controller are reset to the factory settings for the selected metering direction.



## 8.5 Input setting (INPUT)

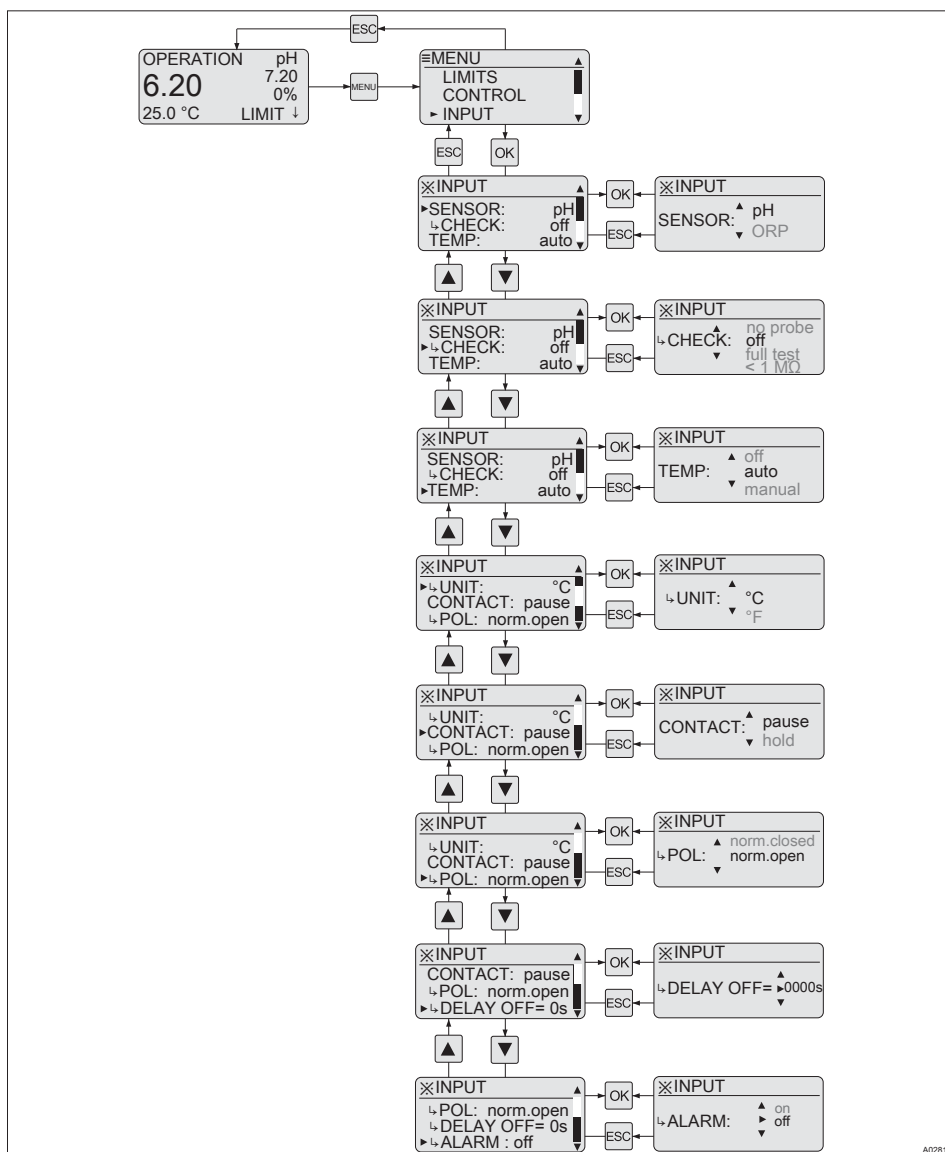


Fig. 30: Input setting (INPUT)



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## Operating menus for the measured variables pH and ORP

---

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remarks
Sensor	pH	pH			Process variables switchover pH <--> redox <sup>1</sup> .
		ORP			
↳CHECK	off	off			Sensor monitoring 'off'
		< 1 MΩ			Sensor break check (glass break)
		no probe			Check for presence
		full test			Check for sensor break and presence
TEMP	off	auto			Pt 1000
		manual			manual
		off			Correction off
↳UNIT	°C	°C			Correction variable unit
		°F			
↳VALUE	25.0 °C	0.1 °C	0.0 °C	120.0 °C	Manual correction variable °C
↳VALUE	77.0 °F	0.1 °F	32 °F	248 °F	Manual correction variable °F
CONTACT	pause	pause			Configuration digital contact input
		hold			
↳POL	norm.open	norm.open			Polarity of the contact input
		norm.close d			
1. Attention: If this setting is changed, all parameters are reset to the corresponding factory settings					



---

## Operating menus for the measured variables pH and ORP

---

Setting		Possible values			
Display	Starting value	Increment	Lower value	Upper value	Remarks
↳ DELAY OFF	0 s	1 s	0 s	1000 s	Contact input switch-off delay. Switching off of the contact input is delayed by this period.
↳ ALARM	OFF	ON			Switch on and off use of the alarm relay 'PAUSE/HOLD'
		OFF			
1. Attention: If this setting is changed, all parameters are reset to the corresponding factory settings					

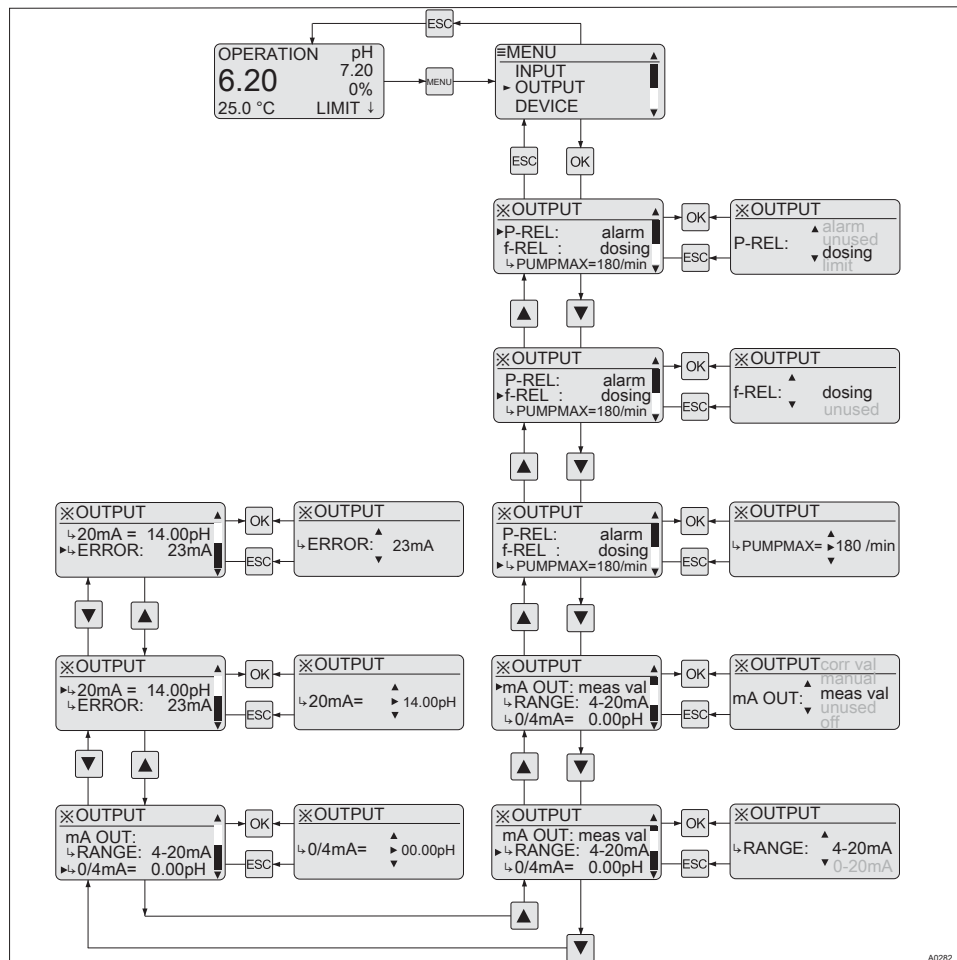
↳ **CHECK** = With configured pH measured variables, it is possible to monitor a sensor connected to the potentiometric input for fault states. This check is disabled as standard.

Monitoring for sensor breakage: The sensor breakage check (glass breakage) identifies a defective sensor due to its low internal resistance. Correctly functioning pH sensors have very high resistances with internal resistances in the high MΩ range. The DULCOMETER® Compact Controller is capable of recognising broken sensors from their internal resistance. This function should be deactivated if very low resistance sensors are used.

Check for presence: The "Presence check" identifies a disconnected sensor or a broken cable. This function should be disabled if pH sensors are used which have a high internal resistance across their entire operating range.



## 8.6 Output setting (OUTPUT)



*Fig. 31: Output setting (OUTPUT)*



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Operating menus for the measured variables pH and ORP

---

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
P-REL (Power relay)	alarm	alarm			Alarm relay
		unused			off
		dosing			PWM relay
		limit			Limit relay
↳PERIOD	60 s	1 s	30 s	6000 s	Cycle time of the PWM control  (P-REL = dosing)
↳MIN ON <sup>1</sup>	10 s	1 s	5 s	PERIOD/4 or 999	Minimum switch on period using PWM control  (P-REL = dosing)
↳DELAY ON	0 s	1 s	0 s	9999 s	Switch-on delay limit value relay  (P-REL = limit)
↳DELAY OFF	0 s	1 s	0 s	9999 s	Switch-off delay limit value relay  (P-REL = limit)
f-REL	dosing	dosing			Activation of the low power relay (frequency relay)
		unused			



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Operating menus for the measured variables pH and ORP

---

Setting	Possible values				Remarks
	Starting value	Increment	Lower value	Upper value	
↳PUMPMA X	1 rpm	1	1	500	Maximum stroke rate of the low power relay (frequency relay)
mA OUT (Output value of the mA standard signal output)	meas val	off			off
		meas val			meas val
		corr val			corr val
		dosing			dosing = control value
		manual			manual
↳RANGE	4 - 20 mA	0 - 20 mA			Range of the mA standard signal output
		4 - 20 mA			
↳0/4 mA	2.00 pH	0.01 pH	0.00 pH	14.00 pH	pH value assigned 0/4 mA
↳20 mA	12.00 pH	0.01 pH	0.00 pH	14.00 pH	pH value assigned 20 mA
↳0/4 mA	0 mV	1 mV	-1000 mV	1000 mV	Redox value assigned 0/4 mA
↳20 mA	1000 mV	1 mV	-1000 mV	1000 mV	Redox value assigned 20 mA
↳0/4 mA	0.0 °C	0.1 °C	0.0 °C	120.0 °C	Temp. value assigned 0/4 mA
↳20 mA	100.0 °C	0.1 °C	0.0 °C	120.0 °C	Temp value assigned 20 mA



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**Operating menus for the measured variables pH and ORP**

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Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
↳0/4 mA	32.0 °F	0.1 °F	32.0 °F	248.0 °F	Temp. value assigned 0/4 mA
↳20 mA	212.0 °F	0.1 °F	32.0 °F	248.0 °F	Temp value assigned 20 mA
↳20 mA <sup>2</sup>	- 100 %	1 %	10 % / - 10 %	100 % / - 100 %	Control value assigned 20 mA (0/4 mA is fixed as 0%)
↳VALUE	4.00 mA	0.01 mA	0.00 mA	25.00 mA	Manual output current value
↳ERROR	off	23 mA			Output current value upon fault, 23 mA
		0/3.6 mA			Output current value upon fault, 0/3.6 mA
		off			off = no fault current is output

1 = The parameter maximum occurs at PERIOD/4 or 999, whichever is smaller

2 = dependent on metering direction, the limits are either -10% and -100% or +10% and +100%



## 8.7 DEVICE setting

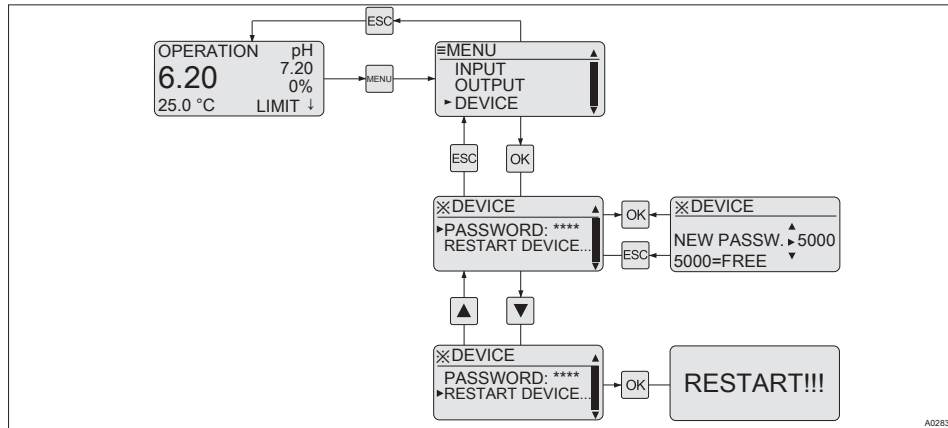



Fig. 32: Device setting

Setting		Possible values			
	Starting value	Increment	Lower value	Upper value	Remarks
Password	5000	1	0000	9999	5000 = no password protection
Restart device					Controller is restarted



## 9 Control parameters and functions

- **User qualification:** trained user, see  
 Chapter 2.2 'Users' qualifications' on page 10

### 9.1 DULCOMETER® Compact Controller function states

DULCOMETER® Compact Controller function states have the following priority:

- 1. 'STOP'
- 2. 'PAUSE/HOLD'
- 3. 'CAL' (calibration)
- 4. 'OPERATION' (normal mode)

"CAL" (calibration) peculiarities

- Control goes to basic load, mA measurement outputs are frozen
- New faults are detected, however they have no effect on the alarm relay or the mA output
- Detection of measurement variable relevant faults during 'CAL' (calibration process) are suppressed (e.g. LIMIT ↑)

"PAUSE" peculiarities

- Control is switched to 0% control variable. The I-proportion is saved
- New faults are detected, however they have no effect on the alarm relay or the mA output
- Special case alarm relay in 'PAUSE': If activated the output relay switches to 'PAUSE' (error message CONTACTIN)

"HOLD" peculiarities

- Control and all other outputs are frozen
- New faults are detected, however they have no effect on the alarm relay or the mA output. However the effect of already existing faults (e.g. fault current) remains
- Special case alarm relay: Activation of the frozen alarm relay is permitted (= no alarm), if all faults have been acknowledged or have disappeared
- Special case alarm relay in 'HOLD': If activated the output relay switches to 'HOLD' (error message CONTACTIN)

"STOP" peculiarities

- Control OFF
- New faults are detected, however they have no effect on the alarm relay or the mA output
- The alarm relay is switched off in 'STOP'

Peculiarities of the "START" event, i.e. switching from "STOP" to "OPERATION" (normal mode)

- Fault detection starts afresh, all existing faults are deleted

Generally applicable information



- If the cause of a fault disappears, then the fault message in the LCD footer disappears.
- A previously existing 'PAUSE/HOLD' state is not influenced by starting a 'CAL' (calibration) process. If during 'CAL' (calibration) the functional state 'PAUSE/HOLD' is released, then all states will remain frozen until the end of the 'CAL' (calibration) process.



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## Control parameters and functions

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- If 'CAL' (calibration) is started while functional state 'OPERATION' (normal mode) is active, then the functional state 'PAUSE/HOLD' is ignored until 'CAL' (calibration) completes. However STOP/START is possible at any time
- An alarm can be acknowledged or removed as follows: By clearing all faults by pressing the  key and the  key while the continuous display is visible



## 9.2 STOP/START key



The control function is started / stopped by pressing the key. The key can be pressed independently of the currently displayed menu. However, the [STOP] state is only shown in the continuous display.

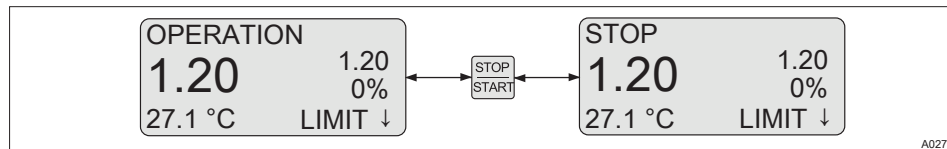


Fig. 33: -Key

When the controller is first switched on, the controller is in [STOP] status.

Upon certain defined fault conditions, the controller switches to the [STOP] status. The control is then off (= 0 % control variable).

To differentiate between the fault-related [STOP] and the operating status [STOP] by pressing the key, instead of [STOP] the identifier [ERROR STOP] is displayed.

Pressing the key causes operating status [ERROR STOP] to change to operating status [STOP]. Pressing once more causes the controller to be started again.

In [STOP] state, the controller must be started manually by pressing the key.

[STOP] of the controller causes the following:

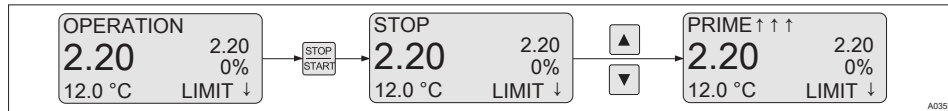
- Control is stopped
- The P-relay functioning as a limit value relay and a PWM relay are switched to the de-energised state
- The P-relay acting as an alarm relay activates (no alarm)

Restarting of the controller causes the following:

- If a [STOP] state existed, then the controller must be manually started after being switched back on.
- Fault detection starts afresh, all existing faults are deleted



### 9.3 Priming (PRIME)



*Fig. 34: Priming, e.g. to vent a pump*

While the continuous display is visible and the states 'STOP' or 'OPERATION' are active, simultaneously pressing ▲ and ▼ causes the priming function 'PRIME' to be started.

At the same time, dependent on the configuration of the controller, the output relay (P-REL) is actuated at 100 %, the frequency relay (f-REL) is actuated at 80 % of "PUMPMAX" and 16 mA is output at the mA output. However this is only the case if these outputs are set as actuator 'dosing'.

The power relay (P-REL) starts after priming in an activated state.

You can use this function, for example, to transport the feed chemical up to the pump to vent the metering line.



## 9.4 Hysteresis limit

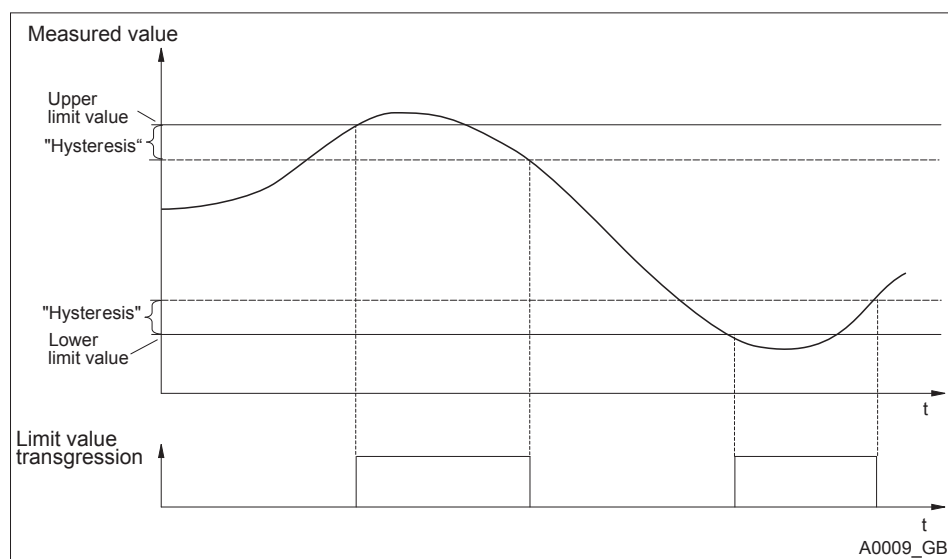


Fig. 35: Hysteresis

Upper limit value =  $\text{LIMIT} \uparrow$

Lower limit value =  $\text{LIMIT} \downarrow$

The range between  $\text{LIMIT} \uparrow$  and  $\text{LIMIT} \downarrow$  is the **valid measuring range**.

The DULCOMETER® Compact Controller has fixed 'hysteresis'.

Measured variable	Hysteresis
pH	0.28 pH
Redox	20 mV




The 'Hysteresis' acts to cause an increase in the limit value transgression, i.e. if the ' $\text{Limit} \uparrow$ ' of e.g. pH 7.5 was exceeded, then the criterion for a limit value transgression is only removed again when the value falls below pH 7.22. The hysteresis behaviour for a ' $\text{Limit} \downarrow$ ' functions in an analogue way (the hysteresis value is here added to the  $\text{Limit} \downarrow$ ), for example ' $\text{Limit} \downarrow$ ' pH 4.00, hysteresis pH 0.28, then the limit value transgression criterion is only removed again when the pH exceeds 4.28.



### 9.5 Temperature correction variable for pH

The correction variable compensates for the effect of the temperature of the medium on the measured value. The correction variable is the temperature of the medium to be measured. The temperature of the medium affects the pH value to be measured.

#### Operating modes

- *[off]*: No temperature compensation takes place
  - For measurements which do not require temperature compensation
- *[auto]*: The DULCOMETER® Compact Controller evaluates the temperature signal of the connected temperature sensor
  - For measurements using a temperature sensor (Pt1000) (0 -120 °C)
- *[manual]*: The temperature of the medium to be measured has to be measured by the user. The measured value is then entered using the keys  and  in the parameter 'VALUE' in the DULCOMETER® Compact Controller and saved using the key 
  - For measurements where the medium to be measured has a constant temperature, which has to be taken into account in the control process



## 9.6 Checkout time for measured variable and correction variable

Error text	Description
LIMIT ERR	Checkout time of the measured variable
TLIMITERR	Checkout time of the correction variable

If upon the expiry of the checkout time, the valid measuring range is not reached, then the DULCOMETER® Compact Controller exhibits the following behaviour:

- **LIMIT ERR:** The control is switched off. An error current is emitted, provided the output is configured as a measured variable output
- **TLIMITERR:** The control is switched off. An error current is emitted, provided the output is configured as a correction variable output or a measured variable output

Initially the transgression of a limit is only a limit value transgression. This leads to a 'WARNING'. Switching on the control time 'TIMELIM' (> 0 minutes), creates an alarm from the limit value transgression. In the event of a [TLIMITERR] a, the control switches to [STOP].

## 9.7 Checkout time control



### Monitoring of the control path

*The checkout time monitors the control path. The checkout time mechanism permits detection of possible defective sensors.*



### Dead time determination

Each control path has a dead time. The dead time is the time, which the control path requires to detect a change or addition of metered chemicals using its own instrumentation.

You must select the checkout time so that it is greater than the dead time. You can determine the dead time, by operating the metering pump in manual mode and, for example, dosing acid.



### NOTICE!

#### Dead time determination

You should only determine the dead time if the current process cannot be negatively influenced by the manual metering.

You must determine the time, which the control path (i.e. the entirety of controllers, sensors, measurement water, flow gauges, etc.) requires to detect a first change in the measured value starting from the beginning of dosing. This time is the 'dead time'. A safety margin, e.g. 25%, must be added to this dead time. You must allocate an appropriate safety margin for your own particular process.

The parameter 'LIMIT' can be used to set a limit for the control variable. If the control variable exceeds this limit value, the CHECKTIME fault is triggered (checkout time of the control has elapsed). The control is switched to basic load and a fault current output.



### 9.8 Power relay "P-REL" as limit value relay

The power relay '*P-REL*' can be configured as a limit value relay. It always act only on the measurement variable, whereby the limits are set in '*LIMITS*'. The relay is activated upon infringement of either the top or lower limit values.

Constant checking is carried out to determine whether a limit has been infringed and if this is interrupted with the power relay configured '*P-REL = limit*' for at least '*DELAY ON*' seconds, then the relay is activated. If the limit value transgression disappears for at least '*DELAY OFF*' seconds, then the limit value relay is again deactivated.

The limit value relay is deactivated immediately upon: '*STOP*', user calibration, '*PAUSE*' and '*HOLD*'.



## 9.9 Setting and functional description of "Relay Used as a Solenoid Valve"

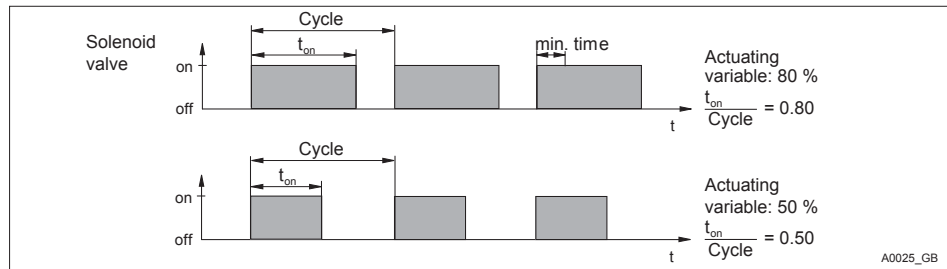


Fig. 36: Solenoid valve (= P-REL.: dosing)

min. time [MIN ON]

Cycle = [PERIOD] (in seconds)



### Solenoid valve switching times

The switching times of the relay (solenoid valve) depend on the cycle time, the control variable and the 'min. time' (smallest permissible switch-on time for the connected device). The actuating variable determines the ratio  $t_{on}/cycle$  and thus also the switching times.

The 'min. time' affects the switching times in two situations:



## Control parameters and functions

### 1. Theoretical switching time < min. time

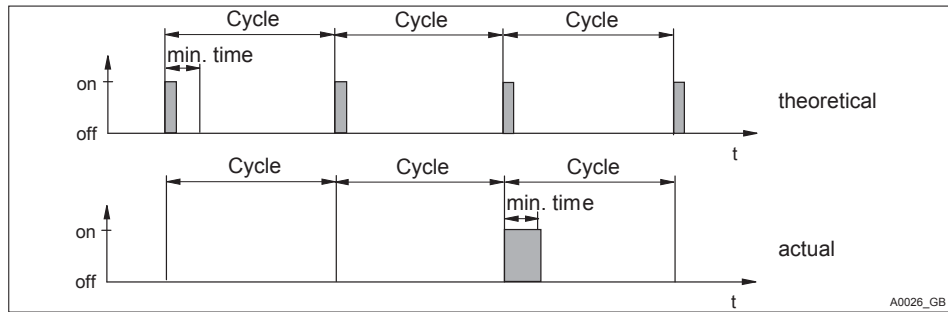


Fig. 37: Theoretical switching time < min. time

min. time [MIN ON]  
 Cycle = [PERIOD] (in seconds)

The DULCOMETER® Compact Controller does not switch on for a certain number of cycles until the sum of the theoretical switching times exceeds 'min. time'. Then it switches for the duration of this total time.

### 2. Theoretical switching time > (cycle - min. time)

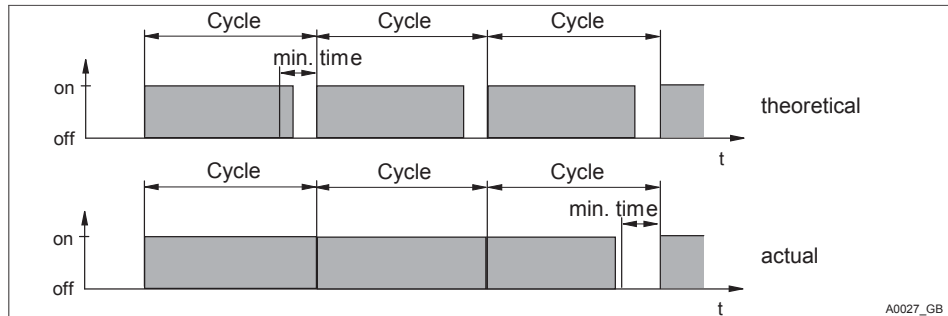


Fig. 38: Theoretical switching time > (cycle - min. time) and calculated switching time < cycle


min. time [MIN ON]  
 Cycle = [PERIOD] (in seconds)

The DULCOMETER® Compact Controller does not switch off for a certain number of cycles until the differences between the cycle and the theoretical switching time exceed 'min. time'.



### 9.10 Alarm relay

The alarm relay triggers in '*OPERATION*' (normal mode) if an error occurs which has been defined as '*ERROR*' and not just as '*WARNING*'.

The error message '*ALARM*' in the continuous display is marked with a \* (star) and can be acknowledged with the  key. The alarm and the \* will then disappear.

### 9.11 "Error logger" operating mode

The last three errors are displayed. Also displayed is how long ago (in minutes) they occurred. When a new fault occurs, the oldest fault is deleted.

Faults are only shown which occur in operating status '*OPERATION*', i.e. not in operating status '*STOP*', '*CAL*' (user calibration), '*HOLD*' or '*PAUSE*'.

Only '*ERRORs*' are shown, not '*WARNINGS*', e.g. a '*LIMIT ERR*' is shown, but not '*LIMIT↑*'.

A fault, whose display has lasted for 999 minutes is automatically deleted from the '*Error Logger*'. The '*Error Logger*' is neither saved nor backed up in the event of power loss.



## 10 Maintenance

- **Users' qualification:** trained user, see  *Chapter 2.2 'Users' qualifications' on page 10*

The DULCOMETER® Compact Controller is maintenance free.

### 10.1 Changing the fuse, DULCOMETER® Compact Controller



#### **WARNING!**

##### **Danger from electrical voltage**

Possible consequence: Fatal or very serious injuries.

- The DULCOMETER® Compact Controller does not have a mains switch
- When working inside the control unit, disconnect the control unit from the mains power via an external switch or by removing the external fuse



#### **NOTICE!**








##### **Use only 5 x 20 mm micro-fuses**

Possible consequence: Damage to the product or its surroundings

- 5x20 T 0.315 A
- Part number 732404


#### **Fuse change**

The mains fuse is located in a sealed fuse holder in the inside of the device.

1.  Disconnect the controller from the mains power
2.  Open the controller and fold the controller housing top section to the left
3.  Remove the PCB cover
4.  Remove the micro-fuse using a suitable tool
5.  Fit the micro-fuse using a suitable tool
6.  Refit the PCB cover
7.  Replace controller housing top section and close the controller



## 10.2 Fault reporting and troubleshooting

- **Users' qualification for diagnostics:** trained user, see  *Chapter 2.2 'Users' qualifications' on page 10*. Further measures depend on the type and scope of possible troubleshooting measures to be carried out.

### Fault reporting and troubleshooting

Display	Description / cause	Status <sup>1</sup>	Mode <sup>2</sup>	Measured variable output <sup>3</sup>	Correction variable output <sup>4</sup>
pH/mV RANGE ↓	Input voltage too low	Error	Basic load	Fault current	-
pH/mV RANGE ↑	Input voltage too high	Error	Basic load	Fault current	-
T RANGE ↓	Measured temperature beneath measuring range	Error	Basic load	Fault current	Fault current
T RANGE ↑	Measured temperature above measuring range	Error	Basic load	Fault current	Fault current
CAL ERROR	No valid user calibration exists	Error	-	-	-
NO PROBE	If activated: pH sensor monitoring outputs: no sensor	Error	Basic load	Fault current	-
PROBE ERR	If activated: pH sensor monitoring outputs: sensor break	Error	Basic load	Fault current	-
CHECK- TIME	Control checkout time elapsed	Error	Basic load	Fault current	-
mA RANGE ↑	mA output current has an upper limit	Error	-	-	-



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## Maintenance

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Display	Description / cause	Status <sup>1</sup>	Mode <sup>2</sup>	Measured variable output <sup>3</sup>	Correction variable output <sup>4</sup>
mA RANGE ↓	mA output current has a lower limit	Error	-	-	-
LIMIT ↑	Measured variable exceeds upper set limit	Warning	-	-	-
LIMIT ↓	Measured variable falls below lower set limit	Warning	-	-	-
T LIMIT ↑	Correction variable exceeds upper set limit	Warning	-	-	-
T LIMIT ↓	Correction variable falls below lower set limit	Warning	-	-	-
LIMIT ERR	Set checkout time for monitoring the measurement variable limits has elapsed	Error	Stop	Fault current	-
TLIMITERR	Set checkout time for monitoring the correction variable limits has elapsed	Error	Stop	Fault current	Fault current
NO CAL	No valid user calibration exists	Warning	-	-	-
CON-TACTIN	If activated: Power relay is activated in 'PAUSE/HOLD'	Error	-	-	-

1 = [Status] Error status after occurrence of the fault (error means: alarm relay deactivates, "E" is displayed before the error message, can be acknowledged with OK)



2 = *[Mode]* Resulting controller mode (relates to control variable and thus, as necessary, mA output)

3 = *[Measured variable output]* Consequence for the current output, if this is set as '*a measured variable output*'

4 = *[Correction variable output]* Consequence for the current output, if this is set as '*a correction variable output*'



## **11      Technical data DULCOMETER® Compact Controller**

### **11.1    Permissible ambient conditions**



#### ***Degree of protection (IP)***

*The controller fulfils the IP 67 degree of protection requirements (wall/pipe mounting) or IP 54 (control panel mounting). This degree of protection is only achieved if all seals and threaded connectors are correctly fitted.*

#### **Permissible ambient operating conditions**

Temperature	-10 °C ... 60 °C
Air humidity	< 95 % relative air humidity (non-condensing)

#### **Permissible ambient storage conditions**

Temperature	-20 °C ... 70 °C
Air humidity	< 95 % relative air humidity (non-condensing)

### **11.2    Sound Pressure Level**

No noise generation measurable



### 11.3 Material data

Part	Material
Housing lower and upper section	PC-GF10
Bracket rear side housing bottom section	PPE-GF20
Operating film	Polyester PET membrane
Seal	Expanded PUR
Cover screws	Stainless steel A2
Profile seal (control panel mounting)	Silicone

### 11.4 Chemical Resistance

The device is resistant to normal atmospheres in plant rooms



### 11.5 Dimensions and weights

Complete device:	128 x 137 x 76 mm (W x H x D)
Packaging:	220 x 180 x 100 mm (W x H x D)
Weight of device without packaging:	approx. 0.5 kg
Gross weight of device with packaging:	approx. 0.8 kg



## 12 Electrical data

Mains connection	
Nominal voltage range	100 – 230 VAC $\pm 10$ %
Frequency	50 – 60 Hz
Current consumption	50 – 100 mA

The mains connection is isolated from other switching parts by reinforced insulation. The device has no mains switch; a fuse is fitted.

Power relay (P-relay)	
Loading of switching contacts	5 A; no inductive loads

Outputs galvanically isolated from other switching parts by reinforced insulation.

Digital input	
Open circuit voltage	15 V DC max.
Short circuit current	approx. 6 mA
Max. switching frequency	Static For switching processes such as 'PAUSE', 'HOLD', etc.

### ! NOTICE!

Do not supply with voltage



---

## Electrical data

---

For the connection of an external semi-conductor or mechanical switch.

<b>mA Output</b>	<b>0 - 20 mA</b>	<b>4 - 20 mA</b>	<b>manual</b>
Current range	0 – 20.5 mA	3.8 – 20.5 mA	0 - 25 mA
In the event of a fault	0 or 23 mA	3.6 or 23 mA	
Max. load	480 $\Omega$ at 20.5 mA		
Max. output voltage	19 V DC		
Overvoltage-resistant up to:	$\pm 30$ V		
Output accuracy	0.2 mA		

Galvanically isolated from all other connections (500 V)

<b>mV input</b>	
Measuring range	-1 V ... + 1 V 0 pH ... 14 pH
Measurement accuracy	$\pm 0.25$ % of the measuring range
Sensor monitoring of input (low resistance threshold) (can be switched off)	< 500 k $\Omega$ ... 1 M $\Omega$ (short circuit)
Sensor monitoring of input (high resistance threshold) (can be switched off)	no pH sensor connected
Display glass sensor resistance of ProMinent pH sensor	0 ... 5000 M $\Omega$
Overvoltage-resistant up to:	$\pm 5$ V



---

## Electrical data

---

Pump control (f-relay)	
Max. switching voltage:	50 V (protective low voltage)
Max. switching current:	50 mA
Max. residual current (open):	10 $\mu$ A
Max. resistance (closed):	60 $\Omega$
Max. switching frequency (HW) at 50% filling factor	100 Hz

Digital output galvanically isolated from all other connections via OptoMos relay.

Temperature input	
Temperature measuring range:	0...120 °C
Measuring flow:	approx. 1.3 mA
Measuring accuracy:	$\pm 0.8$ % of measuring range
Overvoltage-resistant up to:	$\pm 5$ V
Short circuit-resistant	Yes

For connection of a Pt1000 temperature sensor using a 2-wire system. Not galvanically isolated from the mV input



---

**Spare parts and accessories**

---

**13 Spare parts and accessories**

<b>Spare parts</b>	<b>Part number</b>
Fine fuse 5x20 T 0.315 A	732404
Wall/tube retaining bracket	1002502
Guard terminal top part (knurled nut)	733389
Measured variable labels	1002503
DMT fixing strap	1002498
Cable connection set DMTa/DXMa (metric)	1022312
Controller housing lower part (processor/PCB), fully assembled	Identity code DCCA_E_E1 ...
Controller housing top part (display/operating part), fully assembled	Identity code DCCA_E_E2 ...

<b>Accessories</b>	<b>Part number</b>
Mounting kit for control panel installation	1037273
Check strap	1035918



## 14 Replacing spare part units

- **User qualification, mechanical installation:** trained qualified personnel, see  
 ↳ *Chapter 2.2 'Users' qualifications' on page 10*
- **User qualification, electrical installation:** Electrical technician, see  
 ↳ *Chapter 2.2 'Users' qualifications' on page 10*



### CAUTION!

#### Check strap for strain relief

Possible consequence: Material damage.

The ribbon cable and its base cannot be mechanically stressed. Hence it is essential when mounting the controller in the control panel, that the check strap (part number 1035918) is fitted for strain relief and mechanical fixing. Without the check strap, the ribbon cable or its base could be damaged if they were to fall out of the top part of the controller housing.

### 14.1 Replacing the top part of the housing

#### ! NOTICE!

##### Ribbon cable base

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 39

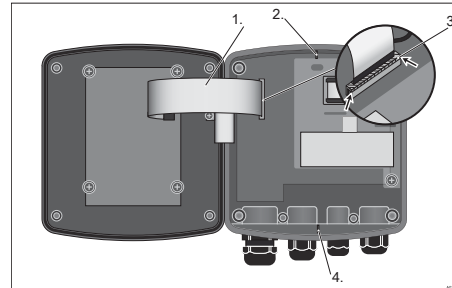


Fig. 39: Loosening the ribbon cable

1. ➔ Undo four screws and open the DULCOMETER® Compact Controller
2. ➔ Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the socket
3. ➔ The catches (2 and 4) are not needed with units for control panel installation.



## Replacing spare part units

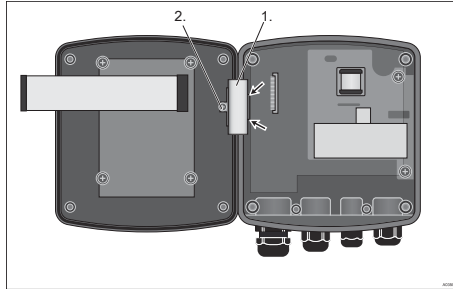


Fig. 40: Dismantling the hinge

4. ➔ Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge
5. ➔ With control panel installation: Remove the two screws and remove the strain relief

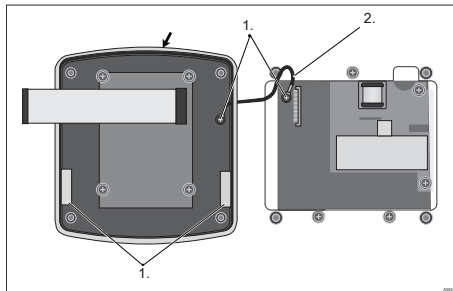


Fig. 41: With control panel installation: Fit the profile seal onto the top part of the controller housing

6. ➔ With control panel installation: Position the profile seal (arrow) evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure
7. ➔ With control panel installation: Secure the strain relief (2) using two screws (1)

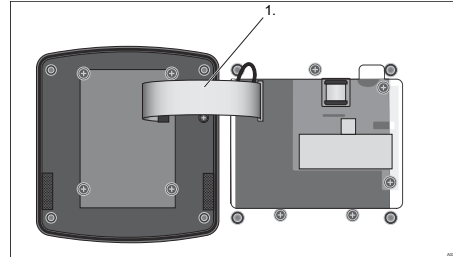


Fig. 42: Pushing and locking the ribbon cable in its base

8. ➔ Push and lock the ribbon cable (1) in its base
9. ➔ Fit the hinge
10. ➔ Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing
11. ➔ With control panel installation: Re-check that the profile seals are fitted properly
  - ⇒ Re-check that the seal is seated properly. Only if the mounting is correct, can IP 67 (wall/pipe mounting) or IP 54 (control panel mounting) degree of protection be achieved



## 14.2 Replacing the lower part of the housing (wall/tube retaining bracket)



### **Complete commissioning of the controller**

Once the lower part of the housing has been replaced, it is necessary to fully commission the measuring and control point, as the new lower part of the housing does not have specific settings, only factory settings.

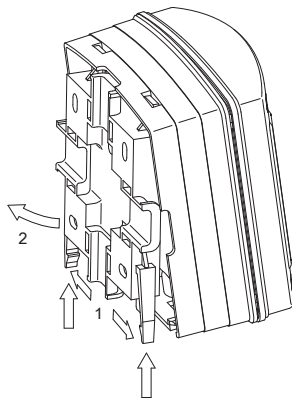


Fig. 43: Removing the wall/tube retaining bracket

1. Remove the wall/tube retaining bracket. Pull the two snap-hooks (1) outwards and push upwards



### **NOTICE!**

#### **Ribbon cable base**

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 39

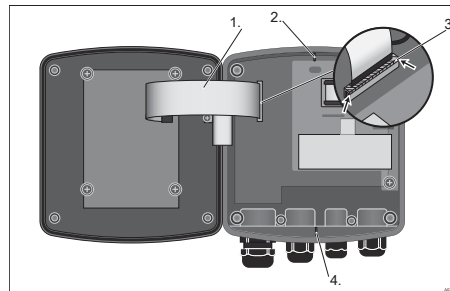


Fig. 44: Loosening the ribbon cable

2. Undo four screws and open the DULCOMETER® Compact Controller
3. Open the right and left lock (3) (arrows) on the base and pull the ribbon cable (1) out of the base. The catches (2 and 4) are used to align the two halves of the housing.



## Replacing spare part units

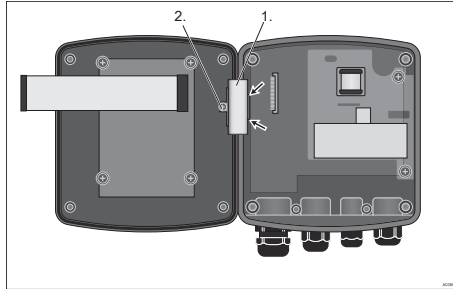


Fig. 45: Dismantling the hinge

4. ➔ Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge
5. ➔ Label the cable connectors fitted to distinguish them and remove the cables from the lower part of the controller

### Preparing the new lower part of the controller housing

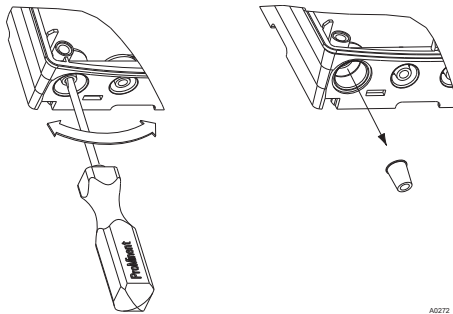


Fig. 46: Punching out the threaded holes

6. ➔



*Large threaded connection (M 20 x 1.5)*

*Small threaded connection (M 16 x 1.5)*

Punch out as many threaded holes on the bottom of the lower part of the controller housing as required

### Fit the cable and threaded connectors

7. ➔ Guide the cable into the respective reducing inserts
8. ➔ Insert the reducing inserts into the threaded connectors
9. ➔ Guide the cable into the controller
10. ➔ Connect the cable as indicated in the terminal diagram
11. ➔ Screw in the required threaded connectors and tighten
12. ➔ Tighten the threaded connector clamping nuts so that they are properly sealed

### Refit the controller

13. ➔ Fit the hinge

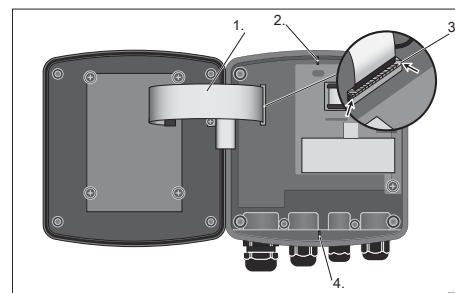


Fig. 47: Fix the ribbon cable



14. Push and lock the ribbon cable (1) in its base. The catches (2 and 4) are used to align the two halves of the housing.
15. Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing
16. Re-check that the seal is seated properly. IP 67 degree of protection (wall/pipe-mounting) can only be provided if the installation is correct

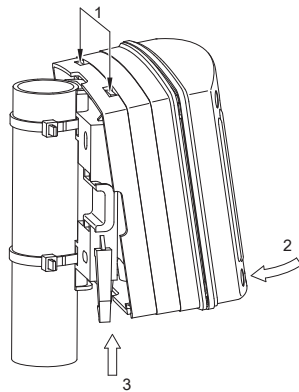


Fig. 48: Suspend and secure the DULCOMETER® Compact Controller

17. Suspend the DULCOMETER® Compact Controller at the top (1) in the wall/tube retaining bracket and push using light pressure at the bottom (2) against the wall/pipe retaining bracket. Then press upwards (3) until the DULCOMETER® Compact Controller audibly snaps into position

### 14.3 Replacing the lower part of the housing (control panel installation)



#### Complete commissioning of the controller

Once the lower part of the housing has been replaced, it is necessary to fully commission the measuring and control point, as the new lower part of the housing does not have specific settings, only factory settings.

#### ! NOTICE!

##### Ribbon cable base

The base of the ribbon cable is firmly soldered onto the PCB. The base cannot be removed. Open the base lock (3) to loosen the ribbon cable, see Fig. 39

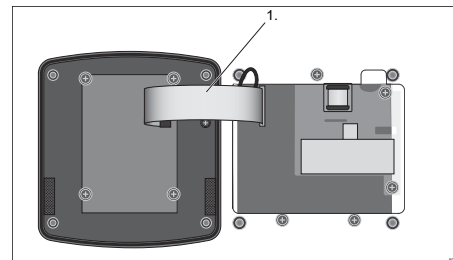


Fig. 49: Loosen the ribbon cable from the base

1. Undo four screws and open the DULCOMETER® Compact Controller
2. Open the right and left lock on the base and pull the ribbon cable (1) out of the base.



## Replacing spare part units

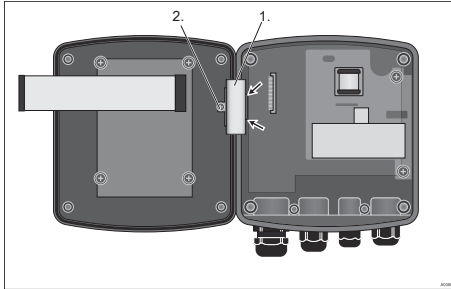


Fig. 50: Dismantling the hinge

3. ➔ Remove the screw (2), unclip the hinge (1) on the lower part of the controller housing (arrows) and remove the hinge

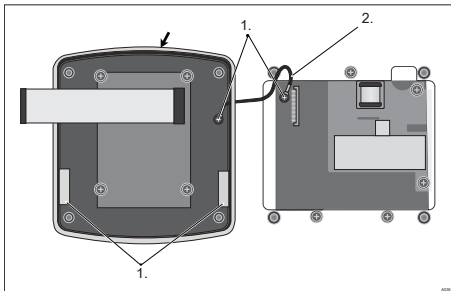


Fig. 51: Removing the strain relief

4. ➔ Remove the strain relief (2). Remove the screws (1) to do so.
5. ➔ Check the profile seal (arrow), then position the profile seal evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure
6. ➔ Remove the top part of the controller housing (3 fixing bolts)
7. ➔ Label the cable connectors fitted to distinguish them and remove the cables from the lower part of the controller

### Preparing the new lower part of the controller housing

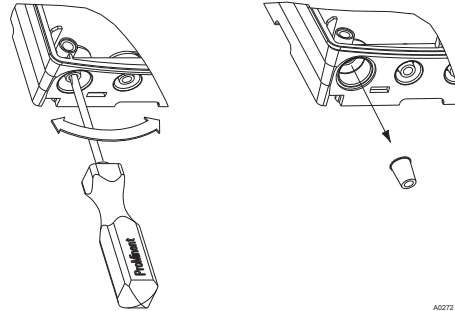


Fig. 52: Punching out the threaded holes

8. ➔



Large threaded connection (M 20 x 1.5)

Small threaded connection (M 16 x 1.5)

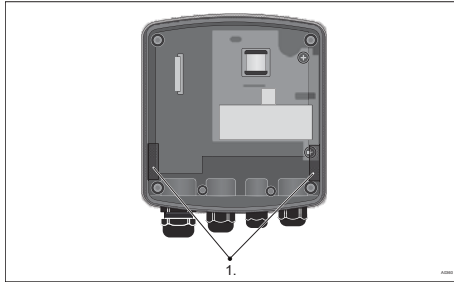
Punch out as many threaded holes on the bottom of the lower part of the controller housing as required

### Fit the cable and threaded connectors

9. ➔ Guide the cable into the respective reducing inserts
10. ➔ Insert the reducing inserts into the threaded connectors
11. ➔ Guide the cable into the controller
12. ➔ Connect the cable as indicated in the terminal diagram
13. ➔ Screw in the required threaded connectors and tighten
14. ➔ Tighten the threaded connector clamping nuts so that they are properly sealed



### Refit the controller



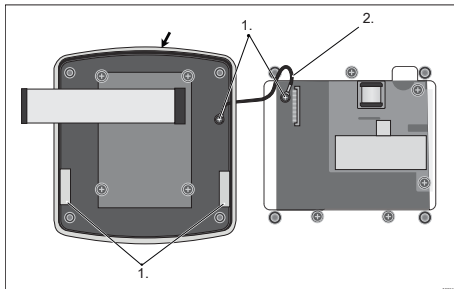
*Fig. 53: Fitting the profile seal on the lower part of the controller housing*

- 15.** Use pliers to break off the catches. They are not needed for control panel installation

Position the profile seal evenly around the top edge of the lower part of the DULCOMETER® Compact Controller housing. Arrange the flaps (1) as shown in the figure

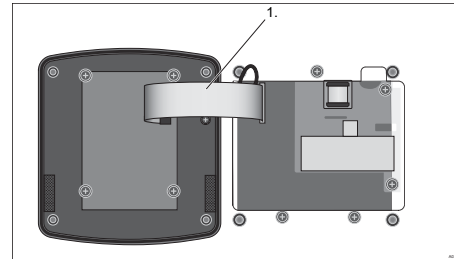
⇒ Ensure that the profile seal evenly surrounds the top edge of the housing.

- 16.** Insert the lower part of the DULCOMETER® Compact Controller housing with the profile seal from behind into the cut-out and use three screws to secure it in place



*Fig. 54: Fit the profile seal onto the top part of the controller housing*

- 17.** Position the profile seal (arrow) evenly into the groove in the top part of the DULCOMETER® Compact Controller housing. Arrange the flaps (3) as shown in the figure
- 18.** Secure the strain relief (2) using two screws (1)
- 19.** Fit the hinge



*Fig. 55: Pushing and locking the ribbon cable in its base*

- 20.** Push and lock the ribbon cable (1) in its base
- 21.** Screw the top part of the controller housing onto the lower part of the DULCOMETER® Compact Controller housing
- 22.** Re-check that the profile seals are fitted properly
- ⇒ IP 54 degree of protection can only be provided if the control panel is mounted correctly



## **15 Standards complied with and Declaration of Conformity**

The EC Declaration of Conformity for the controller is available to download on our homepage.

EN 60529 Specification for degrees of protection provided by housings (IP code)


EN 61000 Electromagnetic Compatibility (EMC)

EN 61010 Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

EN 61326 Electrical equipment for measuring, control and laboratory use - EMC requirements (for class A and B devices)



## 16 Disposal of Used Parts

- **User qualification:** instructed user, see  *Chapter 2.2 'Users' qualifications' on page 10*

### NOTICE!

#### **Regulations governing the disposal of used parts**

- Note the current national regulations and legal standards which apply in your country

The manufacturer will take back decontaminated used units providing they are covered by adequate postage.

Decontaminate the unit before returning it for repair. To do so, remove all traces of hazardous substances. Refer to the Material Safety Data Sheet for your feed chemical.

A current Declaration of Decontamination is available to download on the ProMinent website.



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Internet: [www.prominent.com](http://www.prominent.com)

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E-1248



## SERIES: P16

**Dial:** 1½", 2", 2½", 4"  
**Accuracy:** 1.6%, 2.5%

### DESCRIPTION

Indumart *P16 Series* Fillable Standard Pressure Gauges are used at measuring points with high dynamic alternating loads and strong vibrations and pulses. The glycerin filling of the case provides lubrication of the moving parts which protects the measuring system against wear and at the same time ensures smooth pointer movement and thus good readability.

Indumart *P16 Series* pressure gauges have a high level of functional safety and long service lives. These gauges are suitable for applications in hydraulics, compressors and pumps.

Various types of wall or panel mounting configurations are available.

### SPECIFICATIONS

<b>Accuracy</b>	1.6% (2½" & 4" dials); 2.5% (1½" & 2" dials)
<b>Dial Sizes</b>	1½" (40 mm), 2" (50 mm), 2½" (63 mm), 4" (100 mm)
<b>Case</b>	St. steel (standard)
<b>Bezel</b>	St. steel; crimped bezel
<b>Connection</b>	Centre back or bottom
<b>Thread</b>	½" NPT (1½" dial only), ¼" NPT (2", 2½", 4" dials) ½" NPT (option for 4" dial), BSP thread (option)
<b>Window</b>	Plexiglas
<b>Bourdon Tube</b>	Brass (std.), st. steel (option)
<b>Max. Temperature</b>	60°C
<b>Range</b>	0...10 to 0...8000 psi; 0...60 to 0...60000 kPa; 0...0.6 to 0...600 bar Vacuum and compound ranges are available; see the Range Table

DIMENSIONS (mm) & WEIGHT				
	Ø40 mm	Ø50 mm	Ø63 mm	Ø100 mm
D1	45	55	68	111
D2	41	51	63	100
H1	70	75	84	145
H2	47	52	57	74
L	29	30	30	35
Weight (g)	100	100	150	400

PI-201/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30  
PI-301 - Gauge, Pressure, 0-15psi, Indumart, P16T2-FG-15  
PI-301/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30  
PI-401/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30  
PI-501/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30  
PI-551/2 - Gauge, Pressure, 0-30psi, Indumart, P16T2-FG-30  
PI-553/554 - Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60  
PI-703/704 - Gauge, Pressure, 0-60psi, Indumart, P16T2-FG-60  
PI-601/602 - Gauge, Pressure, 0-15psi, Indumart, P16K2-FG-15



### ORDER CODES

#### Model P16

#### CONNECTION

Back  
Bottom

K  
T

#### DIAL SIZE

40 mm (1½")  
50 mm (2")  
63 mm (2½")  
100 mm (4")

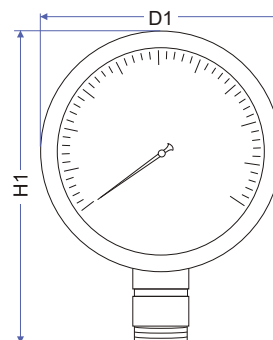
0  
1  
2  
4

#### OPTIONS (more than one option may be selected)

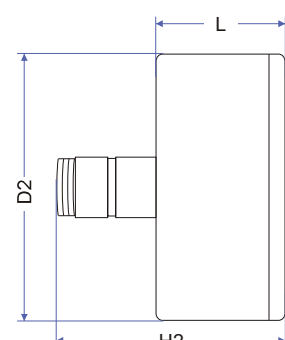
Glycerine Filling  
Silicon Filling  
St. Steel Internal  
½" Process Connection (100 mm dial only)  
BSP Thread  
Back Flange for Wall Mounting (not for 40 mm dial)  
Front Flange for Panel Mounting (not for 40 mm dial)  
Clamp with 2 Screws (63 mm dial only)

FG  
FS  
IT  
TH  
TB  
MK  
MF  
MS

Example: P16T2-FG,IT



Bottom connection



Centre back connection

Specifications may change without prior notice.

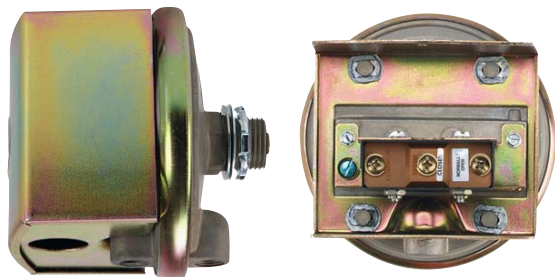


# Series 1800 Low Differential Pressure Switches for General Industrial Service



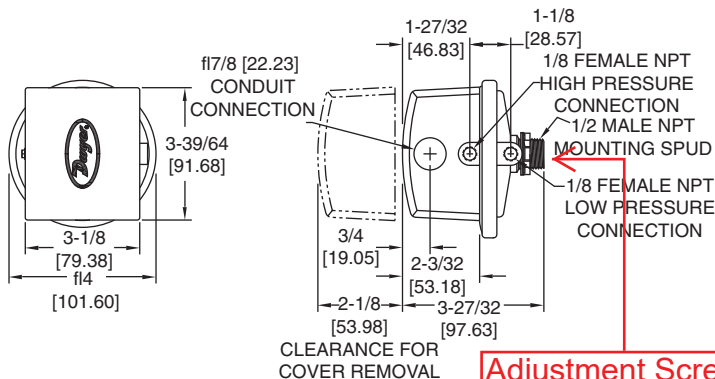
## Specifications — Installation and Operating Instructions

PSL-301 - Switch, Pressure, 1823-2  
 PSL501 - Switch, Pressure, 1823-40  
 PSL-601/2 - Switch, Pressure, 1823-40  
 PSL-7911 - Switch, Pressure, 1823-2



Model 1823 pressure switch. UL and CSA Listed, FM and CENELEC approved.

Series 1823 pressure switch. Conduit enclosure removed to show electric switch.



Construction and dimensions. Series 1823 pressure switches.

**One of our most popular** pressure switches. Combines small size and low price with 2% repeatability for enough accuracy for all but the most demanding applications. Set point adjustment inside the mounting switch on one side of a wall or panel with adjustment easily accessible on the opposite side.

**\*Model 1823 shown; (1823 replaces 1820, 1821 and 1822 which are similar).**

### Environmental (MIL) Switch

Unlisted Model 1820 can be furnished with special snap switch sealed against the environment for high humidity and/or for government applications. Similar to standard Model 1823 except dead band is slightly greater. Specify Model 1820 (Range No.) "MIL" in ordering.

### SERIES 1823 SWITCHES — OPERATING RANGES & DEADBANDS

Model Number	Operating Range, Inches W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1823-00	0.07 to 0.22	0.05	0.05
1823-0	0.15 to 0.5	0.06	0.06
1823-1	0.3 to 1.0	0.08	0.08
1823-2	0.5 to 2.0	0.10	0.12
1823-5	1.5 to 5.0	0.14	0.28
1823-10	2.0 to 10	0.18	0.45
1823-20	3 to 22	0.35	0.70
1823-40	5 to 44	0.56	1.10
1823-80	9 to 85	1.30	3.0

## SPECIFICATIONS

**Service:** Air and non-combustible, compatible gases.

**Wetted Materials:** Consult Factory.

**Temperature Limits:** -30 to 180°F (-34 to 82.2°C). 1823-00, -20 to 180°F (-28.9 to 82.2°C).

**Pressure Limits:** 10 psig (68.95 kPa) continuous, 25 psig (172.4 kPa) surge.

**Switch Type:** Single-pole double-throw (SPDT).

**Repeatability:** ±2%.

**Electrical Rating:** 15 A @ 120-480 VAC, 60 Hz. Resistive 1/8 HP @125 VAC, 1/4 HP @ 250 VAC, 60 Hz. De-rate to 10 A for operation at high cycle rates.

**Electrical Connections:** 3 screw type, common, normally open and normally closed.

**Process Connections:** 1/8" female NPT.

**Mounting Orientation:** Diaphragm in vertical position. Consult factory for other position orientations.

**Set Point Adjustment:** Screw type inside mounting spud.

**Weight:** 1 lb, 5 oz (595 g).

**Agency Approvals:** CE, UL, CSA, FM.

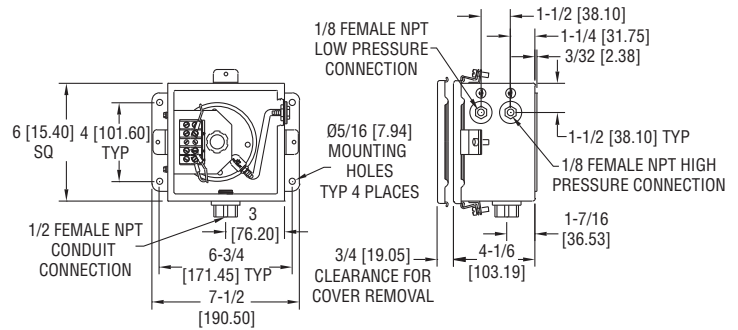


## INSTALLATION

1. Select a location free from excessive vibration and where oil or water will not drip upon the switch. See special housings for unusual conditions.
2. **While not required, positioning the pressure connections down is recommended.** Mount the switch with the diaphragm in a vertical plane. Switch must be recalibrated for each change in operating position.
3. Connect switch to source of pressure differential. Metal tubing with 1/4" O.D. is recommended but any tubing system which will not restrict the air flow is satisfactory. Note that the low pressure connection may be made to the 1/2" spud at the back of the switch if desired. If so connected, drill 1/16" diameter holes in the Spring Retainer flange and the head of Adjustment Screw to provide opening to the switch interior and plug the other low pressure connection.
4. Electrical connections to the standard single pole, double throw snap switch are provided by means of screw terminals marked "common", "norm open", and "norm closed". The normally open contacts close and the normally closed contact open when pressure increases beyond the set point.
5. Switch loads should not exceed the maximum specified current rating of 15 amps resistive. Switch capabilities decrease with high load inductance or rapid cycle rates. Whenever an application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonged switch life.

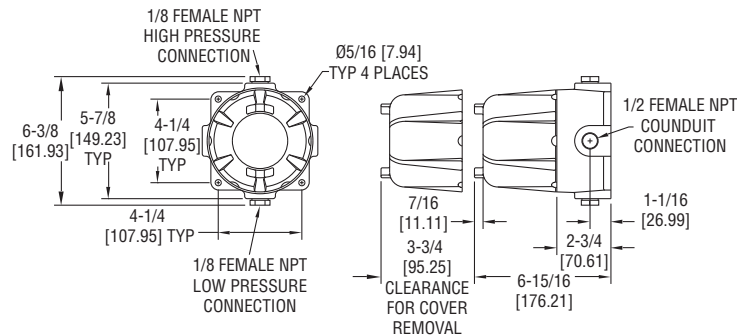
## ADJUSTMENT

1. If the switch has been factory preset, check the set-point before placing in service to assure it has not shifted in transit.
2. If switching has not been preset or it is desired to change the point, observe the following procedure:
  - a. To adjust the set point turn the slotted Adjustment Screw clockwise to increase the set point and counterclockwise to decrease the set point.
  - b. The following is a recommended procedure for calibrating or checking calibration: Use a "T" assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point slowly. Note the manometer and pressure switch will have different response characteristics due to different internal volumes, lengths of tubing, oil drainage, etc. Be certain switch is checked in position it will assume in use, i.e. vertical, horizontal, etc.



## Weatherproof Enclosure

16 ga. steel enclosure for unusually wet or oily conditions. Withstands 200 hour salt spray test. Gasketed cover. Weight 5-1/2 lb (2.5 kg). Switch must be installed at factory. Specify "WP" in addition to switch catalog number.



## Explosion-Proof Housing

Cast iron base and aluminum dome cover. Approximate weight 7-1/2 lb (3.4 kg). Specify "EXPL" in addition to switch catalog number.

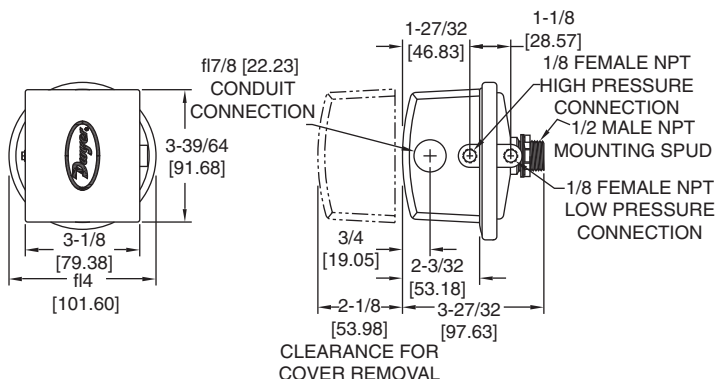



**SERIE  
1800**
**Interrupor Para Baja**
**Presión Diferencial**


Model 1823 pressure switch. UL and CSA Listed, FM approved.



Series 1823 pressure switch. Conduit enclosure removed to show electric switch.



Construction and dimensions. Series 1823 pressure switches.

**Uno de nuestros mas populares** interruptores de presión. Combina un pequeño tamaño y bajo precio, con una repetibilidad del 2%, exactitud suficiente para las aplicaciones con mas demanda. El ajuste del punto de operación en un extremo, permite instalar el interruptor de un lado en las pared o tablero, permitiendo acceso al tornillo de ajuste.

## Interrupor para Ambiente Húmedo (MIL)

El modelo 1820 puede ser fabricado con un sello especial a prueba de intemperie, o para aplicaciones con alta humedad. Similar al modelo 1823, excepto que la banda de operación es mayor.

Especifique el modelo 1820 (Rango No.) "Mil" en su orden.

Model Number	Operating Range, Inches W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
<b>1823-00</b>	0.07 to 0.22	0.05	0.05
<b>1823-0</b>	0.15 to 0.5	0.06	0.06
<b>1823-1</b>	0.3 to 1.0	0.08	0.08
<b>1823-2</b>	0.5 to 2.0	0.10	0.12
<b>1823-5</b>	1.5 to 5.0	0.14	0.28
<b>1823-10</b>	2.0 to 10	0.18	0.45
<b>1823-20</b>	3 to 22	0.35	0.70
<b>1823-40</b>	5 to 44	0.56	1.10
<b>1823-80</b>	9 to 85	1.30	3.0

### Especificaciones:

Interrupor de presión diferencial operado por diafragma de 4", para activar un interruptor de presión tipo simple polo doble tiro. El diafragma esta controlado por un resorte calibrado que se puede ajustar para fijar la presión diferencial exacta a la cual el interruptor actuara. El movimiento del diafragma es transmitido al botón del interruptor por un medio mecánico. Interrupor Dwyer Instruments, Inc. Catalogo No. 1823-\_\_ \_\_ para el rango de operación requerido.

## SPECIFICATIONS

**Service:** Air and non-combustible, compatible gases.

**Wetted Materials:** Consult Factory.

**Temperature Limits:** -30 to 180°F (-34 to 82.2°C). 1823-00, -20 to 180°F (-28.9 to 82.2°C).

**Pressure Limits:** 10 psig (68.95 kPa) continuous, 25 psig (172.4 kPa) surge.

**Switch Type:** Single-pole double-throw (SPDT).

**Repeatability:** ±2%.

**Electrical Rating:** 15 A @ 120-480 VAC, 60 Hz. Resistive 1/8 HP @125 VAC, 1/4 HP @ 250 VAC, 60 Hz. De-rate to 10 A for operation at high cycle rates.

**Electrical Connections:** 3 screw type, common, normally open and normally closed.

**Process Connections:** 1/8" female NPT.

**Mounting Orientation:** Diaphragm in vertical position. Consult factory for other position orientations.

**Set Point Adjustment:** Screw type inside mounting spud.

**Weight:** 1 lb, 5 oz (595 g).

**Agency Approvals:** CE, UL, CSA, FM.

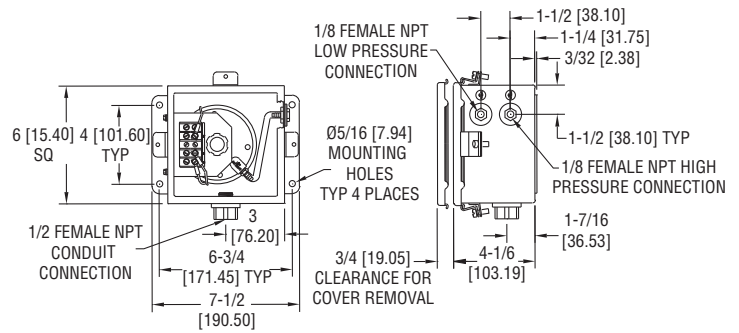


## INSTALACIÓN:

1. Seleccione una ubicación libre de vibración excesiva, en donde el agua o aceite no entre al interruptor. Revise encapsulados especiales para aplicaciones especiales.
2. Mientras no se requiera otra, la conexión de presión inferior es recomendada. Monte el interruptor con el diafragma en posición vertical, el interruptor debe recalibrarse para cada cambio de posición.
3. Conecte el interruptor a la fuente de presión diferencial. Tubo metálico con diámetro de 1/4" es recomendado, pero cualquier sistema de tubería que no restrinja el flujo de aire es bueno.
4. Conexiones eléctricas estándar de los interruptores SPDT, común, NA y NC. Los contactos cambian cuando se incrementa la presión del punto de operación.
5. La carga del interruptor no debe exceder los 15 Amp. Especificados. Las capacidades decrecen con altas cargas inductivas y ciclos rápidos de actuación, por lo que en estos casos los límites de corriente deben ser 10 Amp. 0 menores para incrementar la vida del interruptor.

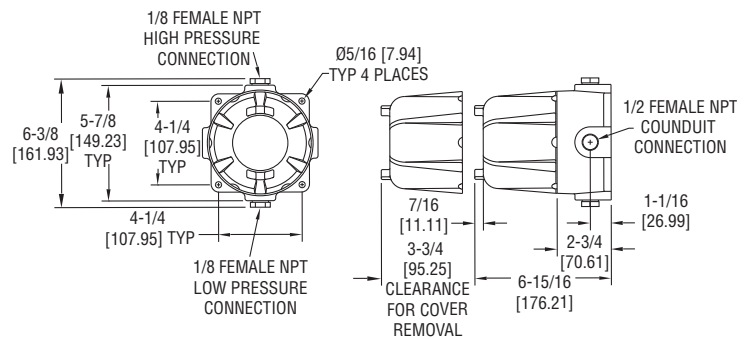
## AJUSTES:

1. Si el interruptor ha sido calibrado en fabrica, revise el punto de operación antes de ponerlo en servicio.
2. De lo contrario, siga los siguientes pasos:
  - A. Para ajustar el punto de operación, gire el tornillo de calibración en sentido de las manecillas del reloj para aumentar el valor y en contra de las manecillas del reloj para disminuir el valor del punto de operación.
  - B. Lo siguiente se recomienda para calibrar o revisar la calibración: Use una T con tres mangueras plásticas, tan pequeñas como sean posible. Conecte una manguera al interruptor de presión, otra al manómetro y por la tercera aplique la presión de esta forma podrá ajustar el interruptor a la presión requerida lo mas exacto posible.



### Encapsulado a Prueba de Intemperie

Encapsulado de acero para condiciones húmedas y/o aceitosas, soporta pruebas de 200 horas de spray salino, pesa 5-1/2 libras. El interruptor debe ser instalado en la planta al momento de su fabricación. Especifique "WP" mas el modelo del interruptor en catalogo.



### Encapsulado a Prueba de Explosión

Encapsulado a base de Hierro y Aluminio, pesa aproximadamente 7-1/2 libras. Especifique "EXPL" mas modelo del interruptor en catalogo.





# PITOT TUBE AIR FLOW METERS

## PFLOW SERIES

### Application:

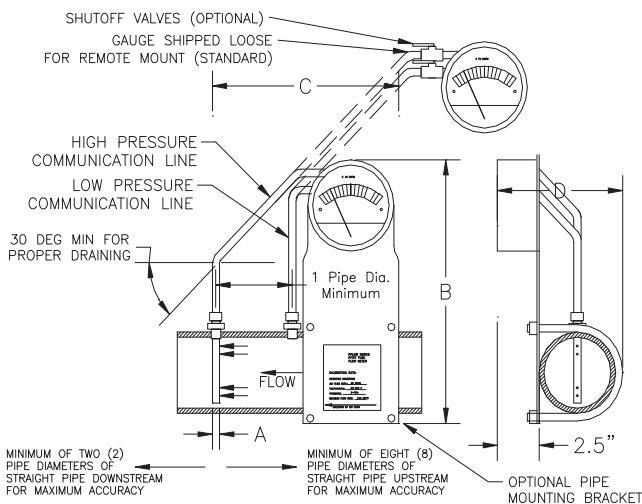
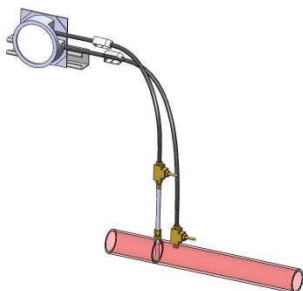
**newterra** Pitot Tube Air Flow Meters are designed to be a cost effective, accurate flow meters that are calibrated for your site-specific conditions. The unique self draining design allows the meter to function in process lines with high humidity and moisture content as well as dry air lines. The PFLOW meter takes two pressure readings in your process line, one at a high-pressure, zero velocity and one at a low-pressure, full velocity. The pressure differential is used to calibrate the meter for a desired flow and operating conditions. When ordering the flow meter, it is critical to supply: operating temperature, pressure or vacuum in psia, and the pipe ID. The PFLOW meter can be supplied with any scale range required in scfm (25deg C, 14.7psia) or acfm at your listed operating conditions.

### Construction:

The high, static pressure is measured using a 304 Stainless Steel probe inserted into the process line. The probe is designed with 4 measurement ports that provide an average reading for flow through your process pipe. Multiple ports on the static pressure line ensure that you can maintain an accurate reading while the tube is self-draining. The low pressure point is measured by tapping a 1/4" hole in the process line ahead of the high-pressure port. This tapping is completed on the top of the pipe to minimize moisture collection in the pressure communication lines. The differential pressure gauge is connected to the pressure ports using 3/8" Buna-N and the brass connections are capable of handling temperatures as high as 250 deg F. The Dwyer Magnehelic® gauge provides a large, clear and accurate display of your airflow reading.

### Standard Features:

- 304SS static pressure probe
- Brass compression fittings and Buna-N pressure communication tubing
- Direct read display can be calibrated for your specific operating conditions. Display can read ACFM or SCFM but SCFM is recommended as there is less error when the meter is operating above or below the calibrated pressure. Other units are available on request.
- Large 4" display for accurate reading
- Standard gauges are shipped loose for installation in an existing pipeline. The gauges can be wall mounted in site-specific locations. A pipe bracket can be purchased.



**Dimensions Chart:**

Part Number	A	B	C	D	Pipe
1" PFLOW	1/4"	12"	12"	4.75"	1"
1-1/2" PFLOW	3/8"	12"	12"	5.25"	1.5"
2" PFLOW	3/8"	12"	12"	5.75"	2"
3" PFLOW	1/2"	12"	12"	6.75"	3"
4" PFLOW	1/2"	14"	14"	7.75"	4"
6" PFLOW	1/2"	14"	14"	9.75"	6"
8" PFLOW	1/2"	14"	14"	12"	8"

Larger pitot tubes can be supplied as required.





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# PITOT TUBE AIR FLOW METERS

## PFLOW SERIES

### Specifications:

Maximum Air Temperature:	250 °F (standard) 300 °F (high temp version)	Accuracy:	2.5 % of scale at calibration point
Max. Operating Pressure	15 psig (standard unit) 35 psig (medium pressure unit) 80 psig (high pressure unit)	Pressure Drop:	Less than 2" WC pressure drop in high flow applications
Repeatability:	1% of scale at calibration point		

The following table provides recommended flow rates for each meter at a given operating pressure range. These values are suitable for temperatures between 70-100 deg F. For meter applications outside this temperature range and outside of the operating pressure ranges listed below please contact our sales department for help in choosing a suitable meter.

Operating pressure	Recommended Operating Flow rates (SCFM)				
	0-5 psi	5-10 psi	0-10" Hg	10-20" Hg	20-26" Hg
<b>PFLOW 1"</b>	15-40	17-50	12-35	8-25	6-20
<b>PFLOW 1-1/2"</b>	35-90	40-115	25-75	20-60	15-50
<b>PFLOW 2"</b>	60-160	70-200	50-150	30-100	25-80
<b>PFLOW 3"</b>	135-360	150-450	100-300	75-250	50-180
<b>PFLOW 4"</b>	250-650	275-800	200-550	120-450	100-320
<b>PFLOW 6"</b>	550-1500	600-1800	450-1200	275-1000	200-750
<b>PFLOW 8"</b>	1000-2500	1100-3200	750-2250	500-1750	350-1250

### Calibration and Correction Factors:

Each PFLOW pitot tube is calibrated for a specific operating temperature and pressure. If the pitot tube operates at a different pressure or temperature than the original design, the flow measurement can be adjusted with the following equation: (Units of Flow<sub>1</sub> and Flow<sub>2</sub> will be the same)

$$\text{Flow}_1 = \text{Flow}_2 \times (P_2/P_1 \times ((T_1+460) / (T_2+460)))^{1/2}$$

Pressure units: psia, Temperature units: °F

### Options Table:

Option	Description
Orientation:	The flow meter gauge can be oriented for flows from Left to Right, Right to Left, Up or Down as required for your specific application.
Site Specific Calibration and Gauge Range:	The following information is required to calibrate the flow meter for your specific application: Operating Pressure (psia): Operating Temperature (°F or °C): Operating Flow Rate (acfm or scfm or other scales as required): Maximum Flow rate (better accuracy is achieved when the operating flow rate is approximately ¾ of the scale range of the flow meter)
4-20ma Option	Flow meters can be ordered with 4-20ma outputs for control systems. Three versions are available: Nema 7 (Class 1 Div 1) FM or CSA approved Two Wire Connection: 24VDC+, Signal Output Power Consumption: 20mA 316SS Wetted parts Nema 4 (Weatherproof) or Nema 1 (General Purpose) Three Wire Connection: 24VDC+, 24VDC-, Signal Output Accuracy on all 4-20ma outputs: 2.5% of full scale for meter Aluminum with Silicon diaphragm
Shutoff Valves	The pressure gauges are not designed to operate with water collecting within the internal components. If you will be operating with hot wet air or condensing air streams, then it is recommended that we install shutoff valves in the pressure communication lines to isolate the gauge from the process lines when the operator is not taking a flow reading.
Pre Installed Section of Pipe	The flow meters can be preinstalled in a section of pipe with any configuration of material and fittings on the end. This will allow the PFLOW meter to be factory installed and tested in this section of pipe before leaving our facility.
Pipe Mounting Bracket	A pipe-mounting bracket can be supplied to allow the gauge to mount directly on the pipe as shown in the above picture.





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## PITOT TUBE AIR FLOW METERS PFLOW SERIES

Company Name: \_\_\_\_\_ Purchase Order Number: \_\_\_\_\_

Contact Name: \_\_\_\_\_ Contact Number (PH/FAX): \_\_\_\_\_ / \_\_\_\_\_

(Note: Please include relevant credit information to set up an account if required.)

Ship to Address: \_\_\_\_\_

Billing Address: \_\_\_\_\_

Credit Card Orders (Please check card type)

☐ VISA

☐ MASTERCARD

Credit Card Number: \_\_\_\_\_ Expiry Date (m/y): \_\_\_\_\_ / \_\_\_\_\_

**Meter Size: (please check box)**

☐ 1"

☐ 2"

☐ 4"

☐ 8"

☐ 1-1/2"

☐ 3"

☐ 6"

**Process Pipe Material and Schedule: (please check box)**

☐ Schedule 40 PVC

☐ Schedule 40 Steel

☐ Schedule 80 PVC

☐ Schedule 80 Steel

For other Materials and Schedule Specify Inner Diameter of Pipe: \_\_\_\_\_

**Orientation: (please check box)**

☐ Flow from Left to Right

☐ Flow Up

☐ Flow from Right to Left

☐ Flow Down

**4-20mA Output (please check box)**

☐ Nema 7, Class 1 Div 1, 316SS, with flow gauge

☐ Nema 7, Class 1 Div 1, 316SS, no direct read display

☐ Nema 4, Weatherproof, with flow gauge

☐ Nema 4, Weatherproof, no direct read display

☐ Nema 1, General Purpose, with flow gauge

☐ Nema 1, General Purpose, no direct read display

☐ None

**Calibration Information (Required Information):**

Operating Pressure: \_\_\_\_\_ Operating Temperature: \_\_\_\_\_

Elevation or Atmospheric Pressure: \_\_\_\_\_

Operating Flow Rate: \_\_\_\_\_ Maximum Flow Rate\*: \_\_\_\_\_

Scfm units are preferred but any flow units can be provided. The operating flow rate should be approximately ¾ of full scale to allow for an accurate reading at that flow rate. Note Lowest accurate reading is at ¼ of full scale.

\*Options for Maximum Flow Rates include: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100 and any scale can be multiplied by 10, 100, 1000, 10000

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newterra E-1256



# Switch-Tek

## Powered Level Switch

LZ12, LU10, LP15 and LO10 Series Manual



Flowline Inc.

10500 Humbolt Street

Los Alamitos, CA 90720

Tel: (562) 598-3015

Fax: (562) 431-8507

[www.flowline.com](http://www.flowline.com)



**About Switch-Pak™ Powered Level Switches:** This manual contains information on all four series of powered level switches; Vibration (LZ12 series), Ultrasonic (LU10 series), Optic Leak (LO10 series) and SuperGuard Capacitance (LP15 series). The switches all feature two outputs: 1) a 4 or 20 mA current switch and 2) a 60VA SPST dry contact relay. All four series are manufactured with thermoplastics, including the cable, making them submersible in design and ideal for corrosive applications. Package the switches with either Flowline controllers (LC10 or LC40 series) or interface directly to another controller or PLC.

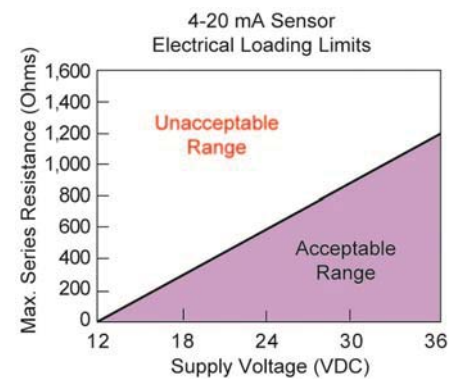
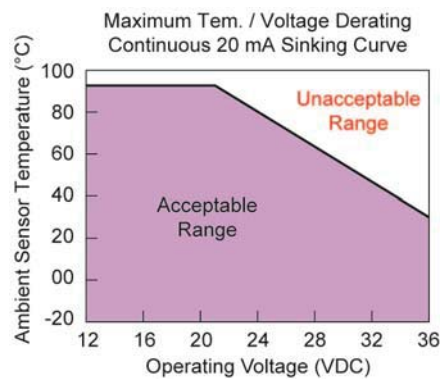
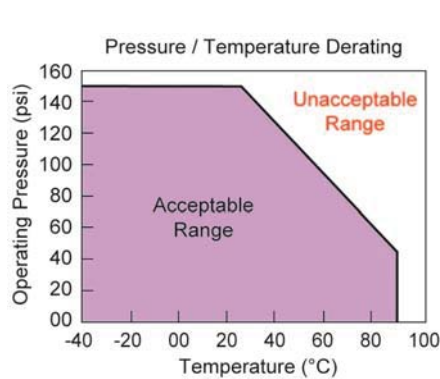
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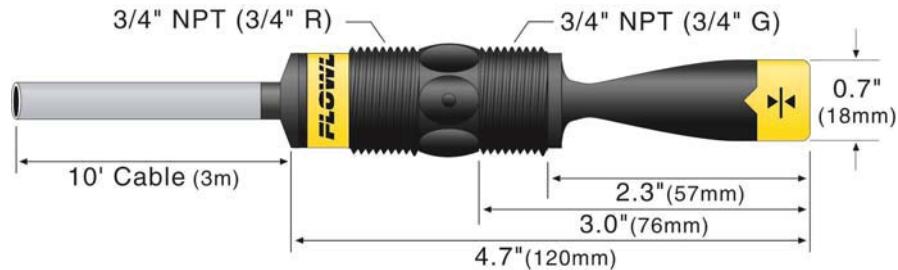
**Common Specifications:**

Orientation:	Universal	Pressure:	150 psi (10 bar) @ 25 °C., derated @ 1.667 psi (.113 bar) per °C. above 25° C.
Accuracy:	± 1 mm in water	Sensor rating:	NEMA 6 (IP68)
Repeatability:	± 0.5 mm in water	Cable type:	4-conductor, #22 AWG (shielded)
Supply voltage:	12-36 VDC 12-30 VDC (LZ12 Only)	Cable length:	10' (3m) - Standard 25' (7.6m) or 50' (15.2m) - Special
Consumption:	25 mA maximum	Process mount:	3/4" NPT (3/4" G / R)
Contact type:	(1) SPST relay	Mount. gasket:	Viton® (G / R version only)
Contact rating:	60VA (125 VAC max / 1A max)	Classification:	General purpose
Contact output:	Selectable NO/NC	CE compliance:	EN 61326 EMC / EN 61010-1 safety
Process temp.:	F: -40° to 176° C: -40° to 80°		





**Vibration Switch (LZ12 Series):** The Tuning Fork vibration switch operates at a nominal frequency of 400 Hz. As the switch becomes immersed in a liquid or slurry, a corresponding frequency shift occurs. When the measured frequency shift reaches the set point value, the switch changes state indicating the presence of a liquid or slurry medium. For optimum performance and proactive maintenance, the sensor automatically adjusts for coating, and if necessary, outputs a preventative maintenance alarm.



**⚠ Do not squeeze the forks together. Doing so could damage or break the sensor and void the warranty.**

When powering up the LZ12, the start-up procedure requires the switch to cycle through a wet condition for 1/2 second in order to determine an initial resonance.

**LZ12 Specifications:**

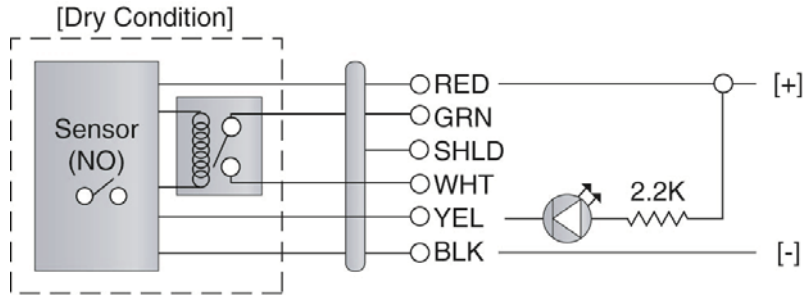
Sensor material:	Ryton® (glass fill) Viton® cable grommet	Maint. alarm:	NPN transistor, 10 mA max.
Process Temp.:	F: -40° to 176° C: -40° to 80°	Cable jacket mat'l:	PP
		Cable type:	5-conductor, #24 AWG (shielded)

**Configurations:**

Part Number	Material (body)	Material (cable)	Thread (inside x outside)
LZ12-1405	Ryton	Polypropylene	3/4" NPT x 3/4" NPT
LZ12-1425	Ryton	Polypropylene	3/4" R x 3/4" G



**Maintenance Alarm (LZ12 Vibration only):** For optimum performance and proactive maintenance, the sensor automatically adjusts for coating, and if necessary, outputs a preventative maintenance alarm. The Yellow wire is a NPN transistor designed to switch when a build-up of material prevents the vibration switch from operating at its operational frequency. Use the Yellow wire to identify when the Vibration switch requires cleaning. To wire the maintenance output wire to an LED, follow the wiring diagram below. The Yellow wire is connected to the LED and a 2.2k $\Omega$  resistor in series and referenced back to the (+) of the power supply.



Sensor Power

[RED & BLK wires] / 36 VDC Max.

5  $\pm$ 1mA Dry / 22  $\pm$ 1mA Wet

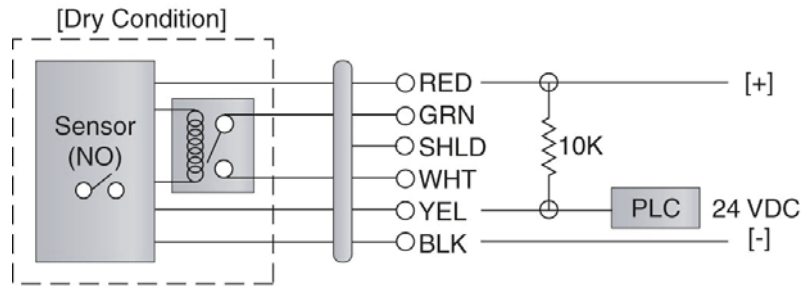
Relay Rating

[GRN & WHT wires] / 60 VA

Maintenance Alarm

[YEL wire] / NPN Transistor / 10mA Max.

To wire the maintenance output wire to a PLC, follow the wiring diagram below. The Yellow wire is connected to the PLC input with a 10 k $\Omega$  resistor parallel to the PLC input and the (+) of the power supply.



Sensor Power

[RED & BLK wires] / 36 VDC Max.

5  $\pm$ 1mA Dry / 22  $\pm$ 1mA Wet

Relay Rating

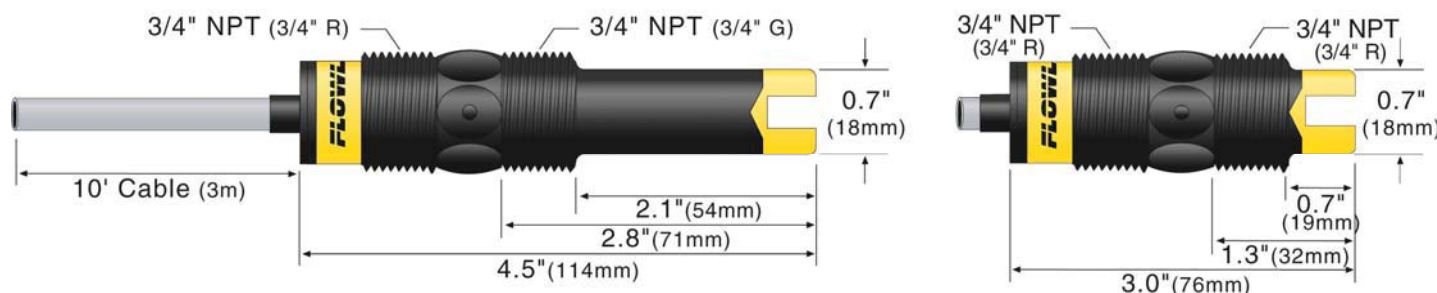
[GRN & WHT wires] / 60 VA

Maintenance Alarm

[YEL wire] / NPN Transistor / 10mA Max.



**Ultrasonic Switch (LU10 Series):** The Ultrasonic level switch generates a 1.5 MHz ultrasonic wave from a miniature piezoelectric transducer located on one side of the gap within it's sensing tip. Another piezo transducer, located on the other side of the gap, acts as a microphone, picking up the sound wave. When liquid enters the gap, there is a change in the speed the wave crosses the gap. This change in the speed of sound identifies whether the sensor is in liquid or in air.



**⚠ The sensor should be installed so that the liquid will drip out of the gap when the sensor becomes dry.**

#### LU10 Specifications:

Sensor material:	1__5: PP 2__5: PFA	Cable jacket mat'l:	1__5: PP 2__5: PFA
Classification:	Intrinsically safe	Parameters:	CSA: Vmax = 32V, Imax = 300 mA, Pmax = 1.3 W; Ci = 0 µF, Li = 0 µH EEx: Ui = 32V; li = 300 mA; Pi = 1.3 W; Ci = 0 µF; Li = 0 µH
Approvals:	CSA: Class I, Groups A, B, C & D; Class II, Groups E, F and G; Class III EEx: Class 1, Division 1, Groups A, B, C, D; EEx ib IIC T6	Certificates:	CSA: LR 79326 EEx: LCIE 01.E6048 X

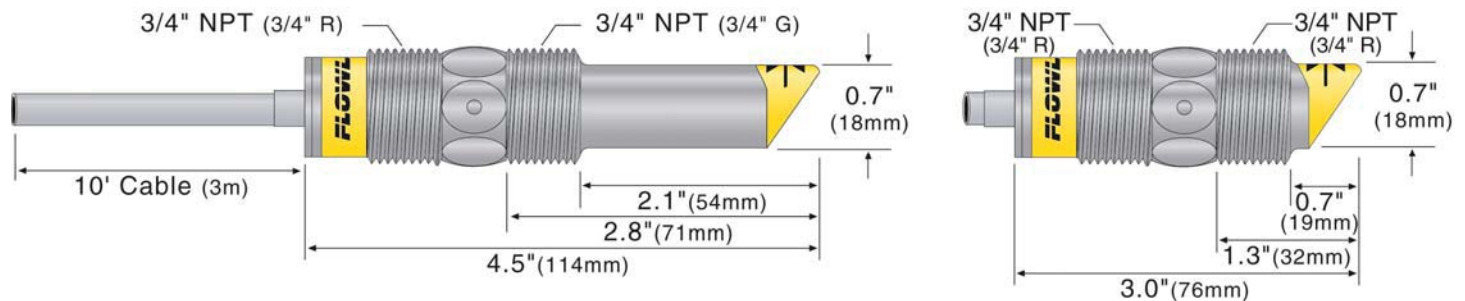
#### Configurations:

Part Number	Length	Material (body)	Material (cable)	Thread	
				cable side	sensor side
LU10-1305	Short (3")	Polypropylene	Polypropylene	(3/4" NPT)	x (3/4" NPT)
LU10-1325	Short (3")	Polypropylene	Polypropylene	(3/4" R)	x (3/4" R)
LU10-1405	Long (4.5")	Polypropylene	Polypropylene	(3/4" NPT)	x (3/4" NPT)
LU10-1425	Long (4.5")	Polypropylene	Polypropylene	(3/4" R)	x (3/4" G)
LU10-2305	Short (3")	PFA	PFA	(3/4" NPT)	x (3/4" NPT)
LU10-2325	Short (3")	PFA	PFA	(3/4" R)	x (3/4" R)
LU10-2405	Long (4.5")	PFA	PFA	(3/4" NPT)	x (3/4" NPT)
LU10-2425	Long (4.5")	PFA	PFA	(3/4" R)	x (3/4" G)



**Optic Leak Detection Switch (LO10 Series):** The Optic Leak Detector use principles of optical refraction to detect the presence or absence of fluid. A pulsed infrared light beam is internally generated by a light emitting diode and aimed at the slanted optical tip of the sensor. If the tip is dry, the light beam bounces at a 90 degree angle to a receiving photo transistor, indicating a dry condition. If the tip is immersed in liquid, the light beam will refract out into the liquid instead of being reflected to the photo transistor, indicating a wet condition.

⚠ The LO10 series is designed as a leak detection switch. The switch should be installed in applications where under normal conditions, it remains away from the liquid and will only come into contact during a leak.



⚠ The Optic Leak Detector cannot detect the presence or absence of specular application liquids that reflect light (such as milk), or viscous liquids (such as paint) that form a coating on the sensor tip.

**LO10 Specifications:**

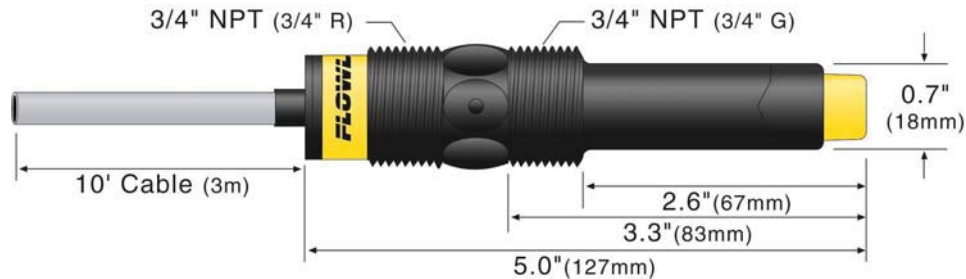
Sensor material: 1__5: PP 2__5: PFA	Cable jacket mat'l: 1__5: PP 2__5: PFA
--	---

**Configurations:**

Part Number	Length	Material (body)	Material (cable)	Thread	
				cable side	sensor side
LO10-1305	Short (3")	Polypropylene	Polypropylene	(3/4" NPT)	x (3/4" NPT)
LO10-1325	Short (3")	Polypropylene	Polypropylene	(3/4" R)	x (3/4" R)
LO10-1405	Long (4.5")	Polypropylene	Polypropylene	(3/4" NPT)	x (3/4" NPT)
LO10-1425	Long (4.5")	Polypropylene	Polypropylene	(3/4" R)	x (3/4" G)
LO10-2305	Short (3")	PFA	PFA	(3/4" NPT)	x (3/4" NPT)
LO10-2325	Short (3")	PFA	PFA	(3/4" R)	x (3/4" R)
LO10-2405	Long (4.5")	PFA	PFA	(3/4" NPT)	x (3/4" NPT)
LO10-2425	Long (4.5")	PFA	PFA	(3/4" R)	x (3/4" G)



**SuperGuard Capacitance Switch (LP15 Series):** The SuperGuard level switch generates a pulse-wave radio frequency signal from the capacitance electrode located in the sensing tip of each sensor. When liquid comes into contact with the sensing tip, the capacitance as measured by the sensor changes based on the dielectric constant of the liquid. The guard circuit rejects the negative effects of coating buildup on the probe by eliminating the coating signal path between the active and reference electrodes.



**⚠ The sensor's operation may vary based on the dielectric properties of various application liquids. The LP15 series sensor is factory-calibrated to be used with liquids with a dielectric value between 20 and 80. Liquids with a dielectric constant less than 20 will not be detected by an LP15 series sensor.**

**Table of Common Dielectric Constants:** NOTE: Liquids with a dielectric constant less than 20 will not be detected by an LP15 series level switch.

Acetone .....21	Chlorotoluene .....4.7	Ethylene chloride .. 10.5	Isobutyl methyl ketone .....13	Nitrotoluene ..... 25	Trichloroethylene .... 3.4
Acetoaldehyde .....22.2	Chloroform ....4.5 to 5.0	Ethyl acetate ..... 6.4	Jet fuel .....1.7	Naphthalene ..2.3 to 2.5	Trichloroacetic acid 4.5
Acetyl methyl hexyl ketone .....28	Chlorine, liquid .....2.0	Ethyl salicylate ..... 8.6	Lead carbonate .....18	Oils, vegetable 2.5 to 3.5	Terephthalic acid .....
Alcohol ..... 16 to 31	Carbon tetrachloride 2.2	Ethyl stearate ..... 2.9	Lead nitrate .....38	Oils, mineral ..2.3 to 2.4	..... 1.5 to 1.7
Ammonia ..... 15 to 25	Cyan .....2.6	Ethyl silicote ..... 4.1	Methyl salicylate ....9.0	Oils, petroleum .....	Thinner ..... 3.7
Acetic acid .... 4.1 to 6.2	Cyclohexane methanol .....	Formic acid ..... 59	Methanol .....33	..... 1.8 to 2.2	Urea ..... 3.5
Butyl chloride .....9.6	.....3.7	Ferric oleate ..... 2.6	Methyl alcohol .33 to 38	Oleic acid .....2.5	Vinyl chloride .. 2.8 to 6
Barium chloride 9 to 11	D.I. Water .....20	Freon ..... 2.2	Margarine, liquid .....	Propane, liquid .....	Vinyl alcohol 1.8 to 2.0
Benzene .....2.3	Ethyl toluene .....2.2	Glycerine ..... 47	.....2.8 to 3.2	..... 1.8 to 1.9	Water, 20°C ..... 80
Benzine .....2.3	Ethyl alcohol .....23	Glycol ..... 30	Methyl acetate .....7.3	Potassium nitrate .....	Water, 100°C ..... 48
Barium nitrate .....5.6	Ethylene glycol .....37	Glycol nitrite ..... 27	N-butyl formate .....2.4	.....5.0 to 5.9	
Bromine .....3.1	Ethylene oxide .....14	Gasoline ..... 2 to 2.2	Nitrobenzene ...26 to 35	Potassium chloride ..5.0	
Chlorobenzene . 4.7 to 6	Ethylene dichloride .....	Hydrochloric acid ... 4.6		Stearic acid .....2.3	
	..... 11 to 17	Isobutyric acid ..... 2.7		Toluene ..... 2.4	

#### LP15 Specifications:

Dielectric range:	>20 constants	Sensor material:	PP
Conductive range:	>100 miromhos	Cable jacket mat'l:	PP

#### Configurations:

Part Number	Material (body)	Material (cable)	Thread	
			cable side	sensor side
LP15-1405	Polypropylene	Polypropylene	( $\frac{3}{4}$ " NPT)	x ( $\frac{3}{4}$ " NPT)
LP15-1425	Polypropylene	Polypropylene	( $\frac{3}{4}$ " R)	x ( $\frac{3}{4}$ " G)



**⚠ About Manual:** PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on all models of Flowline Switch-Tek™ Powered Level Switches: LZ12, LU10, LP15 and LO10 series. Please refer to the part number located on the sensor label to verify the exact model which you have purchased.

**⚠ User's Responsibility for Safety:** FLOWLINE manufactures a wide range of liquid level switches and technologies. While each of these switches are designed to operate in a wide variety of applications, it is the user's responsibility to select a switch model that is appropriate for the application, install it properly, perform tests of the installed system, and maintain all components. The failure to do so could result in property damage or serious injury.

**⚠ Proper Installation and Handling:** Because this is an electrically operated device, only properly trained staff should install and/or repair this product. Use a proper sealant with all installations. *Note: Always install the 3/4" Viton gasket with all versions of Switch-Tek™ with metric threads. The G threaded version will not seal unless the gasket is properly installed.* Never over tighten the sensor within the fitting, beyond a maximum of 80 inch-pounds torque. Always check for leaks prior to system start-up.

**⚠ Material Compatibility:** The LU10 and LO10 series sensors are available in two different wetted materials. Models L\_10-1\_\_5 are made of Polypropylene (PP). Models L\_10-2\_\_5 are made of Perfluoroalkoxy (PFA). The LZ12 series is made of Ryton® (40% glass filled) and the LP15 series is made of PP. Make sure that the model you have selected is compatible with the application liquid. To determine the chemical compatibility between the sensor and its application liquids, refer to an industry reference such as the Compass Corrosion Guide (available from Compass Publications, phone 858-589-9636).

**⚠ Wiring and Electrical:** The supply voltage used to power the sensor should never exceed a maximum of 36 volts DC (30 VDC for LZ12 series). Electrical wiring of the sensor should be performed in accordance with all applicable national, state, and local codes.

**⚠ Flammable, Explosive and Hazardous Applications:** Only the LU10-\_\_5 series switch is rated for use in hazardous locations. Refer to the Certificate of Compliance for all applicable intrinsically safe ratings and entity parameters. Refer to the National Electric Code (NEC) for all applicable installation requirements in hazardous locations. **DO NOT USE THE LZ12, LP15 OR LO10 SERIES GENERAL PURPOSE SWITCH IN HAZARDOUS LOCATIONS.**

**⚠ Warning ⚠**

***The rating for the relay is 60 VA (125 VAC max / 1A max).***

***Flowline's Switch-Tek™ level switches are not recommended for use with electrically charged application liquids. For most reliable operation, the liquid being measured may need to be electrically grounded.***

***Always install the 3/4" Viton gasket with all versions of the powered sensors with metric threads. The G threaded version will not seal unless the gasket is installed properly.***

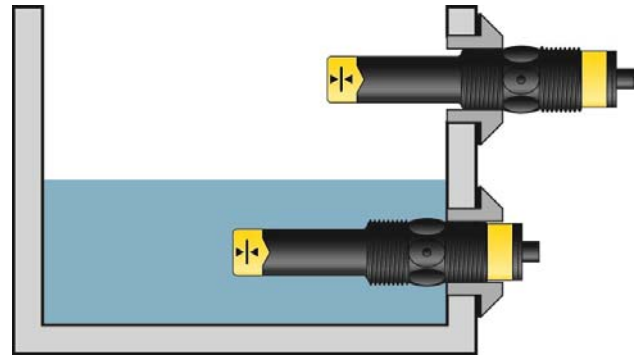


**Make a Fail-Safe System:** Design a fail-safe system that accommodates the possibility of switch and/or power failure. FLOWLINE recommends the use of redundant backup systems and alarms in addition to the primary system. Adding a redundant high level float switch to the system is a cost effective means to prevent costly tank overflows.

All of the Switch-Tek™ Powered Level Sensors have a single internal relay. The normally open (NO) or normally closed (NC) operation is user selected based on the desired system control. Always design a fail-safe system that accommodates for the possibility of functional and/or power failure to the instrument. The "normal" relay state is where the relay coil is de-energized and the relay indicator is OFF. Therefore, if power is cut OFF to the switch it will de-energize the relay. Make sure that the de-energized state is the safe state in your system design. As such, if switch power is lost, a pump will turn OFF if it is connected to the normally open side of the relay.



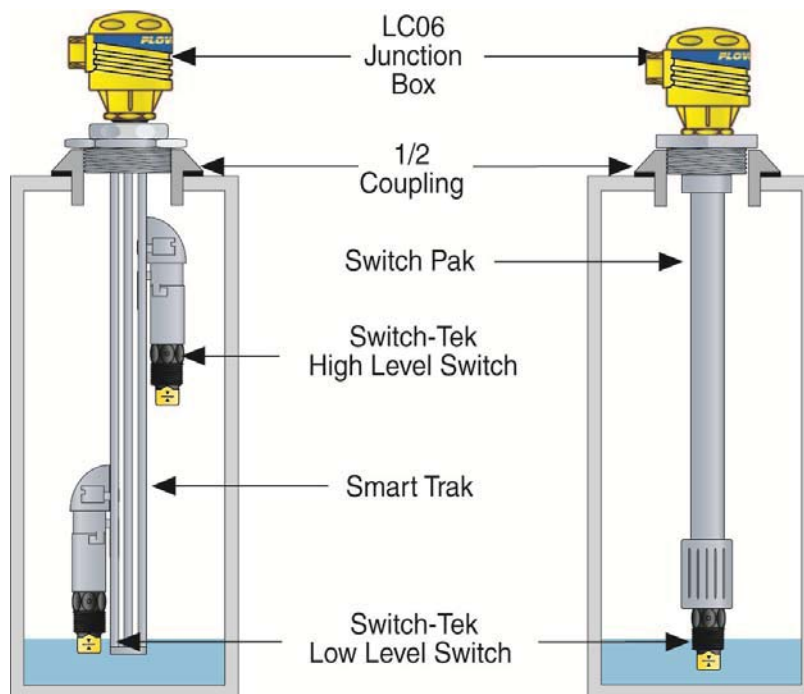
**Through Wall Installation:** Flowline's Switch-Tek™ level switches may be installed through the top, side or bottom of a tank wall. The sensor has male 3/4" NPT threads on either side of a 15/16" wrench flat. This enables the user to select the sensor's mounting orientation, installed outside of the tank in, or inside of the tank out.



**⚠ Always install the 3/4" Viton gasket with the metric (long sensor length) versions of the L \_ \_ \_ \_ 2 \_ . The G threaded version of the Switch-Tek™ will not seal unless the gasket is installed properly.**

**Top Wall Installation:** The powered level switches may be installed through the top wall of a tank. Flowline's Smart Trak LM10 series mounting system is an in-tank fitting which enables users to install up to four FLOWLINE sensors of any technology, to any depth, along the entire length of track. Smart Trak may be installed through the top wall of any tank using a standard 2" NPT tank adapter. If no tank top installation is available, Flowline's side mount bracket, LM50-1001, enables Smart Trak to be installed directly to the side wall of a tank. *Do not use PFA Teflon sensors with Smart-Trak.*

Flowline's Switch Pak LM45 series mounting system is an in-tank fitting which enables users to install one FLOWLINE sensor, of any technology, to a specific depth. The Flowline sensor may be installed onto the 3/4" NPT adapter at the end of the Switch Pak. Switch Pak may be installed through the top wall of any tank using a standard 2" NPT tank adapter. Flowline's side mount bracket, model LM50-1001, may also be used if top wall installation is not available.



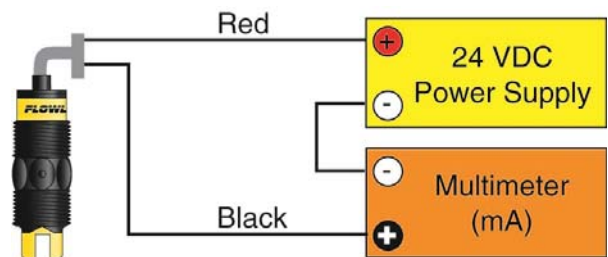


**Supply Voltage:** The supply voltage to the Switch-Tek™ level switch should never exceed a maximum of 36 VDC. Flowline controllers have a built-in 13.5 VDC power supply which provides power to all of Flowline's electrically powered sensors. Alternative controllers and power supplies, with a minimum output of 12 VDC up to a maximum output of 36 VDC (30 VDC with LZ12 series), may also be used with the Switch-Tek™ level switch.

**Required Cable Length:** Determine the length of cable required between the Switch-Tek™ level switch and its point of termination. Allow enough slack to ensure the easy installation, removal and/or maintenance of the sensor. The cable length may be extended up to a maximum of 1000 feet, using a well-insulated, 14 to 20 gauge shielded four conductor cable.

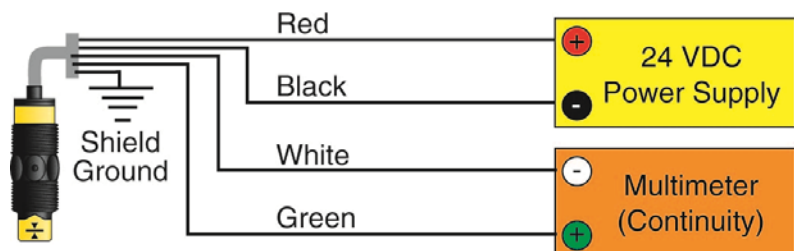
**Wire Stripping:** Using a 10 gauge wire stripper, carefully remove the outer layer of insulation from the last 1-1/4" of the sensor's cable. Unwrap and discard the exposed foil shield from around the signal wires, leaving the drain wire attached if desired. With a 20 gauge wire stripper, remove the last 1/4" of the colored insulation from the signal wires.

**Signal Outputs (Current sensing):** The standard method used by Flowline controllers; this technology uses only two wires (Red and Black). The sensor draws 5 mA when it is dry, and 22 mA when wet. NC/NO status must be set by the controller. The White and Green wires are not used.

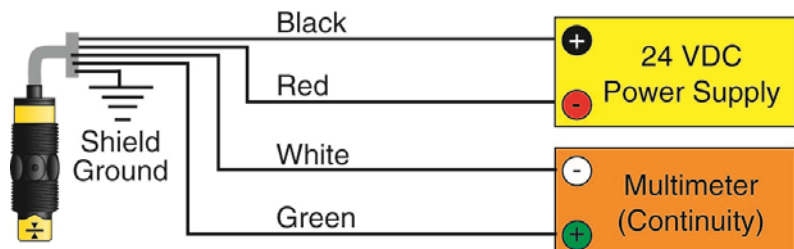


**Signal Output (Relay switching):** Allows the sensor to switch a small load on or off directly, using an internal 1A relay (60 VAC/60 VDC). Only model LU10-\_\_\_5 uses the relay and features 4 wires (red, black, white and green) and a shield wire. The NO/NC status is set by the polarity of the voltage feeding the red and black wires. The green wire is the common for the relay and the white wire is the NO or NC, depending on the polarity of red and black.

#### Normally Open Wiring:



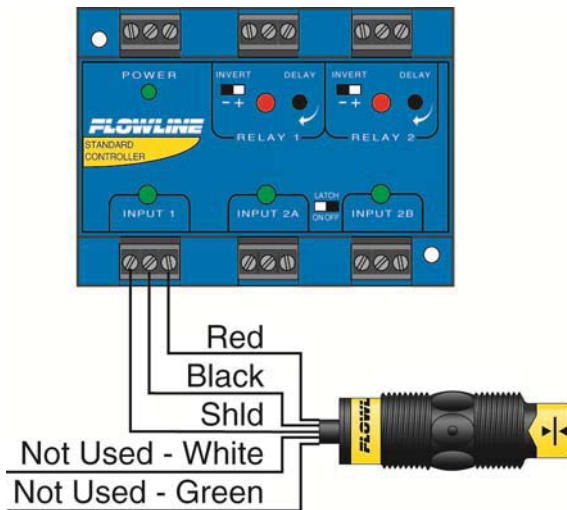
#### Normally Closed Wiring:



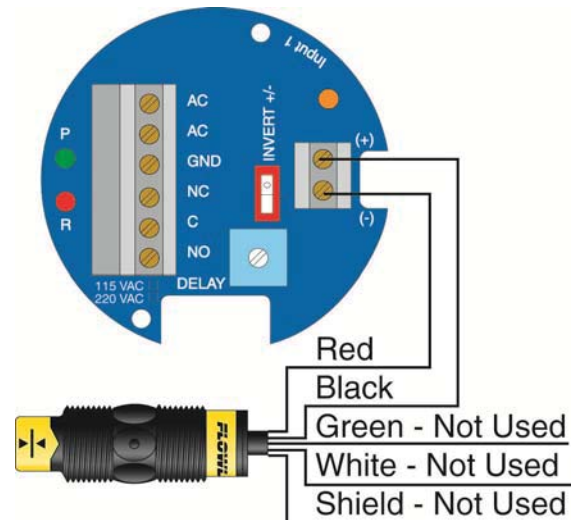


## Wiring to a FLOWLINE Controller

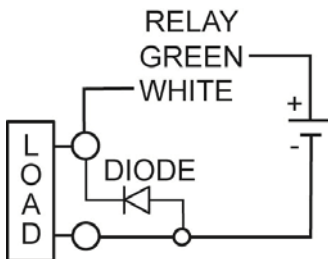
**LC40 Series Controller** (4 or 20 mA output):  
LC42-1001 Shown



**LC10/LC11 Series Controller** (4 or 20 mA output):  
LC11-1001 shown



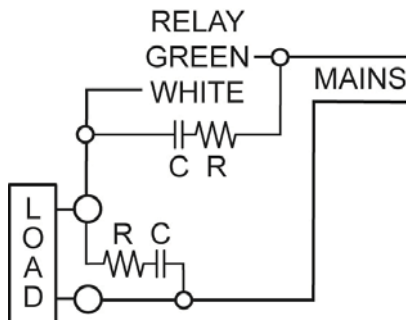
**Switching Inductive Loads:** The use of suppressors (snubbers) is strongly recommended when switching inductive loads to prevent disrupting the microprocessor's operation. The suppressors also prolong the life of the relay contacts. Suppression can be obtained with a catch diode for DC circuits and a resistor-capacitor (RC) for AC circuits.



## Catch Diode

- Always use stepper relays between the sensor and external loads. For DC circuits use a catch diode such as 1N4148, shown on left.

Refer to the following circuits for RC network assembly and installation:



## Choose R and C as follows:

- R: 0.5 to 1 Ohms for each volt across the contacts
- C: 0.5 to 1  $\mu$ F for each amp through closed contacts

## Notes:

- Use capacitors rated for 250 VAC.
- RC networks may affect load release time of solenoid loads. Check to confirm proper operation.
- Install the RC network at the meters relay screw terminals. An RC network may also be installed across the load. Experiment for best results.



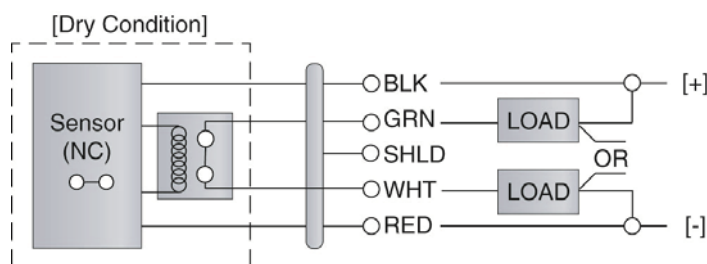
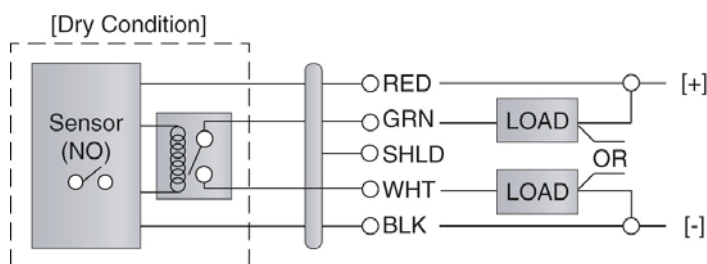
**Wiring the Relay Output:** Switch-Tek™ requires 12 - 36 VDC (30 VDC max. for LZ12 series) power to operate the sensor and switch the relay. All illustrations below identify a Dry switch state as the normal position of the relay.

#### Switching a Normally Open DC Load:

The Red wire connects to Positive (+) of the power supply and the Black wire connects to Negative (-). The LOAD can be attached to either the Green or White wires. Complete the circuit by connecting the Green to (+) VDC power or White to (-) VDC power (see illustration below).

#### Switching a Normally Closed DC Load:

The Black wire connects to Positive (+) of the power supply and the Red wire connects to Negative (-). The LOAD can be attached to either the Green or White wires. Complete the circuit by connecting the Green to (+) VDC power or White to (-) VDC power (see illustration below).



#### Sensor Power

[RED & BLK wires] / 36 VDC Max.  
5 ±1mA Dry / 22 ±1mA Wet

#### Relay Rating

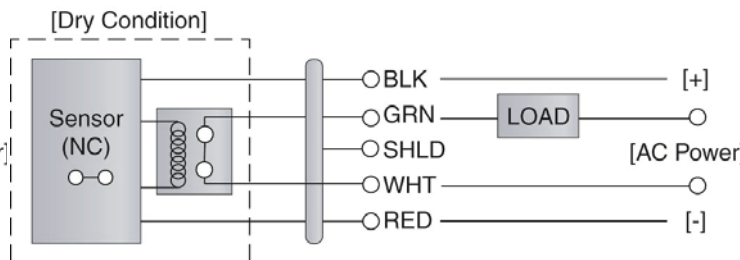
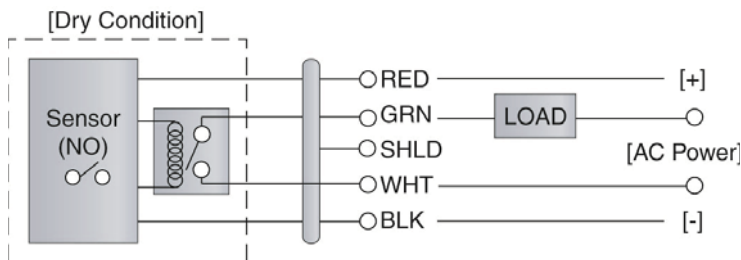
[GRN & WHT wires] / 60 VA

#### Switching a Normally Open AC Load:

The Red wire connects to Positive (+) of the DC power supply and the Black wire connects to Negative (-). The LOAD can be attached to the Green wire and the Hot of the VAC power. Connect the White to the Neutral of the VAC power (see illustration below).

#### Switching a Normally Closed AC Load:

The Black wire connects to Positive (+) of the DC power supply and the Red wire connects to Negative (-). The LOAD can be attached to the Green wire and the Hot of the VAC power. Connect the White to the Neutral of the VAC power (see illustration below).



#### Sensor Power

[RED & BLK wires] / 36 VDC Max.  
5 ±1mA Dry / 22 ±1mA Wet

#### Relay Rating

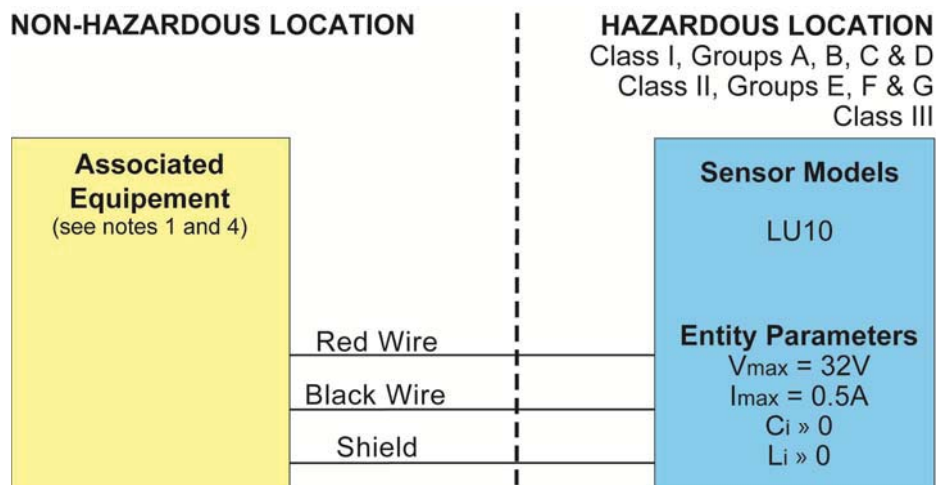
[GRN & WHT wires] / 60 VA



**Models LU10-\_\_5 Only:** The LU10-\_\_5 level switch has been approved for use in Class I, Groups A, B, C & D; UNDER CERTIFICATE NUMBER LR 79326-4. DO NOT USE THE LZ12, LP15 or LO10 SERIES IN INTRINSICALLY SAFE APPLICATIONS. The Entity parameter for the LU10-\_\_5 are:

$$V_{\max} = 32 \text{ VDC} / I_{\max} = 0.5 \text{ A} / C_i = 0 \mu\text{F} / L_i = 0 \text{ mH}$$

**Intrinsically Safe Control Drawing:**



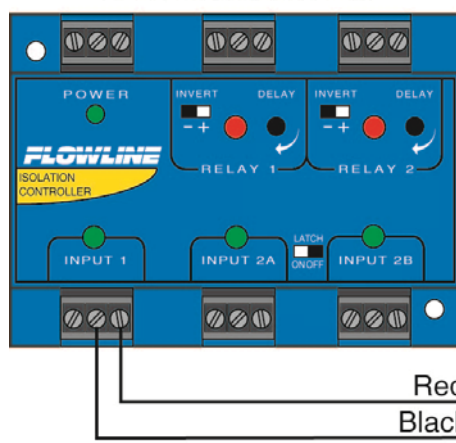
**Notes:**

1. CSA certified associated equipment with entity parameters.
2.  $V_{\max}^3 V_{oc}$ ,  $I_{\max}^3 I_{sc}$ ,  $C_i + C_{\text{cable}} \leq C_{a.}$ ,  $L_i + L_{\text{cable}} \leq L_{a.}$
3. Installation should be in accordance with CEC Part I, or NFPA 70.
4. Associated equipment must be installed per manufacturers instructions

**Sensor Drawing: LSD1**  
**Rev. B 10-01-02**

**Wiring to a Flowline Controller:** LC90 Series Controller (4 or 20 mA Signal Output)  
Non-Hazardous Area | Hazardous Area

**LC90 Series**  
**Entity Parameter**  
 $V_{oc} = 17.47 \text{ VDC}$   
 $I_{sc} = 0.4597 \text{ A}$   
 $C_a = 0.494 \mu\text{F}$   
 $L_a = 0.119 \mu\text{H}$



**LU10 series**  
**Entity Parameter**  
 $V_{\max} = 32 \text{ VDC}$   
 $I_{\max} = 0.5 \text{ A}$   
 $C_i = 0 \mu\text{F}$   
 $L_i = 0 \mu\text{H}$

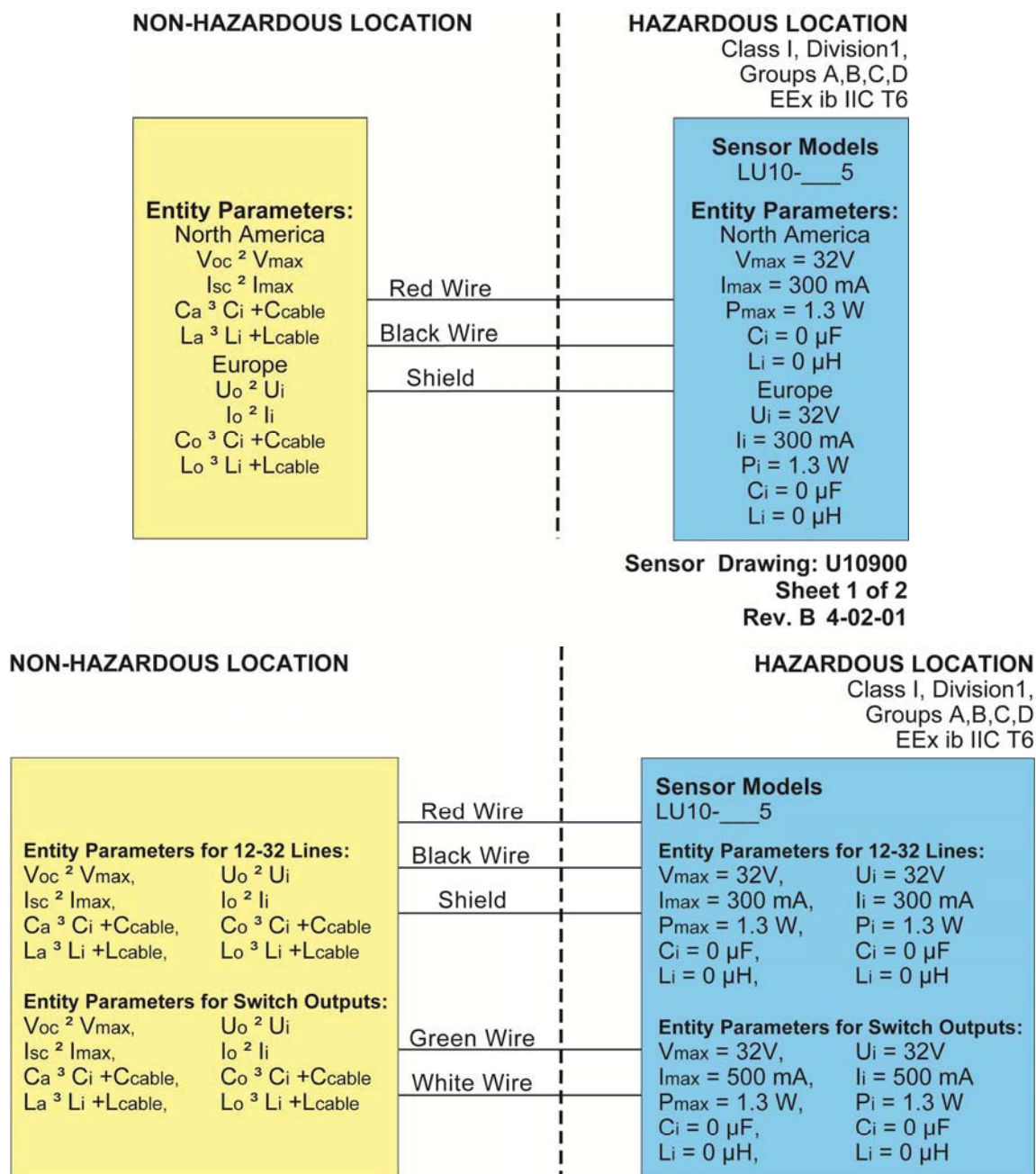


**Models LU10-\_\_\_5 Only:** The LU10-\_\_\_5 level switch has been approved for use in Class I, Division 1, Groups A, B, C & D; EEx ib IIC T6; UNDER CERTIFICATE NUMBER LCIE 01.E6048X. DO NOT USE THE LZ12, LP15 or LO10 SERIES IN INTRINSICALLY SAFE APPLICATIONS. The Entity parameter for the LU10-\_\_\_5 are:

North America -  $V_{max} = 32 \text{ VDC}$  /  $I_{max} = 0.5 \text{ A}$  /  $P_{max} = 1.3 \text{ W}$  /  $C_i = 0 \mu\text{F}$  /  $L_i = 0 \mu\text{H}$

Europe -  $U_i = 32 \text{ VDC}$  /  $I_i = 0.5 \text{ A}$  /  $P_i = 1.3 \text{ W}$  /  $C_i = 0 \mu\text{F}$  /  $L_i = 0 \mu\text{H}$

### Intrinsically Safe Control Drawing:



Notes: PARAMETERS DEPEND ON OUTPUT TYPE

1. Installation should be in accordance with CEC Part 1, or NFPA 70.
2. Associated Equipment shall be CSA certified with entity parameters connected in accordance with manufacturers instructions.

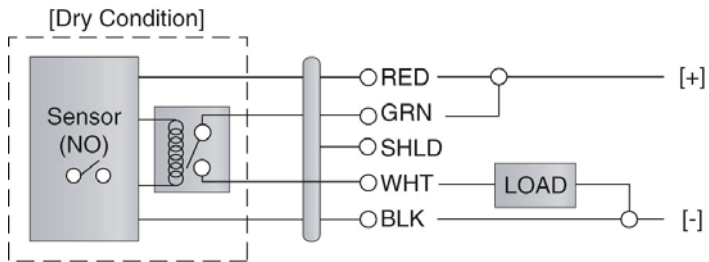
**Sensor Drawing: U10900**  
**Sheet 2 of 2**  
**Rev. B 4-02-01**



**Wiring as a P-Channel or N-Channel output:** The Switch-Tek™ can be substituted for either a P-Channel (PNP, sourcing) output or an N-Channel (NPN, sinking) output.

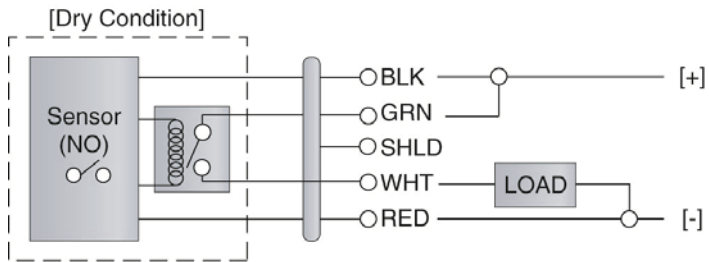
**Normally Open DC Load as a P-Channel Output:**

The Red wire connects to Positive (+) of the power supply and the Black wire connects to Negative (-). The Green wire is jumped to the Red wire while the White wire is connected to the LOAD. Jumper the LOAD to the Negative (-) to complete the circuit.



**Normally Closed DC Load as a P-Channel Output:**

The Black wire connects to Positive (+) of the power supply and the Red wire connects to Negative (-). The Green wire is jumped to the Black wire while the White wire is connected to the LOAD. Jumper the LOAD to the Negative (-) to complete the circuit.



Sensor Power

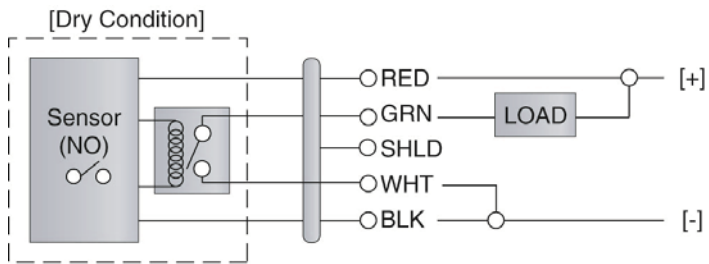
[RED & BLK wires] / 36 VDC Max.  
5 ±1mA Dry / 22 ±1mA Wet

Relay Rating

[GRN & WHT wires] / 60 VA

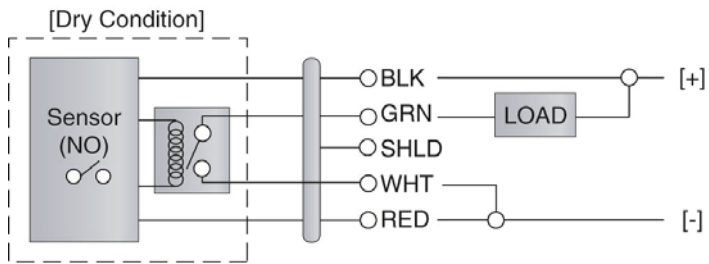
**Normally Open DC Load as a N-Channel Output:**

The Red wire connects to Positive (+) of the power supply and the Black wire connects to Negative (-). The White wire is jumped to the Black wire while the Green wire is connected to the LOAD. Jumper the LOAD to the Positive (+) to complete the circuit.



**Normally Closed DC Load as a N-Channel Output:**

The Black wire connects to Positive (+) of the power supply and the Red wire connects to Negative (-). The White wire is jumped to the Red wire while the White wire is connected to the LOAD. Jumper the LOAD to the Positive (+) to complete the circuit.



Sensor Power

[RED & BLK wires] / 36 VDC Max.  
5 ±1mA Dry / 22 ±1mA Wet

Relay Rating

[GRN & WHT wires] / 60 VA



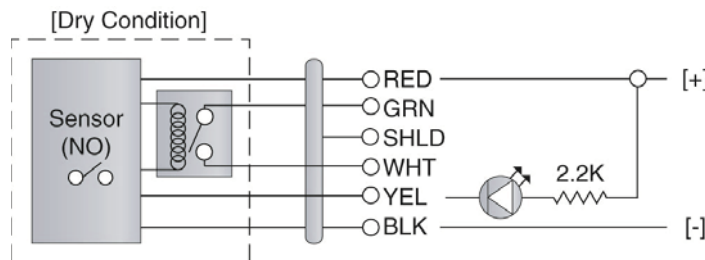
**General:** The Switch-Tek™ level switch requires no periodic maintenance except cleaning as required. It is the responsibility of the user to determine the appropriate maintenance schedule, based on the specific characteristics of the application liquids.

#### Cleaning procedure:

- 1. Power:** Make sure that all power to the switch, controller and/or power supply is completely disconnected.
- 2. Switch removal:** In all through-wall installations, make sure that the tank is drained well below the sensor prior to removal. Carefully, remove the sensor from the installation.
- 3. Cleaning the switch:** Use a soft bristle brush and mild detergent, carefully wash the Switch-Tek™ level switch. Do not use harsh abrasives such as steel wool or sandpaper, which might damage the surface sensor. Do not use incompatible solvents which may damage the sensor's PP, PFA, PVDF or Ryton plastic body.
- 4. Sensor installation:** Follow the appropriate steps of installation as outlined in the Installation section of this manual.

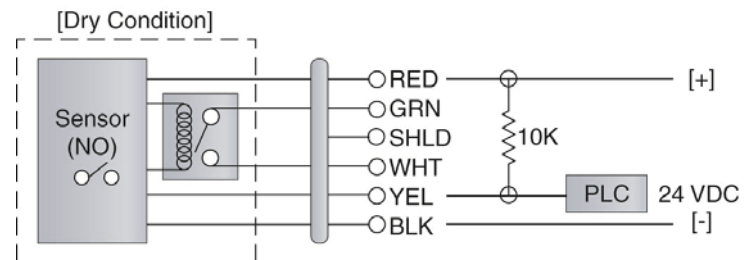
#### Maintenance Output to LED (LZ12 Only):

To wire the maintenance output wire to an LED, follow the wiring diagram below. The Yellow wire is connected to the LED and a 2.2kΩ resistor in series and referenced back to the (+) of the power supply.



#### Maintenance Output to PLC (LZ12 Only):

To wire the maintenance output wire to a PLC, follow the wiring diagram below. The Yellow wire is connected to the PLC input with a 10 kΩ resistor parallel to the PLC input and the (+) of the power supply.



#### Sensor Power

[RED & BLK wires] / 36 VDC Max.  
5 ±1mA Dry / 22 ±1mA Wet

#### Relay Rating

[GRN & WHT wires] / 60  
VA

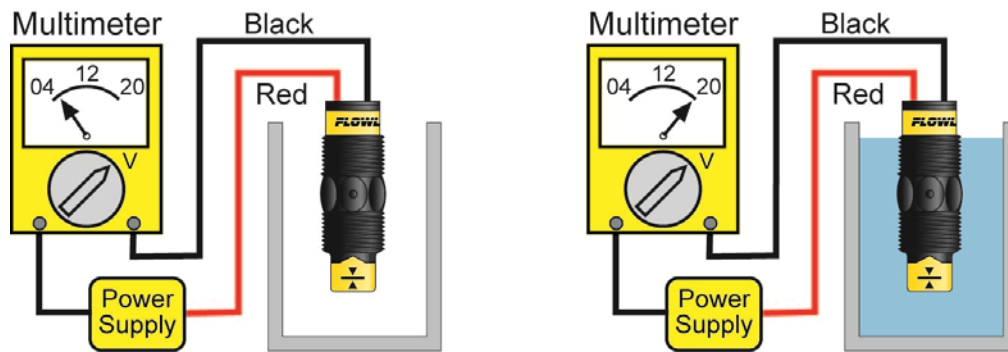
#### Maintenance Alarm

[YEL wire] / NPN Transistor / 10mA Max.

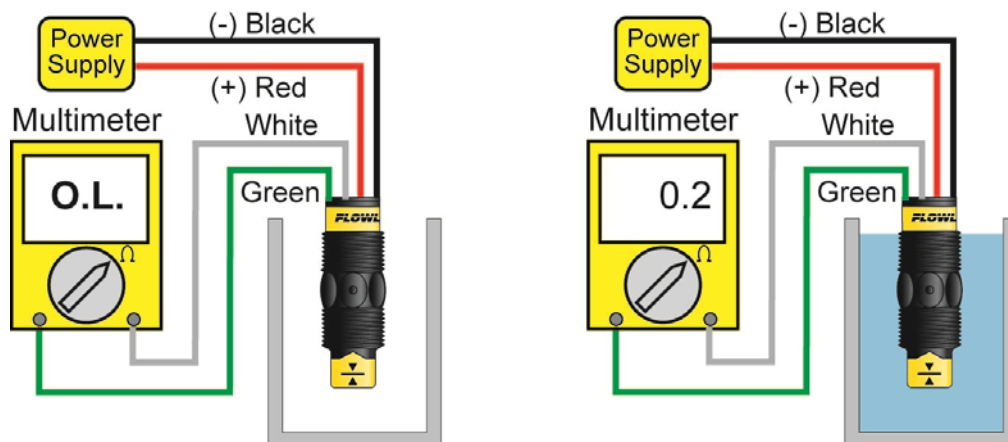


### Testing the installation:

1. **Power:** Turn on power to the controller and/or power supply.
2. **Immersing the switch:** Immerse the sensing tip in its application liquid, by filling the tank up to the switches point of actuation. An alternate method of immersing the switch during preliminary testing is to hold a cup filled with application liquid up to the switch's tip.
3. **Test:** With the switch being fluctuated between wet and dry states, the switch indicator light in the controller should turn on and off. If the controller doesn't have an input indicator, use a voltmeter or ammeter to ensure that the switch produces the correct signal (see below).
4. **Point of actuation:** Observe the point at which the rising or falling fluid level causes the switch to change state, and adjust the installation of the switch if necessary.



**Example:** Testing the LU10 series with a Multimeter set to read current (mA). When wired NO [Red to (+)], the meter will read 5mA,  $\pm 1$ mA when dry and will read 20mA,  $\pm 1$ mA when wet.



**Example:** Testing the LU10 series with a multimeter set to read resistance (ohms). When wired NO [Red to (+)], the meter will read O.L. when dry and will read some small amount of resistance (ex. 0.2 Ohms) when wet.



**Warranty**

*Flowline warrants to the original purchaser of its products that such products will be free from defects in material and workmanship under normal use and service in accordance with instructions furnished by Flowline for a period of two years from the date of manufacture of such products. Flowline's obligation under this warranty is solely and exclusively limited to the repair or replacement, at Flowline's option, of the products or components, which Flowline's examination determines to its satisfaction to be defective in material or workmanship within the warranty period. Flowline must be notified pursuant to the instructions below of any claim under this warranty within thirty (30) days of any claimed lack of conformity of the product. Any product repaired under this warranty will be warranted only for the remainder of the original warranty period. Any product provided as a replacement under this warranty will be warranted for the full two years from the date of manufacture.*

**Returns**

*Products cannot be returned to Flowline without Flowline's prior authorization. To return a product that is thought to be defective, go to [www.flowline.com](http://www.flowline.com), and submit a customer return (MRA) request form and follow the instructions therein. All warranty and non-warranty product returns to Flowline must be shipped prepaid and insured. Flowline will not be responsible for any products lost or damaged in shipment.*

**Limitations**

*This warranty does not apply to products which: 1) are beyond the warranty period or are products for which the original purchaser does not follow the warranty procedures outlined above; 2) have been subjected to electrical, mechanical or chemical damage due to improper, accidental or negligent use; 3) have been modified or altered; 4) anyone other than service personnel authorized by Flowline have attempted to repair; 5) have been involved in accidents or natural disasters; or 6) are damaged during return shipment to Flowline. Flowline reserves the right to unilaterally waive this warranty and dispose of any product returned to Flowline where: 1) there is evidence of a potentially hazardous material present with the product; or 2) the product has remained unclaimed at Flowline for more than 30 days after Flowline has dutifully requested disposition. This warranty contains the sole express warranty made by Flowline in connection with its products. ALL IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY DISCLAIMED. The remedies of repair or replacement as stated above are the exclusive remedies for the breach of this warranty. IN NO EVENT SHALL FLOWLINE BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY KIND INCLUDING PERSONAL OR REAL PROPERTY OR FOR INJURY TO ANY PERSON. THIS WARRANTY CONSTITUTES THE FINAL, COMPLETE AND EXCLUSIVE STATEMENT OF WARRANTY TERMS AND NO PERSON IS AUTHORIZED TO MAKE ANY OTHER WARRANTIES OR REPRESENTATIONS ON BEHALF OF FLOWLINE. This warranty will be interpreted pursuant to the laws of the State of California. If any portion of this warranty is held to be invalid or unenforceable for any reason, such finding will not invalidate any other provision of this warranty.*

*For complete product documentation, video training, and technical support, go to [www.flowline.com](http://www.flowline.com).*

*For phone support, call 562-598-3015 from 8am to 5pm PST, Mon - Fri.*

*(Please make sure you have the Part and Serial number available.)*



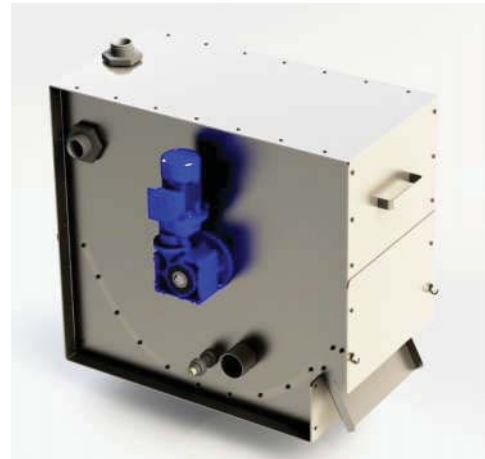


## Waste Water Inlet Screens – SCR SERIES

**newterra** Inlet Screens are specifically designed to protect newterra MicroClear™ flat sheet membranes from fouling due to excessive debris from waste water plant influent. The SCR series is designed to complement the newterra small to medium size wastewater MBR plants. Typically the screens would be used at the inlet to the Equalization Basin or the Aeration Basin. The SCR units are rotating brush design with 0.5mm crossflow wedgewire screens, and are designed to minimize complexity while achieving superior performance.

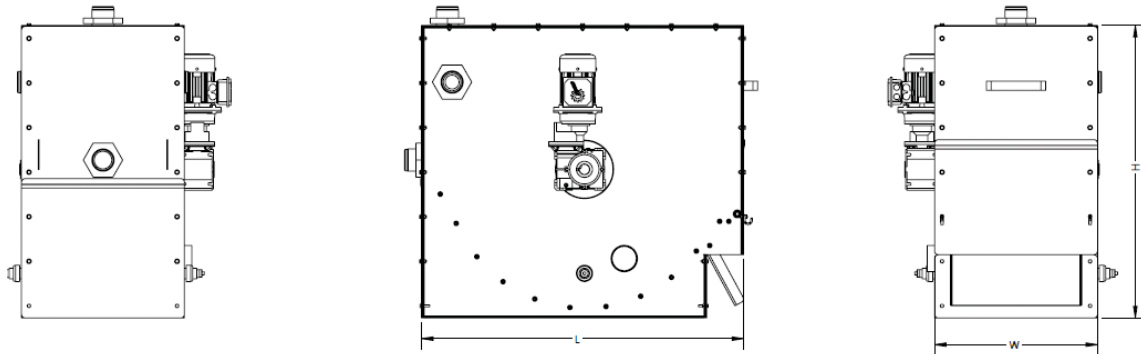
### Standard Features:

- 304 SS construction
- 1/4 HP Gearbox/motor (waterproof aluminum)
- Easily replaceable heavy duty brushes
- Standard inlet on Top,Sides,Back
- Internal inlet baffling to provide full screen contact no matter which inlet is chosen
- Bag support
- High Level Switch Coupling
- Gravity Outlet
- Simple, reliable shear pin shaft/motor protection
- Can ship knocked down, easily assembled on site



### Options:

- Stands
- Discharge Pump Tank
- Complete Packages c/w pumps and controls



### Dimension Chart:

Part Number	Width "W"	Standard Height "H"	Standard Overall Length "L"	Shipping Weight [lbs]	Inlet Size	Outlet Size	Nominal Flowrate gpm	Nominal Flowrate lps	Nominal Flowrate gpd	Nominal Flowrate m3/day
SCR-50	23"	39"	43"	150	2"	Open Bottom	50	3.2	72,000	273
SCR-100	41"	39"	43"	200	3"	Open Bottom	100	6.4	144,000	547

Nominal flowrates based on typical municipal characteristics



**Intelligent Drivesystems, Worldwide Services**

SCR-201/2 - Gear Motor, 230/460V 50/60 3P, 60/50hz 1/4hp  
SK1SI63/H10-56C-63L/4 FRD DIV2 NSD+ 400:1  
Nord Gear, 4.3 RPM, CSA CL1 DIV2"



EN

B 1000

**Gear units**

Operating and Assembly Instructions



E-1278





## General safety and operating instructions

### 1. General

Depending on its protection class, the device may have live, bare, moving or rotating parts or hot surfaces during operation.

Unauthorised removal of covers, improper use, incorrect installation or operation causes a risk of serious personal injury or material damage.

All transport, installation, commissioning and maintenance work must be carried out by qualified specialist personnel (national accident prevention regulations must be observed).

Within the meaning of this basic safety information, qualified specialist personnel are persons who are familiar with the installation, assembly, commissioning and operation of the product and who have the training and experience to recognise and avoid any hazards and risks.

### 2. Correct use

NORD products may only be used according to the information in the catalogue and the associated technical documentation.

**Compliance** with the operating and installation instructions is a **prerequisite for fault-free operation** and for the fulfilment of any warranty claims. **These operating and installation instructions must be read** before working with the device!

These operating and installation instructions contain important information about **servicing**. They must therefore be kept **close to the device**.

All details regarding technical data and permissible conditions at the installation site must be complied with.

### 3. Transport, storage

Information regarding transport, storage and correct handling must be complied with.

### 4. Installation

The device must be protected against impermissible loads. In particular, during transport and handling, components must not be deformed or changed. Touching of electronic components and contacts must be avoided.

### 5. Electrical Connection

When working on live three-phase motors, the applicable national accident prevention regulations must be complied with (e.g. BGV A3, formerly VBG 4).

The electrical installation must be implemented according to the applicable regulations (e.g. cable cross-section, fuses, earth lead connections).

Information regarding EMC-compliant installation – such as shielding, earthing and installation of cables – can be found in the three-phase motor documentation. Compliance with the limiting values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

### 6. Operation

Appropriate safety measures must be taken for applications where failure of the device may result in injury.

Where necessary, systems in which NORD devices are installed must be equipped with additional monitoring and protective equipment according to the applicable safety requirements, e.g. legislation concerning technical equipment, accident prevention regulations, etc.

All covers and guards must be kept closed during operation.

### 7. Maintenance and repairs

After the device has been disconnected from the power supply, live equipment components and power connections should not be touched immediately, because of possible charged capacitors.

Further information can be found in this documentation.

---

**These safety instructions must be kept in a safe place!**

---



## Documentation

Name: B 1000  
 Part No.: 6052802  
 Series: Gear units and geared motors  
 Type series:  
 Gear unit types: **Helical gear unit**  
**NORDBLOC helical gear units**  
**Standard helical gear units**  
**Parallel shaft gear units**  
**Bevel gear units**  
**Helical worm gear units**  
**MINIBLOC worm gear units**  
**UNIVERSAL worm gear units**

## Version list

Title, Date	Order number	Comments
B 1000, February 2013	6052802 / 0713	-
B 1000, September 2014	6052802 / 3814	General corrections
B 1000, April 2015	6052802 / 1915	New gear unit types SK 10382.1 + SK 11382.1
B 1000, March 2016	6052802 / 0916	General corrections New bevel gear units SK 920072.1 + SK 930072.1
B 1000, September 2016	6052802 / 3816	General corrections New SK 071.1 helical gear unit, SK 171.1, SK 371.1, SK 571.1, SK 771.1;

Table 1: Version list B 1000

## Copyright notice

As an integral component of the device described here, this document must be provided to all users in a suitable form.

Any editing or amendment or other utilisation of the document is prohibited.

## Publisher

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## 1 Notes

### 1.1 General information

Read the Operating Manual carefully prior to performing any work on or putting the gear unit into operation. Strict compliance with the instructions in this Operating Manual is essential. This Operating Manual and all associated special documentation must be kept in the immediate vicinity of the gear unit.

Getriebebau NORD accepts no liability for damage to persons, materials or assets as a result of the non-observance of this Operating Manual, operating errors or incorrect use. General wearing parts, e.g. radial seals are excluded from the warranty.





If additional components are attached to or installed on or in the gear unit (e.g. motor, cooling system, pressure sensor etc.) or components (e.g. cooling system) are supplied with the order, the operating instructions for these components must be observed.

If geared motors are used, compliance with the Motor Operating Manual is also necessary.

If you do not understand the contents of this Operating Manual or additional operating instructions, please consult Getriebebau NORD!

### 1.2 Safety and information symbols

#### 1.2.1 Explanation of labels used

 <b>DANGER</b>	Indicates an immediate danger, which may result in death or serious injury.
 <b>WARNING</b>	Indicates a possibly dangerous situation, which may result in death or serious injury.
 <b>CAUTION</b>	Indicates a possibly dangerous situation, which may result in slight or minor injuries.
<b>NOTICE</b>	Indicates a possibly harmful situation, which may cause damage to the product or the environment.
 <b>Note</b>	Indicates hints for use and useful information.



### 1.3 Correct use

These gear units generate a rotational movement and are intended for use in commercial systems. The gear unit must only be used according to the information in the technical documentation from Getriebebau NORD.

Commissioning (start of proper operation) is prohibited until it has been established that the machine complies with the local laws and directives. The EMC Directive 2004/108/EC and the Machinery Directive 2006/42/EC in their currently valid scope of application must be complied with in particular.



#### **DANGER!**

#### **Explosion hazard**

Serious injury and material damage due to explosion are possible.

Use in explosion hazard areas is prohibited.



#### **WARNING**

#### **Injury to persons**

Appropriate safety measures must be taken for applications where failure of a gear unit or geared motor may result in injury.

Safeguard a wide area around the hazard zone.



#### **WARNING**

#### **Material damage and personal injury**

If the gear unit is not used as designed, this may cause damage to the gear unit or the premature failure of components. Personal injury as a result of this cannot be ruled out.

Strict compliance with the technical data on the type plate is essential. The documentation must be observed.



## 1.4 Safety information

**Observe all safety information**, including that provided in the individual sections of this Operating Manual. All national and other regulations on safety and accident prevention must also be observed.



### **DANGER!**

#### **Severe personal injury**

Serious physical and property damage may result from inappropriate installation, non-designated use, incorrect operation, non-compliance with safety information, unauthorised removal of housing components or safety covers and structural modifications to the gear unit.

- All work, e.g. transportation, storage, installation, electrical connection, commissioning, servicing, maintenance and repair must only be performed by qualified specialist personnel.
- Observe the Operating Manual
- Observe the safety information
- Observe the safety and accident prevention regulations.
- Tighten the drive elements or secure the parallel key before switching on.
- Do not make any structural modifications.
- Do not remove any safety devices.
- If necessary, wear hearing protection when working in the immediate vicinity of the gear unit.
- All rotating components must be provided with guards. In standard cases, covers are fitted by NORD. The covers must always be used if contact protection is not provided by other methods.



### **DANGER!**

#### **Injury to persons**

The surfaces of gear units or geared motors may become hot during or shortly after operation. Danger of burns!

- Installation and maintenance work must only be performed when gear unit is at a standstill and has cooled down. The drive must be isolated and secured to prevent accidental start-up.
- Wear protective gloves.
- Shield hot surfaces with contact guards.
- Do not store inflammable objects or substances in the immediate vicinity of the gear unit.



### **WARNING**

#### **Injury to persons**

Serious injury and material damage due to improper transport are possible.

- No additional loads may be attached.
- Transportation aids and lifting gear must have an adequate load-bearing capacity.
- Pipes and hoses must be protected from damage.





## CAUTION

## Injury to persons

Danger of cuts from exterior edges of attachment adapters, flanges and covers.

Contact freezing with metallic components in case of low temperatures.

In addition to personal protective equipment, wear suitable protective gloves and suitable goggles during assembly, commissioning, inspection and maintenance, in order to prevent injuries.

It is recommended that repairs to NORD Products are carried out by the NORD Service department.

## 1.5 Other documents

Further information may be obtained from the following documents:

- Gear unit catalogues (G1000, G1012, G1014, G1035, G1050, G2000),
- Operating and maintenance instructions for the electric motor,
- if applicable, the Operating Manuals for attached or supplied options

## 1.6 Disposal

Observe the current local regulations. In particular, lubricants must be collected and disposed of correctly.

Gear unit components	Material
Gear wheels, shafts, rolling bearings, parallel keys, locking rings, ...	Steel
Gear unit housing, housing components, ...	Grey cast iron
Light alloy gear unit housing, light alloy gear unit housing components, ...	Aluminium
Worm gears, bushes, ...	Bronze
Radial seals, sealing caps, rubber components,...	Elastomers with steel
Coupling components	Plastic with steel
Flat seals	Asbestos-free sealing material
Gear oil	Additive mineral oil
Synthetic gear oil (type plate code: CLP PG)	Polyglycol-based lubricants
Cooling spiral, embedding material of the cooling spiral, screw fittings	Copper, epoxy, yellow brass

**Table 2: Disposal of materials**



## 2 Description of gear unit

### 2.1 Type designations and gear unit types

Gear unit types / Type designations	
<b>Helical gear units</b>	
SK 11E, SK 21E, SK 31E, SK 41E, SK 51E (1-stage)	
SK 02, SK 12, SK 22, SK 32, SK 42, SK 52, SK 62N (2-stage)	
SK 03, SK 13, SK 23, SK 33N, SK 43, SK 53 (3-stage)	
SK 62, SK 72, SK 82, SK 92, SK 102 (2-stage)	
SK 63, SK 73, SK 83, SK 93, SK 103 (3-stage)	
<b>NORDBLOC helical gear units</b>	
SK 320, SK 172, SK 272, SK 372, SK 472, SK 572, SK 672, SK 772, SK 872, SK 972 (2-stage)	
SK 273, SK 373, SK 473, SK 573, SK 673, SK 773, SK 873, SK 973 (3-stage)	
SK 071.1, SK 371.1, SK 571.1, SK 771.1 (1-stage)	
SK 072.1, SK 172.1, SK 372.1, SK 572.1, SK 672.1, SK 772.1, SK 872.1, SK 972.1 (2-stage)	
SK 373.1, SK 573.1, SK 673.1, SK 773.1, SK 873.1, SK 973.1 (3-stage)	
<b>Standard helical gear units</b>	
SK 0, SK 01, SK 20, SK 25, SK 30, SK 33 (2-stage)	
SK 10, SK 200, SK 250, SK 300, SK 330 (3-stage)	
<b>Parallel shaft gear unit</b>	
SK 0182NB, SK 0282NB, SK 1282, SK 2282, SK 3282, SK 4282, SK 5282, SK 6282, SK 7282, SK 8282, SK 9282, SK 10282, SK 11282 (2-stage)	
SK 1382NB, SK 2382, SK 3382, SK 4382, SK 5382, SK 6382, SK 7382, SK 8382, SK 9382, SK 10382, SK 10382.1, SK 11382, SK 11382.1, SK 12382 (3-stage)	
<b>Bevel gear units</b>	
SK 92072, SK 92172, SK 92372, SK 92672, SK 92772;	
SK 920072.1, SK 92072.1, SK 92172.1, SK 92372.1, SK 92672.1, SK 92772.1, SK 93072.1, SK 93172.1, SK 930072.1, SK 93372.1, SK 93672.1, SK 93772.1 (2-stage)	
SK 9012.1, SK 9016.1, SK 9022.1, SK 9032.1, SK 9042.1, SK 9052.1, SK 9062.1, SK 9072.1, SK 9082.1, SK 9086.1, SK 9092.1, SK 9096.1 (3-stage)	
SK 9013.1, SK 9017.1, SK 9023.1, SK 9033.1, SK 9043.1, SK 9053.1 (4-stage)	
<b>Helical worm gear units</b>	
SK 02040, SK 02050, SK 12063, SK 12080, SK 32100, SK 42125 (2-stage)	
SK 13050, SK 13063, SK 13080, SK 33100, SK 43125 (3-stage)	
<b>MINIBLOC worm gear units</b>	
SK1 S32, SK1 S40, SK 1S50, SK 1S63, SK 1SU..., SK 1SM31, SK 1SM40, SK 1SM50, SK 1SM63 (1-stage)	
SK 2S32NB, SK 2S40NB, SK 2S50NB, SK 2S63NB, SK 2SU..., SK 2SM40, SK 2SM50, SK 2SM63 (2-stage)	



Gear unit types / Type designations					
<b>UNIVERSAL worm gear units</b>					
SK 1SI31, SK 1SI40, SK 1SI50, SK 1SI63, SK 1SI75, SK 1SIS31, ..., SK 1SIS75, SK 1SID31, ..., SK 1SID63, SK 1SMI31, ..., SK 1SMI75, SK 1SMID31, ..., SK 1SMID63, SK 1SIS-D31, ..., SK 1SIS-D63 (1-stage), SK 2SMID40, SK 2SMID50, SK 2SMID63, SK 2SID40, ..., SK 2SID63 (2-stage)					
<b>Versions / Options</b>					
-	Foot mounting with solid shaft	D	Torque support	IEC	Standard IEC motor mounting
A	Hollow shaft version	K	Torque bracket	NEMA	Standard NEMA motor attachment
V	Solid shaft version	S	Shrink disc	W	With free drive shaft
L	Solid shaft both sides	VS	Reinforced shrink disc	VI	Viton radial seals
Z	Output flange B14	EA	Hollow shaft with internal spline	OA	Oil expansion tank
F	Output flange B5	G	Rubber buffer	OT	Oil level tank
X	Foot mounting	VG	Reinforced rubber buffer	SO1	Synthetic oil ISO VG 220
XZ	Base and output flange B14	R	Back stop	CC	Casing cover with cooling spiral
XF	Base and output flange B5	B	Fastening element	DR	Pressure venting
AL	Reinforced axial output bearings	H	Covering cap as contact guard	H10	Modular contrate pre-stage
5	Reinforced output shaft (Standard helical gear units)	H66	Covering cap IP66	/31	Worm pre-stage
V	Reinforced drive shaft (Standard helical gear units)	VL	Reinforced bearings	/40	Worm pre-stage
		VL2	Agitator version		
		VL3	Drywell agitator version		

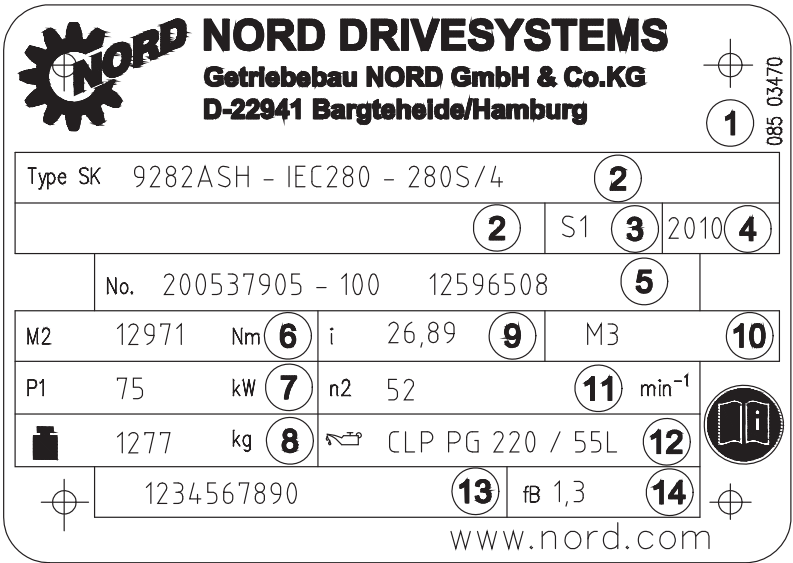
**Table 3: Type designations and gear unit types**

Double gear units consist of two single gear units. They are to be treated as per the instructions in this Manual, i.e. as two individual gear units.

Type designation for double gear units: e.g. SK 73 /22 (consisting of single gear units SK 73 and SK 22)



2.2 Type plate



Explanation

- 1 Matrix or bar code
- 2 NORD gear unit type
- 3 Operating mode
- 4 Year of manufacture
- 5 Serial number
- 6 Rated torque of gear unit output shaft
- 7 Drive power
- 8 Weight according to ordered version
- 9 Overall gear unit ratio
- 10 Installation orientation
- 11 Rated speed of gear unit output shaft
- 12 Lubricant type, viscosity and quantity
- 13 Customer's part number
- 14 Operating factor


Fig. 1: Type plate (example) with explanation of the type plate fields



### 3 Assembly instructions, storage, preparation, installation

Please observe all general safety instructions (please see chapter 1.4 "Safety information"), the safety information in the individual sections and the proper use (please see chapter 1.3 "Correct use")bestimmungsgemäße Verwendung</dg\_ref\_source\_inline>.

#### 3.1 Transporting the gear unit

 <b>WARNING</b>	<b>Hazard due to heavy loads</b>
<p>Severe injuries and material damage due to falling or tipping heavy loads are possible.</p> <ul style="list-style-type: none"><li>• Standing under the gear unit during transport is <b>extremely dangerous</b>.</li><li>• To prevent injury, <b>the danger area must be generously cordoned off</b>.</li><li>• Only transport using the eyebolts attached to the gear unit.</li><li>• No additional loads may be attached.</li><li>• If geared motors have an additional eyebolt attached to the motor, this must also be used.</li><li>• The thread of the eyebolt must be <b>fully</b> screwed in.</li><li>• Avoid <b>pulling</b> the eyebolts at an angle.</li></ul>	
<b>NOTICE</b>	<b>Gear unit damage</b>
<p>Damage to the gear unit due to improper use is possible.</p> <ul style="list-style-type: none"><li>• Prevent damage to the gear unit. Impacts to the free ends of the shafts may cause internal damage to the gear unit.</li><li>• Use adequately dimensioned and <b>suitable means of transportation</b>. Lifting tackle must be designed for the weight of the gear unit. The weight of the gear unit can be obtained from the dispatch documents.</li></ul>	



## 3.2 Storage

**For short-term storage before commissioning, please observe the following:**

Store in the installation position (please see chapter 6.1 "Configurations and maintenance") and secure the gear unit against falling,

- Lightly oil bare metal housing surfaces and shafts
- Store in a dry place.
- Temperature in the range from – 5 °C to + 50 °C without large fluctuations,
- Relative humidity less than 60 %,
- No direct exposure to sunlight or UV light,
- No aggressive, corrosive substances (contaminated air, ozone, gases, solvents, acids, alkalis, salts, radioactivity etc.) in the immediate vicinity,
- No vibration or oscillation

## 3.3 Long-term storage



### CAUTION

### Injury to persons

Incorrect, or excessively long storage may result in malfunctions of the gear unit.

Perform an inspection of the gear unit prior to commissioning if the permissible storage time has been exceeded.



### Information

### Long-term storage

For storage or standstill periods in excess of 9 months, Getriebebau NORD recommends the long-term storage option.

With the long-term storage option and the use of the measures listed below, storage for up to 2 years is possible. As the actual influences on the unit greatly depend on the local conditions, these times should only be regarded as guide values.



**Conditions of the gear unit and storage area for long-term storage prior to commissioning:**

- Store in the installation position (please see chapter 6.1 "Configurations and maintenance") and secure the gear unit against falling.
- Transportation damage to the external paint must be repaired. Check that a suitable rust inhibitor is applied to the flange bearing surfaces. If necessary apply a suitable rust inhibitor to the surfaces.
- Gear units with the long-term storage option are completely filled with lubricant or have VCI corrosion protection agent mixed with the gear oil (see adhesive label on the gear unit, or are not filled with oil, but rather with small quantities of VCI concentrate.
- The sealing band in the vent plug must not be removed during storage. The gear unit must remain sealed tight.
- Store in a dry place.
- In tropical regions, the gear unit must be protected against damage by insects
- Temperature in the range from – 5 °C to + 40 °C without large fluctuations,
- Relative humidity less than 60 %,
- No direct exposure to sunlight or UV light,
- No aggressive, corrosive substances (contaminated air, ozone, gases, solvents, acids, alkalis, salts, radioactivity etc.) in the immediate vicinity,
- No vibration or oscillation

**Measures during storage or standstill periods**

- If the relative humidity is <50 % the gear unit can be stored for up to 3 years.

**Measures before commissioning**

- If the storage or standstill period exceeds 2 years or the temperature during short-term storage has greatly deviated from the standard range, the lubricant in the gear unit must be replaced before commissioning.
- If the gear unit is completely filled, the oil level must be reduced before commissioning.
- For gear units without oil filling, the oil level for the version must be filled before commissioning. The VCI concentrate may remain in the gear unit. Lubricant quantities and types must be filled according to the details on the type plate.



### 3.4 Preparing for installation



#### CAUTION

#### Injury to persons

Transport damage may cause malfunctions of the gear unit, which may cause material damage or personal injury.

Please inspect the delivery for transport and packaging damage immediately on receipt. Report any damage to the carrier immediately. Gear units with transport damage must not be commissioned.

The drive unit must be inspected and may only be installed if no damage is apparent. In particular the radial seals and the sealing caps must be inspected for damage.

Pay attention to leaked lubricants, they may cause slips.

All bare metal surfaces and shafts of the gear unit are protected against corrosion with oil, grease or corrosion protection agents before shipping.

Thoroughly remove all oil, grease or corrosion protection agents and any dirt from the shafts and flange surfaces before assembly.

In applications where an incorrect rotational direction may result in damage or potential risk, the correct rotational direction of the output shaft is to be established by test running the drive when uncoupled and guaranteeing such for subsequent operation.

Gears with integrated return stops are marked with arrows on the drive/driven sides. The arrows point in the rotation direction of the gear unit. When connecting the motor and during motor control, it must be ensured that the gear unit can only operate in the direction of rotation. (For further explanations see catalogue G1000 and WN 0-000 40)

#### NOTICE

#### Gear unit damage

For gear units with an integrated back stop, switching the drive motor to the blocked direction of rotation, i.e. incorrect direction of rotation, may result in damage to the gear unit.

Take care that the direction of rotation is correct.

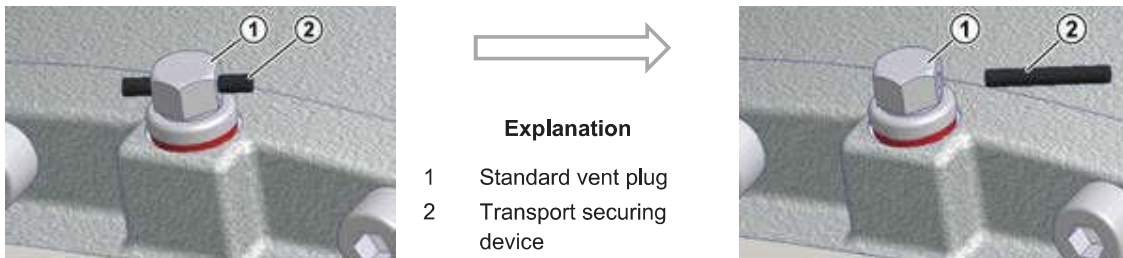
Ensure that no aggressive or corrosive substances are present in the area surrounding the installation site or are subsequently expected during operation, which attack metal, lubricants or elastomers. In case of doubt, please contact Getriebebau NORD and take the recommended action.

Oil expansion tanks (Option OA) must be fitted in accordance with works standard WN 0-530 04. For gear units with an M10x1 vent plug, works standard WN 0-52135 must be also be observed during installation.

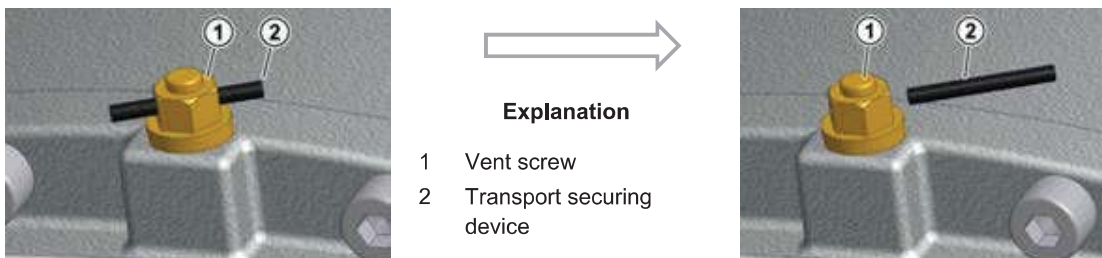
Oil level tanks (Option OT) must be fitted in accordance with works standard WN 0-521 30.

If venting of the gear unit is provided, the vent or the pressure vent must be activated before commissioning. To activate, remove the transport securing device (sealing cord). Position of the vent plug (please see chapter 6.1 "Configurations and maintenance").





**Figure 2: Activating the vent plug**



**Figure 3: Activating the vent plug**

Before commissioning, the vent plug must be replaced with the special pressure vent which is supplied as a loose part.

This is done by unscrewing the vent fitting and replacing it with the special pressure vent and seal (refer to Section 6.1 "Configurations and maintenance"). Double gear units consist of two single units and are equipped with 2 oil chambers and 2 pressure vents.



**Explanation**

- 1 Standard vent plug
- 2 Transport securing device
- 3 Special pressure vent screw

**Figure 4: Removing the vent plug and fitting the special pressure vent**

(please see chapter 6.5 "Torque values")



### 3.5 Installing the gear unit



#### WARNING

#### Danger of burns

The surfaces of gear units or geared motors may become hot during or shortly after operation. Hot surfaces which can be touched directly must be protected with a contact guard.



#### WARNING

#### Danger to persons

If the foundation or the fastening of the gear unit is not adequately dimensioned, the gear unit may detach, fall down or rotate in an uncontrolled manner.

The foundation and the gear unit fastening must be appropriately designed for the weight and the torque. All bolts must be used to fasten the gear unit

#### NOTICE

#### Damage to the gear unit due to overheating

The gear unit may be damaged by overheating.

When installing, check that the cooling air from the motor fan can circulate around the geared motor and the gear unit without obstruction.

The eyebolts screwed into the gear units must be used during installation. No additional load may be attached to the gear unit.

If geared motors have an additional eyebolt attached to the motor, this must also be used. Avoid pulling the eyebolts at an angle. Observe the safety information (please see chapter 1.4 "Safety information").

The base and/or flange to which the gear unit is fitted should be vibration-free, torsionally strong and flat. The smoothness of the mating surface on the base or flange must be according to tolerance class K according to DIN ISO 2768-2. All contamination to the bolting surfaces of gear unit and base and/or flange must be thoroughly removed.

The gear housing must always be earthed. With geared motors, earthing via the motor connection must be ensured.

The gear unit must be precisely aligned with the drive shaft of the machine in order to prevent additional forces from being imposed on the gear unit due to distortion.

Welding of the gear unit is prohibited. The gear unit must not be used as the earth connection for welding work, as this may cause damage to the bearings and gear wheels.

**The gear unit must be installed in the correct orientation**(please see chapter 6.1 "Configurations and maintenance"). (UNIVERSAL SI and SM gear unit types do not depend on the configuration). Changes to the installation position after delivery require adjustment of the quantity of oil, and often other measures such as e.g. the installation of encapsulated roller bearings. **Damage may result if the stated installation position is not observed.**

All gear unit feet and/or all flange bolts on each side must be used. Bolts must have a minimum quality of 8.8. The bolts must be tightened to the correct torques (please see chapter 6.5 "Torque values"). Tension-free bolting must be ensured, particularly for gear units with a foot and flange.

The oil inspection screws, oil drain screws and the vent valves must be accessible.



### 3.6 Fitting hubs on the gear shafts

#### NOTICE

#### Gear unit damage

The gear unit may be damaged by axial forces.

Do not subject the gear unit to harmful axial forces when fitting the hubs. In particular, do not hit the hubs with a hammer.

Drive and driven elements, e.g. coupling and chain-wheel hubs must be mounted onto the drive and driven shaft of the gear unit using suitable pullers that will not apply damaging axial forces onto the gear unit.

#### Information

#### Installation

Use the end thread of the shafts for pulling. Fitting can be aided by coating the hub with lubricant or heating it up to approx. 100 °C beforehand.

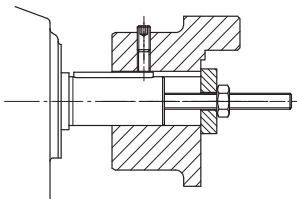


Figure 5: Example of a simple pulling device

#### DANGER

#### Severe personal injury

There is a danger of injury due to rapidly rotating drive and driven elements.

Drive and driven elements, such as belt drives, chain drives, shrink disks, fans and couplings must be fitted with contact protection.

**Drive and driven elements may only subject the drive unit to the maximum radial forces  $F_R$  and axial forces  $F_A$  which are specified in the catalogue.** Observe the correct tension, particularly on belts and chains.

Additional loads due to unbalanced hubs are not permitted.

The transverse force must be applied to the gear unit as closely as possible.

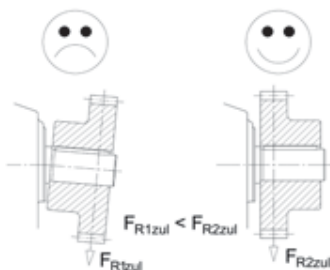


Figure 6: Correct assembly of drive elements



### 3.7 Fitting push-on gear units

#### NOTICE

#### Gear unit damage

The bearings, gear wheels, shafts and housing may be damaged by incorrect fitting.

- Observe the assembly instructions.
- The push-on gear unit must be fitted onto the shaft using a suitable puller, which will not exert damaging axial forces on the gear unit. In particular, do not hit the gear unit with a hammer.

Assembly and subsequent dismantling is aided by applying an anti-corrosive lubricant to the shaft before fitting (e.g. NORD Anti-Corrosion Part No. 089 00099). Excess grease or anti-corrosion agent may escape after assembly and may drip off. Clean these points on the output shaft after a running-in time of approx. 24 hours. This escape of grease is not due to a leak in the gear unit.

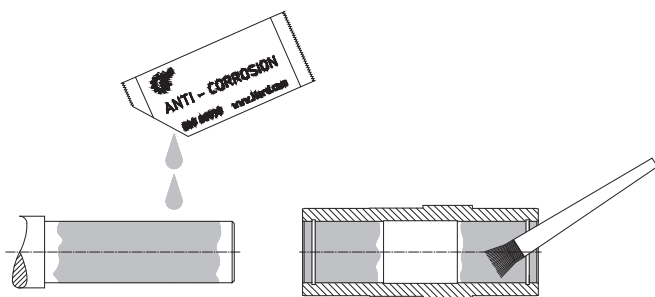


Figure 7: Applying lubricant to the shaft and the hub

#### Information

#### Fastening element

The gear unit can be fitted to shafts with and without a shoulder using the fastening element (Option B). Tighten the bolt of the fastening element to the correct torque (please see chapter 6.5 "Torque values"). For gear units with option H66, the factory-fitted closing cap must be removed before assembly.

For push-on gear units with option H66 and fastening element (Option B) the pressed-in closing cap must be pushed out before fitting the gear unit. The pressed-in closing cap may be destroyed during dismantling. As standard a second closing cap is supplied as a loose spare part. After fitting the gear unit, fit the new / new condition closing cap as described in Section 3.9 "Fitting the covers".





Figure 8: Removing the factory-fitted closing cap

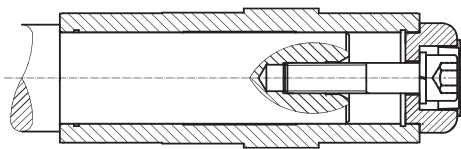


Figure 9: Gear unit mounted to shaft with a shoulder using the fastening element

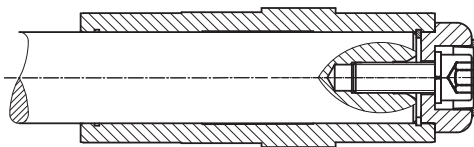


Figure 10: Gear unit mounted to shaft without a shoulder using the fastening element

A gear unit can be dismantled from a shaft with a shoulder using the following device, for example.

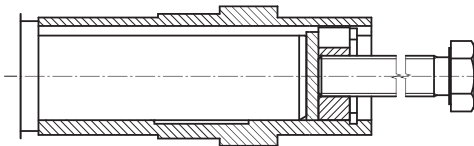
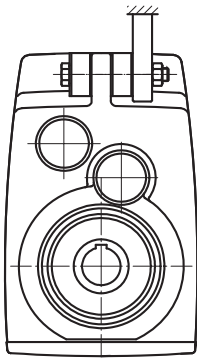


Figure 11: Dismantling using dismantling device

When assembling push-on gears with torque supports, the support must not be distorted. Tension-free mounting is aided by the rubber buffer (Option G or VG).





**Figure 12: Mounting the rubber buffer (Option G or VG) on parallel shaft gear units**

To fit the rubber buffer, tighten the screw fastening until there is no play between the contact surfaces when there is no load.

Then turn the fastening nut half a turn in order to pre-tension the rubber buffer (only applies for screw fastenings with adjusting threads). Greater pre-tension is not permissible

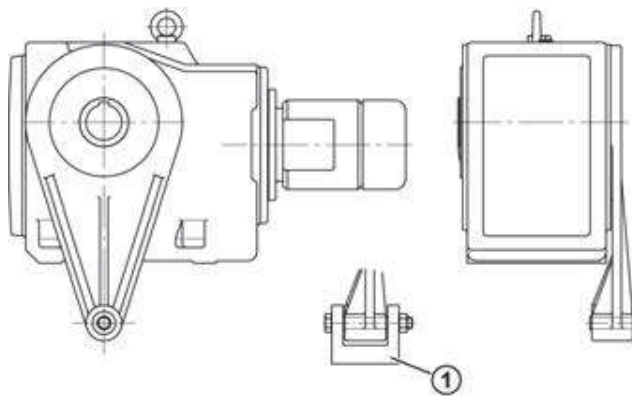


## **WARNING**

## **Risk of injury**

The gear unit may suddenly rotate around the shaft if the bolts are loosened.

Secure the screw fastening against loosening, e.g. with Loctite 242 or a second nut.



## **Explanation**

- 1 Always support torque support on both sides

**Fig. 13: Attaching the torque support on bevel gear and worm gear units**

Tighten the fastenings of the torque support with the correct tightening torques (please see chapter 6.5 "Torque values") and secure against loosening (e.g. Loctite 242, Loxeal 54-03).



### 3.8 Fitting shrink discs



#### CAUTION

#### Risk of injury

Risk of injury from incorrect mounting and dismantling of the shrink disc.

Observe the instructions.

#### NOTICE

#### Gear unit damage

If the tensioning bolts are tightened without the solid shaft inserted, the hollow shaft may be permanently deformed.

Do not tighten bolts if the solid shaft is not inserted!

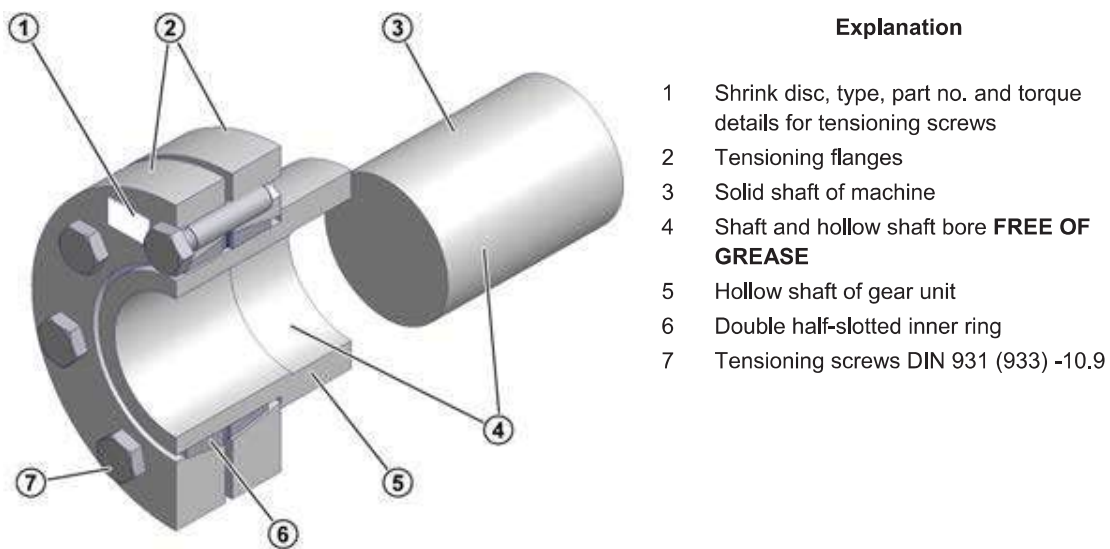


Figure 14: Hollow shaft with shrink disc

The shrink discs are supplied by the manufacturer ready for fitting. They must not be dismantled prior to fitting.

The solid shaft of the machine runs **free of grease** in the hollow shaft of the gear unit.



#### Assembly sequence

1. Remove any transport securing devices.
2. Loosen but do not remove tightening bolt and tighten gently by hand until there is no play between the flanges and the inner ring.
3. Slide the shrink disc onto the hollow shaft until the outer clamping flange is flush with the hollow shaft. The shrink disc is easier to slide on if the bore of the inner ring is lightly greased.
4. Prior to mounting, grease the solid shaft only in the area which will later come into contact with the bronze bush in the hollow shaft of the gear unit. Do not grease the bronze bush, in order to prevent grease penetrating the area around the shrink connection.
5. The hollow shaft of the gear unit must be completely de-greased and **completely free of grease**.
6. In the area of the shrink connection the solid shaft of the machine must be degreased and **completely free** of grease.
7. Insert the solid shaft of the machine into the hollow shaft so as to completely fill the area around the shrink connection.
8. Position the clamping flange by gently tightening the bolts.
9. Tighten the tensioning bolts successively in a clockwise direction by several turns – not crosswise – with approx. ¼ rotation per turn. Tighten the bolts with a torque wrench to the torque indicated on the shrink disc.
10. When the tensioning bolts have been tightened, there must be an even gap between the clamping flanges. If this is not the case, the gear unit must be dismantled and the shrink disc connection checked for correct fit.

#### Dismantling sequence:

1. Loosen the tensioning bolts successively in a clockwise direction by several turns with approx. ¼ rotation per turn. Do not remove the bolts from their thread.
2. Loosen the clamping flanges from the cone of the inner ring.
3. Remove the gear unit from the solid shaft of the machine.

If a shrink disk has been in use for a long period or is dirty, it must be dismantled, cleaned and the conical surfaces coated with Molykote G Rapid Plus or a similar lubricant before it is refitted. The threads and head surfaces of the screws must be treated with grease without Molykote. Any damaged or corroded elements must be replaced.



### 3.9 Fitting the covers



#### **WARNING**

#### **Risk of injury**

There is a danger of injury due to shrink discs and freely rotating shaft journals.

- Use a cover (Option H and Option H66) as a guard.
- If this does not achieve sufficient protection against contact according to the required protection type, the machinery and plant constructor must ensure this by means of special attached components.

All fixing screws must be used and tightened to the correct torque (please see chapter 6.5 "Torque values"). For covers with Option H66, press in the new / new condition closing cap by tapping it lightly with a hammer.



Figure 15: Fitting the covers, Option SH, Option H, and Option H66

### 3.10 Fitting the covers



#### **WARNING**

#### **Risk of injury**

There is a danger of injury due to freely rotating shaft journals.

- Use a cover cap as a guard
- If this does not achieve sufficient protection against contact according to the required protection type, the machinery and plant constructor must ensure this by means of special attached components.

Many versions of the universal worm gear unit are supplied with plastic cover caps as standard. These cover caps protect the shaft sealing ring against the entry of dust and other possible contamination. The cover caps can be removed by hand without the use of tools and pushed onto the A or B side.

The cover cap must be removed before installing the universal worm gear unit. After installation is complete, the cover cap must be pushed into the threaded holes on the output flange on the corresponding side. Care must be taken that the cover cap is removed and pushed on vertically, in order not to damage the expansion elements of the cover cap.



Fig. 16: Removal and fitting of the cover cap



### 3.11 Fitting a standard motor

The maximum permitted motor weights indicated in the table below must not be exceeded when attaching the motor to an IEC/NEMA adapter:

Maximum permitted motor weights														
IEC motor size	63	71	80	90	100	112	132	160	180	200	225	250	280	315
NEMA motor size		56C	143T	145T	182T	184T	210T	250T	280T	324T	326T	365T		
Max. motor weight [kg]	25	30	40	50	60	80	100	200	250	350	500	700	1000	1500



#### **WARNING**

#### **Risk of injury**

Severe injuries may be caused by rapidly rotating parts when installing and servicing couplings.

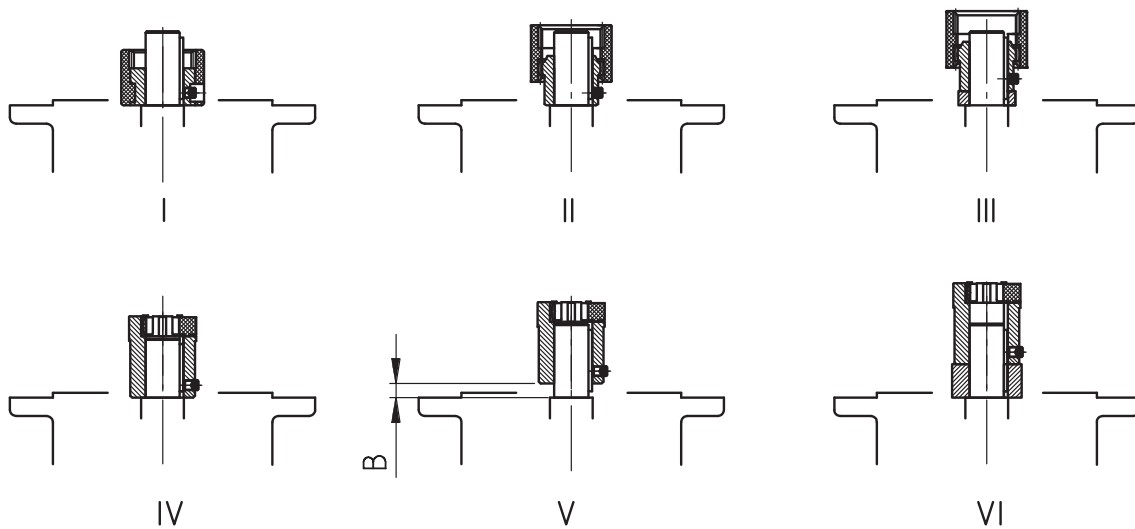
Secure the drive unit against accidental switch-on.

#### **Assembly procedure to attach a standard motor to the IEC adapter (Option IEC/NEMA adapter)**

1. Clean the motor shaft and flange surfaces of the motor and the IEC /NEMA adapter and check for damage. The mounting dimensions and tolerances of the motor must conform to DIN EN 50347/NEMA MG1 Part 4.
2. Push the coupling sleeve onto the motor shaft so that the motor parallel key engages into the groove in the sleeve on tightening.
3. Tighten the coupling sleeve on the motor shaft in accordance with the motor manufacturer's instructions until it touches the collar. With motor sizes 90, 160, 180 and 225, any spacer bushes must be positioned between the coupling sleeve and the collar. With standard helical gear units, dimension B between the coupling sleeve and the collar must be observed (see Figure 17). Certain NEMA adapters require adjustment of the coupling in accordance with the specifications indicated on the adhesive plate.
4. If the coupling half contains a threaded pin, the coupling must be secured axially on the shaft. The threaded pin must be coated prior to use with a securing lubricant e.g. Loctite 242, Loxeal 54-03 and tightened to the correct torque (please see chapter 6.5 "Torque values").



5. Sealing of the flange surfaces of the motor and the IEC/NEMA adapter is recommended if the motor is installed outdoors or in a humid environment. Before the motor is installed, the flange surfaces must be completely coated with surface sealant Loctite 574 or Loxeal 58-14 so that the flange seals after mounting.
6. Mount the motor on the IEC/NEMA adapter. Do not forget to fit the gear rim or the splined sleeve provided (see illustration below).
7. Tighten the bolts of the IEC/NEMA adapter with the correct torque (please see chapter 6.5 "Torque values").



**Figure 17: Fitting the coupling onto the motor shaft - various types of coupling**

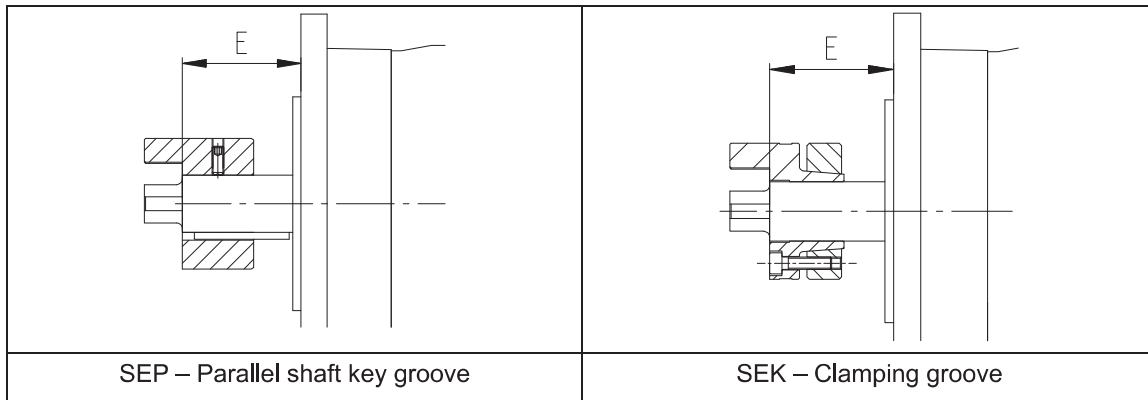
- I Curved tooth coupling
- II Curved tooth coupling, two-part
- III Curved tooth coupling, two-part with spacer bush
- IV Claw coupling, two-part
- V Claw coupling, two-part, observe dimension B:

<b>Standard helical gear unit:</b>		
SK 0, SK 01, SK 20, SK 25, SK 30, SK 33 (2-stage)		
SK 010, SK 200, SK 250, SK 300, SK 330 (3-stage)		
	IEC size 63	IEC size 71
Dimension B (Fig. V)	B = 4.5 mm	B = 11.5 mm

- VI Claw coupling two-part with spacer bush



### 3.12 Installation of a servo motor (Option SEP / SEK)



E = Coupling installation size of flange system

Cylinder type	Coupling size*	Installation size E [mm]
SE. 100	GS 19	40
SE. 130	GS 24	50
SE. 165	GS 28	58
SE. 215	GS 28	80
	GS 48	80
SE. 300	GS 48	82
*) All coupling sizes are available as SEP or SEK versions, the ring gear has a hardness of (Shore) 98 Sh-A-GS, colour red		

**Table 4: Allocation of cylinder types to coupling sizes**

To prevent damage to the coupling, the dimension E which is stated in Table 12 must be complied with!

#### Assembly sequence for the connection of a servo motor to the servo adapter (Option SEP / SEK)

Please refer to the coupling manufacturer's operating/installation instructions for the assembly of the two halves of the coupling.



### 3.13 Fitting the cooling coil to the cooling system



#### WARNING

#### Risk of injury

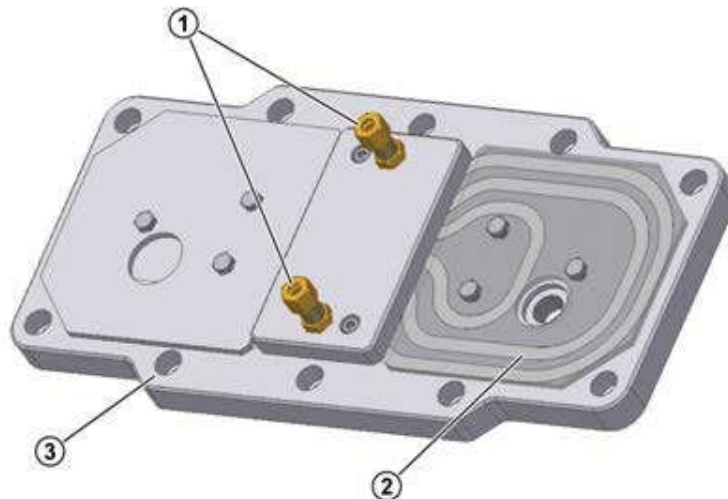
Possibility of injury due to pressure discharge.

Ensure that the pressure is released from the cooling circuit before carrying out any work on the gear unit.

The cooling coil is installed in the casing cover. Cutting ring screw threads according to DIN 2353 are located at the casing cover for the connection of a pipe with an external diameter of 10 mm.

**Remove the closing cap from the screw neck prior to assembly to avoid any contamination of the cooling system.** The screw necks should be connected with the coolant circuit, which must be provided by the operator. The flow direction of the coolant is irrelevant.

**Make sure not to twist the screw necks during or after assembly** as the cooling coil may be damaged. It must be ensured that no external forces act on the cooling coil.



#### Explanation

- 1 Cutting ring screw threads
- 2 Cooling coil
- 3 Housing cover

Figure 18: Cooling cover



### 3.14 Installation of an oil expansion tank, Option OA

The expansion tank must be installed vertically with the hose connection facing downwards and the vent plug upwards. Please note the attached factory standard 0-530-04 for the installation.

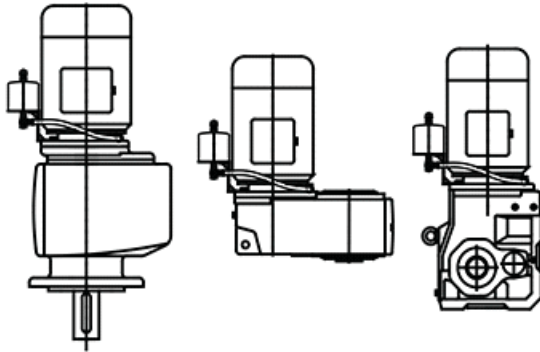


Figure 19: Installing the expansion tank

### 3.15 Subsequent paintwork

#### **NOTICE**

#### **Damage to the device**

For retrospective painting of the gear unit, the radial seals, rubber elements, pressure venting valves, hoses, type plates, adhesive labels and motor coupling components must not come into contact with paints, lacquers or solvents, as otherwise components may be damaged or made illegible.



## 4 Commissioning

### 4.1 Check the oil level

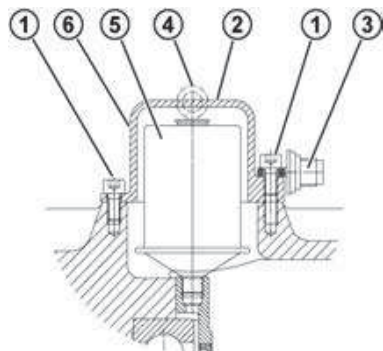
The oil level must be checked prior to commissioning (please see chapter 5.2 "Service and Maintenance Work").

### 4.2 Activating the automatic lubricant dispenser

Some gear unit types with standard motor (Option IEC/NEMA) have an automatic lubricant dispenser for the roller bearings. This dispenser must be activated prior to commissioning. The cartridge case cover of the adapter for attaching an IEC/NEMA standard motor has a red information sign for the activation of the lubricant dispenser. A grease escape opening which is closed with a G1/4 cap screw is located opposite to the lubricant dispenser. After activation of the lubricant dispenser, the cap screw can be removed and replaced with the grease collection container (Part No. 28301210) which is supplied separately with the delivery.

#### Activating the automatic lubricant dispenser:

1. Loosen and remove the cylindrical screws.
2. Remove the cartridge cover.
3. Screw the activation screw into the lubricant dispenser until the lug breaks off at the defined fracture point
4. Re-fit the cartridge cover and fasten it with the cylindrical screw (please see chapter 6.5 "Torque values").
5. Mark activation date on the adhesive label indicating the month/year



#### Explanation

- |   |                            |
|---|----------------------------|
| 1 | Cylindrical screw M8 x 16  |
| 2 | Cartridge cover            |
| 3 | Activation screw           |
| 4 | Lug                        |
| 5 | Lubricant sensor           |
| 6 | Position of adhesive label |

Figure 20: Activating the automatic lubricant dispenser with standard motor mounting



**Adhesive label:**

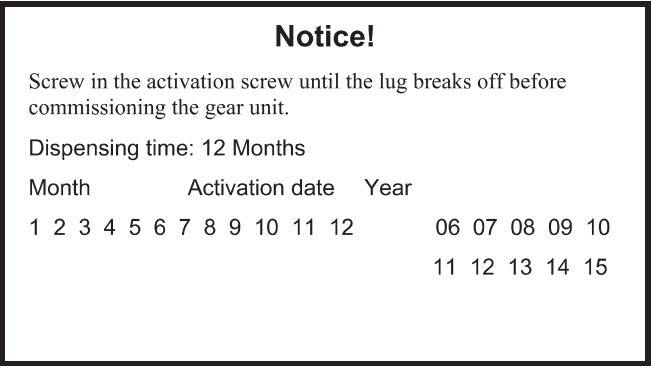


Figure 21: Adhesive label

### 4.3 Operation with lubricant cooling

Water cooling

**NOTICE**

**Gear unit damage**

The gear unit may be damaged by overheating.

The drive may only be commissioned after the cooling spiral has been connected to the cooling circuit, and the cooling circuit has been put into operation.

The coolant must have a similar thermal capacity as water (specific thermal capacity at 20°C  $c=4.18 \text{ kJ/kgK}$ ). Industrial water without any air bubbles or sediments is recommended as a coolant. The hardness of the water must be between 1 dH and 15 dH; the pH value must be between pH 7.4 and pH 9.5. No aggressive liquids may be added to the coolant!

The **coolant pressure** must not exceed **8 bar**. The required **quantity of coolant** is **10 litres/minute**, and the **coolant inlet temperature** must not exceed 40°C; we recommend **10°C**.

We also recommend fitting a pressure reducer or similar at the coolant inlet to avoid damage due to excessive pressure.

If there is a danger of frost the operator should add a suitable anti-freeze solution to the cooling water.

The **temperature of the cooling water** and the **cooling water flow rate** must be supervised and ensured by the operator.

Air/Oil cooler

The version and all important data for the air/oil cooler can be obtained from Catalogue G1000, or contact the manufacturer of the cooling unit.



### 4.4 Running-in time for the worm gear unit



#### Information

#### Running-in time

In order to achieve maximum efficiency of the worm gear unit, the gear unit must be subjected to a running-in period of approx. 25 h – 48 h under maximum load.

There may be a reduction in efficiency before the running-in period is complete.

### 4.5 Checklist

Checklist		
Subject of check	Date checked:	Information see Section
Is the vent plug activated or the pressure vent screwed in?		3.4
Does the required configuration conform with the actual installation?		6.1
Are the external gear shaft forces within permitted limits (chain tension)?		3.6
Is the torque support correctly fitted?		3.7
Are contact guards fitted to rotating components?		3.9
Is the automatic lubricant dispenser activated?		4.2
Is the cooling cover connected to the cooling circuit?		3.13 4.3



## 5 Service and maintenance



### WARNING

### Danger of burns

The surfaces of gear units or geared motors may become hot during or shortly after operation.

- Installation and maintenance work must only be performed when gear unit is at a standstill and has cooled down. The drive must be isolated and secured to prevent accidental start-up.
- Wear protective gloves.
- Shield hot surfaces with contact guards.

### 5.1 Service and Maintenance Intervals

Service and Maintenance Intervals	Service and Maintenance Work	Information see Section
At least every six months	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Check for running noises</li> <li>• Check the oil level</li> <li>• Re-grease / remove excess grease (only applicable for free drive shaft / Option W and for agitator bearings / Option VL2 / VL3)</li> <li>• Replace the automatic lubricator / remove excess grease (for operating times &lt; 8 h / day): (A replacement interval of 1 year is permissible for the lubricant dispenser) (Only for IEC / NEMA standard motor mounting). Empty or replace the lubricant collection container with every second replacement of the lubricant dispenser.</li> </ul>	5.2
For operating temperatures up to 80 °C every 10000 operating hours, at least every 2 years	<ul style="list-style-type: none"> <li>• Change the oil (The interval is doubled if filled with synthetic products)</li> <li>• Cleaning or replacing the vent plug</li> <li>• Replace shaft sealing rings if worn</li> </ul>	5.2
Every 20000 operating hours, at least every 4 years	<ul style="list-style-type: none"> <li>• Re-lubrication of the bearings in the gear unit</li> </ul>	5.2
At least every 10 years	<ul style="list-style-type: none"> <li>• General overhaul</li> </ul>	5.2



### Information

#### Oil change intervals

The oil change intervals apply for normal operating conditions and operating temperatures up to 80 °C. The oil change intervals are reduced in the case of extreme conditions (operating temperatures higher than 80 °C, high humidity, aggressive environment and frequent fluctuations in the operating temperature).

## 5.2 Service and Maintenance Work

### WARNING

#### Severe personal injury

Severe injury and material damage may be caused by incorrect servicing and maintenance work.

Servicing and maintenance work must only be performed by qualified specialist personnel. Wear the necessary protective clothing for servicing and maintenance work (e.g. industrial footwear, protective gloves, goggles, etc.)

### WARNING

#### Severe personal injury

Risk of injury due to rapidly rotating and hot machine components.

Installation and maintenance work must only be performed when gear units are at a standstill and have cooled down. The drive must be isolated and secured to prevent accidental start-up.

### WARNING

#### Severe personal injury

Particles or liquids thrown up during servicing and maintenance can cause injuries.

- Observe the safety information when cleaning with compressed air or a pressure washer.

### WARNING

#### Danger of burns

Danger of burns due to hot oil.

- Allow the gear unit to cool down before carrying out maintenance or repair work.
- Wear protective gloves.

### NOTICE

#### Leaks

Take care that no dirt or water enters the shaft sealing rings or the vents when cleaning

Dirt or water in the shaft sealing rings may cause leaks.

#### Visual inspection

The gear unit must be checked for leaks. In addition, the gear unit must be inspected for external damage and cracks in the hoses, hose connections and rubber buffers. Have the gear unit repaired in case of leaks, e.g. dripping gear oil or cooling water, damage or cracks. Please contact the NORD service department.



---

**i Information**

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**Shaft sealing rings**

Shaft sealing rings are rubbing seals and have sealing lips made from an elastomer material. These sealing lips are lubricated with a special grease at the factory. This reduces the wear due to their function and ensures a long service life. An oil film in the region of the rubbing sealing lip is therefore normal and is not due to leakage. (please see chapter 6.7 "Leaks and seals")

---

**Check for running noises**

If the gear unit produces unusual running noises and/or vibrations, this could indicate damage to the gear unit. In this case the gear should be shut down and a general overhaul carried out.

**Check the oil level**

Section 6.1 "Configurations and maintenance" describes the versions and the corresponding oil level screws. With double gear units, the oil level must be checked on both units. The pressure vent must be at the position marked in Section 6.1 "Configurations and maintenance" Bauformen und Wartung</dg\_ref\_source\_inline>.

The oil level does not need to be checked on gear units without oil level screw (please see chapter 6.1 "Configurations and maintenance").

Gear unit types that are not supplied full of oil must be filled before the oil level is checked.

Check the oil level with an oil temperature of between 20 °C to 40 °C.

1. The oil level may only be checked when the gear unit is at a standstill and has cooled down. The gear unit must be secured to prevent accidental switch-on.
2. The oil level screw corresponding to the version must be screwed out (please see chapter 6.1 "Configurations and maintenance").

---

**i Information**

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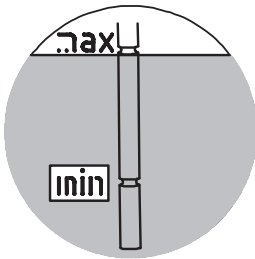
**Checking the oil level**

At the first oil level check a small amount of oil may escape, as the oil level may be below the lower edge of the oil level hole.

---

3. **Gear units with oil level screw:** The correct oil level is at the lower edge of the oil level hole. If the oil level is too low, this must be corrected using the correct type of oil. An oil level glass is available instead of the oil level screw
4. **Gear units with an oil level tank:** The oil level must be checked in the oil level tank with the aid of the dipstick plug (thread G1 1/4). The oil level must be between the upper and lower marking when the dipstick is fully screwed in (see Figure 22). Top up the oil level with the relevant type of oil as necessary. These gearboxes may only be operated in the configuration stated in Section 6.1 "Configurations and maintenance".
5. The oil level screw or the cap screw with dipstick and all other loosened screws must be correctly re-tightened.





**Figure 22: Checking the oil level with a dipstick**

### Re-greasing

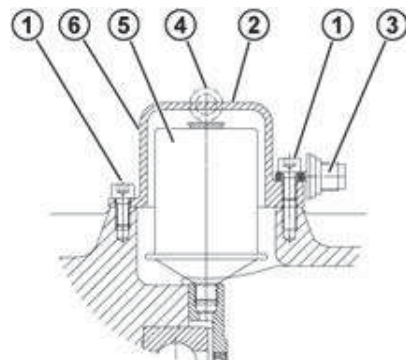
Some gear unit designs (free drive shaft, Option W, agitator designs VL2 and VL3) are equipped with a re-greasing device.

For agitator versions VL2 and VL3, the vent screw located opposite to the grease nipple must be unscrewed before re-greasing. Grease should be injected until a quantity of 20 - 25 g escapes from the vent hole. After this, the vent plug must be reinserted and tightened.

For Option W and some IEC adapters, the outer roller bearing must be re-greased with approx. 20 - 25 g of grease via the grease nipple provided. Remove any excess grease from the adapter.

Recommended grease: Petamo GHY 133N (please see chapter 6.2 "Lubricants") (Fa. Klüber Lubrication).

### Replacing the automatic lubricant dispenser



#### Explanation

- 1 Cylindrical screws M8 x 16
- 2 Cartridge cover
- 3 Activation screw
- 4 Lug
- 5 Lubricant sensor
- 6 Position of adhesive label

**Figure 23: Replacing the automatic lubricant dispenser with standard motor mounting**

The cartridge cover must be unscrewed. The lubrication dispenser is screwed out and replaced with a new component (Part No. 283 0100). Remove any excess grease from the adapter. Then activate (please see chapter 4.2 "Activating the automatic lubricant dispenser").



Empty or replace the grease collection container (Part No. 28301210) with every second replacement of the lubricant container. To empty the container, unscrew it from the screw fitting. The container has an internal piston, which can be pressed back with a rod with a maximum diameter of 10 mm. Collect the grease which is pressed out and dispose of it correctly. Due to the shape of the container, a residual quantity of grease remains in the container. After emptying and cleaning the container, it can be screwed back into the drain hole in the IEC adapter. Replace the container with a new one if it is damaged.

### Change the oil

The figures in Section 6.1 "Configurations and maintenance" show the oil drain screw, the oil level screw and the pressure vent screw for various designs.

Procedure:

1. Place a catchment vessel under the oil drain screw or the oil drain cock.
2. Completely remove the oil level screw or screwed sealing plug with dipstick if an oil level tank is being used and unscrew oil drain screw.



### WARNING

### Danger of burns

Danger of burns due to hot oil.

- Allow the gear unit to cool down before carrying out maintenance or repair work.
- Wear protective gloves.

3. Drain all the oil from the gear unit.
4. If the sealing ring of the oil drain screw or oil level screw is damaged in the thread, a new oil level screw must be used or the thread must be cleaned and coated with securing lubricant, e.g. Loctite 242, Loxeal 54-03 prior to insertion.
5. Screw the oil drain screw into the hole and tighten to the correct torque (please see chapter 6.5 "Torque values").
6. Using a suitable filling device, refill with oil of the same type through the oil level hole until oil emerges from the oil level hole. (The oil can also be filled through the pressure vent screw or a sealing plug located higher than the oil level). If an oil level tank is used, fill the oil through the upper inlet (thread G1¼) until the oil level is set as described in Section 5.2 "Service and Maintenance Work".
7. Wait at least 15 minutes, or at least 30 minutes if an oil level tank is used, and then check the oil level. Proceed as described in Section 5.2 "Service and Maintenance Work".



---

### Information

#### Oil level

The oil does not need to be changed on gear units without oil level screw (please see chapter 6.1 "Configurations and maintenance"). These gear units are lubricated for life.

Standard helical gear units have no oil level screw. Here, the oil is topped up through the pressure vent bolt using the quantities listed in the table in Section 6.4 "Helical gear unit".

---

#### Cleaning or replacing the vent plug

Unscrew the vent screw and thoroughly clean it (e.g. with compressed air) and fit the vent screw in the same place. If necessary, use a new vent screw with a new sealing ring.

#### Replace the shaft sealing ring

Once the shaft sealing ring has reached the end of its service life, the oil film in the region of the sealing lip increases and a measurable leakage with dripping oil occurs. **The shaft sealing ring must then be replaced.** The space between the sealing lip and the protective lip must be filled approximately 50 % with grease on fitting (recommended grease: PETAMO GHY 133N). Take care that after fitting, the new shaft sealing ring does not run in the old wear track.

#### Re-lubricating bearings

For bearings which are not oil-lubricated and whose holes are completely above the oil level, replace the roller bearing grease (recommended grease: PETAMO GHY 133N). Please contact the NORD service department.

#### General overhaul

For this, the gear unit must be completely dismantled. The following work must be carried out:

- Clean all gear unit components
- Examine all gear unit components for damage
- All damaged components must be replaced
- All roller bearings must be replaced
- Replace back stops if fitted
- Replace all seals, radial seals and Nilos rings
- Replace plastic and elastomer components of the motor coupling

The general overhaul must be carried out by qualified personnel in a specialist workshop with appropriate equipment in observance of national regulations and laws. We recommend that the general overhaul is carried out by the NORD Service department.



## 6 Appendix

### 6.1 Configurations and maintenance

Explanation of symbols for the following version illustrations:



Venting



Oil level



Oil drain



#### Information

#### Gear unit - Lubrication

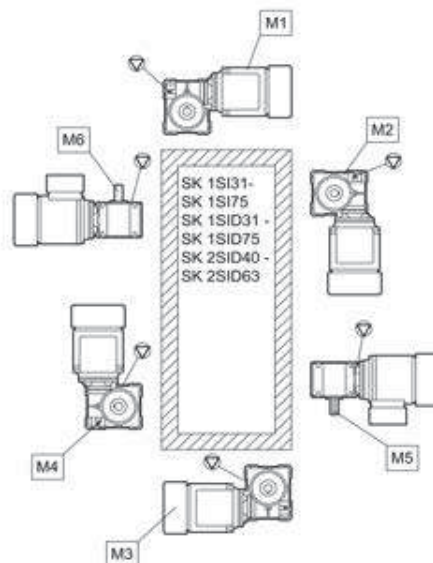
SK 320, SK 172, SK 272, SK 372 as well as SK 273 and SK 373, SK 01282 NB, SK 0282 NB, SK 1382 NB and UNIVERSAL / MINIBLOC gear units are lubricated for life. These gear units do not have an oil filler screw.

#### UNIVERSAL / MINIBLOC worm gear units

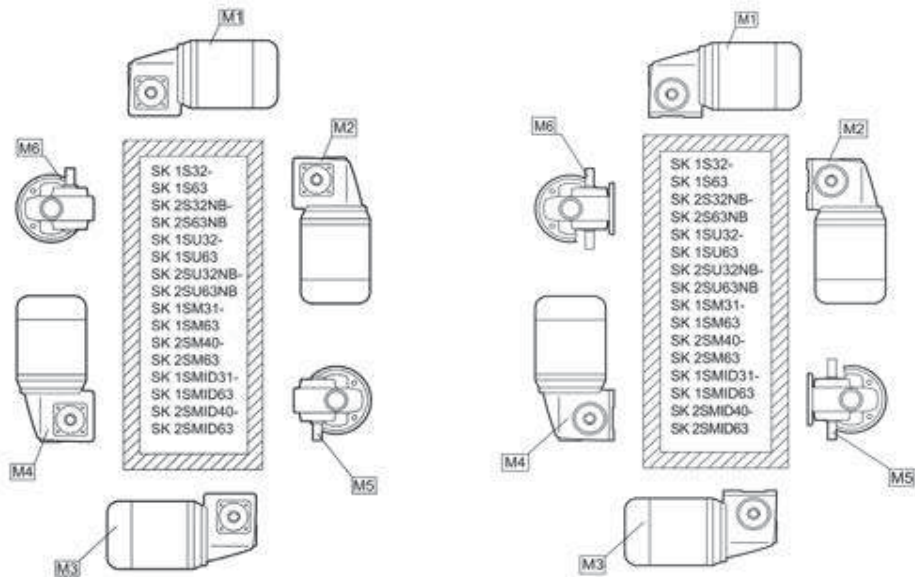
NORD UNIVERSAL / MINIBLOC worm gear units are suitable for all installation positions. They have an oil filler which is independent of the configuration.

As an option, types SI and SMI can be equipped with a vent screw. Gear units with vents must be installed in the stated position.

Types SI, SMI, S, SM and SU as 2-stage gear unit types and types SI, SMI as worm gear units for direct motor mounting have an oil filler which depends on the configuration and must be installed in the stated position.







## Parallel shaft gear units with oil level tank

The following applies for SK 9282, SK 9382, SK 10282, SK 10382, SK 10382.1, SK 11282, SK 11382, SK 11382.1 and SK 12382 in the M4 configuration with oil level tank:

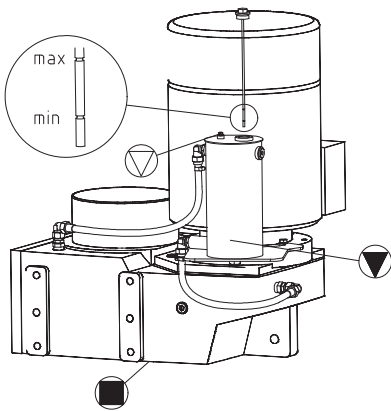
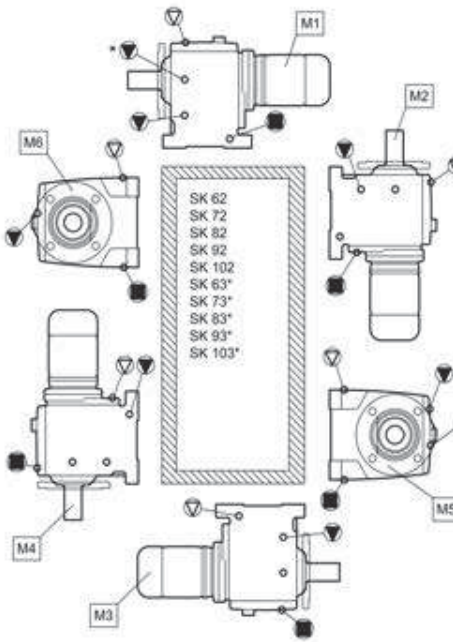
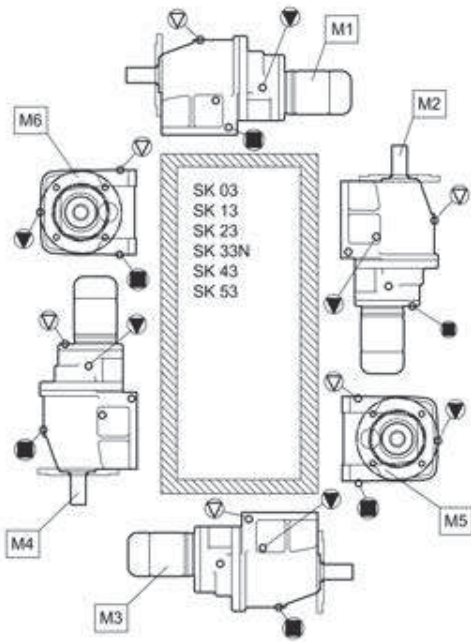
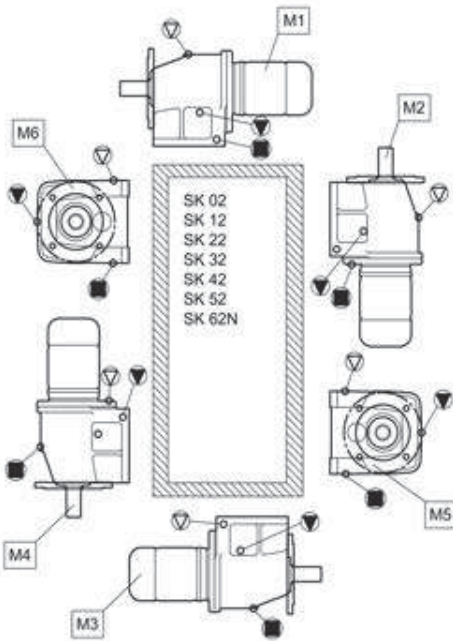
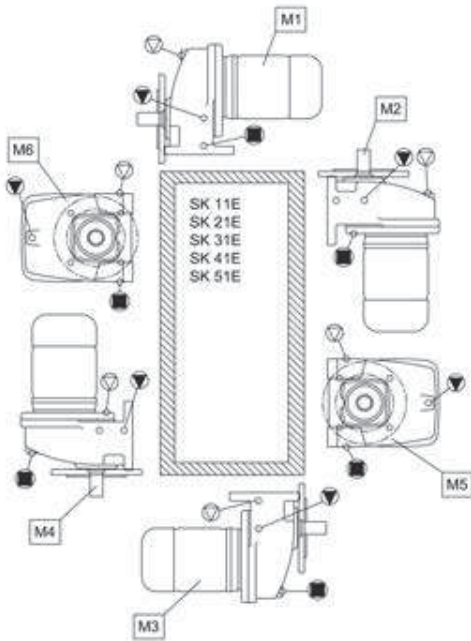
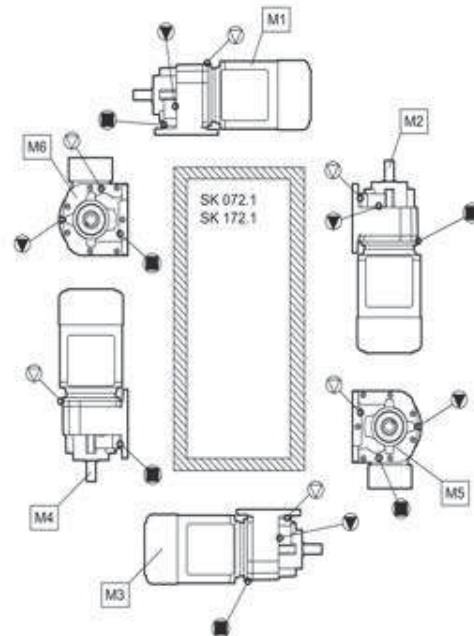
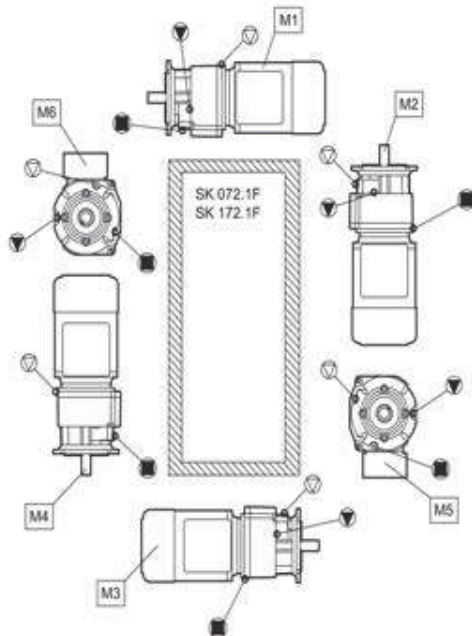
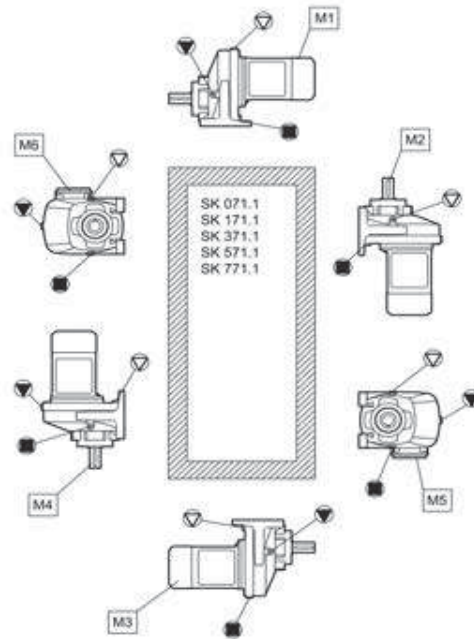
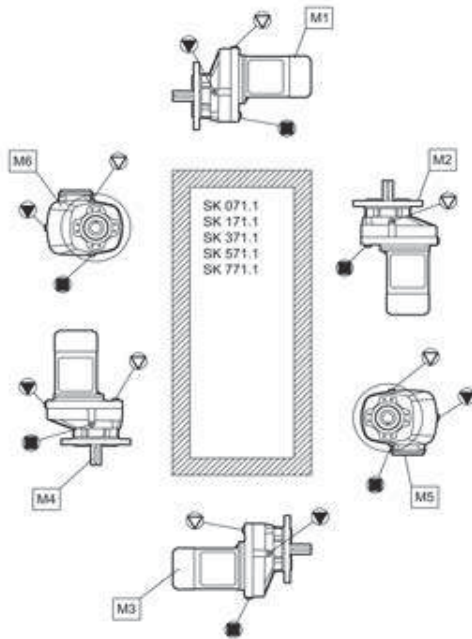


Figure 24: Oil level check with oil level tank

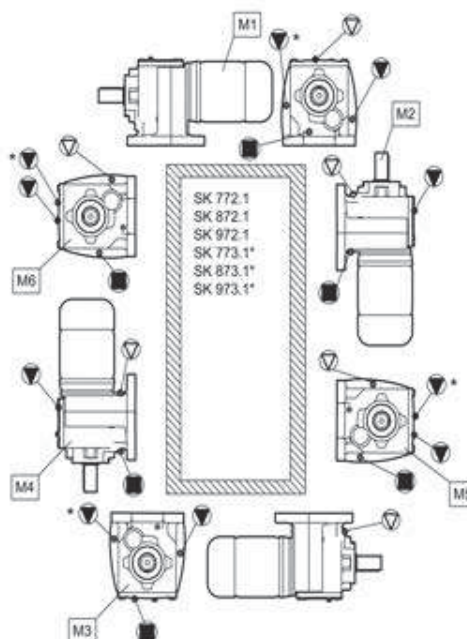
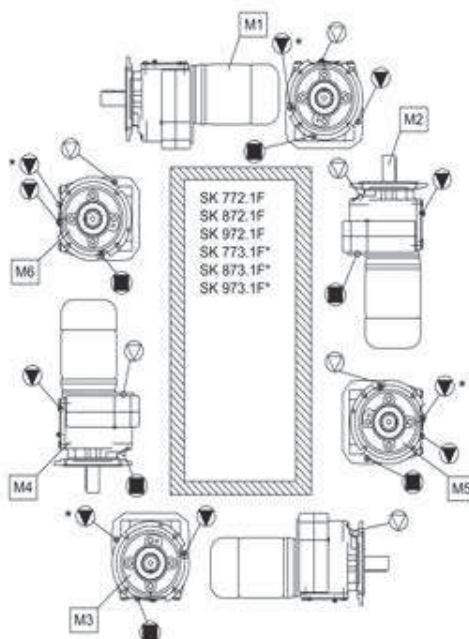
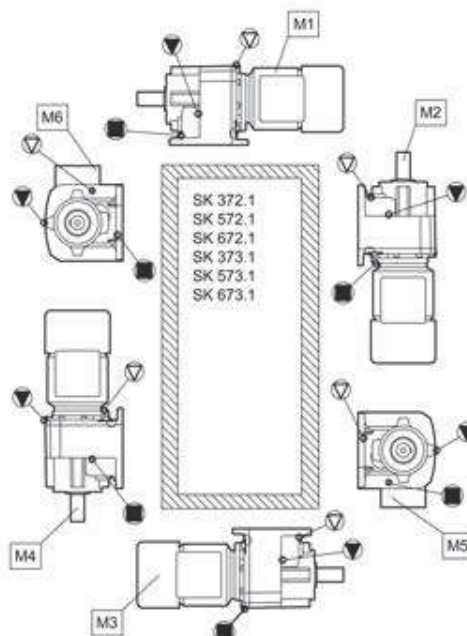
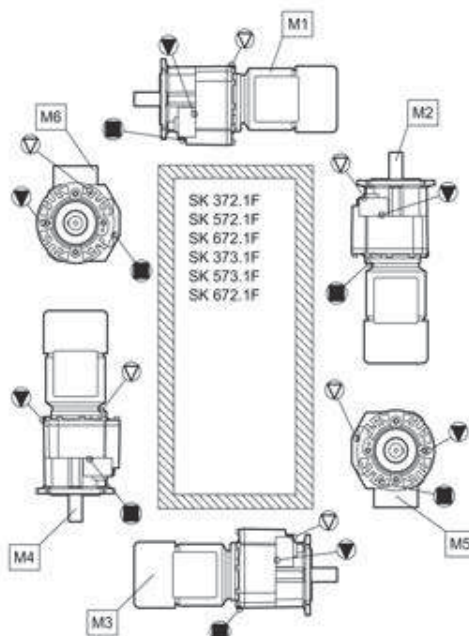




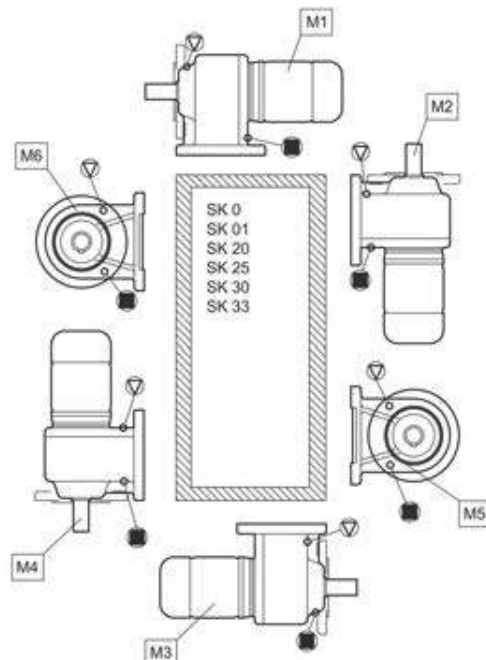
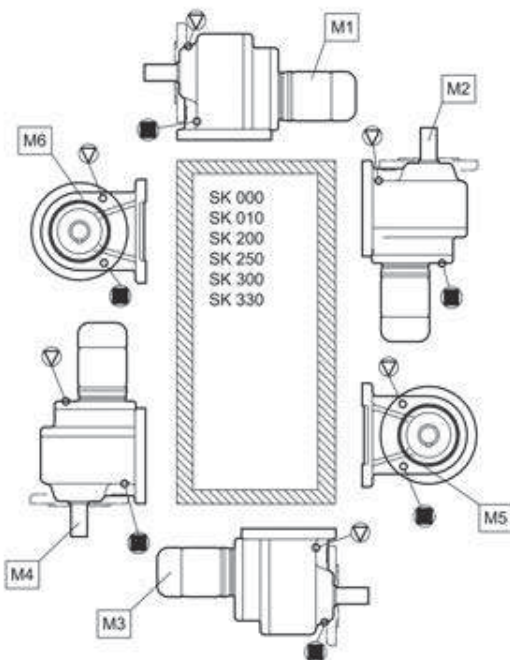
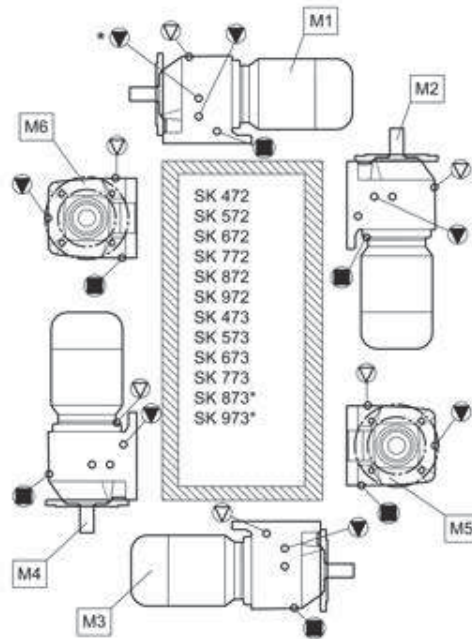




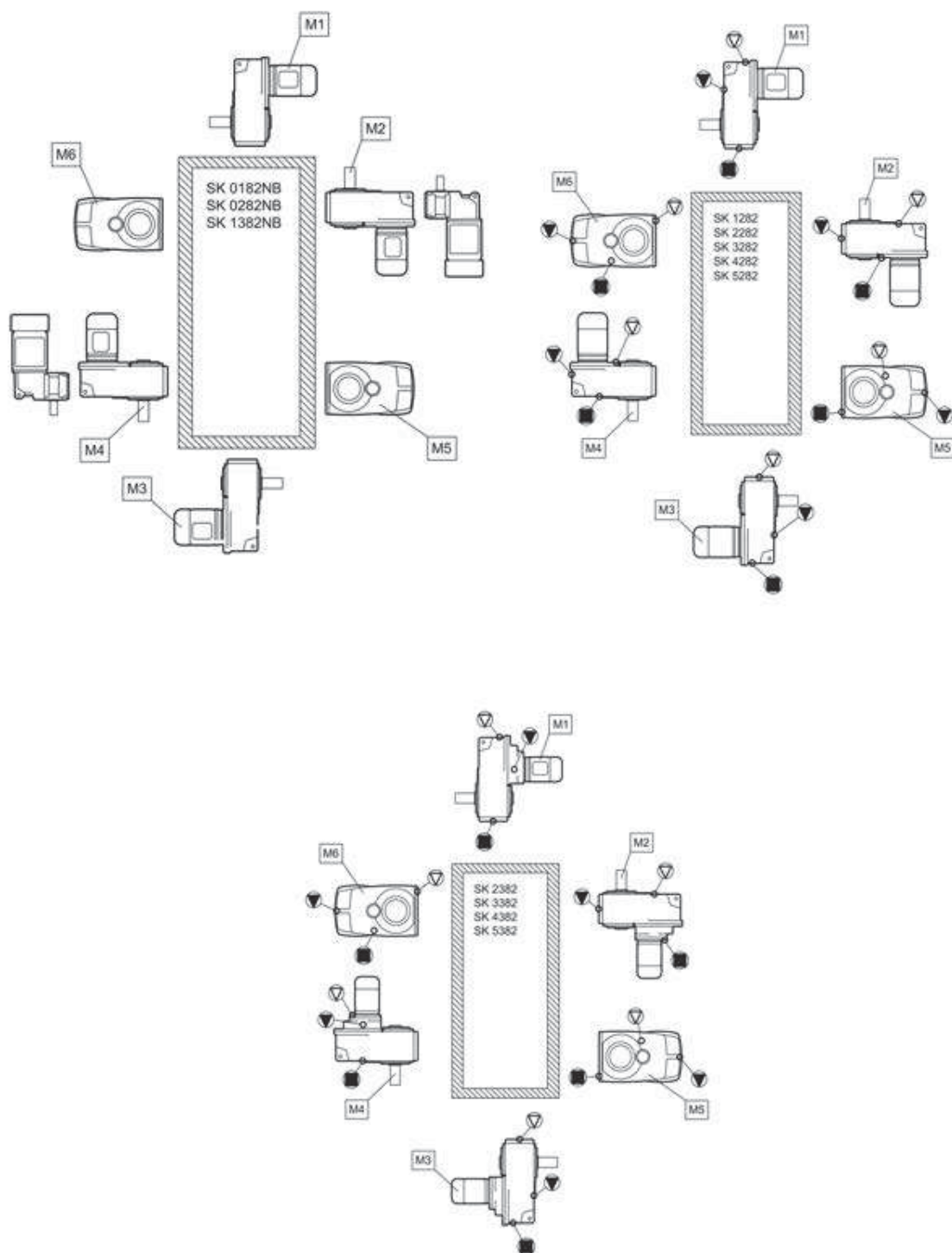




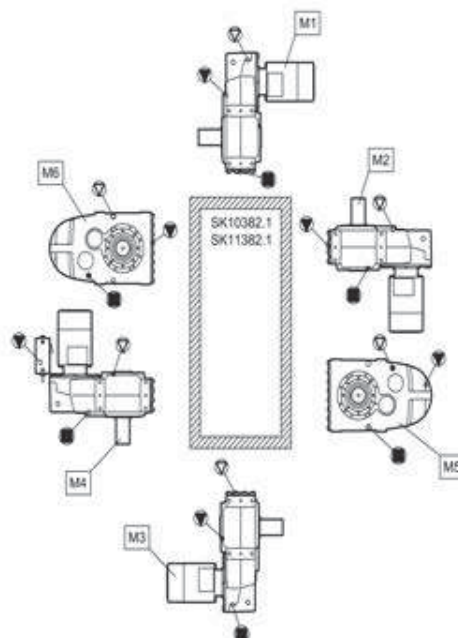
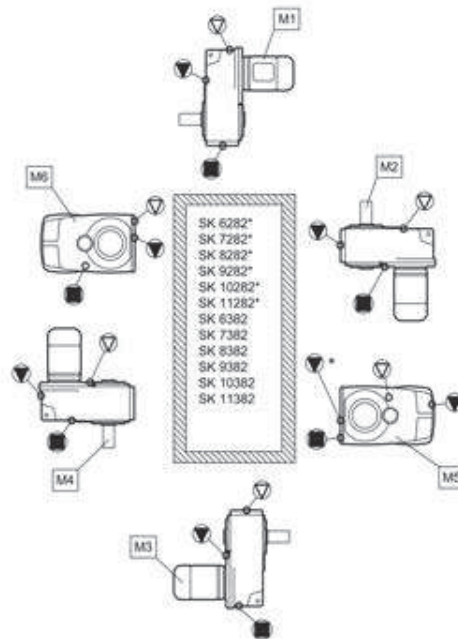




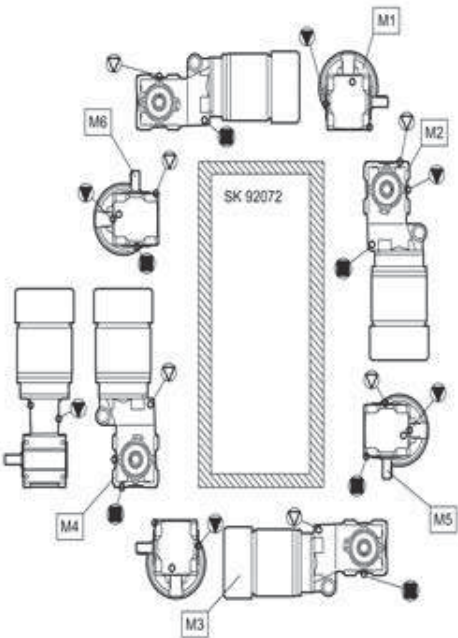
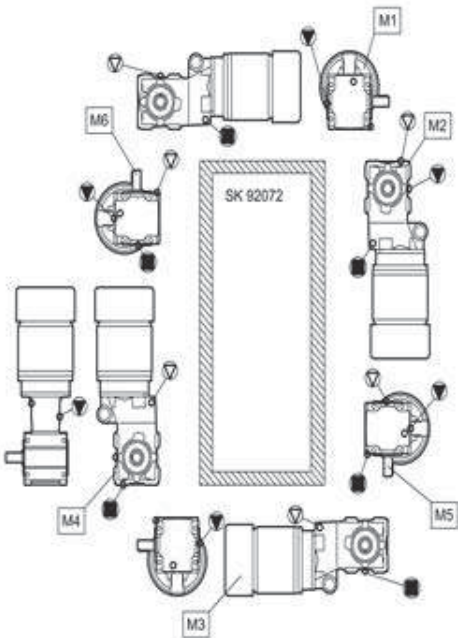
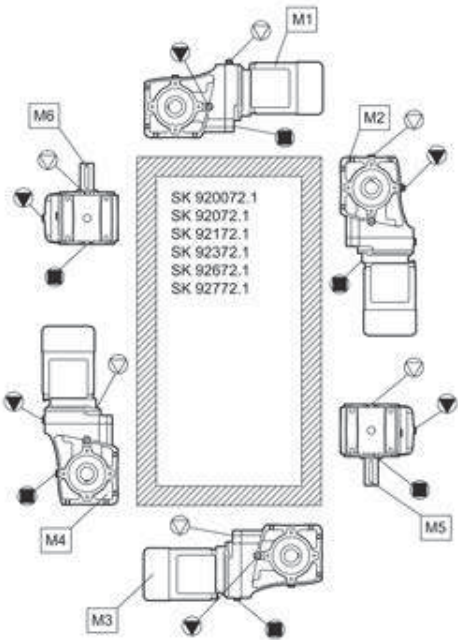
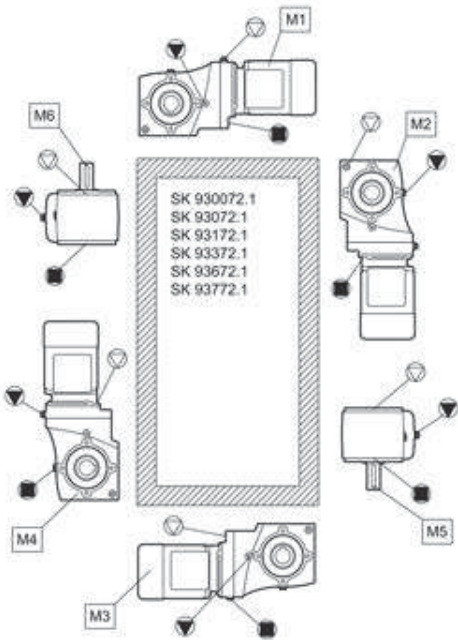




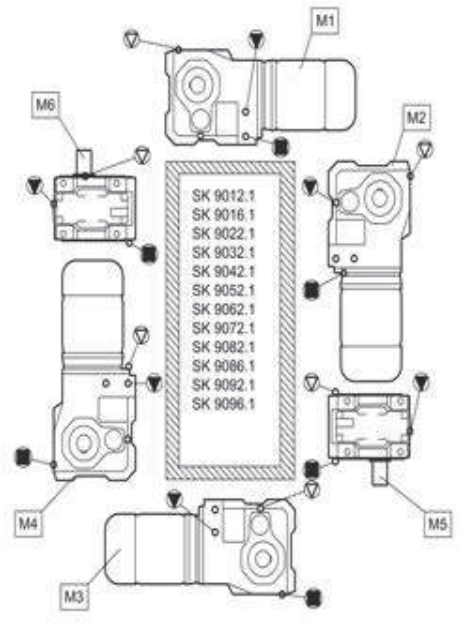
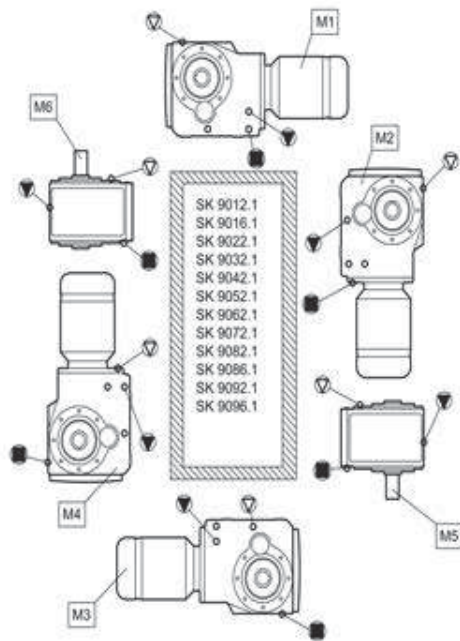
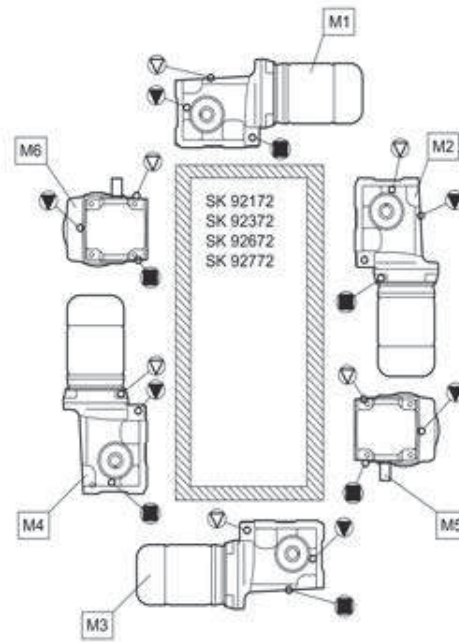
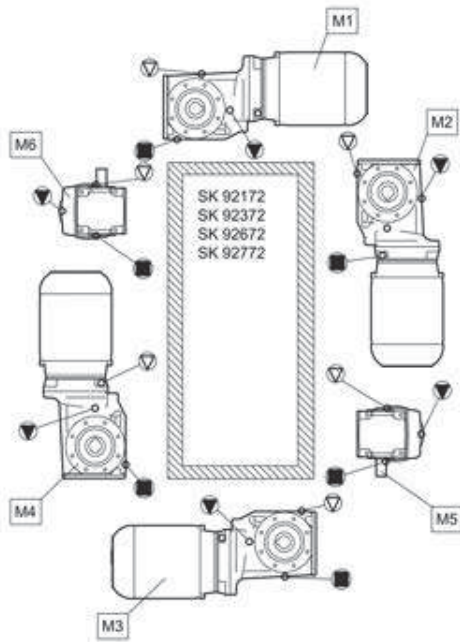




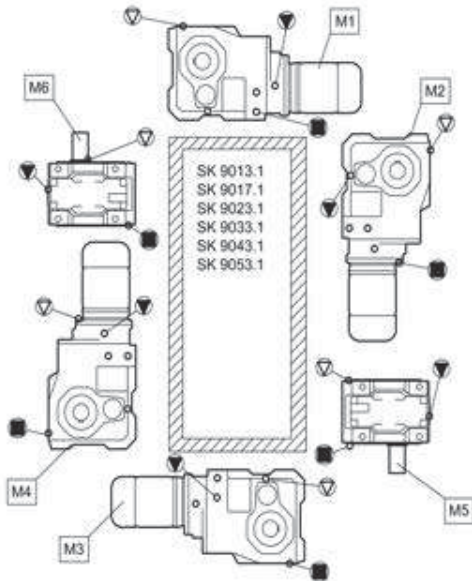
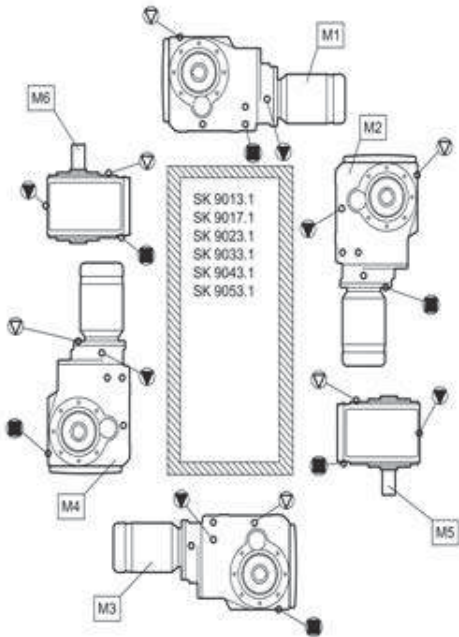




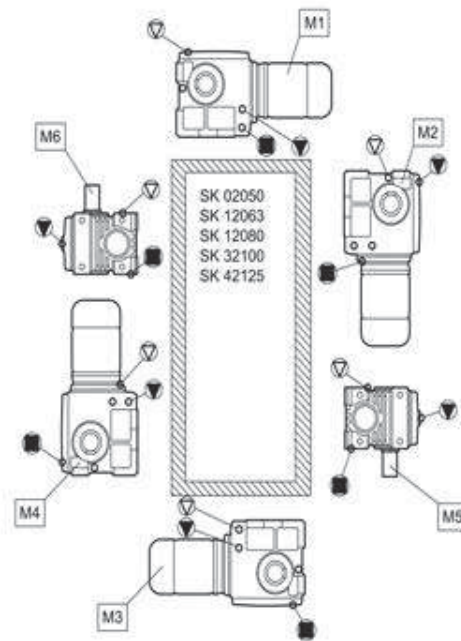
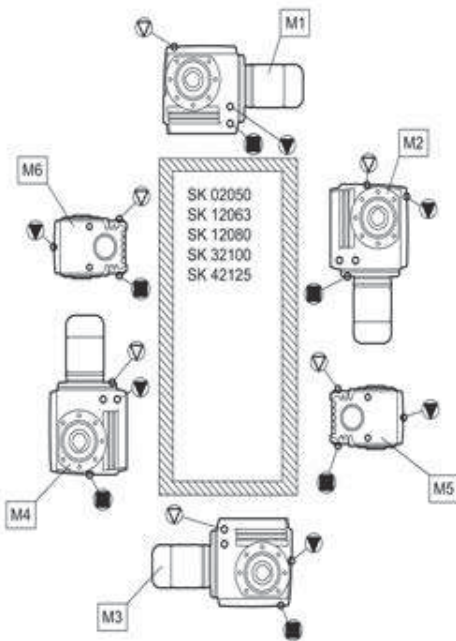
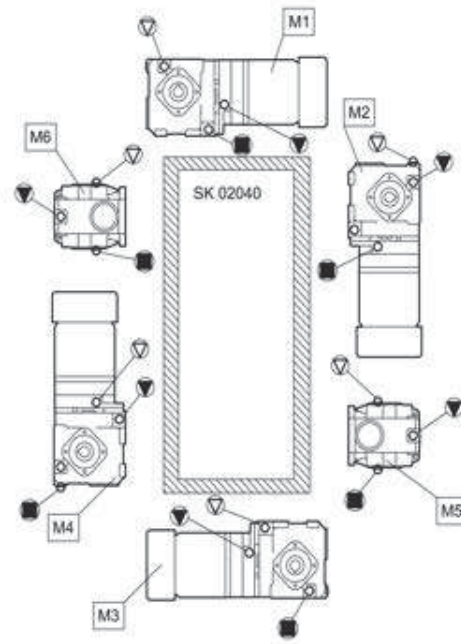
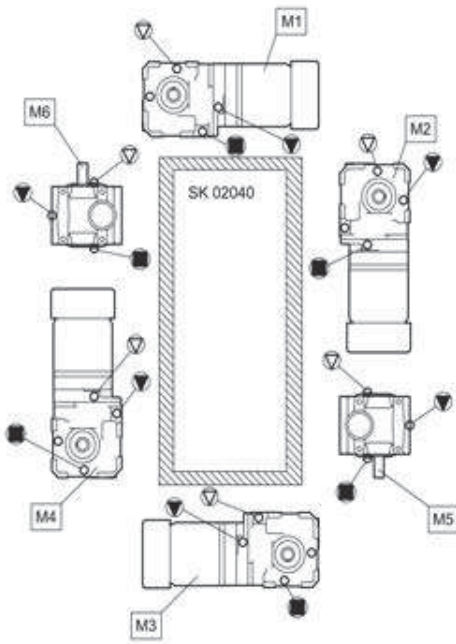














## Remote Bulb Control (Continued)

### Selection Charts (Continued)

#### Replacement Parts

Code Number	Description
CVR28A-617R	Concealed adjustment cover
CVR28A-618R	Visible scale cover
KNB20A-602R	Replacement Knob Kit

#### Accessories

A packing nut is available for closed tank application.  
Specify the part number **FTG13A-600R**.

Bulb wells (WEL14A Series) are available for liquid immersion applications.  
Refer to the selection chart or to *Bulb Wells Catalog Page, LIT-1922135*.

### Technical Specifications

#### Electrical Ratings

Motor Ratings VAC	120	208	240
Wide Range – Adjustable Differential			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A <sup>1</sup>	22 A, 120 to 277 VAC		
Pilot Duty – 125 VA, 24 to 600 VAC			
Fixed Differential and Close Differential			
AC Full Load A	6.0	3.4	3.0
AC Locked Rotor A	36.0	20.4	18.0
Non-Inductive A	10 A, 24 to 277 VAC		
Pilot Duty – 125 VA, 24 to 277 VAC			
Case Compensated – Fixed Differential A19AAC-4			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A <sup>1</sup>	22 A, 120 to 277 VAC		
Pilot Duty – 125 VA, 24 to 600 VAC			
A19AAD-12			
AC Full Load A	6.0	3.4	3.0
AC Locked Rotor A	36.0	20.4	18.0
Non-Inductive A	10 A, 24 to 277 VAC		
Pilot Duty – 125 VA, 24 to 277 VAC			
Manual Reset			
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A	16.0	9.2	8.0
Pilot Duty – 125 VA, 24 to 600 VAC			

1. SPST and N.O. contact of SPDT control;  
SPDT N.C. contact- 16 amps 120 to 277 VAC



TSLL/TSH - Switch, Temperature Thermostat, CN TF115-001  
TSLL7911 - Switch, Temperature Thermostat, CN TF115-001  
TSLL-7941 - Switch, Temperature Thermostat, CN TF115-001



AUTOMATION AND CONTROLS

## NEMA 4X RAINIGHT THERMOSTAT INSTALLATION AND OPERATING INSTRUCTIONS

### INSTRUCCIONES DE INSTALACION Y OPERACION DEL THERMOSTATO A PRUEBA DE LLUVIA NEMA 4X

### THERMOSTAT NEMA 4X ÉTANCHE AUX INTEMPÉRIES INSTRUCTION D'INSTALLATION ET D'UTILISATION

#### WARNING

To prevent overheating or fire, use this control as an operating or regulating thermostat. ALWAYS USE A BACKUP CONTROL OR ALARM if a control failure could cause the controlled appliance to overheat or could cause a fire.

Where thermostat is capable of cycling directly between heating and cooling loads, failure to provide a load transfer switch will result in thermostat failure.

Do not install, use or operate if product appears damaged, the enclosure is cracked or broken or if the sensor has been bent, crimped or is dirty.

#### APPROPRIATE APPLICATION

This thermostat has been tested by CSA and Underwriters Laboratories Inc. (UL), meets the requirements for NEMA 4X equipment and is suitable for use under the National Electrical Code (NEC), Article 547-7, when used with appropriate watertight connectors (not included).

#### INSTALLATION

#### WARNING

To avoid electrical shock or damage to equipment, disconnect all power before installing or servicing.

To avoid potential fire and/or explosion, do not use in potentially flammable or explosive atmospheres.

Installation must be made by a trained, qualified service person in accordance with the National Electrical Code (NEC) and all applicable local codes and ordinances. Installation should meet all applicable national, state and local codes. Refer to the appropriate wiring diagram included. Locate the thermostat (local sensing models) or sensing bulb (remote sensing models) for optimum temperature sensing of the controlled space. Thermostat operation will be affected by unusual heat or cold, such as direct sunlight, near windows or doors or on outside walls.

All fittings and materials used for the installation should be approved, suitable and installed properly for the intended application. For water tightness, the cord seal or conduit hub should be UL listed and marked 4X. The conduit hub is to be tightened onto the conduit before installing in the enclosure.

Where applicable, remove knockout(s) by impacting near the inside edge of the knockout to be removed. **IMPORTANT: Do not impact, dent or use the sensor for support. This will cause calibration and/or thermostat failure.**

#### WARNING

READ INSTRUCTION CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THIS THERMOSTAT. Failure to observe safety information and comply with instructions could result in PERSONAL INJURY, DEATH AND/OR PROPERTY DAMAGE. Retain these instructions for future reference. This product, when installed, will be part of an engineered system whose specifications and performance characteristics are not designed or controlled by PECO. You must review your application and national and local codes to assure that your installation will be functional and safe.

Even though this thermostat is sealed, water or dust could enter through improperly sealed wiring. A drip loop should be provided to prevent water and other liquids from entering the thermostat housing. The cord or conduit connections to the enclosure must be water and dust tight. The cover must be tightened securely to compress the gasket and provide a watertight seal. Use only screws provided. Do not over-tighten.

Maximum sensing element withstand temperature is 35°F (20°C) above the highest temperature setting. Maximum temperature for the plastic enclosure is 140°F 60°C.

#### CAUTION

For use in wet or humid environments or where water tightness is required, failure to use suitable watertight connections and suitable drip loop could allow water to enter the enclosure resulting in thermostat failure.

Use copper wire only. Insulate or wire-nut all unused leads.

Use the grounding provisions provided for connection to the line ground and equipment ground wire.

#### OPERATION AND CHECK-OUT

Allow one hour or necessary amount of time for the thermostat and system to stabilize for normal operation. This thermostat is factory calibrated and requires no correction on site.

#### TO CHECK OPERATION OF HEATING SYSTEMS:

1. Disconnect power.
2. Place the heat/cool selector switch, if applicable, in the heat position.
3. Adjust the thermostat set point to at least 10°F (5°C) below the temperature of the controlled space.
4. Restore power.
5. Slowly adjust the thermostat knob to raise the set point. When the set point reaches the approximate temperature of the controlled space, the heating equipment should start.

#### TO CHECK OPERATION OF COOLING SYSTEMS:

1. Disconnect power.
2. Place the heat/cool selector switch, if applicable, in the cool position.
3. Adjust the thermostat set point to at least 10°F (5°C) above the temperature of the controlled space.
4. Restore power.
5. Slowly adjust the thermostat knob to lower the set point. When the set point reaches the approximate temperature of the controlled space, the cooling equipment should start.

#### LIMITED WARRANTY

1. **WARRANTY COVERAGE.** PECO warrants to the original user of its products that the products will, at the date of initial purchase, meet the applicable specification for such products and will be free from any defects in materials or manufacture under normal use for 18 months after date of manufacture.
2. **DISCLAIMER OF WARRANTY OF PRODUCT SUITABILITY.** PECO makes no warranty to the purchaser or any third party that its products are suitable for a particular application or design. Many states and localities have differing codes or regulations governing the installation and/or use of PECO products. PECO cannot guarantee compliance with such regulations; purchaser is solely responsible for safe and correct installation and use of the product and for compliance with applicable codes and regulations.
3. **EXCLUSION OF IMPLIED WARRANTIES.** This warranty is the only warranty applicable to this product and excludes all other warranties, including any WARRANTY OF MERCHANTABILITY, any warranty of fitness for a particular purpose, and any implied warranties otherwise arising from course of dealing or usage of trade, except where the product purchased is subject to consumer product warranty laws, in which case ANY APPLICABLE IMPLIED WARRANTIES ARE LIMITED TO 18 MONTHS, or such shorter period as permitted or required under applicable law. Some States do not allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you.
4. **REMEDIES FOR NONCONFORMITY.** If the product purchased does not conform to the applicable warranty, PECO will provide, at its option and in accordance with the procedures in the following section, one of the following remedies: (1) repair of the nonconforming product, (2) replacement with a conforming product, (3) refund of the original purchase price, THESE REMEDIES SHALL BE THE EXCLUSIVE AND SOLE REMEDY for any breach of warranty.
5. **TO OBTAIN WARRANTY SERVICE.** For any product believed to be defective within the limited warranty period, first write or call dealer from whom product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to PECO at the address below, giving dealer's name, address, date and number of dealer's invoice, and describe the nature of the defect.
6. **LIMITATION OF LIABILITY.** PECO WILL NOT BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES resulting from any defect in the product purchased. Some States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

Manufactured by PECO, Inc.  
4709 SE 18th Avenue - Portland, OR 97202 - USA  
P.O. Box 82189 - Portland, OR 97282 - USA



## ⚠ ADVERTENCIA

LEALAS INSTRUCCIONES CUIDADOSAMENTE ANTES DE TRATAR DE INSTALAR, OPERAR O HACER EL SERVICIO EN ESTE TERMOSTATO.

Si no se observa la información de seguridad y si no se siguen las instrucciones se pueden producir LESIONES PERSONALES, LA MUERTE Y/O DAÑO A LA PROPIEDAD. Guarde estas instrucciones para referencia en el futuro. Cuando este producto se instale, formará parte de un sistema de ingeniería cuyas especificaciones y características de rendimiento no han sido diseñadas ni son controladas por PECO. Es necesario que estudie su aplicación y los códigos locales y nacionales para asegurarse que su instalación funcionará bien y es segura.

### APLICACION CORRECTA

Este termostato ha sido probado por CSA y por Underwriters Laboratories Inc. (UL), cumple con los requisitos del equipo NEMA 4X y es adecuado para usarse según el Artículo 547-4 del National Electrical Code (NEC), cuando se usa con los conectores impermeables correctos (no vienen incluidos).

### INSTALACION

## ⚠ ADVERTENCIA

Para evitar el choque eléctrico o el daño en el equipo, desconecte toda la energía antes de instalarlo o de hacerle el servicio. Para evitar incendios potenciales y/o la explosión, no lo use en atmósferas potencialmente inflamables o explosivas.

Una persona calificada y capacitada en el servicio tiene que hacer la instalación, según el National Electrical Code (NEC) y según todos los códigos y regulaciones locales. La instalación tiene que cumplir con todos los códigos nacionales, estatales y locales aplicables. Refiérase al diagrama del cableado apropiado que viene incluido.

Ubique el termostato (modelos sensores locales) o la bombilla sensora (modelos sensores remotos) para lograr una percepción óptima de la temperatura del espacio controlado. La operación del termostato se verá afectada por el calor o el frío fuera de lo común, tal como la luz directa del sol, cerca de las ventanas o puertas o en las paredes exteriores.

Todos los accesorios y los materiales que se usan para la instalación tienen que ser aprobados, adecuados y ser instalados correctamente para la aplicación que se les va a dar. El sello del cordón o el cubo del conductor deben estar en la lista de UL y tienen que estar marcados 4X para lograr que sean impermeables. El cubo del conductor tiene que estar apretado en éste antes de instalarlo en la caja.

Cuando sea aplicable, remueva el(los) disco(s) removible(s) golpeando cerca del borde interior del disco removible que se removerá. **IMPORTANTE:** no golpee, ni abolle, ni doble, ni use el sensor como soporte. Esto hará fallar la calibración y/o el termostato.

## ⚠ ADVERTENCIA

Para prevenir el sobrecalentamiento o los incendios, use este control solamente como un termostato de operación o regulador. SIEMPRE USE UN CONTROL DE REFUERZO O UNA ALARMA en los casos cuando el artefacto controlado se puede sobrecalentar o se puede producir un incendio si el control falla. Cuando el termostato puede pasar por el ciclo directamente entre las cargas de calefacción y las de enfriamiento, si no se proporciona un interruptor de transferencia de carga, el termostato puede fallar. No instale, ni use, ni opere el producto si parece dañado, si la caja está partida o rota o si el sensor se ha doblado, plegado o está sucio.

A pesar de que el termostato está sellado, el agua o el polvo podrían entrar a través del cableado mal sellado. Se tiene que proporcionar un ojal de goteo para impedir que el agua u otros líquidos entren en la caja del termostato. Las conexiones del cordón o del conductor que van a la caja tienen que ser impermeables y a prueba de polvo. La cubierta tiene que estar apretada en forma segura para comprimir la empaquetadura y proporcionar el sello impermeable. Use solamente los tornillos que vienen incluidos. No los apriete demasiado.

La temperatura máxima que puede soportar el elemento sensor es 20°C (35°F) sobre el ajuste de temperatura más alto. La temperatura máxima para la caja de plástico es 60°C (140°F).

## ⚠ PRECAUCION

Para usarlo en ambientes mojados o húmedos o en donde se necesita que sea impermeable, si no se usan las conexiones impermeables correctas y el ojal de goteo correcto, el agua podría entrar en la caja haciendo que el termostato falle. Use cables de cobre solamente, aisle o ponga tuercas de cables en todos los conductores que no están en uso. Use las estipulaciones para la conexión a tierra que vienen incluidas para la conexión a tierra de la línea y con el cable de conexión a tierra del equipo.

### OPERACION Y REVISION

Permita una hora o el tiempo necesario para que el termostato y el sistema se establezcan para la operación normal. Este termostato ha sido calibrado en la fábrica y no necesita corregirse en el lugar en donde se va a usar.

#### COMO REVISAR LA OPERACION DE LOS SISTEMAS DE CALEFACCION:

1. Desconecte la energía.
2. Ponga el interruptor selector de calefacción/enfriamiento, si es aplicable, en la posición de calefacción.
3. Ajuste el punto de control del termostato a por lo menos 5°C (10°F) por debajo de la temperatura del espacio controlado.
4. Vuelva a conectar la energía.
5. Lentamente ajusté la manilla del termostato para elevar el punto de control. Cuando el punto de control alcance la temperatura aproximada del espacio controlado, el equipo de calefacción debería arrancar.

#### COMO REVISAR LA OPERACION DE LOS SISTEMAS DE ENFRIAMIENTO:

1. Desconecte la energía.
2. Ponga el interruptor de calefacción/enfriamiento, si es aplicable en la posición de enfriamiento.
3. Ajuste el punto de control del termostato a por lo menos 5°C (10°F) sobre la temperatura del espacio controlado.
4. Vuelva a conectar la energía.
5. Ajuste lentamente la manilla del termostato para bajar el punto de control. Cuando el punto de control alcance la temperatura aproximada del espacio controlado, el equipo de enfriamiento debería arrancar.

### GARANTIA LIMITADA

1. COBERTURA DE LA GARANTIA. PECO le garantiza al usuario original de sus productos, que en la fecha de la compra inicial, cumplen con las especificaciones aplicables y no tendrán defectos ni en los materiales ni en la fabricación, si se someten al uso normal, por 18 meses después de la fecha de fabricación.

2. DECLINACION DE RESPONSABILIDAD DE LA GARANTIA POR LA ADAPTACION DEL PRODUCTO. PECO no le garantiza al comprador, ni a terceros, que sus productos se adaptan a una aplicación o diseño en particular. Muchos estados y jurisdicciones cuentan con códigos o regulaciones diferentes que gobiernan la instalación y/o el uso de los productos de PECO. PECO no puede garantizar que se cumplan dichas regulaciones; el comprador es el único responsable por la instalación segura y correcta, por el uso del producto y por el cumplimiento con los códigos y regulaciones aplicables.

3. EXCLUSION DE LAS GARANTIAS IMPLICITAS. Esta garantía es la única que se aplica a este producto y se excluyen todas las demás garantías. Incluyéndose toda GARANTIA DE COMERCIALIZACION, cualquier garantía de adecuación para un propósito en particular y cualquier garantía implícita que de alguna otra forma se presente en el curso de las transacciones o uso comercial, excepto en el caso cuando el producto comprado esté sujeto a las leyes de las garantías del producto, en cuyo caso TODA GARANTIA IMPLICITA APLICABLE QUEDA LIMITADA A 18 MESES, o a un período de tiempo más corto, según lo permita o lo exija la ley aplicable.

Algunos estados no permiten limitaciones en cuanto a la duración de las garantías implícitas, de modo que las limitaciones anteriores pueden que no se apliquen en su caso.

4. RECURSOS EN EL CASO DE DISCONFORMIDAD. Si el producto comprado no está de acuerdo con la garantía aplicada, PECO proporcionará, a su discreción, y según los procedimientos de la sección siguiente, uno de los recursos siguientes: (1) reparación del producto en disconformidad, (2) lo cambiará por uno conforme, (3) reembolsará el precio de compra original. ESTOS RECURSOS SERAN LOS UNICOS Y EXCLUSIVOS en el caso de cualquier violación de la garantía.

5. COMO OBTENER SERVICIO DEBIDO A LA GARANTIA. En el caso de que se crea que cualquier producto tenga defectos, dentro del período cubierto por la garantía limitada, primero escriba o llame al distribuidor a quien se le compró el producto. El distribuidor le dará las instrucciones adicionales. Si no se puede resolver la situación en forma satisfactoria, escriba a PECO a la dirección a continuación, dando el nombre y la dirección del distribuidor, la fecha y el número de la factura del distribuidor y describa la naturaleza del defecto.

6. LIMITACION DE RESPONSABILIDAD. PECO NO SERA RESPONSABLE POR DAÑOS CONCOMITANTES, ESPECIALES, INDIRECTOS O EMERGENTES que surjan por cualquier defecto del producto comprado. Algunos estados no permiten la exclusión o la limitación de los daños concomitantes o emergentes, de modo que la limitación o exclusión anteriores pueden que no se apliquen en su caso.

Esta garantía le otorga derechos legales específicos y puede que también tenga otros derechos que varían de Estado a Estado.

Fabricado por PECO, Inc.

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## AVERTISSEMENT

LIRE ATTENTIVEMENT LES INSTRUCTIONS AVANT DE COMMENCER À INSTALLER, UTILISER OU FAIRE LE SERVICE DE CE THERMOSTAT. Négliger d'observer les conseils de sécurité et d'appliquer les instructions peut être la cause de BLESSURES CORPORELLES, MORT ET/OU DOMMAGES MATÉRIELS. Conserver ces instructions pour références ultérieures. Quand il est installé, cet appareil fera partie d'un système industriel dont les spécifications et les caractéristiques de rendement ne sont pas conçues ou contrôlées par PECO. L'application et les codes nationaux et locaux doivent être revus pour assurer que l'installation sera fonctionnelle et sans danger.

### APPLICATION APPROPRIÉE

Ce thermostat qui a été soumis aux tests de CSA et de Underwriters Laboratory, Inc. (UL) est en accord avec les conditions requises pour les équipements NEMA 4X et est acceptable pour usage sous les normes National Electrical Code (NEC), Article 547-4, quand utilisé avec les connecteurs étanches appropriés (pas inclus).

### INSTALLATION

## AVERTISSEMENT

Pour éviter les chocs électriques ou les dommages matériels, débrancher l'alimentation électrique avant d'installer ou de faire le service. Pour éviter un incendie et/ou une explosion possible, ne pas utiliser dans un environnement potentiellement inflammable ou explosif.

L'installation doit être faite par un technicien de service qualifié et être en accord avec le National Electrical Code (NEC) et tous les codes nationaux et locaux applicables. Se reporter au diagramme de câblage approprié inclus.

Situer le thermostat (modèles à détection sur place) ou la sonde (modèles à détection éloignée) pour obtenir une détection optimum de la température de l'espace contrôlé. Le fonctionnement du thermostat est affecté par une chaleur ou un froid inhabituel, tel que l'exposition directe au soleil, près d'une fenêtre, un porte ou un mur extérieur.

Tous les raccords et matériaux utilisés pour l'installation doivent être approuvés, adaptés et correctement installés en fonction de l'application prévue. Pour l'étanchéité, le joint du câble ou raccord de conduit doit être classé UL et être marqué 4X. Le raccord de conduit doit être fixé sur le conduit avant de l'installer dans le boîtier.

Si applicable, les parties éjectables doivent être retirées par impact près du bord intérieur de la partie éjectable qui doit être retirée. IMPORTANT: NE PAS TAPER, ÉBRÉCHER, TORDRE OU UTILISER LA SONDE COMME SUPPORT. CECI CAUSERAIT LA DÉFAILLANCE DU CALIBRAGE ET/OU DU THERMOSTAT. SONDE COMME SUPPORT. CECI CAUSERAIT LA DÉFAILLANCE DU CALIBRAGE ET/OU DU THERMOSTAT.

## AVERTISSEMENT

Pour éviter la surchauffe ou le feu, utiliser ce contrôle uniquement comme un thermostat de fonctionnement ou de réglage. TOUJOURS UTILISER UN CONTRÔLE OU UNE ALARME DE REDONDANCE si une défaillance du contrôle pourrait causer la surchauffe de l'appareil contrôlé ou pourrait causer un incendie. Si le thermostat est capable d'entrer en cycle directement entre des charges de chauffage et de refroidissement, négliger d'installer un commutateur de transfert de charge résultera en défaillance du thermostat. Ne pas installer, utiliser ou faire fonctionner si l'appareil semble endommagé, si le boîtier est fendu ou cassé, ou si la sonde a été tordue, pilée ou est sale.

Bien que ce thermostat soit scellé, l'eau ou la poussière peuvent y entrer par un câblage mal étanchéifié. Une boucle d'égouttage doit être prévue pour empêcher l'eau ou tout autre liquide d'entrer dans le boîtier du thermostat. La connexion de câble ou de conduit avec le boîtier doit être hermétique à l'eau et à la poussière. Le couvercle doit être solidement fixé pour compresser le joint et créer l'étanchéité. Utiliser uniquement les vis fournies. Ne pas surser. L'élément de sonde maximum peut supporter une température de 20°C (35°F) au-dessus du réglage de la plus haute température. La température maximum pour le boîtier plastique est de 60°C (140°F).

## ATTENTION

Pour usage dans un environnement mouillé ou humide ou si l'étanchéité est requise, négliger d'utiliser des connexions adaptées pour l'étanchéité et une boucle d'égouttage appropriée pourrait permettre la pénétration d'eau dans le boîtier et causer la défaillance du thermostat.

Utiliser uniquement des fils de cuivre, isoler ou placer sous cônes d'isolation tous les conducteurs inutilisés. Utiliser les bornes de mise à la terre prévues pour connexion sur la ligne de prise de terre et le fil de terre de l'équipement.

### FONCTIONNEMENT ET VÉRIFICATION

Attendre une heure ou la période de temps nécessaire pour que le système et le thermostat se stabilisent sur un fonctionnement normal. Ce thermostat a été calibré à l'usine et il ne nécessite aucun ajustement sur place.

### POUR VÉRIFIER LE FONCTIONNEMENT DES SYSTÈMES DE CHAUFFAGE:

1. Débrancher l'alimentation électrique
2. Si applicable, place le sélecteur chaud/froid sur la position "chaud".
3. Ajuster le réglage du thermostat sur un point au moins 5°C (10°F) au-dessous de la température de l'espace contrôlé.
4. Rebrancher l'alimentation électrique.
5. Ajuster lentement la molette du thermostat pour monter le point de réglage. Quand le point de réglage atteint la température approximative de l'espace contrôlé, l'équipement de chauffage doit se mettre en marche.

### POUR VÉRIFIER LE FONCTIONNEMENT DES SYSTÈMES DE REFOUILLISSEMENT:

1. Débrancher l'alimentation électrique.
2. Si applicable, placer le sélecteur chaud/froid sur la position "froid".
3. Ajuster le réglage du thermostat sur un point au moins 5°C (10°F) au-dessous de la température de l'espace contrôlé.
4. Rebrancher l'alimentation électrique.
5. Ajuster lentement la molette du thermostat pour descendre le point de réglage. Quand le point de réglage atteint la température approximative de l'espace contrôlé, l'équipement de climatisation doit se mettre en marche.

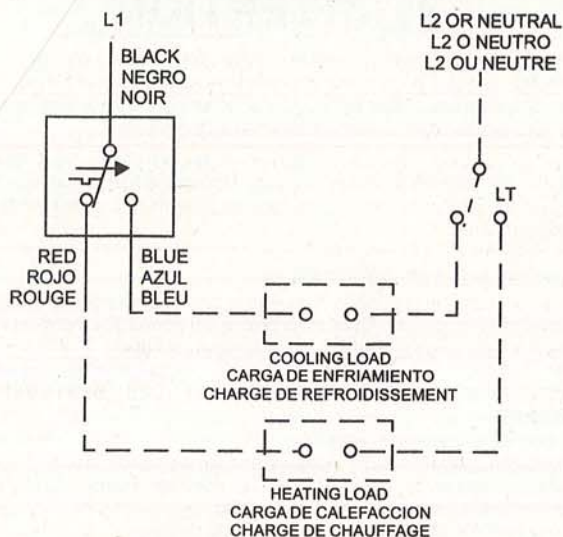
### GARANTIE LIMITÉE

1. COUVERTURE GARANTIE. PECO garantit au premier utilisateur de ses produits, que les produits sont, à la date de l'achat initial, en accord avec les spécifications applicables pour ces productions et seront, sous usage normal, sans défauts de matières premières ou de main d'œuvre pendant 18 mois à partir de la date de fabrication.
2. DÉSISTEMENT DE GARANTIE D'APTITUDE DU PRODUIT. PECO ne donne aucune garantie à l'acheteur ou à toute autre tierce personne concernant l'adaptabilité de ses produits pour une application ou une conception particulière. De nombreuses juridictions ont des codes différents ou des règlements gouvernant l'installation et/ou l'usage des produits de PECO. PECO ne peut pas garantir l'observance de ces règlements, l'acheteur est seul responsable de l'installation et de l'usage correct et sans danger de ce produit ainsi que de l'observance des codes et règlements applicables.
3. EXCLUSION DE GARANTIES IMPLIQUÉES. Cette garantie est la seule applicable à ce produit, et elle exclut toutes autres garanties, compris toute GARANTIE DE COMMERCIALISATION, toute garantie d'adaptabilité à un usage particulier, et toutes garanties impliquées au cours de transactions commerciales, sauf là où le produit acheté est soumis aux lois de garantie de produit aux consommateurs, dans tous les cas TOUTES GARANTIES IMPLIQUÉES APPLICABLES SONT LIMITÉES À 18 MOIS, ou à une période Plus courte si permise ou requise par la loi applicable. Certaines juridictions ne permettent de limitations de la durée de la garantie, donc les limitations ci-dessus peuvent ne pas s'appliquer dans le cas présent.
4. REMÈDES CONTRE L'ANON-CONFORMITÉ. Si le produit acheté n'est pas conforme à la garantie applicable, PECO fournira, à son choix et en accord avec le processus de la section suivante, l'un des remèdes suivants: (1) réparation du produit non-conforme. (2) remplacement par un produit conforme. (3) remboursement du prix d'achat d'origine. CES REMÈDES SERONT LES REMÈDES SEULS ET EXCLUSIFS pour toute infraction à la garantie.
5. POUR OBTENIR LE SERVICE SOUS GARANTIE. Pour tout produit considéré défectueux au cours de la période couverte par la garantie, commencer par écrire ou appeler le concessionnaire chez qui le produit a été acheté. Le concessionnaire doit donner des directions additionnelles. Si un accord satisfaisant ne peut pas être obtenu, écrire à PECO à l'adresse ci-dessous, en donnant le nom et l'adresse du concessionnaire, la date et le numéro de la facture du concessionnaire et en décrivant la nature du défaut.
6. LIMITATION DE RESPONSABILITÉ. PECO NE SERA PAS RESPONSABLE DE TOUTS DOMMAGES IMPRÉVUS, SPÉCIAUX, INDIRECTS OU FORTUITS résultant d'un produit acheté défectueux. Certaines juridictions ne permettent pas l'exclusion ou la limitation des dommages indirects ou fortuits, donc la limitation ou exclusion ci-dessus peut ne pas s'appliquer dans le cas présent.

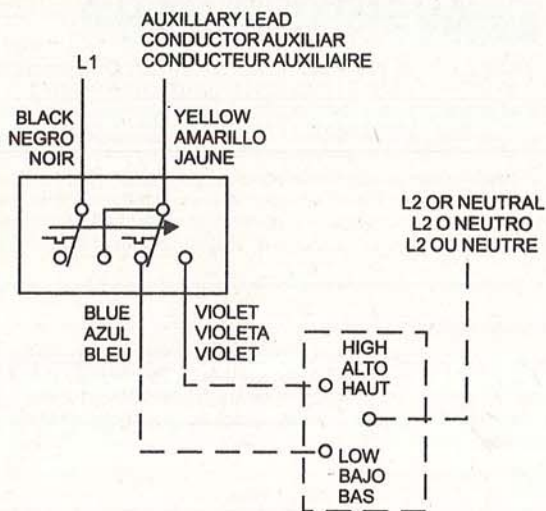
Cette garantie donne des droits légaux spécifiques, et il peut y avoir d'autres droits variants de juridiction à juridiction.

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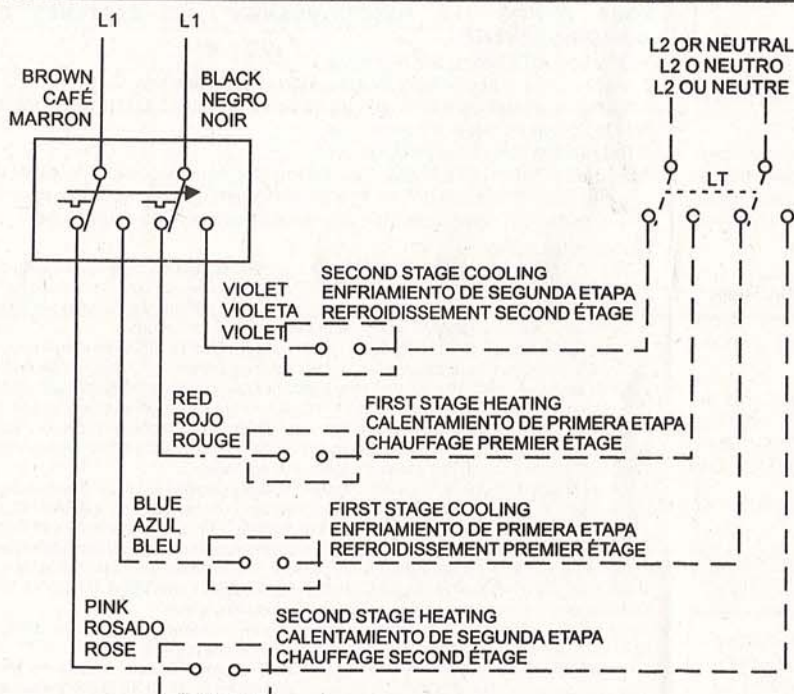




**T115 TA119 TC109 TC119**



**TJ109 MODELS**



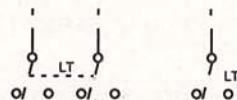
**TH109**

**LEGEND  
LEYENDA  
LÉGENDE**

THERMOSTAT WIRING  
CABLEADO DEL TERMOSTATO  
CABLAGE DU THERMOSTAT

FIELD WIRING  
CABLEADO EN EL TERRENO  
CABLAGE SUR PLACE

INDICATES SEQUENCE ON  
TEMPERATURE RISE  
INDICA LA SECUENCIA CUANDO LA  
TEMPERATURA SE  
INDIQUE LA SE SÉQUENCE DE LA MONTÉE  
DE TEMPÉRATURE



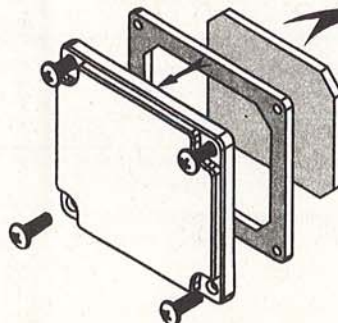
LOAD TRANSFER SWITCH  
INTERRUPTOR DE TRANSFERENCIA DE CARGA  
INTERRUPTEUR DE TRANSFERT DE CHARGE

**WARNING  
ADVERTENCIA  
AVERTISSEMENT**

-TO INSURE WATER TIGHTNESS, THE ENCLOSED GASKET MUST BE INSTALLED UNDER THE WIRING CAP.

-PARA ASEGURAR LA ESTANQUIDAD AL AGUA, LA JUNTA SUMINISTRADA DEBERÁ INSTALARSE DEBAJO DEL CASQUETE DEL ALAMBRADO.

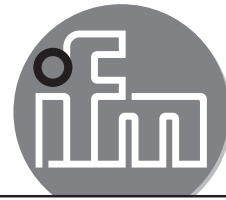
-POUR ASSURER L'ÉTANCHÉITÉ À L'EAU, LE JOINT STATIQUE (FOURNI) DOIT ÊTRE INSTALLÉ SOUS LE CULOT POUR CÂBLAGE.



-REMOVE AND DISCARD  
THE CENTER OF THE GASKET  
-EXTRAIGA Y DESCARTE  
LA PARTE CENTRAL DE LA JUNTA  
-ENLEVER LE CENTRE DU  
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ifm electronic



VT-701/ 702 - Transmitter, Pressure/ Vacuum, IFM efector, PG2409 Scale -14.5- 14.5 PSI 4-20mA



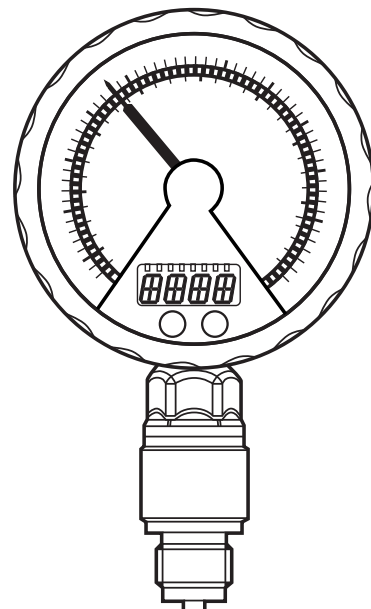
Operating instructions  
Electronic manometer

**efector500®**

**PG24xx**

**UK**

706086/00 08/2011



E-1375



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## 1 Preliminary note

### 1.1 Symbols used

- Instruction
- > Reaction, result
- [...] Designation of pushbuttons, buttons or indications
- Cross-reference
-  Important note  
Non-compliance can result in malfunctions or interference.
-  Information  
Supplementary note.

## 2 Safety instructions

- Please read this document prior to set-up of the unit. Ensure that the product is suitable for your application without any restrictions.
- If the operating instructions or the technical data are not adhered to, personal injury and/or damage to property can occur.
- Check the compatibility of the product materials (→ 12 Technical data) with the media to be measured in all applications.
- Use in gases at pressures > 25 bar only after contacting the manufacturer ifm.



- High-pressure units (250 bar, 400 bar) are supplied with an integrated damping device to comply with the regulations for UL approval and to avoid any risk of injury in case of bursting when bursting pressure is exceeded.



Any manipulation of the damping device is not permissible.

When the damping device is removed, there is no damping function any more. ATTENTION: risk of injury!

For units with cULus approval this approval becomes invalid when the damping device is removed.

For the scope of validity cULus:

The Sensor shall be connected only by using any R/C (CYJV2) cord, having suitable ratings.

The device shall be supplied from an isolating transformer having a secondary Listed fuse rated either

a) max 5 amps for voltages 0~20 Vrms (0~28.3 Vp) or

b) 100/Vp for voltages of 20~30 Vrms (28.3~42.4 Vp).

## 3 Functions and features

The unit monitors the system pressure in a plant.

### 3.1 Applications

Type of pressure: relative pressure

Order no.	Measuring range (in brackets: extended display range)		Permissible overpressure		Bursting pressure	
	bar	PSI	bar	PSI	bar	PSI
PG2409	-1...1 (1.6)	-14.52...14.52 (23.22)	10	145	30	435
PG2450	0...400 (600)	0...5800 (8700)	800	11600	1200	17400
PG2451	0...250 (400)	0...3625 (5800)	600	8700	1000	14500
PG2452	0...100 (160)	0...1449 (2322)	300	4350	700	9400
PG2453	-1...25 (40)	-14.5...362.5 (580.0)	100	1450	350	5070
PG2454	-1...10 (16)	-14.4...145 (232)	50	725	150	2175
PG2455	-1...4 (6.4)	-14.5...58 (92.8)	30	435	100	1450
PG2456	-0.125...2.5 (4)	-1.8...36.25 (58.00)	20	290	50	725
PG2457	-0.05...1 (1.6)	-0.72...14.5 (23.20)	10	145	30	435



Order no.	Measuring range (in brackets: extended display range)		Permissible overpressure		Bursting pressure	
	mbar	inH2O	bar	inH2O	bar	inH2O
PG2458	-12.5...250 (400)	-5.0..100.4 (160.6)	10	4015	30	12044
PG2489	-5...100 (160)	-2.00...40.16 (64.24)	4	1606	30	12044



Avoid static and dynamic overpressure exceeding the given overload pressure by taking appropriate measures.

The indicated bursting pressure must not be exceeded.

Even if the bursting pressure is exceeded only for a short time, the unit may be destroyed. ATTENTION: risk of injury!

Use in gases at pressures > 25 bar only after contacting the manufacturer ifm.

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## 4 Function

### 4.1 Processing of the measured signals

- The unit generates 2 output signals according to the parameter settings.

<b>OUT1</b>	• Switching signal for system pressure limit value.
<b>OUT2</b>	• Analogue signal (4...20 mA, 20...4 mA).

- The unit displays the current system pressure.

Analogue display: circular scale with pointer.
Digital display (alphanumeric display, 4 digits).

- In addition, an LED ring with one of the following display options is available:

Display of set point and reset point.
Trend display (rising pressure / falling pressure).
Lag indicator function for maximum value or minimum value.
Display of pulsating signals and pressure peaks.



## 4.2 Pressure monitoring / switching function

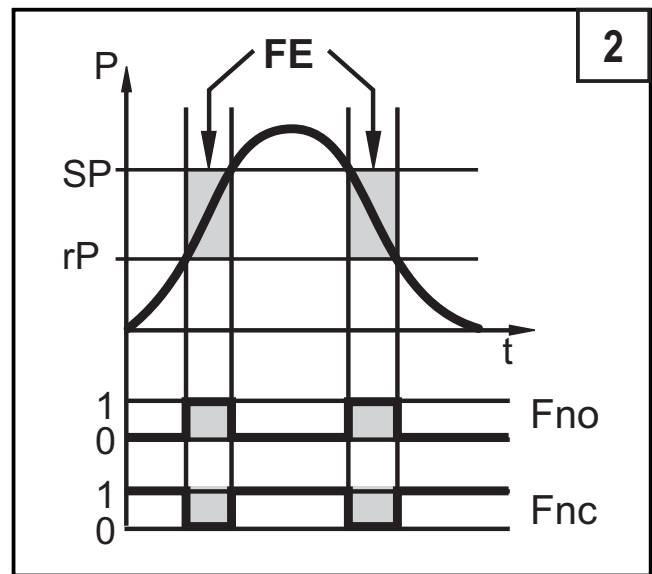
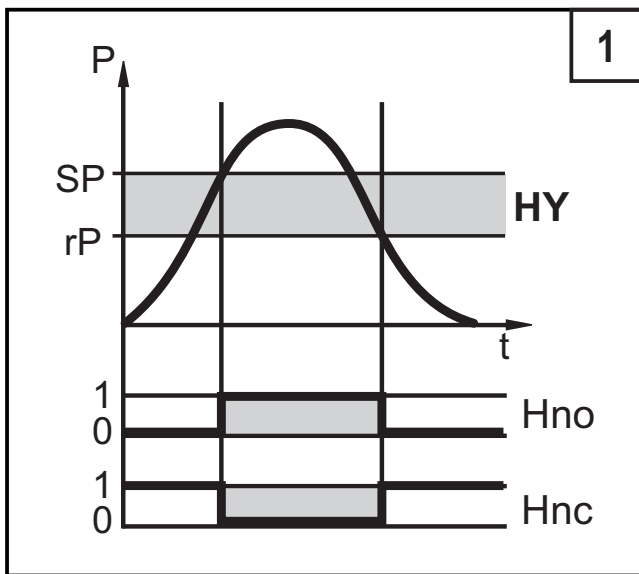
OUT1 changes its switching state if it is above or below the set switching limits (SP1, rP1). The following switching functions can be selected:

- Hysteresis function / normally open: [OU1] = [Hno] (→ fig. 1).
- Hysteresis function / normally closed: [OU1] = [Hnc] (→ fig. 1).

First the set point (SP1) is set, then the reset point (rP1) with the requested difference.

- Window function / normally open: [OU1] = [Fno] (→ fig. 2).
- Window function / normally closed: [OU1] = [Fnc] (→ fig. 2).

The width of the window can be set by means of the difference between SP1 and rP1. SP1 = upper value, rP1 = lower value.



P = system pressure; HY = hysteresis; FE = window



### 4.3 Pressure monitoring / analogue function

The analogue output can be configured.

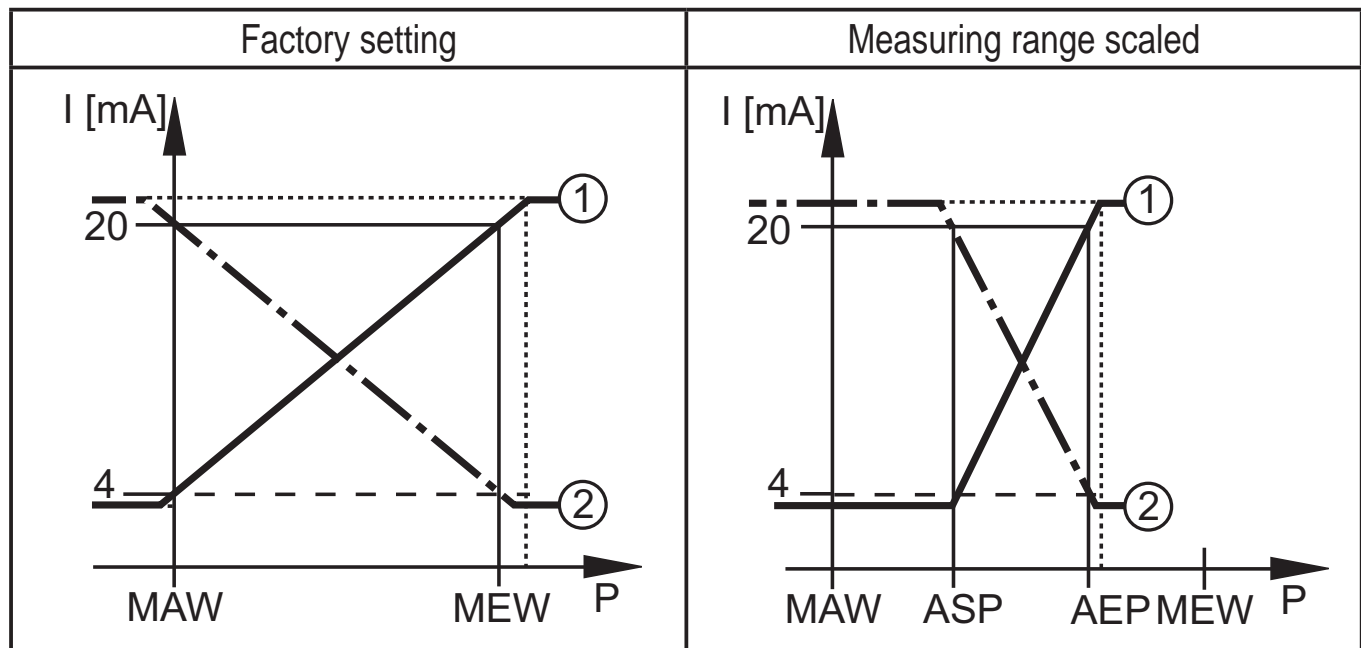
- [OU2] defines whether the set measuring range is provided as 4...20 mA ([OU2] = [I]) or as 20...4 mA ([OU2] = [InEG]).

Scaling can be set by means of the teaching process or by entering a value for the ASP and AEP parameters.

- Teaching the analogue start point [tASP] or setting the parameter [ASP] defines at which measured value the analogue signal is 4 mA (20 mA at [InEG]).
- Teaching the analogue end point [tAEP] or setting the parameter [AEP] defines at which measured value the output signal is 20 mA (4 mA at [InEG]).

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Minimum distance between [ASP] and [AEP] = 25 % of the final value of the measuring range.



P = system pressure , MAW = initial value of the measuring range, MEW = final value of the measuring range

①: [OU2] = [I]; ②: [OU2] = [InEG]

In the set measuring range the output signal is between 4 and 20 mA ([OU2] = [I]) or between 20 and 4 mA ([OU2] = [InEG]).

It is also indicated:

- System pressure above the measuring range:
  - Output signal 20 to 20.5 mA at [OU2] = [I].
  - Output signal 4 to 3.8 mA at [OU2] = [InEG].
- System pressure below the measuring range:
  - Output signal 4 to 3.8 mA at [OU2] = [I].
  - Output signal 20 to 20.5 mA at [OU2] = [InEG].

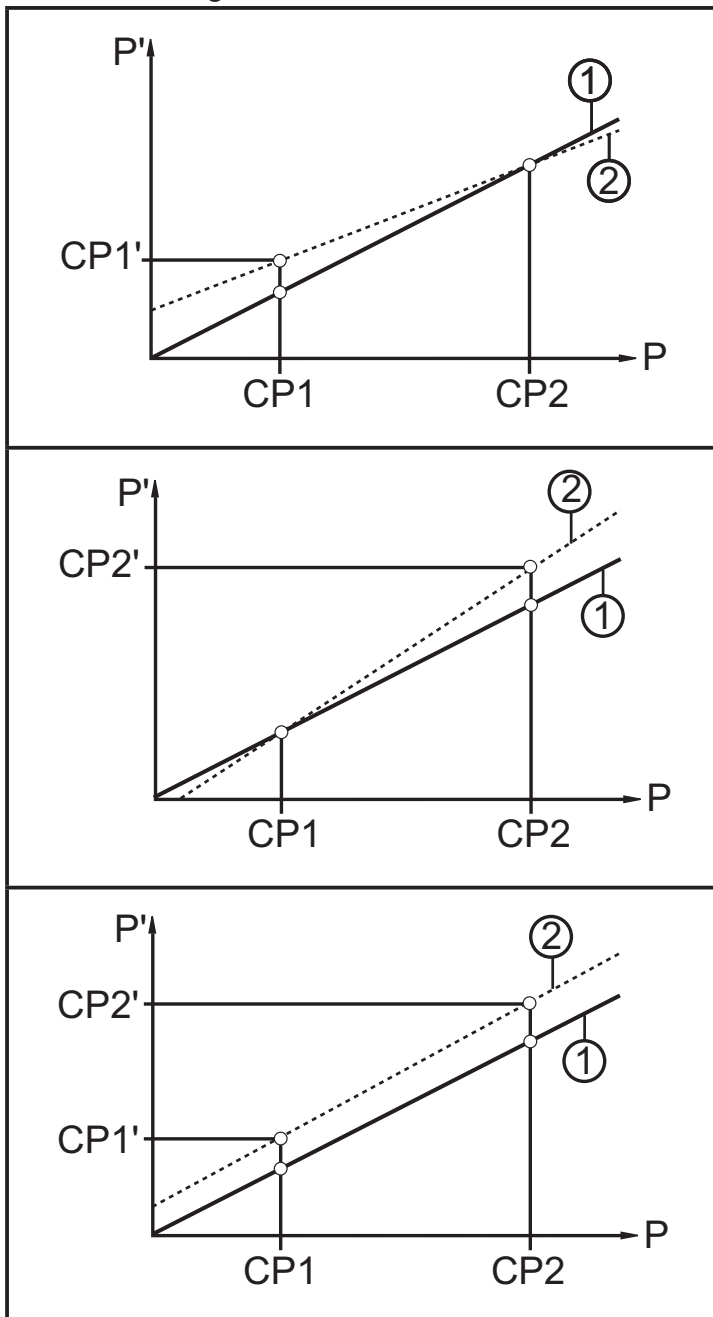


## 4.4 Customer-specific calibration

The customer-specific calibration changes the curve of measured values compared to the real measured values (shifting / change of the gradient; → 9.4.6 [CAL]).

- Two calibration points can be defined (CP1, CP2). The two points are independent of each other. They must be within the measuring range and not in the extended display range.
- The zero point calibration [COF] influences the calibration of the curve of measured values. Recommendation: set [COF] to 0 (→ 9.4.1 [COF]), then calibrate the curve of measured values.

After a change the calibration can be reset to factory setting (→ 9.5.2 [rES]).



- $P$  = measured pressure;  
 $P'$  = modified measured value
- CP1 = calibration point 1;  
CP1' = modified measured value for CP1
- CP2 = calibration point 2;  
CP2' = modified measured value for CP2
- 1 = curve of measured values at factory setting
- 2 = curve of measured values after calibration



## 5 Installation



Before installing and removing the unit: make sure that no pressure is applied to the system. Note: If 0% is displayed and no pointer is visible, this does not mean that no pressure is applied to the system !

We recommend horizontal installation for high medium temperatures.

The unit can be fixed to different process connections. Options are as follows:

1	<b>Installation with seals to DIN EN 837-1</b> <ul style="list-style-type: none"> <li>▶ Insert the unit and the seal into the process connection with cylindrical pipe thread G<math>\frac{1}{2}</math> and tighten.</li> </ul> <p>All seals to DIN EN 837-1 can be used if they are suitable for process connections with cylindrical pipe thread, e.g. flat seals or double-edge sealing rings.</p>
2	<b>Installation with sealing tape</b> <ul style="list-style-type: none"> <li>▶ Insert the unit and the sealing tape into the process connection with G<math>\frac{1}{2}</math> internal thread (e.g. welding adapter) and tighten.</li> </ul>
3	<b>Installation at flange G<math>\frac{1}{2}</math> (based on DIN 3852-11)</b> <p>The sealing ring on the sensor is used as process seal. The upper sealing area on the process connection must be flush with the tapped hole and have a surface characteristic of min. Rz 6.3.</p> <ul style="list-style-type: none"> <li>▶ Grease the sensor thread with a suitable paste.</li> <li>▶ Insert the unit into the process connection.</li> <li>▶ Tighten it using a spanner. Tightening torque: 35 Nm.</li> </ul>

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After installation the analogue display can be rotated / adapted to the installation position (to do so wear protective gloves).



## 6 Electrical connection

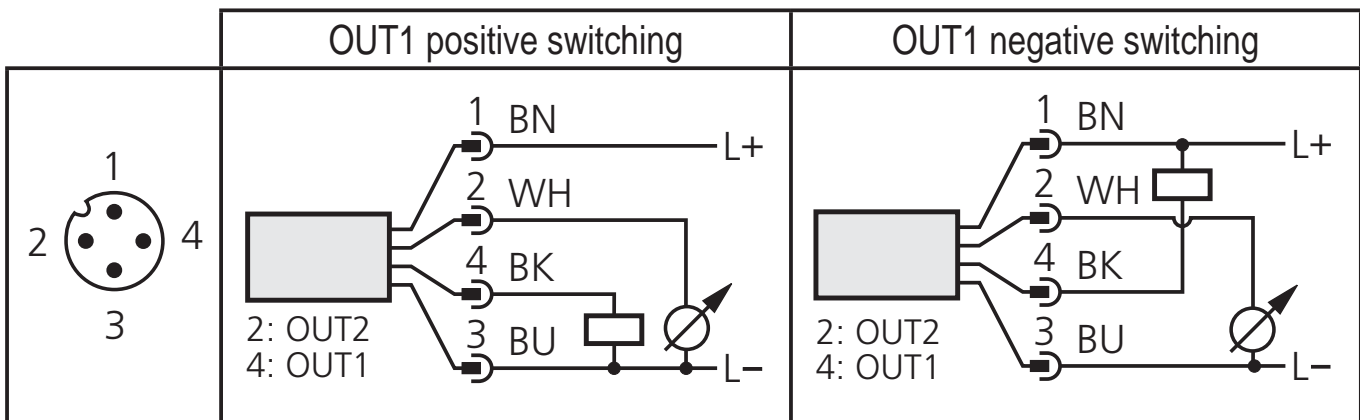


The unit must be connected by a qualified electrician.

The national and international regulations for the installation of electrical equipment must be adhered to.

Voltage supply according to EN 50178, SELV, PELV.

- Disconnect power.
- Connect the unit as follows:



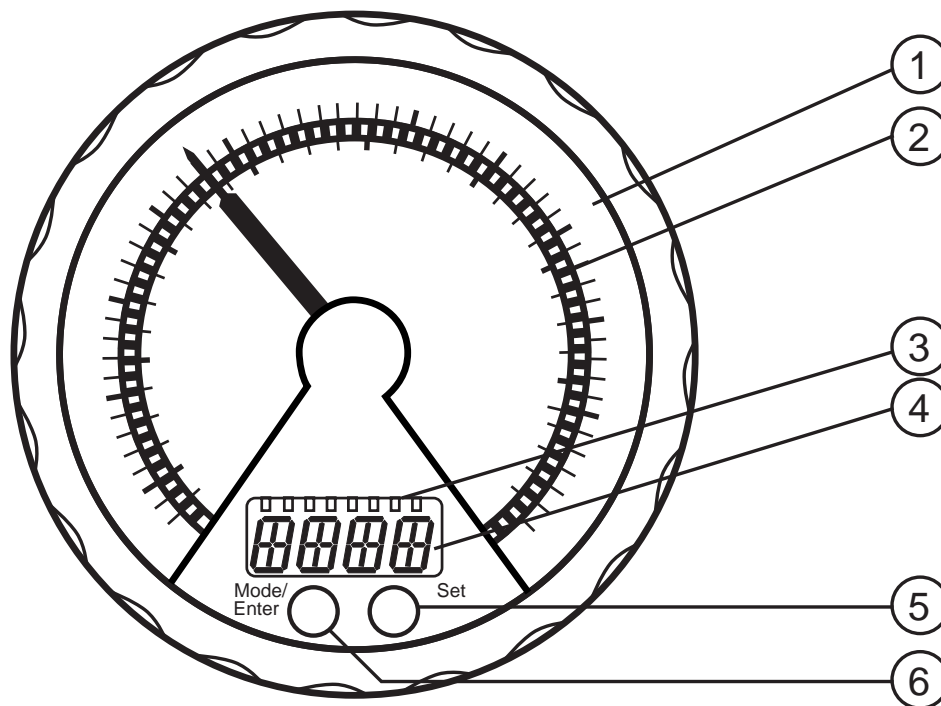
<b>Pin 1</b>	Ub+
<b>Pin 3</b>	Ub-
<b>Pin 4 (OUT1)</b>	• Binary switching output pressure monitoring
<b>Pin 2 (OUT2)</b>	• Analogue output for system pressure

Core colours of ifm sockets:

1 = BN (brown), 2 = WH (white), 3 = BU (blue), 4 = BK (black)



## 7 Operating and display elements



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### 1: Analogue display

- Display of the current system pressure in bar and PSI or mbar and inH2O.

### 2: LED ring

According to the setting of parameter [LED] (→ 9.2):

- Display of set point and reset point.
- Lag indicator function for maximum value or minimum value.
- Display of pulsating signals and pressure peaks.
- Trend display: rising pressure or falling pressure.

### 3: Indicator LEDs

- LED 1 = system pressure of the digital display in bar.
- LED 2 = system pressure of the digital display in mbar.
- LED 3 = system pressure of the digital display in PSI.
- LED 4 = system pressure of the digital display in inH2O.
- LED 6 = system pressure in % of the scaling (range ASP to AEP) or COF value in %.
- LEDs 5, 7 = not used.
- LED 8 = switching status OUT1 (lights if output 1 is switched)

### 4: Alphanumeric display, 4 digits

- Display of the current system pressure.
- Display of the parameters and parameter values.

### 5: Touch button Set\*

- Setting of the parameter values (continuously by touching permanently; step by step by touching briefly several times).



## 6: Touch button Mode/Enter\*

- Selection of the parameters and acknowledgement of the parameter values.

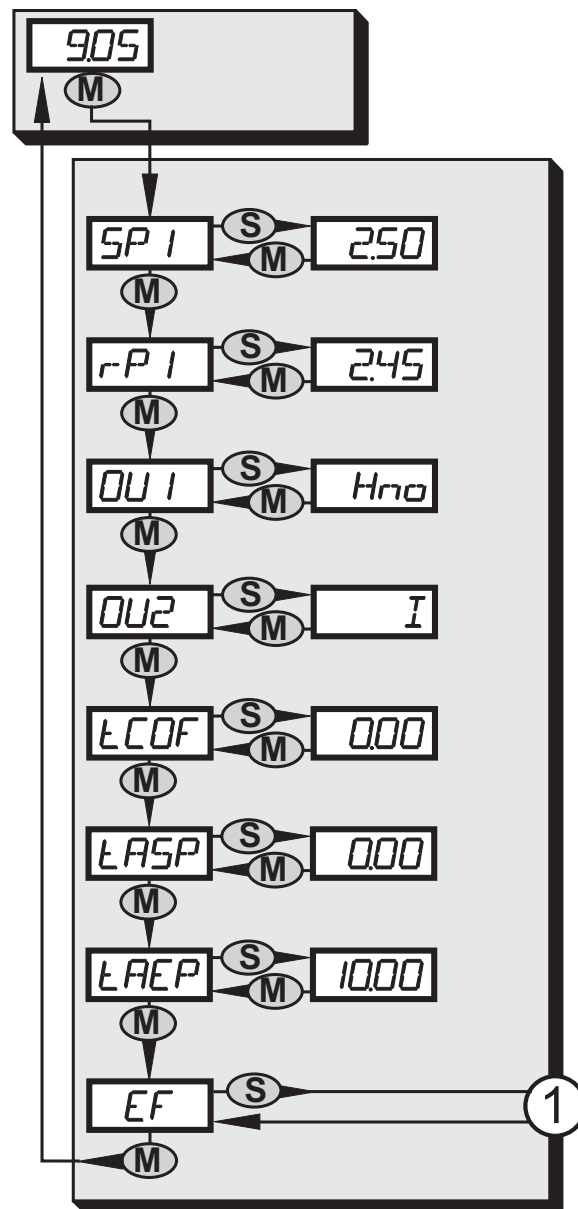
\* The two touch buttons are activated simply by touching / deactivated by releasing the touch button.

The touch button must be completely covered to be activated.

Slow covering (e.g. liquid flows over the display) does not activate the touch button.

## 8 Menu

### 8.1 Menu structure: main menu



1: Change to menu level 2 (extended functions)



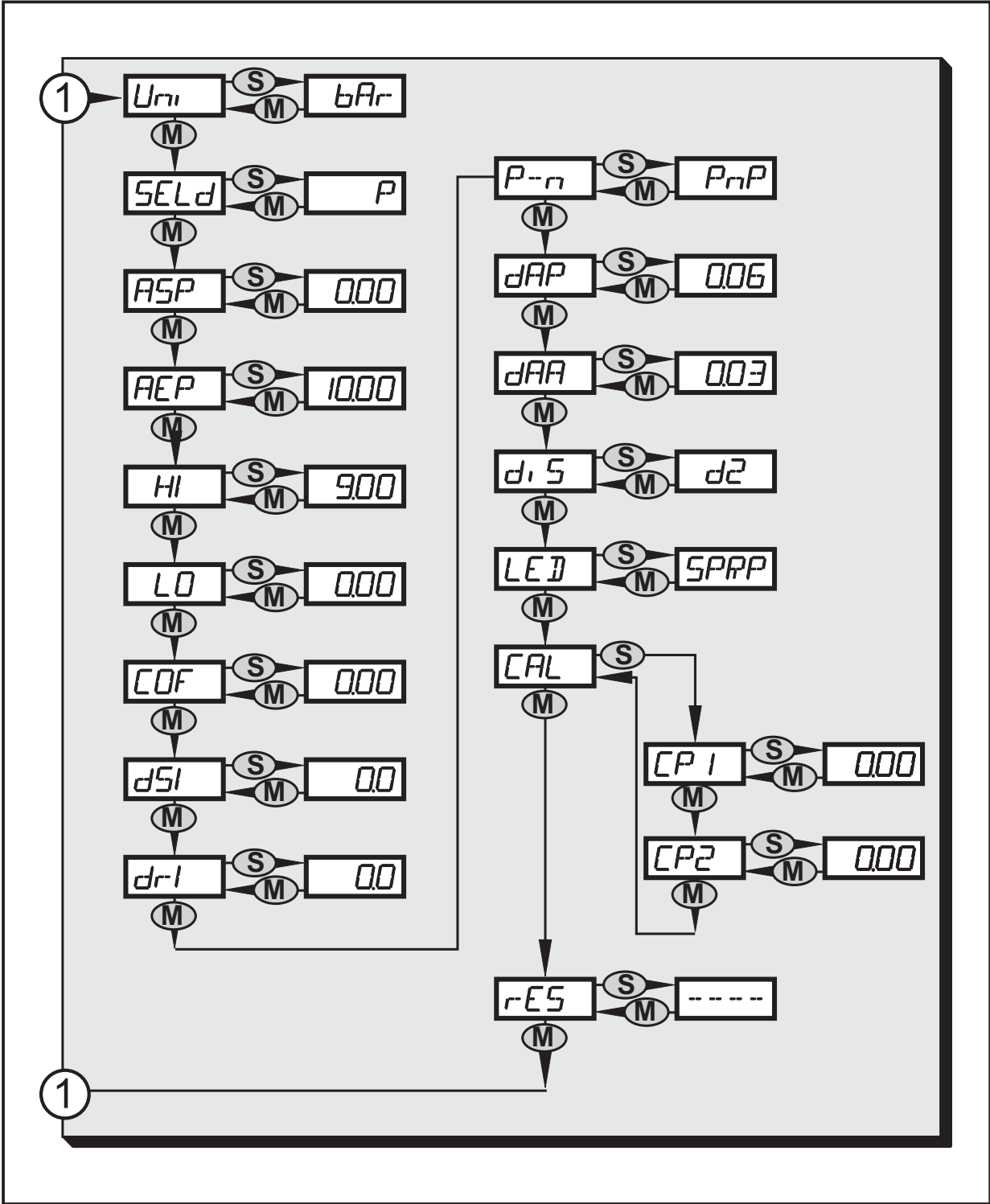
## 8.2 Explanation of the main menu

SP1/rP1	Upper / lower limit value for system pressure at which OUT1 switches.
OU1	Output function for OUT1: • Switching signal for the pressure limit values: hysteresis function [H ..] or window function [F ..], either normally open [. no] or normally closed [. nc].
OU2	Output function for OUT2: • Analogue signal for the current system pressure: 4...20 mA [I], 20...4 mA [InEG].
tCOF	Teach zero-point calibration.
tASP	Teach analogue start point for system pressure: set measured value at which 4 mA is provided (20 mA if [OU2] = [InEG]).
tAEP	Teach analogue end point for system pressure: set measured value at which 20 mA is provided (4 mA if [OU2] = [InEG]).
EF	Extended functions / opening of menu level 2.

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8.3 Menu structure: level 2 (extended functions)



1: Change to the main menu



## 8.4 Explanation of the menu level 2

Uni	Standard unit of measurement for system pressure (bar or PSI).
SELd	Display mode: <ul style="list-style-type: none"> <li>• Pressure in the unit set in [Uni].</li> <li>• Pressure in % of the set scaling of the analogue output.</li> </ul>
ASP	Analogue start point for system pressure: measured value at which 4 mA is provided (20 mA if [OU2] = [InEG]).
AEP	Analogue end point for system pressure: measured value at which 20 mA is provided (4 mA if [OU2] = [InEG]).
HI	Maximum value memory for system pressure.
LO	Minimum value memory for system pressure.
COF	Zero-point calibration.
dS1	Switch-on delay for OUT1.
dr1	Switch-off delay for OUT1.
P-n	Switching logic for OUT1: pnp or npn.
dAP	Damping for switching outputs and display.
dAA	Damping for analogue output (OUT2).
diS	Update rate and orientation of the display.
LED	Setting for the LED ring.
CAL	Calibration function (setting the curve of measured values).
CP1	Calibration point 1
CP2	Calibration point 2
rES	Restore factory settings.

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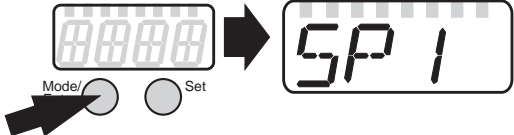
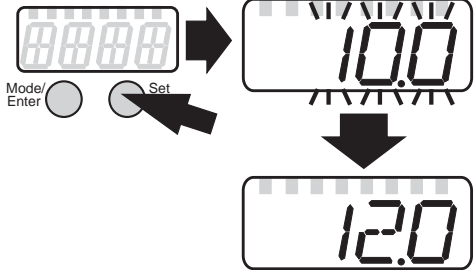
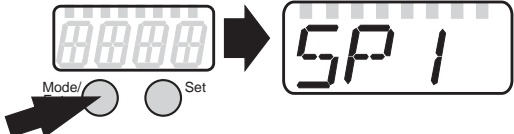
## 9 Parameter setting

During parameter setting the unit remains in the operating mode. It continues its monitoring function with the existing parameters until the parameter setting has been completed.

Exceptions: changes to the parameters COF (→ 9.4.1), CP1 and CP2 (→ 9.4.6) take effect immediately.

### 9.1 General parameter setting

3 steps must be taken for each parameter setting:

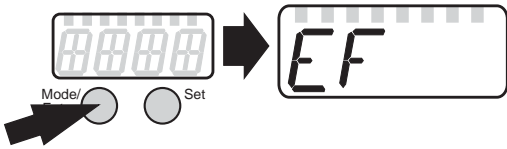
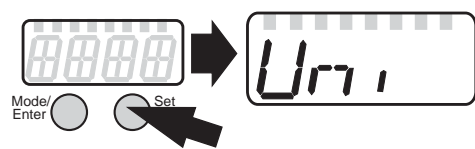
1	<b>Select parameter</b> <ul style="list-style-type: none"> <li>▶ Touch [Mode/Enter] until the requested parameter is displayed.</li> </ul>	
2	<b>Set parameter value</b> <ul style="list-style-type: none"> <li>▶ Touch [Set] and keep it touched.</li> <li>&gt; Current setting value of the parameter flashes for 5 s.</li> <li>&gt; After 5 s: setting value is changed: step by step by touching briefly several times or continuously by touching permanently.</li> </ul>	
	Numerical values are incremented continuously. To reduce the value: let the display move to the maximum setting value. Then the cycle starts again at the minimum setting value.	
3	<b>Acknowledge parameter value</b> <ul style="list-style-type: none"> <li>▶ Touch [Mode/Enter] briefly.</li> <li>&gt; The parameter is displayed again. The new setting value is saved.</li> </ul>	
<b>Set other parameters</b> <ul style="list-style-type: none"> <li>▶ Start again with step 1.</li> </ul>		
<b>Finish parameter setting</b> <ul style="list-style-type: none"> <li>▶ Touch [Mode/Enter] several times until the current measured value is displayed or wait for 15 s.</li> <li>&gt; The unit returns to the operating mode.</li> </ul>		

- Timeout:

If no touch button is activated for 15 s during parameter setting, the unit returns to the operating mode with unchanged values.



- Change from menu level 1 to menu level 2:

<ul style="list-style-type: none"> <li>▶ Touch [Mode/Enter] until [EF] is displayed.</li> </ul>	
<ul style="list-style-type: none"> <li>▶ Touch [Set] briefly.</li> <li>&gt; The first parameter of the submenu is displayed (here: [Uni]).</li> </ul> <p>If the menu level 2 is protected by an access code, "Cod1" flashes in the display.</p> <ul style="list-style-type: none"> <li>▶ Touch [Set] and keep it touched until the valid code no. appears.</li> <li>▶ Touch [Mode/Enter] briefly.</li> </ul> <p>On delivery by ifm electronic: no access restriction.</p>	

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- Locking / unlocking





The unit can be locked electronically to prevent an unintentional operation.

<ul style="list-style-type: none"> <li>▶ Make sure that the unit is in the normal operating mode.</li> <li>▶ Touch [Set],</li> <li>▶ additionally touch [Mode/Enter] and keep both buttons touched for 10 s.</li> <li>&gt; The LED for the current unit of measurement flashes, the current system pressure continues to be displayed. After 10 s the display goes out for approx. 1 s.</li> <li>▶ Release [Mode/Enter] and [Set] again. Both buttons must be released within 4 s. If this does not happen, the unit remains unlocked.</li> <li>&gt; [Loc] is displayed, the unit is locked. .</li> </ul> <p>During operation the indicator LED for the display unit (→ chapter 7) is flashing if you try to open the menu.</p>	<p>For unlocking:</p> <ul style="list-style-type: none"> <li>▶ Make sure that the unit is in the normal operating mode.</li> <li>▶ Touch [Set],</li> <li>▶ additionally touch [Mode/Enter] and keep both buttons touched for 10 s.</li> <li>&gt; The LED for the current unit of measurement flashes, the current system pressure continues to be displayed. After 10 s the display goes out for approx. 1 s.</li> <li>▶ Release [Mode/Enter] and [Set] again. Both buttons must be released within 4 s. If this does not happen, the unit remains unlocked.</li> <li>&gt; [uLoc] is displayed, the unit is unlocked.</li> </ul>
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On delivery: unlocked.



## 9.2 Configuration of the digital display (optional)

<p>► Select [Uni] and set the unit of measurement:</p> <ul style="list-style-type: none"> <li>- [bAr] / [mbAr].</li> <li>- [PSI] / [inHO].</li> </ul>	
<p>► Select [SEld] and set type of indication:</p> <ul style="list-style-type: none"> <li>- [P]: system pressure in the unit set in Uni.</li> <li>- [P%]: system pressure in % of the set scaling of the analogue output; the following applies: 0 % = ASP value / 100 % = AEP value.</li> </ul> <p>Note: display "0 %" does not mean that no pressure is applied to the system.</p>	
<p>► Select [diS] and set the update rate of the display:</p> <ul style="list-style-type: none"> <li>- [d1]: update of the measured values every 50 ms.</li> <li>- [d2]: update of the measured values every 200 ms.</li> <li>- [d3]: update of the measured values every 600 ms.</li> <li>- [OFF] = The measured value display is deactivated in the Run mode. Touching one of the buttons indicates the current measured value for 15 s. Touching the [Mode/Enter] button again activates the display mode. The indicator LEDs remain active even if the display is deactivated.</li> </ul>	
<p>► Select [LED] and set the display function for the digital display and LED ring:</p> <ul style="list-style-type: none"> <li>- [SPRP]: One LED on the LED ring indicates the set point and a second LED the reset point.</li> <li>- [HInd]: 2 adjacent LEDs on the LED ring mark the lag indicator for maximum value ([HInd], high indication).</li> <li>- [LInd]: 2 adjacent LEDs on the LED ring mark the lag indicator for minimum value ([LInd], low indication).</li> </ul> <p>To reset:</p> <ul style="list-style-type: none"> <li>► Touch [Set] for 1 second.</li> <li>&gt; The two LEDs jump to the current position of the pointer.</li> </ul> <ul style="list-style-type: none"> <li>- [Ph]: Display of pulsating signals and pressure peaks: <ul style="list-style-type: none"> <li>- In case of quick pressure changes (quickly pulsating signals) the digital display and LED ring indicate the minimum value and the maximum value.</li> <li>- In case of one-time short pressure peaks the digital display and LED ring show the indication for a longer time.</li> </ul> </li> <li>- [Pdir]: The LED ring indicates the trend of the pressure changes (5 LEDs below the pointer for rising pressure; 5 LEDs above the pointer for falling pressure).</li> </ul> <p>A damping set with dAP or dAA also has an effect on this display.</p>	



## 9.3 Set output signals

### 9.3.1 Set output functions

<ul style="list-style-type: none"> <li>▶ Select [OU1] and set the switching function:           <ul style="list-style-type: none"> <li>- [Hno] = hysteresis function/NO.</li> <li>- [Hnc] = hysteresis function/NC.</li> <li>- [Fno] = window function/NO.</li> <li>- [Fnc] = window function/NC.</li> </ul> </li> </ul>	<i>OU 1</i>
<ul style="list-style-type: none"> <li>▶ Select [OU2 ] and set the analogue function:           <ul style="list-style-type: none"> <li>- [I] = current signal proportional to pressure 4...20 mA.</li> <li>- [InEG] = current signal proportional to pressure 20...4 mA.</li> </ul> </li> </ul>	<i>OU2</i>

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### 9.3.2 Set switching limits

<ul style="list-style-type: none"> <li>▶ Select [SP1] and set the value at which the output switches.</li> </ul>	<i>SP 1</i>
<ul style="list-style-type: none"> <li>▶ Select [rP1] and set the value at which OUT1 switches off. rP1 is always smaller than SP1. The unit only accepts values which are lower than SP1.</li> </ul>	<i>r-P 1</i>

### 9.3.3 Scale analogue value for OUT2

<ul style="list-style-type: none"> <li>▶ Set the minimum pressure requested in the system.</li> <li>▶ Touch [Mode/Enter] until [tASP] appears.</li> <li>▶ Touch [Set] and keep it touched.           <ul style="list-style-type: none"> <li>&gt; Current setting value flashes.</li> </ul> </li> <li>▶ Release [Set] when the display stops flashing.           <ul style="list-style-type: none"> <li>&gt; New setting value is displayed.</li> </ul> </li> <li>▶ Touch [Mode/Enter] briefly.           <ul style="list-style-type: none"> <li>&gt; The current system pressure is defined as start value for the analogue signal.</li> </ul> </li> </ul>	<i>tASP</i>
<ul style="list-style-type: none"> <li>▶ Set the maximum pressure requested in the system.</li> <li>▶ Touch [Mode/Enter] until [tAEP] appears.</li> <li>▶ Touch [Set] and keep it touched.           <ul style="list-style-type: none"> <li>&gt; Current setting value flashes.</li> </ul> </li> <li>▶ Release [Set] when the display stops flashing.           <ul style="list-style-type: none"> <li>&gt; New setting value is displayed.</li> </ul> </li> <li>▶ Touch [Mode/Enter] briefly.           <ul style="list-style-type: none"> <li>&gt; The current system pressure is defined as end value for the analogue signal.</li> </ul> </li> </ul>	<i>tAEP</i>
<p>ASP / AEP can only be set automatically within defined limits (→ 12.1 Setting ranges). If automatic setting is carried out at an invalid pressure value, [UL] or [OL] is displayed. After acknowledgement by [Mode/Enter] [Err] flashes, the ASP value / AEP value is not changed.</p>	



<p>As an alternative:</p> <ul style="list-style-type: none"> <li>▶ Select [ASP] and set the measured value at which 4 mA is provided (20 mA at [OU2] = [InEG]).</li> <li>▶ Select [AEP] and set the measured value at which 20 mA is provided (4 mA at [OU2] = [InEG]).</li> </ul> <p>Minimum distance between ASP and AEP = 25 % of the final value of the measuring range (turn-down 1:4).</p>	ASP AEP
--	------------

## 9.4 User settings (optional)

### 9.4.1 Carry out zero point calibration

<ul style="list-style-type: none"> <li>▶ Select [COF] and set a value between -5 % and 5 % of the final value of the measuring range. The internal measured value "0" is shifted by this value.</li> </ul>	COF
<p>As an alternative: automatic adjustment of the offset in the range 0 bar <math>\pm</math> 5 %.</p> <ul style="list-style-type: none"> <li>▶ Make sure that no pressure is applied to the system.</li> <li>▶ Touch [Mode/Enter] until [tCOF] appears.</li> <li>▶ Touch [Set] and keep it touched.</li> </ul> <p>&gt; The current offset value (in %) flashes briefly. &gt; The current system pressure is displayed.</p> <ul style="list-style-type: none"> <li>▶ Release [Set].</li> <li>▶ Touch [Mode/Enter] briefly (= to confirm the new offset value).</li> </ul>	tCOF

### 9.4.2 Set delay time for OUT1

<p>[dS1] = switch-on delay / [dr1] = switch-off delay.</p> <ul style="list-style-type: none"> <li>▶ Select [dS1] or [dr1] and set a value between 0.1 and 50 s (at 0.0 the delay time is not active).</li> </ul>	dS 1 dr 1
--	--------------

### 9.4.3 Set switching logic for OUT1


<ul style="list-style-type: none"> <li>▶ Select [P-n] and set [PnP] or [nPn].</li> </ul>	P--n
--	------

### 9.4.4 Set damping for the switching signal

<ul style="list-style-type: none"> <li>▶ Select [dAP] and set a value between 0.01 and 30 s.</li> </ul> <p>dAP value = response time between pressure change and change of the switching status in seconds.</p> <p>[dAP] influences the switching frequency: <math>f_{\max} = 1 \div 2dAP</math>.</p> <p>[dAP] also has an effect on the display.</p>	dAP
---	-----



### 9.4.5 Set damping for the analogue signal



<p>► Select [dAA] and set a value between 0.01 and 30 s. dAA value = response time between pressure change and change of the analogue signal in seconds.</p>	
--	---

### 9.4.6 Calibrate curve of measured values

If the unit is to adopt the settings for the calibration points, the following conditions must be adhered to:

- CP1 and CP2 must be within the measuring range (i.e. between ASP and AEP).
- CP1 and CP2 must not be in the extended display range.
- Minimum distance between the calibration points CP1 and CP2 = 5 % of the final value of the measuring range.
- Maximum correction value =  $\pm 2$  % of the final value of the measuring range.


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<p>► Set a defined reference pressure between ASP and AEP in the system. ► Select [CAL]. ► Touch [Set] briefly. &gt; [CP1] is displayed. ► Touch [Set] for 5 s. &gt; The pressure measured by the unit is displayed. ► Touch [Set] until the set reference pressure is indicated (measured pressure = reference pressure) or the corresponding analogue signal is provided to OUT2. ► Touch [Mode/Enter] briefly. &gt; [CP1] is displayed. ► Touch [Mode/Enter] briefly. &gt; [CP2] is displayed. Continue with a) or b).</p>	
<p>a) Finish calibration: ► Touch [Mode/Enter] briefly. &gt; [CAL] is displayed. b) Change a 2nd point on the curve of measured values: ► Set a second defined reference pressure in the system. ► Touch [Set] for 5 s. &gt; The pressure measured by the unit is displayed. ► Touch [Set] until the set reference pressure is indicated (measured pressure = reference pressure) or the corresponding analogue signal is provided to OUT2. ► Touch [Mode/Enter] briefly. &gt; [CP2] is displayed. ► Touch [Mode/Enter] briefly. &gt; [CAL] is displayed, the process is finished.</p>	




## 9.5 Service functions

### 9.5.1 Read min/max values for system pressure

<ul style="list-style-type: none"><li>▶ Select [HI] or [LO] and touch [Set] briefly. [HI] = maximum value, [LO] = minimum value. Delete memory:<ul style="list-style-type: none"><li>▶ Select [HI] or [LO].</li><li>▶ Touch [Set] and keep it touched until [----] is displayed.</li><li>▶ Touch [Mode/Enter] briefly.</li></ul></li></ul>	
--	---

### 9.5.2 Reset all parameters to factory setting

<ul style="list-style-type: none"><li>▶ Select [rES].</li><li>▶ Touch [Set] and keep it touched until [----] is displayed.</li><li>▶ Touch [Mode/Enter] briefly.</li></ul> <p>It is recommended to take down your own settings in the table before carrying out a reset (→13 Factory setting).</p>	
--	---

## 10 Operation

After power on, the unit is in the Run mode (= normal operating mode). It carries out its measurement and evaluation functions and provides output signals according to the set parameters.

Operating indicators → 7 Operating and display elements.

Reset the lag indicator (if [LED] = [HInd] or [LInd]):

- ▶ Touch [Set] for 1 second.
- > The two lag indicator LEDs jump to the current position of the pointer.

### 10.1 Read set parameters

- ▶ Touch [Mode/Enter] until the requested parameter is displayed.
- ▶ Touch [Set] briefly.
- > The unit displays the corresponding parameter value for about 15 s. After another 15 s it returns to the Run mode.

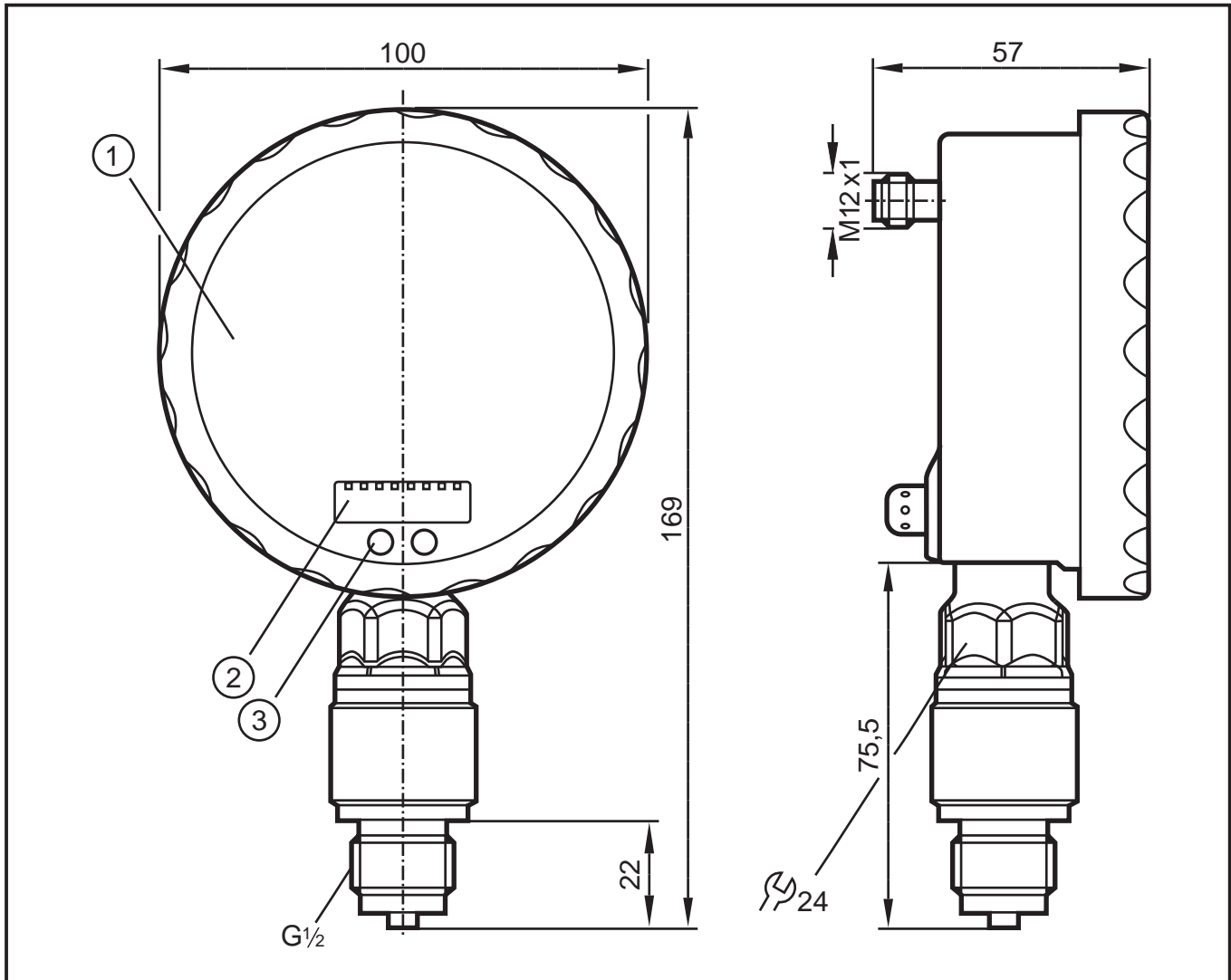
### 10.2 Error indications

[OL]	Overload pressure (measuring range exceeded).
[UL]	Underload pressure (below measuring range).
[SC1]	Short circuit in OUT1. The output is switched off as long as the short circuit persists.
[Err]	Flashing: internal error, invalid entry.

The messages SC1 and Err are displayed even if the display is switched off.



## 11 Scale drawing



UK

Dimensions in mm

1: analogue display

2: digital display

3: touch button (programming button)



## 12 Technical data

Operating voltage [V].....	18...32 DC	
Current consumption [mA].....	< 70 (24 V)	
Current rating [mA] .....	250	
Short-circuit protection; reverse polarity protection / overload protection, integrated watchdog		
Voltage drop [V] .....	< 2	
Power-on delay time [s] .....	6	
Min. response time switching output [ms] .....	9	
Switching frequency [Hz] .....	75	
Analogue output .....	4...20 mA / 20...4 mA	
Max. load [ $\Omega$ ] .....	$(U_b - 10) \times 50$	
Step response time analogue output [ms] .....	28	
Accuracy / deviations (in % of the span) <sup>1)</sup>		
	PG2409 PG2452 ... PG2458	PG2450 PG2451 PG2489
Switch point accuracy	< $\pm 0.5$	< $\pm 0.6$
Switch point accuracy in the extended display range	< $\pm 1.5$	< $\pm 1.5$
Characteristics deviation	< $\pm 0.25$ (BFSL) < $\pm 0.5$ (LS)	< $\pm 0.35$ (BFSL) < $\pm 0.6$ (LS)
Hysteresis	< 0.25	< 0.5
Repeatability (in case of temperature fluctuations < 10 K)	< $\pm 0.1$	< $\pm 0.1$
Long-term stability (in % of the span / 6 months)	< $\pm 0.1$	< $\pm 0.1$
Temperature coefficients (TEMPCO) in the compensated temperature range 0 ...70°C (in % of the span per 10 K)		
	PG2409 PG2452 ... PG2458	PG2450 PG2451 PG2489
Greatest TEMPCO of the zero point	< $\pm 0.2$	< $\pm 0.3$
Greatest TEMPCO of the span	< $\pm 0.2$	< $\pm 0.3$



Materials (wetted parts) .....	stainless steel 316L / 1.4404 ceramics (Al <sub>2</sub> O <sub>3</sub> ); FPM
Housing materials.....	stainless steel 316L / 1.4404; PA; FPM (Viton); PTFE; viewing glass: laminated safety glass 4 mm
Protection rating .....	IP 67 / IP 69K
Protection class .....	III
Insulation resistance [MΩ] .....	> 100 (500 V DC)
Shock resistance [g] .....	50 (DIN IEC 68-2-27, 11 ms)
Vibration resistance [g] .....	20 (DIN IEC 68-2-6, 10 - 2000 Hz)
Switching cycles min. ....	100 million
Ambient temperature [°C] .....	-20 ... 80
Medium temperature [°C] .....	-25...80
Storage temperature [°C] .....	-40...100
EMC EN 61000-4-2 ESD: .....	4 / 8 kV
EN 61000-4-3 HF radiated: .....	10 V/m
EN 61000-4-4 Burst: .....	2 kV
EN 61000-4-5 Surge: .....	0.5 / 1 kV
EN 61000-4-6 HF conducted: .....	10 V

UK

<sup>1)</sup> 1) All indications are referred to a turn-down of 1:1

### 13 Setting ranges

		SP1		rP1		ASP		AEP		ΔP
		min	max	min	max	min	max	min	max	
<b>PG2409</b>	bar	-0.992	1.600	-1.000	1.592	-1.000	1.100	-0.500	1.600	0.004
	PSI	-14.40	23.22	-14.52	23.10	-14.52	15.96	-7.26	23.22	0.06
<b>PG2450</b>	bar	2	600	0	598	0	500	100	600	1
	PSI	30	8700	0	8670	0	7250	1450	8700	10
<b>PG2451</b>	bar	1.0	400.0	0.0	399.0	0.0	350.0	50.0	400.0	0.5
	PSI	15	5800	0	5785	0	5075	725	5800	5
<b>PG2452</b>	bar	0.4	160.0	0.0	159.6	0.0	135.0	25.0	160.0	0.2
	PSI	6	2322	0	2316	0	1959	363	2322	3

ΔP = step increment



		SP1		rP1		ASP		AEP		$\Delta P$
		min	max	min	max	min	max	min	max	
<b>PG2453</b>	bar	-0.90	40.00	-1.00	39.90	-1.00	33.75	5.25	40.00	0.05
	PSI	-13.0	580.0	-14.5	578.5	-14.5	489.5	76.0	580.0	0.5
<b>PG2454</b>	bar	-0.96	16.00	-1.00	15.96	-1.00	13.50	1.50	16.00	0.02
	PSI	-14.0	232.0	-14.4	231.6	-14.4	195.8	21.8	232.0	0.2
<b>PG2455</b>	bar	-0.98	6.40	-1.00	6.38	-1.00	5.40	0.00	6.40	0.01
	PSI	-14.2	92.8	-14.5	92.5	-14.5	78.3	0.0	92.8	0.1
<b>PG2456</b>	bar	-0.115	4.000	-0.125	3.990	-0.125	3.350	0.525	4.000	0.005
	PSI	-1.65	58.00	-1.80	57.85	-1.80	48.60	7.60	58.00	0.05
<b>PG2457</b>	bar	-0.046	1.600	-0.050	1.596	-0.050	1.340	0.200	1.600	0.002
	PSI	-0.66	23.20	-0.72	23.14	-0.72	19.58	2.90	23.20	0.02
<b>PG2458</b>	mbar	-11.5	400.0	-12.5	399.0	-12.5	337.5	50.0	400.0	0.5
	inH2O	-4.6	160.6	-5.0	160.2	-5.0	135.6	20.0	160.6	0.2
<b>PG2489</b>	mbar	-4.6	160.0	-5.0	159.6	-5.0	135.0	20.0	160.0	0.2
	inH2O	-1.84	64.24	-2.00	64.08	-2.00	54.24	8.00	64.24	0.08

$\Delta P$  = step increment



## 14 Factory setting

	Factory setting	User setting
SP1	25.0 % VMR*	
rP1	24.9 % VMR*	
OU1	Hno	
OU2	I	
COF / tCOF	0.0	
ASP / tASP	0 % VMR*	
AEP / tAEP	100 % VMR*	
Uni	bAr / mbAr	
SELd	P	
dS1	0.0	
dr1	0.0	
P-n	pnP	
dAP	0.06	
dAA	0.03	
dis	d2	
LED	SPRP	
CP1	0.00	
CP2	0.00	

UK

\* = the indicated percentage of the final value of the measuring range (VMR) of the corresponding sensor is set.

More information at [www.ifm.com](http://www.ifm.com)



# APPENDIX F

## Material Safety Data Sheets



**MATERIAL SAFETY DATA SHEET****Aluminium Sulphate Solution****Section 01 - Chemical And Product And Company Information**

**Product Identifier** ..... Aluminium sulphate solution

**Product Use** ..... Coagulating agent in municipal and industrial water and wastewater treatment, additive in papermaking.

**Supplier Name** ..... ClearTech Industries Inc.  
2302 Hanselman Avenue  
Saskatoon, SK. S7L 5Z3  
Canada

**Prepared By** ..... ClearTech Industries Inc. Technical Department  
Phone: (306)664-2522

**Preparation Date** ..... November 26, 2009

**24-Hour Emergency Phone** ..... 306-664-2522

**Section 02 - Composition / Information on Ingredients**

**Hazardous Ingredients** ..... Aluminum sulphate hydrate 45-55%

**CAS Number** ..... Aluminum sulphate hydrate 16828-12-9

**Synonym (s)** ..... Liquid alum; aluminum sulfate solution; papermaker's alum; sulphuric acid, aluminum salt.

**Section 03 - Hazard Identification**

**Inhalation** ..... Inhalation of mists can be irritating to the respiratory tract and lungs.





- Skin Contact / Absorption**..... Mild to moderate irritation can occur. Aluminum is very poorly absorbed through the skin and toxic effects would not be expected following short-term skin contact.
- Eye Contact**..... May result in mild to moderate irritation to eyes.
- Ingestion**..... Amounts ingested incidental to industrial handling are not likely to cause injury. Large amounts may cause abdominal pain, nausea, vomiting. Can cause burns of the mouth, bleeding stomach, incoordination, muscle spasms, and kidney injury.
- Exposure Limits**..... ACGIH/TLV-TWA= 2mg/m<sup>3</sup>(Soluble Aluminum Salts)  
OSHA/PEL-TWA= 2mg/m<sup>3</sup>(Soluble Aluminum Salts)

#### Section 04 - First Aid Measures

- Inhalation**..... Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.
- Skin Contact / Absorption**..... Remove contaminated clothing. Wash affected area with soap and water. Seek medical attention if irritation occurs or persists.
- Eye Contact**..... Flush immediately with water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention.
- Ingestion**..... Do not induce vomiting. If vomiting occurs, lean victim forward to prevent breathing in vomitus. Give large amounts of water. Do not give anything by mouth to an unconscious or convulsing person. Seek immediate medical attention.
- Additional Information**..... Not available

#### Section 05 - Fire Fighting

- Conditions of Flammability**..... Non-flammable
- Means of Extinction**..... Product itself does not burn. However, decomposition product sulfur trioxide will react with water to form sulfuric acid. Use appropriate extinguishing agent.
- Flash Point**..... Not applicable





**Auto-ignition Temperature**..... Not applicable

**Upper Flammable Limit** ..... Not applicable

**Lower Flammable Limit**..... Not applicable

**Hazardous Combustible Products**... Under fire conditions (or at temperatures greater than 650°C), product decomposes to give off sulfur trioxide, an oxidizing agent which will support combustion.

**Special Fire Fighting Procedures**..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing.

**Explosion Hazards**..... Liquid alum may react with some metals, to give flammable, potentially explosive hydrogen gas. Hydrogen gas can accumulate to explosive concentrations inside confined spaces. Follow appropriate NFPA codes.

## Section 06 - Accidental Release Measures

**Leak / Spill**..... Wear appropriate personal protective equipment. Ventilate area. Stop or reduce leak if safe to do so. Prevent material from entering sewers. Cover spill with dry earth, sand or other non-combustible material.

**Deactivating Materials**..... Lime, limestone, soda ash, sodium bicarbonate, dilute sodium hydroxide or dilute aqua ammonia.

## Section 07 - Handling and Storage

**Handling Procedures**..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure.

**Storage Requirements**..... Store in a cool, dry, well-ventilated place. Keep container tightly closed, and away from incompatible materials. Store at temperatures below 40°C and above 0°C.

## Section 08 - Personal Protection and Exposure Controls

### Protective Equipment

**Eyes**..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.





- Respiratory**..... A NIOSH/MSHA approved air-purifying respirator equipped with acid gas/fume, mist cartridges for concentrations up to 20 mg/m<sup>3</sup>. An air-supplied respirator if concentrations are higher or unknown.
- Gloves**..... Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.
- Clothing**..... Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.
- Footwear**..... Impervious boots of chemically resistant material should be worn at all times.

### Engineering Controls

- Ventilation Requirements**..... Mechanical ventilation (dilution or local exhaust), process or personnel enclosure and control of process conditions should be provided. Supply sufficient replacement air to make up for air removed by exhaust systems.
- Other**..... Emergency shower and eyewash should be in close proximity.

## Section 09 - Physical and Chemical Properties

- Physical State**..... Liquid
- Odor and Appearance**..... Pale straw coloured, clear odourless liquid.
- Odor Threshold**..... Not available
- Specific Gravity (Water=1)**..... 1.335
- Vapor Pressure (mm Hg, 20C)**..... Not available
- Vapor Density (Air=1)**..... Not available
- Evaporation Rate**..... Not available
- Boiling Point**..... 101°C
- Freeze/Melting Point**..... -16°C
- pH**..... 1.9-2.3





**Water/Oil Distribution Coefficient**.... Not available

**Bulk Density**..... Not available

**% Volatiles by Volume**..... Not available

**Solubility in Water**..... Completely miscible

**Molecular Formula**.....  $\text{Al}_2(\text{SO}_4)_3 \cdot 14\text{H}_2\text{O}$

**Molecular Weight**..... 594.14

## Section 10 - Stability and Reactivity

**Stability**..... Stable under normal conditions.

**Incompatibility**..... Corrosive to carbon steel, aluminum, and zinc. Reacts with strong bases to form aluminum hydroxide.

**Hazardous Products of Decomposition**.. May react with many metals including carbon steel and aluminum to form flammable gases including sulphur oxides and hydrogen. Liquid alum is stable below 60°C.

**Polymerization**..... Will not occur

## Section 11 - Toxicological Information

**Irritancy**..... Corrosive

**Sensitization**..... Not available

**Chronic/Acute Effects**..... Skin irritation may be aggravated in individuals with existing skin lesions. Breathing of vapors or sprays (mists) may aggravate acute or chronic asthma and chronic pulmonary disease such as emphysema and bronchitis.

**Synergistic Materials**..... Not available

**Animal Toxicity Data**.....  $\text{LD}_{50}(\text{mouse, oral}) = >9000 \text{ mg/kg}$   
 $\text{LD}_{50}(\text{rat, oral}) = >9000 \text{ mg/kg}$

**Carcinogenicity**..... Sulfuric acid mist: Classified 1 (Proven for humans) by IARC, 1 (Known to be human carcinogens) by NTP  
  
Sulfuric acid mist: Classified A2 (Suspected for humans) by ACGIH





**Reproductive Toxicity**..... Not available

**Teratogenicity**..... Not available

**Mutagenicity**..... Not available

## Section 12 - Ecological Information

**Fish Toxicity**..... LD<sub>50</sub>(72 hrs, goldfish)= 100mg/L

**Biodegradability**..... The products of biodegradation are more toxic than the original product.

**Environmental Effects**..... May be harmful to aquatic life. Toxicity is primarily associated with the acidic pH. Acidic soil conditions develop where contamination with this material occurs.

## Section 13 - Disposal Consideration

**Waste Disposal**..... Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

## Section 14 - Transportation Information

### TDG Classification

**Class**..... 8

**Group**..... III

**PIN Number**..... UN 3264

**Other**..... Secure containers (full and/or empty) with suitable hold down devices during shipment.

## Section 15 - Regulatory Information

**WHMIS Classification**.....E

**NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS.**

**NSF Certification**.....Product is certified under NSF/ANSI Standard 60 for coagulation and flocculation at a maximum dosage of 330mg/L.



## Section 16 - Other Information

**Note:** The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

### Attention: Receiver of the chemical goods / MSDS coordinator

As part of our commitment to the Canadian Association of Chemical Distributors (CACD) Responsible Distribution® initiative, ClearTech Industries Inc. and its associated companies require, as a condition of sale, that you forward the attached Material Safety Data Sheet(s) to all affected employees, customers, and end-users. ClearTech will send any available supplementary handling, health, and safety information to you at your request.

If you have any questions or concerns please call our customer service or technical service department.

## ClearTech Industries Inc. - Locations

**Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3**

**Phone: 306-664-2522**

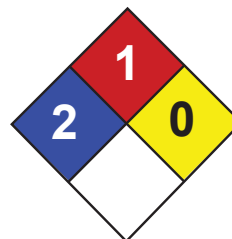
**Fax: 306-665-6216**

**[www.ClearTech.ca](http://www.ClearTech.ca)**

Location	Address	Postal Code	Phone Number	Fax Number
Richmond, B.C.	12431 Horseshoe Way	V7A 4X6	604-272-4000	604-272-4596
Calgary, AB.	5516E - 40 <sup>th</sup> St. S.E.	T2C 2A1	403-279-1096	403-236-0989
Edmonton, AB.	11750 - 180 <sup>th</sup> Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon, SK.	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282
Regina, SK.	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg, MB.	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga, ON.	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

**24 Hour Emergency Number - All Locations - 306-664-2522**





Health	2
Fire	1
Reactivity	0
Personal Protection	E

## Material Safety Data Sheet

### Citric acid MSDS

#### Section 1: Chemical Product and Company Identification

**Product Name:** Citric acid

**Catalog Codes:** SLC5449, SLC2665, SLC4453, SLC1660, SLC3451

**CAS#:** 77-92-9

**RTECS:** GE7350000

**TSCA:** TSCA 8(b) inventory: Citric acid

**CI#:** Not available.

**Synonym:** 2-Hydroxy-1,2,3-propanetricarboxylic acid

**Chemical Name:** Citric Acid

**Chemical Formula:** C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>

#### Contact Information:

**Sciencelab.com, Inc.**

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: [ScienceLab.com](http://ScienceLab.com)

**CHEMTREC (24HR Emergency Telephone), call:**

1-800-424-9300

**International CHEMTREC, call:** 1-703-527-3887

**For non-emergency assistance, call:** 1-281-441-4400

#### Section 2: Composition and Information on Ingredients

##### Composition:

Name	CAS #	% by Weight
Citric acid	77-92-9	100

**Toxicological Data on Ingredients:** Citric acid: ORAL (LD50): Acute: 5040 mg/kg [Mouse]. 3000 mg/kg [Rat].

#### Section 3: Hazards Identification

##### Potential Acute Health Effects:

Hazardous in case of eye contact (irritant), of inhalation (lung irritant). Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion. The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Severe over-exposure can produce lung damage, choking, unconsciousness or death.

##### Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to teeth. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

#### Section 4: First Aid Measures



**Eye Contact:**

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

**Skin Contact:**

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

**Serious Skin Contact:**

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

**Inhalation:**

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

**Serious Inhalation:** Not available.

**Ingestion:**

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

**Serious Ingestion:** Not available.

## Section 5: Fire and Explosion Data

**Flammability of the Product:** May be combustible at high temperature.

**Auto-Ignition Temperature:** 1010°C (1850°F)

**Flash Points:** Not available.

**Flammable Limits:** LOWER: 0.28 Kg/M3 (Dust) UPPER: 2.29 Kg/M3 (Dust)

**Products of Combustion:** These products are carbon oxides (CO, CO<sub>2</sub>).

**Fire Hazards in Presence of Various Substances:**

Slightly flammable to flammable in presence of heat. Non-flammable in presence of shocks.

**Explosion Hazards in Presence of Various Substances:**

Slightly explosive in presence of open flames and sparks. Non-explosive in presence of shocks.

**Fire Fighting Media and Instructions:**

SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

**Special Remarks on Fire Hazards:** As with most organic solids, fire is possible at elevated temperatures

**Special Remarks on Explosion Hazards:**

Fine dust dispersed in air in sufficient concentrations, and in the presences of an ignition source is a potential dust explosion hazard.

## Section 6: Accidental Release Measures

**Small Spill:**

Use appropriate tools to put the spilled solid in a convenient waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

**Large Spill:**

Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.



## Section 7: Handling and Storage

### Precautions:

Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe dust. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, reducing agents, metals, alkalis.

**Storage:** Keep container tightly closed. Keep container in a cool, well-ventilated area.

## Section 8: Exposure Controls/Personal Protection

### Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

### Personal Protection:

Safety glasses. Lab coat. Gloves (impervious). Dust respirator. Be sure to use an approved/certified respirator or equivalent. The dust respirator should be used for conditions where exposure has exceeded recommended exposure limits, dust is apparent, and engineering controls (adequate ventilation) are not feasible.

### Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

### Exposure Limits:

No exposure guidelines have been established. ACGIH, NIOSH and OSHA have not developed exposure limits for this product. The exposure limits given below are for particulates not otherwise classified: ACGIH: 10 mg/m<sup>3</sup> TWA (Total Inhalable fraction); 3 mg/m<sup>3</sup> TWA (Respirable fraction) OSHA: 15 mg/m<sup>3</sup> TWA (Total dust); 5 mg/m<sup>3</sup> TWA (Respirable Fraction)

## Section 9: Physical and Chemical Properties

**Physical state and appearance:** Solid. (Crystalline powder)

**Odor:** Odorless.

**Taste:** Acid. (Strong.)

**Molecular Weight:** 192.13 g/mole

**Color:** Not available.

**pH (1% soln/water):** Not available.

**Boiling Point:** Decomposes.

**Melting Point:** 153°C (307.4°F)

**Critical Temperature:** Not available.

**Specific Gravity:** 1.665 (Water = 1)

**Vapor Pressure:** Not applicable.

**Vapor Density:** Not available.

**Volatility:** Not available.

**Odor Threshold:** Not available.

**Water/Oil Dist. Coeff.:** The product is more soluble in water; log(oil/water) = -1.7



**Ionicity (in Water):** Not available.

**Dispersion Properties:** See solubility in water, diethyl ether.

**Solubility:**

Soluble in cold water, hot water, diethyl ether. Insoluble in benzene.

## Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Excess heat, incompatible materials

**Incompatibility with various substances:** Reactive with oxidizing agents, reducing agents, metals, alkalis.

**Corrosivity:**

Corrosive in presence of aluminum, of zinc, of copper. Non-corrosive in presence of glass.

**Special Remarks on Reactivity:**

Incompatible with oxidizing agents, potassium tartrate, alkali, alkaline earth carbonates and bicarbonates, acetates, and sulfides, metal nitrates

**Special Remarks on Corrosivity:** Will corrode copper, zinc, aluminum and their alloys.

**Polymerization:** Will not occur.

## Section 11: Toxicological Information

**Routes of Entry:** Inhalation. Ingestion.

**Toxicity to Animals:** Acute oral toxicity (LD50): 3000 mg/kg [Rat].

**Chronic Effects on Humans:** May cause damage to the following organs: teeth.

**Other Toxic Effects on Humans:**

Hazardous in case of inhalation (lung irritant). Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion.

**Special Remarks on Toxicity to Animals:** LDL[Rabbit] - Route: oral; Dose: 7000mg/kg

**Special Remarks on Chronic Effects on Humans:** Not available.

**Special Remarks on other Toxic Effects on Humans:**

Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material. Eyes: Causes moderate to severe eye irritation and possible injury. Ingestion: May cause gastrointestinal (digestive) tract irritation with nausea, vomiting, diarrhea. Excessive intake may cause erosion of teeth and hypocalcemia (calcium deficiency in blood). May affect behavior/central nervous system (tremor, convulsions, muscle contraction or spasticity). Inhalation: Causes moderate respiratory tract and mucous membrane irritation. Chronic Potential Health Effects: Frequent intake of citrated beverages may cause erosion of dental enamel and irritation of mucous membranes.

## Section 12: Ecological Information

**Ecotoxicity:** Not available.

**BOD5 and COD:** Not available.

**Products of Biodegradation:**

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

**Toxicity of the Products of Biodegradation:** The product itself and its products of degradation are not toxic.



**Special Remarks on the Products of Biodegradation:** Not available.

### Section 13: Disposal Considerations

**Waste Disposal:**

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

### Section 14: Transport Information

**DOT Classification:** Not a DOT controlled material (United States).

**Identification:** Not applicable.

**Special Provisions for Transport:** Not applicable.

### Section 15: Other Regulatory Information

**Federal and State Regulations:** TSCA 8(b) inventory: Citric acid

**Other Regulations:** EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

**Other Classifications:**

**WHMIS (Canada):** CLASS E: Corrosive solid.

**DSCL (EEC):**

R36/37/38- Irritating to eyes, respiratory system and skin. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37/39- Wear suitable gloves and eye/face protection.

**HMIS (U.S.A.):**

**Health Hazard:** 2

**Fire Hazard:** 1

**Reactivity:** 0

**Personal Protection:** e

**National Fire Protection Association (U.S.A.):**

**Health:** 2

**Flammability:** 1

**Reactivity:** 0

**Specific hazard:**

**Protective Equipment:**

Gloves (impervious). Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

### Section 16: Other Information

**References:** Not available.

**Other Special Considerations:** Not available.

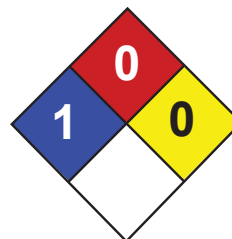
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Health	3
Fire	0
Reactivity	0
Personal Protection	

## Material Safety Data Sheet

### Sodium Hypochlorite, 5% MSDS

#### Section 1: Chemical Product and Company Identification

**Product Name:** Sodium Hypochlorite, 5%

**Catalog Codes:** SLS1654

**CAS#:** Mixture.

**RTECS:** Not applicable.

**TSCA:** TSCA 8(b) inventory: Sodium hypochlorite; Sodium hydroxide; Water

**CI#:** Not applicable.

**Synonym:** Chlorine Bleach, Bleach, Soda Bleach, Chlorox; Sodium Hypochlorite, Solution, 5% Available Chlorine

**Chemical Name:** Hypochlorous acid, sodium salt, solution

**Chemical Formula:** Not applicable.

#### Contact Information:

**Sciencelab.com, Inc.**

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: [ScienceLab.com](http://ScienceLab.com)

**CHEMTREC (24HR Emergency Telephone), call:**

1-800-424-9300

**International CHEMTREC, call:** 1-703-527-3887

**For non-emergency assistance, call:** 1-281-441-4400

#### Section 2: Composition and Information on Ingredients

##### Composition:

Name	CAS #	% by Weight
Sodium hypochlorite	7681-52-9	4-7
Sodium hydroxide	1310-73-2	<1
Water	7732-18-5	>92

**Toxicological Data on Ingredients:** Sodium hypochlorite: ORAL (LD50): Acute: 5800 mg/kg [Mouse]. 8910 mg/kg [Rat].

#### Section 3: Hazards Identification

##### Potential Acute Health Effects:

Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.



**Potential Chronic Health Effects:**

Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Sodium hypochlorite]. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Sodium hypochlorite]. Mutagenic for mammalian somatic cells. [Sodium hydroxide]. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to lungs, mucous membranes, skin, eyes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

**Section 4: First Aid Measures****Eye Contact:**

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

**Skin Contact:**

In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

**Serious Skin Contact:**

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

**Inhalation:**

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

**Serious Inhalation:**

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

**Ingestion:**

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

**Serious Ingestion:** Not available.

**Section 5: Fire and Explosion Data**

**Flammability of the Product:** Non-flammable.

**Auto-Ignition Temperature:** Not applicable.

**Flash Points:** Not applicable.

**Flammable Limits:** Not applicable.

**Products of Combustion:** Not available.

**Fire Hazards in Presence of Various Substances:** combustible materials, metals, organic materials

**Explosion Hazards in Presence of Various Substances:**

Slightly explosive in presence of open flames and sparks. Non-explosive in presence of shocks.

**Fire Fighting Media and Instructions:** Not applicable.

**Special Remarks on Fire Hazards:**

Releases chlorine when heated above 35 deg. C. The substance itself is non-combustible and does not burn. However, when heated to decomposition it emits corrosive and/or toxic fumes. May ignite combustibles. Fire risk in contact with organic materials. Contact with metals may evolve flammable hydrogen gas.



**Special Remarks on Explosion Hazards:**

Anydrous Sodium Hypochlorite is very explosive. Primary amines and calcium hypochlorite or sodium hypochlorite react to form normal chloroamines, which are explosive. Interaction of ethyleneimine with sodium (or other) hypochlorite gives the explosive N-chloro compd. Removal of formic acid from industrial waste streams with sodium hypochlorite soln becomes explosive at 55 deg C. Several explosions involving methanol and sodium hypochlorite were attributed to formation of methyl hypochlorite, especially in presence of acid or other esterification catalyst. Use of sodium hypochlorite soln to destroy acidified benzyl cyanide residues caused a violent explosion, thought to have been due to formation of nitrogen trichloride. (Sodium hypochlorite)

**Section 6: Accidental Release Measures****Small Spill:**

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

**Large Spill:**

Corrosive liquid. Oxidizing material. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

**Section 7: Handling and Storage****Precautions:**

Keep locked up.. Keep container dry. Keep away from heat. Keep away from sources of ignition. Keep away from combustible material.. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as reducing agents, combustible materials, organic materials, metals, acids.

**Storage:**

Keep container tightly closed. Keep container in a cool, well-ventilated area. Separate from acids, alkalies, reducing agents and combustibles. See NFPA 43A, Code for the Storage of Liquid and Solid Oxidizers. Air Sensitive Sensitive to light. Store in light-resistant containers.

**Section 8: Exposure Controls/Personal Protection****Engineering Controls:**

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

**Personal Protection:**

Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

**Personal Protection in Case of a Large Spill:**

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

**Exposure Limits:**

Sodium hypochlorite TWA: 1 CEIL: 1 (ppm as Cl<sub>2</sub>) STEL: 1 (ppm as Cl<sub>2</sub>) from ACGIH (TLV) [United States] Sodium hydroxide STEL: 2 (mg/m<sup>3</sup>) from ACGIH (TLV) [United States] TWA: 2 CEIL: 2 (mg/m<sup>3</sup>) from OSHA (PEL) [United States] CEIL: 2 (mg/m<sup>3</sup>) from NIOSH Consult local authorities for acceptable exposure limits.

**Section 9: Physical and Chemical Properties**



**Physical state and appearance:** Liquid.

**Odor:** Characteristic. Chlorine-like (Slight.)

**Taste:** Not available.

**Molecular Weight:** Not applicable.

**Color:** Colorless to light greenish yellow

**pH (1% soln/water):** Neutral.

**Boiling Point:** Decomposition temperature: 40°C (104°F)

**Melting Point:** Not available.

**Critical Temperature:** Not available.

**Specific Gravity:** 1.07 - 1.093 (Water = 1)

**Vapor Pressure:** 2.3 kPa (@ 20°C)

**Vapor Density:** The highest known value is 0.62 (Air = 1) (Water).

**Volatility:** Not available.

**Odor Threshold:** Not available.

**Water/Oil Dist. Coeff.:** Not available.

**Ionicity (in Water):** Not available.

**Dispersion Properties:** See solubility in water.

**Solubility:** Easily soluble in cold water.

## Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Incompatible materials. light, air, heat

**Incompatibility with various substances:** Reactive with reducing agents, combustible materials, organic materials, metals, acids.

### Corrosivity:

Extremely corrosive in presence of aluminum. Corrosive in presence of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

### Special Remarks on Reactivity:

Decomposed by carbon dioxide from air. Slowly decomposes on contact with air. Unstable in air unless mixed with sodium hydroxide. Incompatible with ammonium acetate, ammonium carbonate, ammonium nitrate, ammonium oxalate, and ammonium phosphate. Decomposition of sodium hypochlorite takes place within a few seconds with these salts. Also incompatible with primary amines, phenyl acetonitrile, ethyleneimine, methanol, acidified benzyl cyanide, formic acid, urea, nitro compounds, methylcellulose, cellulose, aziridine, ether, ammonia. Mixing this product with chemicals (e.g. ammonia, acids, detergents, etc.) or organic matter (e.g. urine, feces, etc.) will release chlorine gas. Chloramine gas may be evolved when ammonia and bleach are mixed. Decomposed by hot water. Sensitive to light. Exposure to light accelerates decomposition.

### Special Remarks on Corrosivity:

Sodium Hypochlorite is extremely corrosive to brass, and moderately corrosive to bronze. There is no corrosivity information for copper.

**Polymerization:** Will not occur.



## Section 11: Toxicological Information

**Routes of Entry:** Absorbed through skin. Eye contact. Inhalation. Ingestion.

**Toxicity to Animals:** Acute oral toxicity (LD50): 5800 mg/kg [Mouse]. (Sodium hypochlorite).

**Chronic Effects on Humans:**

CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Sodium hypochlorite]. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. [Sodium hypochlorite]. Mutagenic for mammalian somatic cells. [Sodium hydroxide]. Contains material which may cause damage to the following organs: lungs, mucous membranes, skin, eyes.

**Other Toxic Effects on Humans:**

Very hazardous in case of skin contact (irritant), of ingestion, . Hazardous in case of skin contact (corrosive), of eye contact (corrosive). Slightly hazardous in case of inhalation (lung sensitizer, lung corrosive).

**Special Remarks on Toxicity to Animals:** Not available.

**Special Remarks on Chronic Effects on Humans:** May affect genetic material (mutagenic) (Sodium hypochlorite)

**Special Remarks on other Toxic Effects on Humans:**

Potential Health Effects: Can cause severe irritation and possible burns to skin and eyes. Eye contact may also cause corneal and conjunctival edema, conjunctival hemorrhages. Contact with skin may also cause vesicular eruptions and eczematoid dermatitis which becomes evident upon re-exposure. Prolonged or repeated eye contact may cause conjunctivitis. Ingestion can cause burns to the digestive tract. Symptoms may include: 1. pain and inflammation of the mouth, pharynx, esophagus, and stomach, 2. erosion of the mucous membranes (chiefly of the stomach), nausea, vomiting, choking, coughing, hemorrhage, 3. circulatory collapse with cold and clammy skin (due to methemoglobinemia), cyanosis, and shallow respirations, 4. confusion, delirium, coma, 5. edema of the pharynx, glottis, larynx with stridor and obstruction, 6. perforation of the esophagus, or stomach, with mediastinitis or peritonitis. Inhalation causes slight to severe respiratory tract irritation and delayed pulmonary edema. Prolonged or repeated inhalation may cause allergic respiratory reaction (asthma).

## Section 12: Ecological Information

**Ecotoxicity:** Not available.

**BOD5 and COD:** Not available.

**Products of Biodegradation:**

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

**Toxicity of the Products of Biodegradation:** The product itself and its products of degradation are not toxic.

**Special Remarks on the Products of Biodegradation:** Not available.

## Section 13: Disposal Considerations

**Waste Disposal:**

Dilute with water and flush to sewer if local ordinances allow, otherwise, whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Waste must be disposed of in accordance with federal, state and local environmental control regulations.

## Section 14: Transport Information

**DOT Classification:** Class 8: Corrosive material

**Identification:** : Hypochlorite solution UNNA: 1791 PG: III

**Special Provisions for Transport:** Not available.

## Section 15: Other Regulatory Information



**Federal and State Regulations:**

Illinois toxic substances disclosure to employee act: Sodium hydroxide Illinois chemical safety act: Sodium hydroxide New York release reporting list: Sodium hydroxide Rhode Island RTK hazardous substances: Sodium hydroxide Pennsylvania RTK: Sodium hypochlorite; Sodium hydroxide Florida: Sodium hypochlorite Minnesota: Sodium hypochlorite; Sodium hydroxide Massachusetts RTK: Sodium hypochlorite; Sodium hydroxide New Jersey: Sodium hypochlorite; Sodium hydroxide Louisiana spill reporting: Sodium hydroxide TSCA 8(b) inventory: Sodium hypochlorite; Sodium hydroxide; Water CERCLA: Hazardous substances.: Sodium hypochlorite: 100 lbs. (45.36 kg); Sodium hydroxide: 1000 lbs. (453.6 kg);

**Other Regulations:** OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

**Other Classifications:**

**WHMIS (Canada):** CLASS E: Corrosive liquid.

**DSCL (EEC):**

R8- Contact with combustible material may cause fire. R31- Contact with acids liberates toxic gas. R36/38- Irritating to eyes and skin. S28- After contact with skin, wash immediately with plenty of water. S36/37/39- Wear suitable protective clothing, gloves and eye/face protection. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

**HMIS (U.S.A.):**

**Health Hazard:** 3

**Fire Hazard:** 0

**Reactivity:** 0

**Personal Protection:**

**National Fire Protection Association (U.S.A.):**

**Health:** 1

**Flammability:** 0

**Reactivity:** 0

**Specific hazard:**

**Protective Equipment:**

Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

**Section 16: Other Information**

**References:** Not available.

**Other Special Considerations:** Not available.

**Created:** 10/09/2005 06:32 PM

**Last Updated:** 05/21/2013 12:00 PM

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# Material Safety Data Sheet

H.M.I.S.  
Health: 0  
Flammability: 1  
Reactivity: 0  
These ratings should be used only as a part of a fully implemented H.M.I.S. program.

## Section I - Product Identification

Trade Name and Synonyms <b>AEON-PD</b>	Part Numbers: <b>28G23; 28G24; 28G25; 28G28; 28G40; 28G41</b>	Health Emergency Phone Number <b>(217) 222-5400</b> <b>Safety Department</b>
Manufacturer's Name Gardner Denver, Inc.		
Address 1800 Gardner Expressway - Quincy, IL 62305		Transport Emergency Phone Number <b>(800) 424-9300 (CHEMTREC)</b>
Product Identification Positive Displacement Blower Lubricant		
Chemical Names and Synonyms Polyalphaolefin	Use or Description Gear Oil	

## Section II - Composition/Information on Ingredients

Chemical Family:	Synthetic Hydrocarbon	CAS Number	Proprietary
Formula:	C <sub>10</sub> H <sub>20</sub> n+2		

## Section III - Chemical and Physical Properties

Appearance:	Blue Liquid	Specific Gravity:	(water=1):0.84-0.89
Odor:	None	Vapor Pressure:	<0.01mmHg@20°C
Volatile, Percent by Volume:	0%	Solubility in Water:	Insoluble
Boiling Point:	>600°F	Evaporation Rate (butyl acetate=1):	Nil

## Section IV - Hazards Identification

Threshold Limit Value:	5mg/m <sup>3</sup> ACGIH
Situations to Avoid	Avoid breathing oil mists.
This product is non-hazardous. The product contains no known carcinogens. No special warning labels are required under OSHA 29 CFR 1910. 1200.	

## Section V - First Aid Measures

Eye Contact:	Flush eyes with water for 15 minutes and consult physician.
Skin Contact:	Upon contact with skin, wash with soap and water.
Inhalation:	Product is not toxic by inhalation. If oil mist is inhaled, remove to fresh air and consult physician.
Ingestion:	Consult physician at once. <b>DO NOT INDUCE VOMITING.</b> May cause nausea and diarrhea.
To the best of our knowledge the toxicity of this product has not been fully investigated. Analogous compounds are considered to be essentially non-toxic.	

## Section VI - Fire Fighting Measures

Flash Point: 405-495°F	Method: Cleveland Open Cup - COC
Flammable Limits:	Not established
Autoignition Temperature:	No data
Extinguishing Media:	Dry chemical; CO <sub>2</sub> foam; water spray (fog)
Fire Fighting Instructions:	Burning fluid may evolve irritating/noxious fumes. Firefighters should use NIOSH/MNSA Approved self-contained breathing apparatus. Use water to cool fire-exposed containers. Use water carefully near exposed liquid to avoid frothing and splashing of hot liquid.
NFPA Classification:	Not established



## Section VII - Stability and Reactivity

<b>Chemical Stability</b>	Stable
<b>Conditions to Avoid:</b>	Excessive heat
<b>Incompatibility with other Materials:</b>	Strong oxidizers
<b>Hazardous Decomposition Products:</b>	Analogous compounds evolve carbon monoxide, carbon dioxide, and other unidentified fragments when burned.
<b>Hazardous Polymerization:</b>	Will not occur.

## Section VIII - Accidental Release Measures

<b>Safeguards (Personnel):</b>	Wear suitable protective equipment, especially goggles.
<b>Initial Containment:</b>	Stop source of spill. Dike spill area. Use absorbent materials to soak up fluid (i.e. sand, sawdust, and commercially available materials.)
<b>Spill Clean-Up:</b>	Wash spill area with large amount of water. Properly dispose of all materials

## Section IX - Handling and Storage

<b>Handling (Personnel):</b>	Do not take internally. Avoid contact with skin, eyes, and clothing. Upon contact with skin, wash with soap and water. Flush eyes with water for 15 minutes and consult physician. Wash contaminated clothing before reuse.
<b>Handling (Physical Aspects):</b>	
<b>Storage:</b>	Keep container tightly sealed when not in use.

## Section X - Exposure Controls/Personal Protection

<b>ENGINEERING CONTROLS:</b>	
<b>Ventilation:</b>	Local exhaust
<b>PERSONAL PROTECTIVE EQUIPMENT:</b>	
<b>Respiratory Protection:</b>	Use in well ventilated area
<b>Protective Gloves:</b>	Not required, but recommended, especially for prolonged exposure.
<b>Eye Protection:</b>	Goggles
<b>Other Protective Equipment:</b>	
<b>EXPOSURE GUIDELINES:</b>	
<b>Applicable Exposure Limits:</b>	

## Section XI - Toxicological Information

<b>Animal Data:</b>	No specific animal toxicological data available for this product.
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## Section XII - Ecological Information

<b>Ecotoxicological Information:</b>	No specific aquatic data available for this product.
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## Section XIII - Disposal Considerations

<b>Waste Disposal:</b>	Incinerate this product and all associated wastes in a licensed facility in accordance with Federal, state, and local regulations.
<b>Container Disposal:</b>	

## Section XIV - Transportation Information

<b>Shipping Information:</b>	DOT - Not regulated. ICAO/IMO - Not restricted.
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## Section XV - Regulatory Information

U.S. FEDERAL REGULATIONS:	
OSHA Hazard Determination:	Under normal conditions of use, this material is not known to be hazardous as defined by OSHA's Hazard Communication Standard, 29 CFR 1910.1200.
CERCLA/Superfund:	This material is not known to contain hazardous substances in sufficient quantity to make it subject to CERCLA regulations.
SARA, Title III, 302/304:	This material is not known to contain extremely hazardous substances.
Title III Hazard Classifications Sections 311, 312:	Acute: No Chronic: No Reactivity: No Pressure: No Fire: No
SARA Title III, 313:	This material is not known to contain any chemical(s) at a level of 1.0% or greater (0.1% for carcinogens) on the list of Toxic Chemicals and subject to release reporting requirements.
TSCA:	Material and/or components are listed in the TSCA Inventory of Chemical Substances (40 CFR 710).
RCRA:	This material has been evaluated for RCRA characteristics and does not meet hazardous waste criteria if discarded in its purchased form. Because of product use, transformation, mixing, processing, etc., which may render the resulting material hazardous, it is the product user's responsibility to determine at the time of disposal whether the material meets RCRA hazardous waste criteria.
Clean Water Act:	This material is not known to contain any ingredient(s) subject to the Act.
STATE REGULATIONS (U.S.):	
California "Prop 65":	Product may contain ingredient(s) known to the State of California to cause cancer, birth defects, or other reproductive harm, but the degree of exposure poses a health risk that is below the Prop 65 No Significant Risk Level for the listed chemical(s).
Pennsylvania Worker & Community Right to Know Act:	This material is not known to contain any ingredient(s) subject to the Act.
CANADIAN REGULATIONS:	This is not a WHMIS controlled product. Transport/Medical Emergency Phone Number: 613-348-3616.

## Section XVI - Other Information

<b>NFPA, NPCA-HMIS:</b>		
<b>NFPA Rating:</b>		
Health	0	Personal Protection B
Flammability	1	
Reactivity	0	
<b>NPCA-HMIS Rating:</b>		
Health		Personal Protection B
Flammability		
Reactivity		

This information in this material safety data sheet should be provided to all who use, handle, store, transport, or are otherwise exposed to this product.



**NOVOZYMES BIOLOGICALS, INC.**  
**111 Kessler Mill Road**  
**Salem, VA 24153**

Telephone number: 540-389-9361 Fax: 540-389-9364

Emergency Contact: 540-389-9361 CHEMTREC: 1-800-424-9300

**Material Safety Data Sheet**

**Date: 03/31/2006**

**SECTION I—PRODUCT IDENTIFICATION**

**NAME: –BI-CHEM<sup>®</sup> DC CWT Blend CAN**

**PRODUCT CODE - 7009848**

**DOT CLASS:** Not Regulated.

**UN NUMBER:** NA

**PROPER SHIPPING NAME:** NA

**HMIS RATING & CANADIAN WHMIS CLASSIFICATION**

HEALTH	1	CANADIAN WHMIS CLASSIFICATION:	D 2 B
FIRE	0		
REACTIVITY	0		

**SECTION II - INGREDIENTS**

ALL COMPONENTS APPEAR ON THE TSCA INVENTORY AND CANADIAN DSL LIST. COMPONENTS NOT LISTED ARE EITHER NON HAZARDOUS OR IN CONCENTRATIONS OF LESS THAN 1%.

<b>Ingredient Name</b>	<b>CAS Number</b>	<b>OSHA PEL</b>	<b>ACGIH TLV/TWA</b>
Viable Bacterial Cultures	NA	NA	NA

**SECTION III – PHYSICAL CHARACTERISTICS**

<b>Boiling Point</b>	No Data	<b>Appearance and Odor</b>	Tan free flowing grain like substance, earthly odor.
<b>Bulk Density</b>	Approximately 0.66-0.77 gm/cm3	<b>Melting Point</b>	No Data
<b>NA</b>	6.5 - 8.5	<b>Vapor Density</b>	No Data
<b>Vapor Pressure</b>	No Data	<b>Solubility</b>	Minimal



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## **SECTION IV – FIRE/EXPLOSION**

<b>Flash Point:</b>	No data
<b>Flash Point Method Used:</b>	NA
<b>LEL:</b>	Not know
<b>UEL:</b>	Not known

**Extinguishing Media:** Water spray, carbon dioxide or dry chemical.

**Special Fire Fighting Procedures:** None

**Unusual Fire and Explosion Hazards:** None known.

## **SECTION V – REACTIVITY DATA**

**Stable:** X

**Unstable:**

**Incompatibility:** Strong acids or alkali compounds may inactivate biological cultures.

**Hazardous Decomposition or By Products:** Not Known.

**Hazardous Polymerization:** Will not occur.

## **SECTION VI – HEALTH HAZARD DATA**

### **Acute Health Affects**

<b>Routes of Entry:</b>	<b>Inhalation:</b> yes	<b>Absorption:</b> no	<b>Ingestion:</b> yes	<b>Eyes:</b> yes
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**Eyes:** This product may cause eye irritation.

**Skin Contact:** Could cause mild skin irritation after prolonged contact.

**Inhalation:** Inhaling dust from this product could cause irritation to the lungs and mucus membranes.

**Ingestion:** Ingestion of this product could cause irritation to the mouth and throat or cause choking.

**Signs and Symptoms of Over Exposure:** None Known



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**Aggravated Medical Conditions:** None known, however persons with respiratory problems should avoid breathing dust from this product.

**Supplemental Health Information:** None

## **Emergency First Aid Procedures**

**Eye Contact:** Rinse eyes with water for fifteen minutes, if irritation persists, see a physician.

**Inhalation:** Move person to fresh air and avoid breathing dust from product. If breathing problems develop, seek the care of a physician.

**Skin Contact:** Wash the product off the skin with soap and water; if irritation develops seek the care of a physician.

**Ingestion:** Do not induce vomiting, if victim is choking clear airway and seek medical attention.

## **SECTION VII – SPILL OR LEAK PROCEDURE**

**Steps to be taken in case material is spilled or leaked:**

**Waste Disposal Method:** Contain and collect material, place in proper container for reuse or disposal. Dispose of materials in accordance with all federal, state and local laws.

**Precautions To Be Taken In Handling and Storage:** Store in a location away from children, food items and potable water.

Store in an area out of the direct sunlight, keep container closed when not in use, avoid storing in a damp environment.

Always wash hands with soap and water before handling food or smoking.

Use good chemical hygiene practices when working with any chemical.

**Other Precautions:** None

## **SECTION VIII – CONTROL MEASURES (PPE)**

**Respiratory Protection:** Use a NIOSH approved dust mask to control nuisance dust.

**Protective Gloves:** Recommended. Disposable nitrile exam gloves are suitable for preventing prolonged contact with the skin.

**Eye Protection:** Safety glasses with side shields are recommended.

**Other Protective Clothing:** None required, however, avoid prolonged contact with the skin from soiled clothing.

**Ventilation:** Local exhaust should be sufficient. Avoid creating dust from the product. If used in a manner that creates dust, mechanical ventilation may be necessary.



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The information and recommendations contained in this Material Safety Data Sheet have been compiled from sources believed to be reliable and to represent current opinion on the subject when the MSDS was prepared. No warranty, guaranty or representation is made as to the correctness or sufficiency of the information. The user of this product must decide what safety measures are necessary to safely use this product, either alone or in combination with other products, and determine its environmental regulatory compliance obligations under any applicable federal, state and local laws.



## 1. PRODUCT AND COMPANY IDENTIFICATION

**Product Name:** MicroC<sup>®</sup> 2000      **Publication Date:** May 31, 2015  
**Product Code:** NA      **Replaces:** February 26, 2015  
**Product Use:** A reducing agent for biological processes

### Supplier Information:

Environmental Operating Solutions, Inc      Phone: 508-743-8440  
160 MacArthur Blvd., Unit 6      Fax: 508-743-8443  
Bourne, MA 02532      Website: www.microc.com

**EMERGENCY TELEPHONE NUMBER:**      **CHEMTREC**      **800-424-9300**

## 2. HAZARDS IDENTIFICATION

### **OSHA Regulatory Status:**

**This product when used as intended is not hazardous according to 29 CFR 1910.1200**

**Note: When vaporized, glycerin mist may cause irritation of the respiratory tract.**

### Potential Health Effects

Routes of Exposure	Ingestion, inhalation, skin contact, eye contact
Eyes	May cause slight irritation
Skin	May cause slight irritation
Inhalation	High mist concentrations may cause irritation of respiratory tract.
Ingestion	May be harmful if swallowed in large quantities

## 3. COMPOSITION / INFORMATION ON INGREDIENTS

Chemical Name	CAS #	% by Weight
Glycerin; glycerol	56-81-5	70-74%
Water	7732-18-5	22-26%
Sodium Chloride	7647-14-5	4-6%
Methanol	67-56-1	< 1%



# Safety Data Sheet

## 4. FIRST AID MEASURES

<b>Eye Contact</b>	Immediately flush eyes thoroughly with plenty of water for 15 minutes and consult a physician immediately.
<b>Skin Contact</b>	Remove contaminated clothing and wash affected area with water and soap. Consult physician if irritation develops
<b>Inhalation</b>	Remove individual to fresh air. Seek medical attention if breathing problems persist
<b>Ingestion</b>	Do not induce vomiting. Rinse mouth thoroughly. Seek medical attention.
<b>General Advice</b>	If individual feels unwell following the exposure to the product consult a physician immediately. Present this Safety Data Sheet to the doctor in attendance
<b>Note to physician</b>	Treat patient symptomatically

## 5. FIRE FIGHTING MEASURES

<b>Flammability Summary (OSHA and NFPA)</b>	Non-flammable Material
<b>Protection of Firefighters:</b>	Wear suitable protective equipment. Wear self contained breathing apparatus if necessary
<b>Extinguishing Media</b>	Use equipment appropriate to the main source of the fire. Water spray, alcohol foam, dry chemical or CO2. Water or alcohol foam may cause frothing
<b>Specific hazards arising from the chemical</b>	Carbon oxides

## 6. ACCIDENTAL RELEASE MEASURES

<b>Personal Protection for Spills</b>	Keep unnecessary personnel away from spill. Use personal protective equipment. Ventilate area of leak or spill. Avoid breathing vapors and mist.
<b>Methods for Containment</b>	Eliminate all sources of ignition. Stop flow of material if safe to do so. Dike spilled material. Absorb spill with inert absorbent material. Sand, earth and vermiculite are suitable absorbent materials.
<b>Environmental Precautions</b>	Prevent further leakage. Contain spill if safe to do so. Do not let product enter storm drains if possible.

## 7. HANDLING AND STORAGE

<b>Precautions for Safe Handling</b>	See other relevant sections of this SDS. Avoid contact with skin and eyes. Avoid breathing mist. Use with adequate ventilation. Do not handle and store near open flames, high heat or sources of ignition.
<b>Storage</b>	Keep containers closed when not in use. Minimize evaporative losses. Keep away from ignition sources.
<b>Incompatible Materials for Storage</b>	None known



# Safety Data Sheet

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

INSUFFICIENT DATA ON MIXTURE. DATA ON INDIVIDUAL COMPONENTS PROVIDED BELOW

Component	Concentration in Product	ACGIH TLV	OSHA TABLE Z-1 Limits for Air Contaminants	NIOSH
Glycerin CAS No: 56-81-5	70-74% w/w	Form: Glycerin Mist TWA: 10 mg/m3	Form: Total Dust PEL: 15 mg/m3  Form: Respirable Fraction PEL: 5 mg/m3	Insufficient Data on Glycerin Mist
Methanol CAS No: 67-56-1	< 1 % w/w	TWA: 260 mg/m3	PEL: 260 mg/m3	TWA: 260 mg/m3

### Engineering Controls

Use proper equipment and storage conditions to control airborne levels below recommended exposure limits.

### Personal Protective Equipment

#### Eye Protection:

Use normal eye protection practices such as safety glasses with side shields. Use chemical goggles if risk of splashing is high.

#### Skin Protection

Handle with chemical resistant gloves. Dispose of contaminated gloves after use. Nitrile gloves recommended.

#### Respiratory Protection

If workers could be exposed to concentrations above the exposure limits in Section 8, use a full face respirator with multipurpose combination cartridges.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid	Flash Point	None to Boil (ASTM D93)
Color	Light brown	Boiling Point	Not determined
Odor	Musty – Sweet Odor	Evaporation Rate	Not determined
Odor Threshold	Not determined	UEL/LEL	Not determined
		Flammability (solid, gas)	Not determined
pH	4.00-11.00	Vapor Pressure	Not determined
Solubility in Water	Highly soluble in water	Vapor Density	Not determined
		Relative Density	Not Determined
Bulk Density	10.22 lbs/gal	Partition Coefficient	Not determined
Specific gravity	1.225@ 20°C	Autoignition Temperatures	
		Decomposition	
Viscosity	45 cPs @ 20C	Temperature	Not determined



# Safety Data Sheet

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## 10. STABILITY AND REACTIVITY

<b>Reactivity</b>	Avoid contact with oxidizing agents (e.g. nitric acid, peroxides, chromates)
<b>Chemical Stability</b>	Stable under normal storage conditions
<b>Possibility of hazardous reactions</b>	None known
<b>Conditions to Avoid</b>	Heat, flames, sparks. Contact with oxidizing agents
<b>Incompatible Materials</b>	None known
<b>Hazardous Decomposition Products</b>	Oxides of carbon under high heat

## 11. TOXICOLOGY

INSUFFICIENT DATA ON MIXTURE. DATA ON INDIVIDUAL COMPONENTS PROVIDED BELOW

<b>Eye Contact</b>	The components in this product may result in mild eye irritation from contact with liquid or vapors. Symptoms include redness, swelling, watering.
<b>Skin Contact</b>	The components in this product may result in mild skin irritation. Symptoms include redness, itching, burning, dermatitis.
<b>Inhalation</b>	Breathing high mist concentrations may be harmful. Inhalation can cause irritation of the throat and lungs.
<b>Ingestion</b>	Ingestion of this product may result in nausea, vomiting and diarrhea. Aspiration into the lungs can cause damage and inflammation to the lungs.
<b>Target Organs</b>	Lungs, Kidneys
<b>Prolonged Exposure</b>	Symptoms include nausea, headache, vomiting

### Glycerin; Glycerol CAS No. 56-81-5

<b>Acute Toxicity</b>	Dermal LD50 = > 10,000 mg/kg (Rabbit) Inhalation LC50 = > 570 mg/m <sup>3</sup> 1 hr (Rat) Oral LD50 = 12,600 mg/kg (Rat)
<b>Carcinogenicity</b>	Not listed by ACGIH, IARC, NIOSH, NTP or OSHA
<b>Mutagenicity</b>	No data available
<b>Reproductive Toxicity</b>	No data available

### Methanol 67-56-1

<b>Acute Toxicity</b>	Dermal LD50 = 15,800 mg/kg (Rabbit) Inhalation LC50 = 64,000 mg/m <sup>3</sup> 4 hr (Rat) Oral LD50 = 5,600 mg/kg (Rat)
<b>Carcinogenicity</b>	Not listed by ACGIH, IARC, NIOSH, NTP or OSHA
<b>Mutagenicity</b>	No data available
<b>Reproductive Toxicity</b>	No data available



# Safety Data Sheet

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## 12. ECOLOGICAL INFORMATION

<b>Ecotoxicity</b>	Glycerin: 96 hr LC50: 51,000-57,000 mg/L (Rainbow Trout), > 5000 mg/L Goldfish Methanol: 96 hr LC50: > 15,400-29,400 mg/L (Fish)
<b>Persistence and degradability</b>	No data available
<b>Bioaccumulative potential</b>	No data available
<b>Mobility in soil</b>	No data available
<b>Other adverse effects</b>	No data available

## 13. DISPOSAL CONSIDERATIONS

This product as supplied is not classified as a RCRA hazardous waste according to 40 CFR 261. However it should be fully characterized prior to disposal as contamination with other materials may subject it to hazardous waste regulations. RCRA requires the user of the product to determine whether the product meets RCRA criteria for hazardous waste. Always consult with local, state and federal regulations prior to disposal.

## 14. TRANSPORTATION INFORMATION

<b>US Domestic DOT</b>	Not Regulated
<b>Shipping Name</b>	Glycerin; Glycerol
<b>IMDG</b>	Not dangerous goods
<b>IATA</b>	Not dangerous goods
<b>Marine pollutant</b>	No

## 15. REGULATORY INFORMATION

### United States

#### Toxic Substances Control Act

The components of this product are listed on the TSCA Inventory of Existing Chemical Substances

<b>Section 302 (EHS) TPQ</b>	Not applicable
<b>Section 304 (EHS) TPQ</b>	Not applicable

#### SARA Section 311/312 Hazard Categories

Acute - NO  
Chronic - NO  
Physical - None  
Pressure Hazard - NO  
Fire Hazard - NO



# Safety Data Sheet

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## **SARA Section 313**

This product may contain trace amounts of a chemical that is subject to reporting requirements of SARA

Methanol CAS # 67-56-1 Typical % Weight in Product 0.0-0.10%

## **CERCLA**

This product may contain trace amounts of a chemical that is subject to reporting requirements of CERCLA

Methanol RQ # 5,000. Typical % Weight in Product 0.0-0.10%

## **Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3): None**

## **State Right to Know Regulations**

Chemical Name: Glycerin

California – Proposition 65 Not applicable

Massachusetts Right to Know Glycerin

Minnesota Hazardous Substances List Glycerin mist

New Jersey Right to Know None

Pennsylvania Right to Know Glycerin

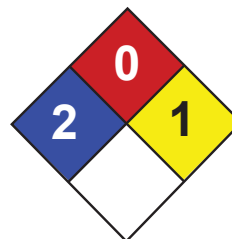
Rhode Island Right to Know Glycerin

## **16. ADDITIONAL INFORMATION**

MSDS REVISION STATUS: May 31, 2015 | Replaces February 26, 2015

THIS MATERIAL SAFETY DATA SHEET (MSDS) HAS BEEN PREPARED IN COMPLIANCE WITH THE FEDERAL OSHA HAZARD COMMUNICATION STANDARD, 29 CFR 1910.1200. THE INFORMATION IN THIS MSDS SHOULD BE PROVIDED TO ALL WHO WILL USE, HANDLE, STORE, TRANSPORT, OR OTHERWISE BE EXPOSED TO THIS PRODUCT. WE BELIEVE THIS INFORMATION TO BE RELIABLE AND UP TO DATE AS OF ITS PUBLICATION DATE, BUT MAKE NO WARRANTY THAT IT IS. IF THIS MSDS IS MORE THAN THREE YEARS OLD YOU SHOULD CONTACT THE SUPPLIER TO MAKE CERTAIN THAT THE INFORMATION IS CURRENT.





Health	2
Fire	0
Reactivity	1
Personal Protection	E

## Material Safety Data Sheet

### Sodium carbonate MSDS

#### Section 1: Chemical Product and Company Identification

**Product Name:** Sodium carbonate

**Catalog Codes:** SLS3481, SLS1264, SLS4105, SLS1894, SLS3316

**CAS#:** 497-19-8

**RTECS:** VZ4050000

**TSCA:** TSCA 8(b) inventory: Sodium carbonate

**CI#:** Not available.

**Synonym:** Crystal Carbonate, Disodium Carbonate, Sal Soda, Soda Asha, Washing Soda

**Chemical Name:** Sodium Carbonate, Anhydrous

**Chemical Formula:** Na<sub>2</sub>-C-O<sub>3</sub>

#### Contact Information:

**Sciencelab.com, Inc.**

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: [ScienceLab.com](http://ScienceLab.com)

**CHEMTREC (24HR Emergency Telephone), call:**  
1-800-424-9300

**International CHEMTREC, call:** 1-703-527-3887

**For non-emergency assistance, call:** 1-281-441-4400

#### Section 2: Composition and Information on Ingredients

##### Composition:

Name	CAS #	% by Weight
Sodium carbonate	497-19-8	100

**Toxicological Data on Ingredients:** Sodium carbonate: ORAL (LD50): Acute: 4090 mg/kg [Rat]. 6600 mg/kg [Mouse]. DUST (LC50): Acute: 2300 mg/m<sup>2</sup> 2 hours [Rat]. 1200 mg/m<sup>2</sup> 2 hours [Mouse].

#### Section 3: Hazards Identification

**Potential Acute Health Effects:** Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation (lung irritant).

##### Potential Chronic Health Effects:

Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to upper respiratory tract, skin, eyes. Repeated or prolonged exposure to the substance can produce target organs damage.

#### Section 4: First Aid Measures



**Eye Contact:**

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

**Skin Contact:**

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

**Serious Skin Contact:**

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

**Inhalation:**

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

**Serious Inhalation:** Not available.

**Ingestion:**

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

**Serious Ingestion:** Not available.

## Section 5: Fire and Explosion Data

**Flammability of the Product:** Non-flammable.

**Auto-Ignition Temperature:** Not applicable.

**Flash Points:** Not applicable.

**Flammable Limits:** Not applicable.

**Products of Combustion:** Emits Na<sub>2</sub>O fumes when heated to decomposition.

**Fire Hazards in Presence of Various Substances:** Not applicable.

**Explosion Hazards in Presence of Various Substances:**

Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

**Fire Fighting Media and Instructions:** Not applicable.

**Special Remarks on Fire Hazards:**

Sodium carbonate can ignite and burn fiercely in contact with fluoride. Sodium Carbonate in contact with fluorine decomposed at ordinary temperature with incandescence.

**Special Remarks on Explosion Hazards:**

Reacts explosively with red-hot aluminum metal. Sodium carbonate + ammonia in arabic gum solution will explode.

## Section 6: Accidental Release Measures

**Small Spill:**

Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of acetic acid. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

**Large Spill:**

Use a shovel to put the material into a convenient waste disposal container. Neutralize the residue with a dilute solution of acetic acid. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.



## Section 7: Handling and Storage

### Precautions:

Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as acids.

### Storage:

Hygroscopic. Keep container tightly closed. Keep container in a cool, well-ventilated area. Do not store above 24°C (75.2°F).  
Hygroscopic

## Section 8: Exposure Controls/Personal Protection

### Engineering Controls:

Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

### Personal Protection:

Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

### Personal Protection in Case of a Large Spill:

Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

**Exposure Limits:** Not available.

## Section 9: Physical and Chemical Properties

**Physical state and appearance:** Solid. (Solid powder.)

**Odor:** Odorless.

**Taste:** Alkaline.

**Molecular Weight:** 105.99 g/mole

**Color:** White.

**pH (1% soln/water):** 11.5 [Basic.]

**Boiling Point:** Not available.

**Melting Point:** 851°C (1563.8°F)

**Critical Temperature:** Not available.

**Specific Gravity:** Density: 2.532 (Water = 1)

**Vapor Pressure:** Not applicable.

**Vapor Density:** Not available.

**Volatility:** Not available.

**Odor Threshold:** Not available.

**Water/Oil Dist. Coeff.:** Not available.

**Ionicity (in Water):** Not available.

**Dispersion Properties:** See solubility in water.

**Solubility:**



Soluble in hot water, glycerol. Partially soluble in cold water. Insoluble in acetone, alcohol.

## Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Incompatible materials, moisture

**Incompatibility with various substances:**

Reactive with acids. Slightly reactive to reactive with moisture.

**Corrosivity:** Non-corrosive in presence of glass.

**Special Remarks on Reactivity:**

Hygroscopic. Combines with water with evolution of heat. Incompatible with phosphorus pentoxide, lithium, fluorine, fluoride, ammonia + silver nitrate, 2,4,6-trinitrotoluene, ammonia, acids, sodium sulfide + water, hydrogen peroxide, red hot aluminium metal, sodium sulfide, zinc, calcium hydroxide. Sodium Carbonate is decomposed by acids with effervescence. Reacts violently with F<sub>2</sub>, Lithium, and 2,4,6-trinitrotoluene. Sodium begins to decompose at 400 C to evolve CO<sub>2</sub>.

**Special Remarks on Corrosivity:** Hot concentrated solutions of sodium carbonate are mildly corrosive to steel.

**Polymerization:** Will not occur.

## Section 11: Toxicological Information

**Routes of Entry:** Inhalation. Ingestion.

**Toxicity to Animals:**

WARNING: THE LC<sub>50</sub> VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD<sub>50</sub>): 4090 mg/kg [Rat]. Acute toxicity of the dust (LC<sub>50</sub>): 1200 mg/m<sup>3</sup> 2 hours [Mouse].

**Chronic Effects on Humans:** May cause damage to the following organs: upper respiratory tract, skin, eyes.

**Other Toxic Effects on Humans:** Hazardous in case of skin contact (irritant), of ingestion, of inhalation (lung irritant).

**Special Remarks on Toxicity to Animals:** LDL (Lowest Published Lethal Dose) [Man] - Route: Oral; Dose: 714 mg/kg

**Special Remarks on Chronic Effects on Humans:** May cause adverse reproductive effects based on animal test data

**Special Remarks on other Toxic Effects on Humans:**

Acute Potential Health Effects: Skin: Causes skin irritation with possible burns depending on the concentration, site (abraded or intact skin), and duration of exposure. Eyes: Causes eye irritation and possible burns. Concentrated solutions may cause permanent corneal injury (permanent corneal opacity). Ingestion: Sodium carbonate ingestion may cause irritation of the digestive tract resulting in nausea, vomiting, diarrhea, thirst, abdominal pain depending on concentration and amount ingested. May also affect the cardiovascular system. Inhalation: Dust may cause respiratory tract and mucous membrane irritation with coughing and shortness of breath (dyspnea), pulmonary edema. Chronic Potential Health Effects: Chronic inhalation may result in decreased pulmonary function, nasal congestion, nosebleeds, perforation of the nasal septum. Other effects of chronic exposure are skin (dermatitis and ulceration), and gastrointestinal complaints. However, the effects of chronic exposure seem to be reversible if exposure is decreased.

## Section 12: Ecological Information

**Ecotoxicity:** Not available.

**BOD<sub>5</sub> and COD:** Not available.

**Products of Biodegradation:**

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.



**Toxicity of the Products of Biodegradation:** The products of degradation are less toxic than the product itself.

**Special Remarks on the Products of Biodegradation:** Not available.

### Section 13: Disposal Considerations

**Waste Disposal:**

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

### Section 14: Transport Information

**DOT Classification:** Not a DOT controlled material (United States).

**Identification:** Not applicable.

**Special Provisions for Transport:** Not applicable.

### Section 15: Other Regulatory Information

**Federal and State Regulations:** TSCA 8(b) inventory: Sodium carbonate

**Other Regulations:** EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

**Other Classifications:**

**WHMIS (Canada):** CLASS D-2B: Material causing other toxic effects (TOXIC).

**DSCL (EEC):**

R36/37/38- Irritating to eyes, respiratory system and skin. S22- Do not breathe dust. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

**HMIS (U.S.A.):**

**Health Hazard:** 2

**Fire Hazard:** 0

**Reactivity:** 1

**Personal Protection:** E

**National Fire Protection Association (U.S.A.):**

**Health:** 2

**Flammability:** 0

**Reactivity:** 1

**Specific hazard:**

**Protective Equipment:**

Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

### Section 16: Other Information

**References:** Not available.

**Other Special Considerations:** Not available.



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# APPENDIX G

## GLOSSARY & TERMS



## **Glossary & Terms**

The following section defines abbreviations and technical terms used within this manual and the wastewater treatment industry in general.

### **1. ACRONYMS & ABBREVIATIONS**

<b>ACRONYM</b>	<b>DEFINITION</b>
<b>AT</b>	Aeration Tank
<b>BOD</b>	Biological Chemical Oxygen Demand
<b>cBOD</b>	Carbonaceous Biological Oxygen Demand
<b>CaCO<sub>3</sub></b>	Calcium Carbonate
<b>CIP</b>	Clean In Place
<b>COD</b>	Chemical Oxygen Demand
<b>DO</b>	Dissolved Oxygen
<b><i>E-Coli</i></b>	Escherichia coli - Gram-negative, rod-shaped bacterium
<b>EQ</b>	Equalization Tank
<b>FOG</b>	Fat, Oil and Grease
<b>kPa</b>	Kilo Pascal
<b>L</b>	Liter
<b>LMH</b>	Liters / m <sup>2</sup> of Membrane Area per Hour ( Flux)
<b>MBR</b>	Membrane Bioreactor
<b>MLSS</b>	Mixed Liquor Suspended Solids
<b>MLVSS</b>	Mixed Liquor Volatile Suspended Solids
<b>MT</b>	Membrane Tank
<b>NaOCl</b>	Sodium Hypochlorite
<b>NaOH</b>	Sodium Hydroxide
<b>NH<sub>3</sub> -N</b>	Ammonia as Nitrogen (unionized)
<b>NH<sub>4</sub> -N</b>	Ammonium as Nitrogen (ionized)
<b>NO<sub>3</sub> -N</b>	Nitrate Nitrogen



ACRONYM	DEFINITION
<b>NO<sub>2</sub> -N</b>	Nitrite Nitrogen
<b>NTU</b>	Nephelometric Turbidity Unit
<b>O<sub>2</sub></b>	Molecular Oxygen
<b>OUR</b>	Oxygen Uptake Rate
<b>PC</b>	Primary Clarifier
<b>P&amp;ID</b>	Process and Instrumentation Diagram
<b>pH</b>	Measure of Acidity & Alkalinity
<b>PLC</b>	Programmable Logic Controller
<b>ppb</b>	parts per billion
<b>ppm</b>	parts per million
<b>psi</b>	pounds per square inch
<b>PSL</b>	Pressure Switch Low
<b>RAS</b>	Return Activated Sludge
<b>SDI</b>	Silt Density Index
<b>TP</b>	Total Phosphorus
<b>TMP</b>	Transmembrane Pressure
<b>TKN</b>	Total Kjeldahl Nitrogen
<b>TN</b>	Total Nitrogen
<b>TDS</b>	Total Dissolved Solids
<b>TS</b>	Total Solids
<b>TSS</b>	Total Suspended Solids
<b>VFD</b>	Variable Frequency Drive
<b>VSS</b>	Volatile Suspended Solids
<b>UF</b>	Ultrafiltration
<b>UV</b>	Ultraviolet
<b>WAS</b>	Waste Activated Sludge
<b>WWTP</b>	Waste Water Treatment Plant



## 2. TECHNICAL TERMS DEFINITION

<b>ACID</b>	Substance which solution has a pH below 7.0, sour taste, releases hydroxyl ions in water and reacts with bases.
<b>ACTIVATED SLUDGE</b>	The floc produced in wastewater due to the growth of bacteria and other organisms in the presence of dissolved oxygen.
<b>ACTIVATED SLUDGE PROCESS</b>	Activated sludge is a process for treating sewage and industrial wastewaters using air and a biological floc composed of bacteria and protozoa.
<b>ACTUATED VALVE</b>	Valve with an actuator that is controlled by an external command.
<b>ADVANCED WASTEWATER TREATMENT</b>	Process designed to produce an effluent of higher quality than normally achieved by secondary treatment processes.
<b>AEROBIC</b>	Life or processes that require, or are not destroyed by, the presence of free elemental oxygen.
<b>AEROBIC BACTERIA</b>	Bacteria that require the presence of oxygen to live and grow.
<b>AEROBIC DIGESTION</b>	The aerobic digestion process is a treatment process that utilizes aerobic microbes to stabilize the solids. The microbes digest solids from primary sedimentation processes, and those from secondary treatment processes. Due to the length of time that the solids remain under aeration, the long solids retention time allows for the microbes to feed off of the cell contents of other dying/decaying microbes under digestion. This is referred to as "endogenous respiration" or "endogenous stabilization." There will be an "inert fraction" between 20 and 25% by weight, in the resulting stabilized solids. This inert fraction will consist of fine inorganic solids, organic solids, and cell components that will not be degradable by



**AEROBIC ZONE**

An environment where there is dissolved air or free oxygen.

**AIR DIAPHRAGM METERING PUMP**

Air diaphragm metering pump provides chemical dosing at measured rates. The dosing is set manually and it is regulated either by the amount of compressed air driving the pump or by setting the backpressure of the pumps.

**AIR FLOW SWITCH (PSL)**

Located on the supplemental aeration piping, used to indicate when a specific flow rate has been reached for a blower. This flow rate identifies low aeration to the aeration or membrane tank, triggering an alarm or alert.

**AIR SCOURING**

Diffusers placed below the membrane modules generate air bubbles in water that scour (rub) the membrane surface and keep it clean.

**ALARM**

A visible or audible indication of abnormal situation. An alarm may be an operator interface screen message, a light, a buzzer or another form of communication to the operator.

**ALKALINE**

A solution having an excess of hydroxyl (OH) ions - with pH greater than 7.0.

**ALKALINITY**

The capacity of water or wastewater for neutralizing an acid. Alkalinity in wastewater results from the presence of carbonate, bicarbonate, and hydroxide. Alkalinity in water helps to resist changes in pH caused by addition of acids. Generally expressed as an amount of CaCO<sub>3</sub> equivalent.

**ANAEROBIC**

Life or processes that require, or are not destroyed by, the absence of free elemental oxygen.

**ANAEROBIC BACTERIA**

Any bacteria that can survive in partial or complete absence of oxygen by using molecular oxygen found in



nitrates and sulfates.

**ANAEROBIC BIOLOGICAL REACTOR**

Anaerobic (in the absence of oxygen) decomposition breaks down large molecules into small molecules increasing the rate of methane generation, which can be used for energy recovery.

**ANALOG**

An electrical signal that is proportional to the size of the variable being monitored or controlled.

**ANOXIC**

Conditions where some species other than oxygen acts as the electron donor for biochemical reactions.

**AUTOMATIC FLOW VALVE**

This valve is used when regular changes are required in the state of the valve (fully open or fully closed only). It is controlled by the PLC.

**BACKPULSE / BACKFLUSH /  
BACKWASH**

A mode of operation in which the flow of permeate is reversed through the membrane. During backwash, accumulated solids go away from the membrane surface due to the combined effects of the membrane air scouring and backwash of permeate.

**BIOCHEMICAL (BIOLOGICAL) OXYGEN  
DEMAND**

A measure of the amount of oxygen consumed in the biological process breaking down organic matter in water – the greater the BOD, the greater the degree of pollution.

**BIOCIDE**

A chemical for preventing biological growth.

**BIOLOGICAL TREATMENT (or  
BIOTREATMENT)**

Process whereby dissolved organic chemical constituents are removed through biodegradation.

**BIOMASS**

The mixture of biodegradable material, bacteria, and biosolids present in a biological wastewater treatment system.

**BIOSOLIDS**

Material from sludge treatment, which contains organic matter and plant nutrient; unlike excess waste activated sludge, biosolids have undergone a treatment to decrease or eliminate pathogenic organisms. Biosolids



can be beneficially recycled.

**BLOWER**

Blowers are used to introduce air in order to create an aerobic environment for BOD removal and for scouring the membranes to prevent membrane fouling.

**MODULE ( for newterra MicroClear® MBR)**

Membrane filtration unit; it is a group of interlocked MicroClear® cassettes, fastened together to act as a single unit.

**CHEMICAL OXYGEN DEMAND**

A test used to estimate the amount of organic matter within a sample using a strong chemical oxidizing agent. The COD is generally higher than the BOD (for sewage BOD / COD ratio varies from 0.4 to 0.8).

**COAGULANT**

An agent that causes fine or suspended impurities to group together (coagulate).

**COMBINED SEWER**

A sewer system that carries both sanitary sewage and stormwater (SW) runoff.

**CONDITIONING FOULING**

First stage of membrane fouling through adsorption of material.

**CONTAMINANT**

A source of contamination, an impurity and any substance in water which is not H<sub>2</sub>O.

**CRITICAL FLUX**

Flux below which permeability decline is considered negligible.

**DENITRIFICATION**

Biochemical reduction of nitrate to nitrogen gas.

**EFFLUENT**

Wastewater – treated or untreated – that flows out of a treatment plant, sewer, or industrial outfall.

**ELECTRON DONOR**

Species capable of donating an electron to a suitable



acceptor and is oxidized as a result.

<b>EQUALIZATION TANK</b>	Used for equalization of flow and composition of wastewater.
<b>F/M (RATIO)</b>	Food-to-microorganism ratio (F/M) – rate at which substrate is fed to the biomass compared to the mass of biomass solids.
<b>FEED</b>	Feed is the term use to define fluid entering a membrane module or wastewater treatment plant.
<b>FILTER CAKE</b>	Accumulated particles on a filter surface.
<b>FILTRATE</b>	Portion of the feed stream which has passed through a filter; also known as “permeate” in membrane system.
<b>FLOC</b>	Aggregated solid (biomass) particle.
<b>FLUX (or PERMEATE VELOCITY)</b>	Quantity of material (water) passing through an area of membrane per unit time – usually expresses LMH (L/m <sup>2</sup> .h), or gfd (gal/ft <sup>2</sup> .d).
<b>FOULING</b>	Processes leading to deterioration of flux due to surface or internal blockage of the membrane.
<b>GLYCERIN</b>	Glycerin is the commercial form of glycerol. It is used for membrane long term preservation to avoid membrane drying.
<b>HOUSING</b>	Vessel which holds a membrane module.
<b>HYDRAULIC LOADING RATE</b>	Rate at which water enters the reactor.



**HYDRAULIC RETENTION TIME (HRT)**

The time required to displace the working volume of a bioreactor.  $HRT (d) = \text{Bioreactor volume (L)} / \text{Feed flow rate (L/d)}$ .

**INFILTRATION**

Entry of water into a sewer system from sources other than infiltration – such as defective pipes, pipe joints, connections, or manhole walls.

**INFLOW**

Entry of water into a sewer system through such sources as defective pipes, pipe joints, connections, or manhole walls.

**INPUTS / OUTPUTS**

Inputs / Outputs refer to the direction of the electronic signal in reference to the PLC. They can be either digital or analog signals.

**INTENSIVE / RECOVERY CLEAN**

Cleaning with aggressive chemicals to recover membrane permeability.

**IRREVERSIBLE / PERMANENT FOULING**

Not removed by physical cleaning but removed by chemical cleaning.

**LAND APPLICATION**

Treatment or disposal of wastewater or wastewater solids by spending it on land under controlled conditions.

**LEVEL SWITCH**

Level switches are placed in tanks to indicate water level.

**MICROORGANISMS**

Microscopic organisms, either plant or animal, invisible or barely visible to the naked eye. Examples: algae, bacteria, fungi, protozoa, and viruses.

**MAINTENANCE CLEANING**

Cleaning with less aggressive chemicals to maintain membrane permeability.

**MEMBRANE**

A porous synthetic material which acts as a highly efficient barrier or filter in the range of molecular dimensions – allowing passage of ions, water and other solvents, and very small molecules – but most impermeable to macromolecules. Membrane classes include – MF (microfiltration), UF (ultrafiltration), NF (nanofiltration), RO (reverse osmosis).



<b>MEMBRANE BIOREACTOR</b>	A biological wastewater treatment system that uses a membrane to separate water from biomass.
<b>MEMBRANE CONFIGURATION</b>	In membrane separation technology, configuration of a membrane product describes its construction or membrane spatial arrangement. Basic membrane configurations include hollow fiber, spiral, tubular, and flat-sheet.
<b>MEMBRANE PACKING DENSITY</b>	Membrane area per unit volume.
<b>MEMBRANE TANK / BASIN</b>	Tank/basin wherein membrane cassettes are placed.
<b>MESOPHILIC</b>	Thriving at intermediate temperatures: 20 to 45 °C (15 °C optimum).
<b>MESOPORE</b>	Pore with diameter between 2 and 50 µm.
<b>METHANOGENS</b>	Microorganisms producing methane as a metabolic byproduct.
<b>MICROFILTRATION (MF)</b>	A process using a membrane class to separate relatively large particles – 0.1 to 3 µm in diameter, with relatively low applied pressures. In crossflow microfiltration system, feed solution flows perpendicular to the filter surface.
<b>MIXED LIQUOR SUSPENDED SOLIDS (MLSS, mg/L)</b>	A measure of the quantity of suspended solids in the aeration tank of an activated sludge treatment system.
<b>MIXED LIQUOR VOLATILE SUSPENDED SOLIDS (MLVSS, mg/L)</b>	The portion of MLSS that vaporizes when heated to 550°C (1022° F).
<b>MODULE (membrane)</b>	Smallest practical unit containing one or more membranes and supporting structures.



**NITRIFICATION**

Biochemical oxidation of ammonia to nitrate.

**NUTRIENTS**

Any substance that is assimilated by organisms and promotes growth; generally applied to nitrogen and phosphorus in wastewater, but also applied to other essential and trace elements.

**OPERATION AND MAINTENANCE (O&M)**

Organized procedure for causing a piece of equipment or a treatment plant to perform its intended functions and for keeping the equipment or plant in such a condition that it is able to continually and reliably perform its intended function.

**(ORGANIC) LOADING RATE**

Rate at which (organic) matter is introduced into the reactor.

**PERMEABLE**

Porous to the passage or penetration by fluids.

**PERMEABILITY**

The ratio of the flux and transmembrane pressure at that flux ( $L/m^2 / h / kPa$  or  $gfd/psi$ ).

**PERMEATE**

Water or fluid which has passed through the membrane; also referred to as "filtrate".

**PERMEATE PUMP**

Vacuum pump which draws permeate through the membrane, as in MBR.

**PERMIT**

A legal document issued by the government agency. In wastewater treatment, a discharge permit requires that the plant operator achieve specific water quality standards and discharge limits by a certain date, and also establishes monitoring and reporting requirements.

**PLATE-AND-FRAME**

Synonymous with "flat-sheet".

**PLUG FLOW**

Flow in which no back-mixing or dispersion occurs along the length of the pipe or reactor.



<b>POLLUTANT</b>	A contaminant at high enough concentration to endanger the aquatic environment or public health.
<b>PORE</b>	An opening in a membrane or filter matrix.
<b>POROUS</b>	Ability of certain substances to pass fluids due to an open physical structure.
<b>POROUS PLUGGING</b>	Type of membrane fouling – due to pore blockage.
<b>POROUS MEMBRANE</b>	Membrane of low selectivity operating by physical straining alone.
<b>PRETREATMENT</b>	In membrane wastewater treatment systems, pretreatment is the initial processing of wastewater to prolong the life of a membrane system and to optimize membrane performance. Pretreatment includes screening, equalization, oil & grease removal, primary clarification, aeration to oxidize colloidal and dissolved organics in wastewater.
<b>RECEIVING STREAM</b>	A river, lake, ocean, or other water course into which wastewater or treated effluent is discharged.
<b>RELAXATION</b>	Ceasing permeation whilst continuing to scour the membrane with air bubbles.
<b>RESISTANCE</b>	Resistance to flow – proportional to flow rate-to-pressure ratio.
<b>RETENTATE</b>	Water or fluid which is rejected by the membrane – portion of the feed solution in UF and RO that does not pass through the membrane; also called “concentrate” or “reject”.
<b>REVERSIBLE OR TEMPORARY FOULING</b>	Gross solids attached to the membrane surface and which can be removed by physical cleaning relatively easily – such as backflushing or relaxation.



<b>SANITARY SEWER</b>	A sewerage system that carries only household and commercial wastewater / sewage.
<b>SCALING</b>	Buildup of precipitated salts on a surface – such as pipes, tanks, boiler tubes, membrane surface (in RO, UF) resulting in a physical or chemical change.
<b>SECONDARY TREATMENT - CONVENTIONAL</b>	Generally, a level of treatment that produces removal efficiencies of 85 percent for BOD and suspended solids – sometimes used interchangeably with the concept of biological wastewater treatment, where wastewater is mixed with air or oxygen and sludge to encourage the growth of bacteria that “eat” organic pollutants.
<b>SEWER</b>	An artificial, usually subterranean conduit, used to carry off sewage or wastewater.
<b>SILT DENSITY INDEX (SDI)</b>	A test used to measure the level of suspended solids in feed water (especially for RO). It is a measure of the tendency of water to foul a membrane, based on a timed flow through a membrane filter (0.45 µm), at a constant pressure, also known as “fouling index”.
<b>SHEAR (STRESS)</b>	Force applied to a body which tends to produce a change in its shape, but not its volume.
<b>SIDE-STREAM</b>	Stream outside the bioreactor.
<b>STACK</b>	Smallest practical unit containing one or more membranes and supporting structures.
<b>SUBSTRATE</b>	Surface or medium on which an organism grows or is attached.
<b>SUPERNATANT</b>	Liquid clarified by sedimentation.



<b>SURFACE POROSITY</b>	Percentage of the surface area occupied by the pores.
<b>SUSPENDED SOLIDS</b>	Solid pollutants that either float on the surface of, or are suspended in, wastewater.
<b>SUSTAINABLE FLUX</b>	Flux for which the TMP (transmembrane pressure) increases gradually at an acceptable rate, such that chemical cleaning is not necessary.
<b>THERMOPHILIC</b>	Thriving at relatively high temperatures (49- 57 °C (45 °C optimum).
<b>TOTAL SOLIDS</b>	Total dissolved and undissolved solids in water or wastewater.
<b>TRANSMEMBRANE PRESSURE</b>	Pressure difference from the feed side of the membrane to the permeate side.
<b>TURBIDITY</b>	A suspension of fine particles in water that obscure the light rays and cause cloudiness and will not readily settle due to small particle size. Measure of the clarity of an otherwise clean liquid – cloudy or hazy appearance in a naturally clear liquid. Typically, turbidity of the MBR permeate is less than 1 N.T.U.
<b>TURBIDITY UNITS</b>	Measurement of relative ability of a solution to allow a light beam to pass through it; usual units are N.T.U. (Nephelometric Turbidity Units).
<b>ULTRAFILTER</b>	A mechanical unit used in the membrane separation process.
<b>ULTRAFILTRATE</b>	A synonym for UF “permeate”.



**ULTRAFILTRATION (UF)**

Membrane separation process based on size exclusion. UF operates in the molecular weight cut-off (MWCO) range from 1,000 MWCO to 200,000 MWCO, or 0.002  $\mu\text{m}$  to 0.1  $\mu\text{m}$ . Emulsified oils, suspended solids, bacteria, and large molecules are rejected by UF membranes. Water and small molecules – dyes, surfactants, dissolved salts, and solvents pass through in the permeate.

**VOLUMETRIC MASS TRANSFER COEFFICIENT**

A combination of the overall liquid mass transfer coefficient and the specific area for mass transfer. The term measures the mass transfer of oxygen into the liquid via air bubbles.

**WASTEWATER**

Spent or used water from a community or industry that contains dissolved and/or suspended matter.

**$\alpha$  or  $\beta$  FACTOR**

Factors applied to correct biological aeration demand for dissolved and suspended solids content of biomass.



# APPENDIX

## Biological Treatment & Monitoring Parameters



## **Biological Treatment and Monitoring Parameters**

This section offers the introduction of some key terms for biological control and wastewater quality description. It is important that the operators become familiar with how these parameters are obtained and what each of these terms mean and how each relates to the MBR wastewater treatment process operation.

### **1. Removal of substrates in wastewater**

#### **Carbonaceous pollutants removal**

The concept of carbonaceous pollutants treatment is very simple. The bacteria remove small organic carbon molecules by 'eating' them. As a result, the bacteria grow, and the wastewater is cleaned. Although there are many thousands of chemical reactions involved in the metabolism of a bacterium, three major processes that are relevant to the biological treatment of sewage are ingestion, respiration, and growth and division.

Some of organic carbons go along the pathway of catabolism or respiration and end up as carbon dioxide, and they are lost to the system. The remaining organic carbons follow the anabolism or growth pathway and end up in new biomass, and these carbons are therefore retained in the system. The purpose of respiration is also to provide the energy that is required for growth and for the maintenance of the bacterium.

These three processes of ingestion, respiration and growth are very highly coupled or meshed. No one process can go faster than the other. One implication of this is that, for instance, if you measure the respiration rate, you are indirectly also measuring the rate of growth and the rate of carbon ingestion.

Growth is the driver and rate-limiting step. Every bacterium has a genetically programmed maximum rate of growth that will be achieved under ideal conditions. As it grows, it withdraws carbon compounds from the internal pool in its cytoplasm. Carbon flows in from the mixed liquor in order to keep this pool topped up. At the same time, energy is used for biosynthesis and growth, and hence the catabolism pathways of respiration also withdraw carbon from the internal pool, and this also results in carbon being drawn in by ingestion.

The three processes correspond to the major processes that we shall see when we examine the operation of the treatment works in aeration basin. Ingestion, respiration and growth and division correspond to biodegradation, aeration requirement and biomass production respectively.



Whilst the concept is very simple, the control of the treatment process is very complex, because of the large number of variables that can affect it. Whilst the major substrate requirement is for carbon growth is also dependent on the intake of nitrogen and phosphorus. The optimum ratio of C:N:P in the mixed liquor is generally thought to be 100:5:1. Trace components, which include S, Na, Ca, Mg, K, and Fe are also required, and are available in abundance in domestic sewage. By contrast, the wastewater from brewing, pulp and paper, and food-processing industries can be deficient in nitrogen and phosphorus. Nutrients therefore need to be added to the mixed liquor to obtain maximum bacterial growth and to optimise carbonaceous treatment. From an operational point of view, lack or an insufficiency of a critical nutrient may result in incomplete treatment, because the bacteria are unable to grow optimally.

Growth can be inhibited, if oxygen concentration falls to very low levels in the aeration tank. This is because oxygen becomes limiting for respiration. Dissolved Oxygen (DO) is not limiting above concentrations of about 1.0 – 2.0 mg/L for bacteria in flocs and about 0.6 mg/L for dispersed bacteria. Below these critical concentrations, the respiration rate falls rapidly due to the unavailability of oxygen. Filamentous bacteria have a greater tolerance of low oxygen levels than floc bacteria. At DO concentrations below the critical concentration, filamentous bulking can occur, as their relative biomass increases.

Bacteria have a genetically determined viable temperature range. For most carbonaceous bacteria of the activated sludge, this is from about 0 to 35°C. However thermophilic bacteria survive and grow between about 35°C and 60°C. In general, growth rate follows the rule of Arrhenius that chemical reactions double in rate for a 10°C increase in temperature. Thus as the temperature increases, the rate of growth, and hence requirement of oxygen for respiration, increases.

Toxic chemicals in the wastewater can enter the bacteria and inhibit one or more enzymes of the pathways involved in either anabolism or catabolism. If the catabolic reactions of respiration are affected, the rate of respiration and energy production is reduced and the rate of growth is therefore reduced. On the other hand, if the anabolic pathways of biosynthesis are inhibited, the rate of growth is reduced, and this is accompanied by a fall in the rate of respiration, as the requirement for energy is reduced. In the aeration tank, toxicity has the effect of reducing the rate at which organic carbon is degraded. This can be easily monitored by observing changes in the rate of respiration of the activated sludge.

### **Ammonia removal by nitrification**



The ammonia ( $\text{NH}_4\text{-N}$ ) removal is achieved by biological nitrification process. Biological nitrification is an aerobic process of conversion of ammonia to nitrite ( $\text{NO}_2\text{-N}$ ) and then to nitrate ( $\text{NO}_3\text{-N}$ ). Because of the low growth rate and poor cell yield of nitrifying bacteria, nitrification is generally a rate-limiting step in biological nitrogen removal process. The key requirement for nitrification to occur is that the net rate of accumulation of biomass (and hence the net rate of withdrawal of biomass from the system) is less than the growth rate of nitrifying bacteria. Long sludge retention time (SRT) used in MBR system ensures near complete nitrification with an effluent  $\text{NH}_4\text{-N}$  concentration of less than 1 mg/L (as long as influent wastewater characteristics stays within the design range).

Nitrification is affected by a number of environmental factors including pH, temperature, DO concentration, and toxicity. Nitrification is pH sensitive. A pH of 7.0 to 7.2 is normally used to maintain reasonable nitrification rates, with optimal rate occur at pH of 7.5 to 8.0. Alkalinity addition is required, if deficient, to maintain the proper operating pH range. Nitrifiers are much more sensitive to temperature than heterotrophic bacteria. To ensure sufficient nitrification, it is recommended that the MBR unit is operated at a temperature of greater than 15°C. Nitrification rate is also affected by DO level. Nitrifiers are strict aerobes, and thus the reaction rate is susceptible to inhibition at very low DO levels. A DO of 1 mg/L is considered as a minimum requirement to prevent any rate inhibition caused by insufficient DO level. No impact on nitrifiers growth rate is evident when the DO level is greater than 2 mg/L. Toxicity is typically not of concern for camp type wastewater, unless quat ammonia is being used as a disinfectant agent in the camp. Nitrification can easily be restored if non quat based disinfectant is being used.

### **Total nitrogen removal by nitrification/denitrification**

Biological nitrification/denitrification is a two-step process. The first step is nitrification, which is conversion of  $\text{NH}_4\text{-N}$  to  $\text{NO}_3\text{-N}$  through the action of nitrifying bacteria. The second step is nitrate conversion (denitrification), which is carried out by facultative heterotrophic bacteria under anoxic conditions. In denitrification, nitrate serves as the electron acceptor in energy metabolism and is converted to various gaseous end products but principally molecular nitrogen,  $\text{N}_2$ , which is then stripped from the liquid stream.

Denitrification or reduction of nitrate to nitrogen gas under anoxic conditions depends on nitrate being produced in the nitrification process under aerobic conditions. For total nitrogen removal, first nitrification and then denitrification should occur efficiently to achieve the desired effluent quality. Denitrification releases nitrogen which escapes as an inert gas to the atmosphere while oxygen released stays dissolved in the liquid and thus reduces the overall oxygen requirement of the process. Denitrification also returns part of the alkalinity consumed during nitrification. Thus where feasible, denitrification can be incorporated to reduce energy cost and external alkalinity addition.



The heterotrophic bacteria that perform denitrification are typically less sensitive to inhibition from toxic chemicals compared to nitrifiers. However, toxicity is still a concern. Oxygen has been found to inhibit nitrate reduction by repressing the nitrate reduction enzyme, slowing the rate of nitrite reduction. A carbon source is also essential as electron donor for denitrification to take place. This source may be in the form of carbon internally available in sewage or artificially added (eg. as methanol). Typically, if influent BOD/TKN or COD/TKN is higher than 5 or 10, assuming COD/BOD ratio of 2, MBR treatment can meet stringent effluent total nitrogen requirement (i.e., < 5mg/L) without providing supplemental carbon.

Temperature has a significant influence on maximum growth rate of denitrifying population, and the maximum growth rate of denitrification roughly doubles for every 10°C increase in temperature between 5 and 25°C. The denitrification rate is strongly affected by the kinetic regime of the reactor. Plug-flow reactors and reactors in series will produce higher denitrification rates. This typically will happen when the availability of substrate limits the denitrification reaction. In contrast to nitrifying organisms, there has been less concern about pH influences on denitrification rates. Also, no significant effect on the denitrification rate has been reported for pH from 7.0 to 8.0.

### **Phosphorus removal**

Phosphorus removal from wastewater can take place by biological or chemical methods. For each treatment method, the plant-layout and operation will be different and the consumption of energy and chemicals may be quite different.

The chemical phosphorus (P) removal relies on the transformation of soluble phosphorus to a particle form, which is then by solid-liquid separation processes, such as membrane separation. This reaction is deceptively simple and must be considered in light of the many competing reactions and their associated equilibrium constants and the effects of alkalinity, pH, trace elements found in wastewater. The overall chemical (usually lime, alum, iron and PAC) dose requirement for phosphorus removal depends on the phosphorus limit required in the permit and the design features of the treatment plant. An important operation parameter is the observed added chemical dose to the removed orthophosphate molar ratio for a plant. This parameter varies depending on the type of processes used for removing orthophosphate and particulate phosphate and the total phosphorus (TP) and orthophosphate residual required to attain permit limit. Dosages are generally established on the basis of bench-scale tests and occasionally by full-scale tests, especially if polymers are used. Typically, as the orthophosphate residuals decreased, the molar ratio of coagulant added to phosphorus removed increases.

In the biological phosphorus removal, the main actors are the polyphosphate accumulating organisms (PAOs) who take up large amounts of phosphorus from phosphates by exposing



them to alternating anaerobic and anoxic/aerobic conditions, and phosphorus is subsequently removed from the process as a result of sludge wasting.

## **2. Monitoring parameters**

### **Biochemical Oxygen Demand (BOD)**

One of the most commonly measured constituents of wastewater is the biochemical oxygen demand, or BOD. Wastewater is composed of a variety of inorganic and organic substances. Organic substances refer to molecules that are based on carbon and include fecal matter as well as detergents, soaps, fats, greases and food particles. These large organic molecules are easily decomposed by bacteria. However, oxygen is required for this process of breaking large molecules into smaller molecules and eventually into carbon dioxide and water. The amount of oxygen required for this process is known as the BOD. The Five-day BOD or BOD<sub>5</sub> is determined by incubating a sealed sample of wastewater for five days and measuring the loss of oxygen from the beginning to the end of the test.

The main focus of wastewater treatment plants is to reduce the BOD in the effluent discharged to natural waters. If effluent with high BOD levels is discharged into a stream or river, it will accelerate bacterial growth and consume the oxygen levels in the river. The oxygen may diminish to levels that are lethal for most fish and many aquatic insects.

### **Chemical Oxygen Demand (COD)**

COD is the oxygen equivalent of organic material in wastewater that can be chemically oxidized using dichromate in an acid solution. COD does not differentiate between biologically available and inert organic matter, and it is a measure of the total quantity of oxygen required to oxidize all organic material into carbon dioxide and water. And, some inorganic substances that are oxidized by the dichromate will increase the apparent organic content of the wastewater sample. COD values are always greater than BOD values and overestimate the carbon that can be removed by the activated sludge, but COD measurements can be made in a few hours while BOD<sub>5</sub> measurements take five days.

### **Total Suspended Solids (TSS)**

Wastewater usually contains large quantities of suspended solids that are organic and inorganic in nature. TSS is a laboratory measurement of the quantity of suspended solids present in wastewater, and it is determined by filtering a well-mixed sample through a weighed standard glass-fiber filter and the residue retained on the filter is dried to a constant weight at 103 to 105°C. The increase in weight of the filter represents the total suspended solids. TSS includes



the total suspended particulate matter, both inert and volatile, but does not include dissolved solids.

TSS is one of the two universally used effluent standards (along with BOD) by which the performance of treatment plants is judged for regulatory control purposes. As levels of TSS increase, a water body begins to lose its ability to support a diversity of aquatic life, because suspended solids can cause the increase of water temperature and decrease of dissolved oxygen and photosynthesis, and it also harm fish directly by clogging gills, reducing growth rates, and lowering resistance to disease.

### **Volatile Suspended Solids (VSS)**

VSS is a measure of the volatile portion of the TSS (the volatile portion which burns off at 550°C). VSS is usually interpreted as an accurate estimate of the microbial or organic portion of TSS. VSS is determined from laboratory analysis of TSS samples.

### **Total Dissolved Solids (TDS)**

TDS is a measurement of the total solids in the filtrate after filtering a wastewater sample.

### **Mixed Liquor Suspended Solids (MLSS)**

MLSS is a measurement of the solids particulate matter (i.e., the TSS concentration) in a sample collected from the aeration or membrane tanks. The MLSS concentration result is used to determine when and how much sludge is to be wasted from the system. The initial target MLSS concentration is 10,000 mg/L.

### **Mixed Liquor Volatile Suspended Solids (MLVSS)**

MLVSS is a measurement of the concentration of the volatile portion of the MLSS. MLVSS is interpreted as an approximate estimate of the microbial or organic portion of MLSS.

### **Turbidity**

Turbidity is another indicator of the amount of material suspended in water, and it measures the amount of light that is scattered or absorbed. Photoelectric turbidimeters measure turbidity in nephelometric turbidity units (NTUs). Turbidity units are supposed to correspond to TSS concentrations, but this correlation is only approximate.

### **Nitrogen**



Nitrogen compounds are of interest to wastewater treatment plant operators because of the importance of nitrogen in the life cycles of plants and animals. Nitrogen is a nutrient and occurs in many forms including ammonia, organic, nitrate and nitrite each of which may be tested for in a variety of ways. Raw domestic wastewater nitrogen is normally present in the organic nitrogen and ammonia forms, with small quantities of the nitrite and nitrate forms. Depending on the amount of nitrification which occurs within the plant, the effluent may contain either ammonia or nitrate nitrogen. Under normal circumstances, the nitrite form of nitrogen will not be present in large quantities due to its rapid oxidation or conversion to nitrate.

Ammonia nitrogen ( $\text{NH}_4\text{-N}$ ) occurs partly in the form of ammonium ions ( $\text{NH}_4^+$ ) and partly as ammonia ( $\text{NH}_3$ ). Ammonia and organic forms of nitrogen are often measured as Total Kjeldahl Nitrogen (TKN). TKN is the sum of organic nitrogen,  $\text{NH}_3$ , and  $\text{NH}_4^+$  in the chemical analysis of wastewater. Today, TKN or  $\text{NH}_4\text{-N}$  ( $\text{NH}_3$  and  $\text{NH}_4^+$ ) is a required parameter for regulatory reporting at many treatment plants, and as a means of monitoring plant operations, because the presence of large concentrations of ammonia in a stream or lake can create a large oxygen demand. This demand is caused by the conversion of ammonia to nitrate.

Nitrate can have serious health effects when it enters drinking water wells and is consumed. Nitrate and other forms of nitrogen can also have deleterious effects on the environment, especially in coastal areas where excess nitrogen stimulates the process known as eutrophication. For this reason, many alternative technologies have been designed to remove total nitrogen (TN), nitrate nitrogen ( $\text{NO}_3\text{-N}$ ), nitrite nitrogen ( $\text{NO}_2\text{-N}$ ) and TKN. These technologies use bacteria to convert ammonia and nitrate to gaseous nitrogen,  $\text{N}_2$ . In this form, nitrogen is inert and is released to the air.

## **Phosphorus**

Both phosphorus and nitrogen are essential nutrients for the plants and animals that make up the aquatic food web. Since phosphorus is the nutrient in short supply in most fresh waters, even a modest increase in phosphorus can, under the right conditions, set off a whole chain of undesirable events in a stream including accelerated plant growth, algae blooms, low dissolved oxygen, and the death of certain fish, invertebrates, and other aquatic animals. Thus, there is presently much interest in controlling the amount of phosphorus compounds that enter surface waters from wastewater treatment plants.

The principal forms of phosphorus in wastewater are organically bound phosphorus, polyphosphates, and orthophosphates. Organically bound phosphorus originates from body and food waste and, upon biological decomposition of these solids, is converted to orthophosphates. Polyphosphates, which can be hydrolyzed to orthophosphates, are used in synthetic detergents, and used to contribute as much as one-half of the total phosphates in wastewater. Most household phosphate inputs now come from human waste and automatic dishwasher detergent.



Thus, the principal form of phosphorus in domestic wastewater is assumed to be orthophosphates, although the other forms may exist. Orthophosphates consist of the negative ions  $\text{PO}_4^{3-}$ ,  $\text{HPO}_4^{2-}$ , and  $\text{H}_2\text{PO}_4^-$ . These may form chemical combinations with cations (positively charged ions).

The total phosphorus (TP) test measures all the forms of phosphorus in the wastewater sample. This is accomplished by first "digesting" (heating and acidifying) the sample to convert all the other forms to orthophosphate. Then the orthophosphate is measured by the ascorbic acid method. Because the sample is not filtered, the procedure measures both dissolved and suspended orthophosphate.

### **pH/Alkalinity**

pH is a measure of the amount of free hydrogen ions in wastewater. Because pH is measured on a logarithmic scale, an increase of one unit indicates an increase of ten times the amount of hydrogen ions. The wastewater treatment bacteria operate most efficiently at a pH of 6.8-7.2 (somewhere around neutral). When the pH drops below 6.0 or rises above 8.5, activity drops off dramatically. As a result, under normal operating conditions, pH of the MBR contents should be in the range of 6.0 to 8.5. If the pH drifts too far out of this range then corrective action is required. A low pH must be increased as soon as possible by the addition of alkaline chemical. Extended aeration at low pH will cause severe membrane fouling as a result of poor biological activity. Measurements of pH can be obtained either in the field with a portable pH meter, or in the laboratory from samples collected by the operator.

Alkalinity is the capacity to neutralize acids, and the alkalinity in wastewater results from the presence of the hydroxides, carbonates and bicarbonates of elements such as calcium, magnesium, sodium, potassium, and ammonia. The alkalinity in wastewater helps to resist change in PH change. Sufficient alkalinity is very essential to the nitrification of wastewater.

### **Temperature**

The biological activity within the MBR system is directly affected by the influent wastewater temperature and ambient temperature. Biological activity (i.e., the rate of removal of organic matter, nitrogen and phosphorus) decreases as the biomass temperature decreases. Membrane flux rate is also affected by temperature. In general, a warmer temperature improves system performance in terms of biological activity rate, and membrane flux rate up to a maximum at approximately 35°C.

### **Dissolved Oxygen (DO)**



The DO concentration in the aeration basin is measured with a DO meter/probe. The objective is to maintain a DO concentration of 1.0 – 2.0 mg/l at all times in the aeration tank.

### **Viscosity**

The sludge viscosity is one parameter used to track the condition of the MBR sludge with system performance. Monitoring of viscosity testing may be required when treating certain type of industrial wastewaters.

### **Sludge Filterability**

Sludge filterability is a key monitoring test to determine the condition of the MBR mixed liquor. Method for determining the sludge filterability is provided in Section 6.2.2.

### **Fats, Oil and Grease (FOG)**

FOG includes the fats, oils, waxes and other related constituents found in wastewater, and is contributed to wastewater in butter, lard, margarine and vegetable fats and oils. FOG can coat and kill bacteria, causing the microorganisms to float out of the system, interfere with oxygen-transfer efficiency, and cause membrane fouling. If FOG is not removed from wastewater, it can interfere with the biological life in the surface waters and create unsightly films.

### **Bacterial Indicators**

Another issue that must be addressed in wastewater treatment is the removal of pathogenic bacteria that can cause water-borne diseases. Wastewater operators need to be mindful of the potential contact with organisms that are responsible for typhoid, cholera, dysentery, and hepatitis.

Coliform bacteria are enteric bacteria. This means that they are found in the intestinal tract of warm-blooded animals, including humans. These bacteria, known as *E. coli* in humans, do not cause disease but are necessary for the digestion of food. The waterborne pathogens are also enteric bacteria and are part of the coliform family. Therefore, if coliform bacteria are present in the water, pathogens may also be present. The coliform bacteria live longer in water and are easier to detect by laboratory testing. This is the reason the coliform group has been chosen as the indicator organism for waterborne pathogens. If coliform bacteria are not present it is assumed there are no pathogens present either. The following are specific organisms that have been used as indicators of fecal contamination of wastewater.

**Total Coliform:** species of gram-negative rods that may ferment lactose with gas production at 35±0.5°C. The total coliform group includes four genera in the Enterobacteriaceae family. These are *Escherichia*, *Citrobacter*, *Enterobacter*, and *Klebsiella*. Of the group, the *Escherichia* genus (*E. coli* species) appears to be the most representative of fecal contamination.



**Fecal Coliform:** A fecal coliform bacteria group was established based on the ability to produce gas at an elevated incubation temperature ( $44.5 \pm 0.2^{\circ}\text{C}$  for  $24 \pm 2$  h).

***E. coli:*** The *E. coli* is one of the coliform bacteria populations and is more representative of fecal sources than other coliform genera.

### **Food to Microorganism Ratio (F:M)**

Another important design parameter, the F:M ratio represents a ratio between the mass of food provided and the mass of microorganisms in the wastewater treatment system. The amount of food applied is estimated from the results of the BOD and COD tests. These oxygen demand tests provide a reliable approximation of the actual amount of food available to the microorganisms. The MLSS/MLVSS is a good approximation of the microorganism concentration in the sludge. The F:M ratio is, therefore, expressed in terms of  $\text{kg BOD}/(\text{kg MLSS} \cdot \text{d})$ ,  $\text{kg BOD}/(\text{kg MLVSS} \cdot \text{d})$  or  $\text{kg COD}/(\text{kg MLSS} \cdot \text{d})$ ,  $\text{kg COD}/(\text{kg MLVSS} \cdot \text{d})$ .



## APPENDIX I

### Process and Chemicals Dosage Calculations



## Process and Chemical Dosage Calculations

This section offers calculations for the membrane permeability, chemical dosing, monitoring parameters and excess sludge wasting.

### Membrane Permeability

To check the effectiveness of a cleaning procedure, calculate the permeability of the membranes before / after the membrane cleaning.

Please refer to the example below:

**Example:** The permeate flowrate per module was recorded at 4,200 L/h at a membrane pressure of 0.06 bar. Membrane surface area per module (in case of MB3-3 module) is 315 m<sup>2</sup>. The membranes are operated on a 10 minute cycle, where permeate is withdrawn for 9 minutes followed by 1 minute of relaxation (no permeation). The temperature of the mixed liquor is 15 °C.

- 1) Calculate instantaneous (gross) Flux (**J**), the quantity of wastewater passing through a unit area of membrane module per unit time (LMH or L/(m<sup>2</sup>.h)). Flux is occasionally referred to as the permeate production or filtration velocity.

- a. Instantaneous (Gross) Flux:

$$J_{Inst} = \frac{\text{Flowrate}}{\text{Membrane Area}} = \frac{4200L/h}{315m^2} = 13.3LMH$$

- b. Net Flux:

$$J_{Net} = \frac{\text{Flowrate}}{\text{Membrane Area}} \frac{\text{PermeationTime}}{\text{CycleTime}} = \frac{4200L/h}{315m^2} \frac{9\text{ min}}{10\text{ min}} = 12.0LMH$$

- c. Temperature Corrected Flux:

$$J_{20^\circ C} = J_{Inst@15^\circ C} e^{\theta(20-T)} = 13.3LMH * (2.718)^{0.0239*(20-15)} = 15.0LMH$$

- 2) Calculate membrane permeability (**K**), the ratio of the flux and transmembrane pressure (TMP).

$$K = \frac{J_{20^\circ C}}{TMP} = \frac{15.0LMH}{0.06bar} = 250LMH / bar$$

**Note: this parameter has been incorporated on the touch screen and is being monitored via PLC on a continuous basis**



## Chemical Dosing

To determine the quantity of a chemical required for dosing into the system, refer to the following calculation example.

**Example:** The aeration tank influent (domestic wastewater) flow rate is 5,000 L/h. The influent total phosphorus (TP) concentration is 10 mg/L, and effluent TP limit is 1 mg/L. The TP uptake through sludge production is 2.5 mg/L. The alum stock solution concentration is 48% by weight, and its density is 1310 kg/m<sup>3</sup>. Calculate the alum dosage to aeration tank,  $Q_{Al}$ , for TP removal.

- 1) Determine the alum concentration needed for phosphorus removal in the aeration tank.

Table C.1: Molar ratio of Al (III) dose to phosphorus removed as a function of effluent TP concentration limit for domestic wastewater

Effluent TP limit (mg/L)	Alum:Phosphorous (mol/mol)
$\geq 1$	1.0
0.1 - 1	2.0
0.05 – 0.1	2.5
$< 0.05$	3.5

- Select Al: P ratio = 1.0 mol/mol, because the effluent TP limit is 1 mg/L (See Table C.1)
- Determine the weight of Al required per unit weight of P:

$$\frac{Al}{P} = \frac{1.0 \text{ mol Al} / \text{mol P}}{2 \times 26.98 \text{ g} / \text{mol} / 666.5 \text{ g} / \text{mol}} = 12.4 \text{ g Al} / \text{g P}$$

- Calculate phosphorus required to be removed:  $10 - 1 - 2.5 = 6.5 \text{ mg/L}$
- Determine the concentration of alum required, [Al], in the aeration tank:

$$[Al] = 12.4 \text{ g Al} / \text{g P} \times 6.5 \text{ mg} / \text{L} = 80.6 \text{ mg} / \text{L}$$

- 2) Determine the amount of alum solution required per hour,  $Q_{Al}$ , which is the alum dosing pump flow rate:

$$Q_{Al} = \frac{5,000 \text{ L} / \text{h} \times 80.6 \text{ mg} / \text{L}}{48\% \times 1310 \text{ kg} / \text{m}^3 \times 1,000 \text{ mg} / \text{g}} = 0.64 \text{ L} / \text{h}$$



## Chemical Dosing with Dry Chemicals

To determine the quantity of dry chemical and water to use to make-up a chemical solution refer to the following two calculation examples:

**Example:** The alkalinity and pH in the system are to be maintained using soda ash (sodium carbonate). The solubility of soda ash is 22 %wt at 20 °C, and has a density of 2.54 g/cm<sup>3</sup>. The chemical make-up tank can hold 300 L of solution. The soda ash is shipped in 25 kg bags. The influent flow rate is 100 m<sup>3</sup>/d

1) Determine the amount of dry soda ash need to make-up a batch of soda ash solution:

- Use 20 %wt solution in order to more readily dissolve the soda ash
- Determine the density of the final solution:

$$\rho_{\text{solution}} = 0.2 * 2.54 \text{ g/cm}^3 + (1 - 0.2) * 1.0 \text{ g/cm}^3 = 1.31 \text{ g/cm}^3$$

- Determine the mass of soda ash in 300 L of solution:

$$m_{\text{Na}_2\text{CO}_3} = 300 \text{ L} * 1.31 \text{ g/cm}^3 * \frac{1000 \text{ cm}^3 / \text{L}}{1000 \text{ g/kg}} * 0.2 \text{ kg}_{\text{Na}_2\text{CO}_3} / \text{kg}_{\text{Solution}} = 78.6 \text{ kg}$$

- Therefore 78.6 kg of soda ash are needed, or approximately 75 kg which is 3 X 25 kg bags.

2) Determine the amount of water to use to make-up the soda ash solution

- Determine the volume displaced by the soda ash:

$$V_{\text{Na}_2\text{CO}_3} = \frac{75 \text{ kg}}{2.54 \text{ g/cm}^3} * \frac{1000 \text{ g/kg}}{1000 \text{ cm}^3 / \text{L}} = 29.5 \text{ L of elements}$$

- Determine the volume of water required:

$$V_{\text{H}_2\text{O}} = 300 \text{ L} - 29.5 \text{ L} = 270.5 \text{ L}$$

3) Determine the dosing rate to add 100 mg/L of alkalinity as CaCO<sub>3</sub> to the system.

- Determine the equivalent concentration as soda ash (Na<sub>2</sub>CO<sub>3</sub>):

$$[\text{Alk}]_{\text{Na}_2\text{CO}_3} = [\text{Alk}]_{\text{CaCO}_3} \frac{MM_{\text{Na}_2\text{CO}_3}}{MM_{\text{CaCO}_3}} = 100 \text{ mg/L} \frac{106 \text{ mg/mmol}}{100 \text{ mg/mmol}} = 106 \text{ mg/L}$$



- Determine the dosing rate of soda ash on a mass basis:

$$\dot{m}_{Na_2CO_3} = [Alk]_{Na_2CO_3} * Q_{inf} = 106 \text{ mg} / \text{L} * 100 \text{ m}^3 / \text{d} * \frac{1000 \text{ L} / \text{m}^3}{1000 \text{ mg} / \text{g}} = 10,600 \text{ g} / \text{d}$$

- Determine the dosing rate of soda ash solution on a volume basis:

$$Q_{Na_2CO_3} = \frac{\dot{m}_{Na_2CO_3}}{[Na_2CO_3]} = \frac{10,600 \text{ g} / \text{d}}{250 \text{ g} / \text{L}} = 42.4 \text{ L} / \text{d}$$

**Example:** A filter press is to be used to dewater sludge, and a polymer is to be used to flocculate the sludge. The polymer make-up concentration is to be 0.2% (2 g/L) and to be made up using dry polymer with a density of 0.8 g/mL. The polymer make-up tank has a capacity of 300 L. The flocculation tank has a capacity of 900 L. The wasted sludge has an MLSS concentration of 1% (10 g/L). The ratio of polymer to sludge should be 10 g/kg on a dry basis.

- 1) Determine the amount of dry polymer required to make up a batch of 0.2% polymer solution:

- Determine mass of dry polymer required

$$m_{DryPolymer} = [Polymer] * V_{PolymerSolution} = (2 \text{ g} / \text{L}) * (300 \text{ L}) = 600 \text{ g}$$

- Determine volume of dry polymer required

$$V_{DryPolymer} = \frac{m_{DryPolymer}}{\rho_{DryPolymer}} = \frac{600 \text{ g}}{0.8 \text{ g} / \text{mL}} = 750 \text{ mL}$$

- Therefore 750 mL of dry polymer, or 3 cups, are required to make-up a batch of 0.2% polymer solution.

- 2) Determine the dose of polymer solution required to flocculate a batch of sludge:

- Determine mass of solids to be flocculated on a dry basis

$$m_{DrySolids} = [MLSS] * V_{Sludge} = (10 \text{ g} / \text{L}) * (900 \text{ L}) = 9000 \text{ g} = 9 \text{ kg}$$

- Determine mass of polymer required to flocculate sludge on a dry basis

$$m_{DryPolymer} = Polymer : SolidsRatio * m_{DrySolids} = (10 \text{ g} / \text{kg}) * (9 \text{ kg}) = 90 \text{ g}$$

- Determine volume of polymer solution required to flocculate sludge



$$V_{PolymerSolution} = \frac{m_{DryPolymer}}{[Polymer]} = \frac{90g}{2g/L} = 45L$$

- Therefore 45 L of 0.2% polymer solution are required per batch to flocculate the 900 L of 1% sludge.

## **Monitoring Parameters**

To determine the food to microorganism (F/M) ratio, BOD loading rate and solids retention time (SRT) refer to the following examples.

**Example:** The influent flow rate is 100 m<sup>3</sup>/d with a BOD concentration of 400 mg/L (g/m<sup>3</sup>). The volume of the reactor (aeration tank and membrane tank) is 100 m<sup>3</sup> and contains mixed liquor with a suspended solids concentration of 10,000 mg/L and a MLVSS/MLSS ratio of 0.70. Excess sludge is wasted at a rate of 5 m<sup>3</sup>/d

- 1) Determine the BOD loading:

$$BOD_{Loading} = \frac{[BOD] * Q_{inf}}{V_{Reactor}} = \frac{(400g/m^3) * 100m^3/d}{100m^3}$$

$$BOD_{Loading} = 400 \frac{g}{m^3 * d} = 0.4 \frac{kg}{m^3 * d}$$

- 2) Determine F/M ratio:

$$F/M = \frac{[BOD] * Q_{inf}}{MLSS * \frac{MLVSS}{MLSS} V_{Reactor}} = \frac{(400g/m^3) * 100m^3/d}{(10,000g/m^3) * (0.70) * (100m^3)}$$

$$F/M = 0.057 \frac{kgBOD}{kgMLVSS * d}$$

- 3) Determine SRT:

$$SRT = \frac{V_{Reactor}}{Q_{WAS}} = \frac{100m^3}{5m^3/d}$$

$$SRT = 20d$$



## **Excess Sludge Wasting**

Excess activated sludge is wasted periodically during the MBR operation. To determine the amount of excess sludge wasted, refer to the following calculation example.

**Example:** The measured MLSS concentration of activated sludge in aeration tank is 15,000 mg/L. Excess sludge has to be drained to keep its design concentration of 10,000 mg/L. The volume of aeration tank is 100 m<sup>3</sup>. Calculate the volume of excess sludge (Vs) to be wasted.

$$V_s = \frac{(15,000 - 10,000) \text{ mg} / \text{L} \times 100 \text{ m}^3 \times 1,000 \text{ L} / \text{m}^3}{15,000 \text{ mg} / \text{L}} = 33,333 \text{ L}$$

***The operator can set the sludge wasting pump flowrate according to the above calculated volume.***



# Soda Ash Make-Up Instructions

1. Fill soda ash make-up tank approximately  $\frac{3}{4}$  full of 20 °C water
  - MBR permeate may be used
2. Turn on mixer M-6101
3. Slowly add sodium carbonate to make up a 20%wt solution(Rule of thumb: 1 X 25 kg bag per 100 L)
  - This is based on 20 °C water. If water temperature is colder, the solubility will be lower.
  - Check between additions of each bag to ensure sodium carbonate is dissolving. If sodium carbonate is not dissolving, do not add any more.
4. Once fully dissolve, turn off mixer M-6101

*Caution: This soda ash make-up process is exothermic (generates heat), and personal protective equipment for chemicals handling must be worn.*



# **APPENDIX J**

## **newterra MicroClear™ Membrane Clean Water Testing Sheet & Cleaning Log Sheet**



## newterra MicroClear™ MEMBRANE CLEAN WATER TESTING SHEET – MBR HYDRAULICS

Clean Water Test Information	
Date	
Performed By	
Observed By	

Plant Conditions	
Ambient Temperature	
Water Temperature	
Normal Operating Level	
Static Pressure at Normal Operating Level	

### MEMBRANE TANK HYDRAULICS

Flux (LMH)	Flow Rate (Lpm)	TMP during steady flow (bar)	Permeability (LMH/bar)



**newterra MicroClear™ MEMBRANE CLEANING LOG SHEET**

Precautions have to be taken to handle membrane chemical cleaning.



**Chemical cleaning is only to be carried out by qualified and trained personnel! Chemicals can lead to serious injuries. Always wear personal protective equipment (PPE) when handling chemicals! Obey the chemical safety handling procedure, as listed in the Material Safety Data Sheets.**

Date	Type of Cleaning		Start time	Finish time	Sodium Hypochlorite (NaOCl)		Citric Acid (C <sub>6</sub> H <sub>8</sub> O <sub>7</sub> )		Permeability * (LMH/bar)
	Maintenance (CEB)	Recovery (R)			Volume ( L )	Conc. (mg/L)	Volume ( L )	Conc. (mg/L)	

*\*Normal permeability after cleaning: 150 to 300 LMH/bar. Repeat the cleaning procedures if the normal permeability value is not attained.*



# APPENDIX K

## Control Narrative





# 1704432 - Agnico Eagle System Control Narrative - Test Protocol

Revision	YYYY-MM-DD	Description	By
A	2017-05-25	Submittal	JJK
C	2017-05-11	As-Built	JJK





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## System Inputs

Module	Tag	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)	Notes	Input Verification
100	FIT-101	Flow Indicating Transmitter	Analog	GPM	0-760lpm	0-760lpm	Y	Y		
100	FQI-101	Flow Totalizer	Discrete N.O.	Pulse/Gal	1 liter/ Pulse					
100	LSHH-101	Level Switch High High	Discrete N.C.							
100	LSHH-102	Level Switch High High	Discrete N.C.							
100	LSHH-103	Level Switch High High	Discrete N.C.							
200	FIT-201	Flow Indicating Transmitter	Analog	GPM	0-760lpm	0-760lpm	Y	Y		
200	FQI-201	Flow Totalizer	Discrete N.O.	Pulse/Gal	1 liter/ Pulse					
200	LSHH-201	Level Switch High High	Discrete N.C.							
200	LSHH-202	Level Switch High High	Discrete N.C.							





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## System Inputs

Module	Tag	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)	Notes	Input Verification
200	LSHH-203	Level Switch High High	Discrete N.C.							
200	LSH-203	Level Switch High	Discrete N.C.							
200	LSL-203	Level Switch Low Low	Discrete N.O.							
300	LSHH-301	Level Switch High High	Discrete N.C.							
300	LT-301	Level Transmitter	Analog	%	0-10 ftWC	0-10 ftWC	Y	Y		
300	TT-301	Temperature Transmitter	Analog	°C	0-100c	0-100c	n	n	Added to System	
300	LSL-301	Level Switch Low Low	Discrete N.O.						Must be above all immersion heaters in Tank	
300	PSL-301	Pressure Switch Low	Discrete N.C.		9-85"WC					





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## System Inputs

Module	Tag	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)	Notes	Input Verification
400	LSHH-401	Level Switch High High	Discrete N.C.							
400	TSL-401	Temperature Switch Low	Discrete N.C.							
400	LSLL-401	Level Switch Low Low	Discrete N.O.							
500	LSHH-501	Level Switch High High	Discrete N.C.							
500	LSLL-501	Level Switch Low Low	Discrete N.O.						Must be above all immersion heaters in Tank	
500	PH-501	pH Transmitter	Analog		0-14 pH		Y	Y		
500	DO-501	Dissolved Oxygen Transmitter	Modbus	ppm	0-10		Y	Y		
500	TT-501	Temperature Transmitter	Modbus	°C	0-100					
500	LT-501	Level Transmitter	Analog	%	0-10 ft		Y	Y		



## System Inputs

Module	Tag	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)	Notes	Input Verification
500	PSL-501	Pressure Switch Low	Discrete N.C.		9-85"WC					
500	LSHH-502	Level Switch High High	Discrete N.C.							
500	LSLL-502	Level Switch Low Low	Discrete N.O.						Must be above all immersion heaters in Tank	
500	TSL-502	Temperature Switch Low	Discrete N.C.							
600	LSHH-601	Level Switch High High	Discrete N.C.							
600	LSH-601	Level Switch High	Discrete N.O.							
600	LSHH-602	Level Switch High High	Discrete N.C.							
600	LSH-602	Level Switch High	Discrete N.O.							
600	PSL-601	Pressure Switch Low	Discrete N.C.		9-85"WC					





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## System Inputs

Module	Tag	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)	Notes	Input Verification
600	PSL-602	Pressure Switch Low	Discrete N.C.		9-85"WC					
700	VT-701	Vacuum Transmitter	Analog	Bar	-1.0 - 1.0 Bar		Y	Y		
700	VT-702	Vacuum Transmitter	Analog	Bar	-1.0 - 1.0 Bar		Y	Y		
700	VFD-701	VFD Status	Communication							
700	VFD-702	VFD Status	Communication							
700	FIT-701	Flow Indicating Transmitter	Analog	GPM	0-300bpm		Y	Y		
700	FQI-701	Flow Totalizer	Discrete N.O.	Pulse/Gal	1liter / Pulse					
700	FIT-702	Flow Indicating Transmitter	Analog	GPM	0-300bpm		Y	Y		
700	FQI-702	Flow Totalizer	Discrete N.O.	Pulse/Gal	1liter / Pulse					





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## System Inputs

Module	Tag	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)	Notes	Input Verification
800	LSH-801	Level Switch High	Discrete N.C.							
800	LSL-801	Level Switch Low Low	Discrete N.O.							
900	LSHH-901	Level Switch High High	Discrete N.C.							
7900	PSL-7911	Pressure Switch Low	Discrete N.O.		0.4 - 1.6"WC				Proof of Continuous Ventilation.	
7900	LSHH-7911	Level Switch High High	Discrete N.C.							
7900	TSSL-7911	Temperature Switch Low Low	Discrete N.C.	°F	-30-100 °F					





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## System Inputs

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System Inputs

<u>Module</u>	<u>Tag</u>	<u>Description</u>	<u>Input Type</u>	<u>HMI Display Units</u>	<u>Device Range and Units</u>	<u>Device Span/PLC Scale</u>	<u>Datalog (Y)</u>	<u>Trending (Y)</u>	<u>Notes</u>	<u>Input Verification</u>





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## System Setpoints

<u>Module</u>	<u>Tag</u>	<u>Description</u>	<u>Factory Setpoint</u>	<u>Setpoint Range and Units</u>	<u>Setpoint Change Control</u>	<u>Alarm setpoint (Y/N)</u>	<u>Notes</u>	<u>Setpoint Verification</u>
100	FTAH-101-SP	Flow Transmitter Alarm High Setpoint	75	0-200 GPM	Open	Y		
200	FTAH-201-SP	Flow Transmitter Alarm High Setpoint	75	0-200 GPM	Open	Y		
300	LTL-301-SP	Level Transmitter Low Setpoint	10%	0-100%	Open			
300	LTHFLUX-301-SP	High Flux Level Setting	50%	0-100%			Puts the MBR Permeate pumps into High Flux Mode	
300	LTH-301-SP	Level Transmitter High Setpoint	80%	50-100%	Open			
500	LTL-501-SP	Level Transmitter Low Setpoint	70%	0-100%	Open			
500	LTH-501-SP	Level Transmitter High Setpoint	80%	0-100%	Open			



## System Setpoints

Module	Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes	Setpoint Verification
500	LT501-SLUDGE-SP	Waste Level for P-503	75%	0-100%	Open			
500	LT501-PERM-SP	Level Control for Permeate Pumps	75%	0-100%	Open		If Level drops below, permeate pumps will stop	
500	P503 WASTE HOUR	When P-503 will waste	12pm	0-23				
500	P503 WASTE SP	Time that P-503 wastes for	10min	0-99				
500	PH-501-SP	pH Normal Setpoint	7 pH	6-8pH	Open			
500	PHAH-501-SP	pH Alarm High Setpoint	8 pH	7 - 14 pH	Open	Y		
500	PHAL-501-SP	pH Alarm Low Setpoint	6 pH	0-7 pH	Open	Y		
500	DO-501-SP	Dissolved Oxygen Normal Setpoint	2 ppm	0-6 ppm	Open			
500	B500 I SP	Integral Gain setting DO PID Loop	10s	0-99				
500	B500 P SP	Proportional Gain setting DO PID Loop	100%	0-99				





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## System Setpoints

Module	Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes	Setpoint Verification
500	B501 MAN SP	Manual Speed B-501	50%	0-100				
500	B502 MAN SP	Manual Speed B-502	50%	0-100				
500	DOAL-501-SP	Dissolved Oxygen Alarm Low Setpoint	0.5 ppm	0-6 ppm	Open	Y		
500	ALUM DOSE	Alum Dose setting (xGal per Pulse)	10 Gallons	0-99 Gallons	Open		Setpoint controls a single pulse of Alum P-6101 dosing.	
500	MICROC DOSE	Micro C Dose setting (xGal per Pulse)	10 Gallons	0-99 Gallons	Open		Setpoint controls a single pulse of Alum P-6101 dosing.	
500	TALL-501-SP	Temperature Alarm Low Low	10 deg C	5 - 25 deg C	Password	Y		
500	TTL-501-SP	Temperature Transmitter Low Setpoint	15 deg C	5-25 deg C	Open			
500	PAL-501-SP	Pressure Alarm Low Setpoint	28"WC (PSIG)		On Device	Y		
500	TALL-502-SP	Temperature Alarm Low Low	10 deg C	5 - 25 deg C	Password	Y		



## System Setpoints

Module	Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes	Setpoint Verification
700	VT-701-SP	MBR-1 Vac Mode Permeate Setpoint	-0.1 bar	-0.2 - 0 bar	Open			
700	VT-701-HFSP	MBR-1 Vac Mode Permeate High Flux Setpoint	-0.15 bar	-0.2 - 0 bar	Open			
700	VTAH-701-SP	MBR-1 Vacuum Transmitter Alarm High	-0.3 bar	-0.3 - 0 bar	Open	Y		
700	VT-702-SP	MBR-2 Vac Mode Permeate Setpoint	-0.1 bar	-0.2 - 0 bar	Open			
700	VT-702-HFSP	MBR-2 Vac Mode Permeate High Flux Setpoint	-0.15 bar	-0.2 - 0 bar	Open			
700	VTAH-702-SP	MBR-2 Vacuum Transmitter Alarm High	-0.3 bar	-0.3 - 0 bar	Open	Y		
700	FT-701-SP	MBR-1 Flow Mode Permeate Setpoint	60 GPM	0-200	Open			
700	FT-701-HFSP	MBR-1 Flow Mode Permeate High Flux Setpoint	75%	0-200	Open			
700	FTAH-701-SP	MBR-1 Flow Transmitter Alarm High Setpoint	100	0-200	Open	Y		
700	FTAL-701-SP	MBR-1 Flow Transmitter Alarm Low Setpoint	10	0-200	Open	Y		





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## System Setpoints

Module	Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes	Setpoint Verification
700	FT-702-SP	MBR-2 Flow Mode Permeate Setpoint	60 GPM	0-200	Open			
700	FT-702-HFSP	MBR-2 Flow Mode Permeate High Flux Setpoint	75GPM	0-200	Open			
700	FTAH-702-SP	MBR-2 Flow Transmitter Alarm High Setpoint	100	0-200	Open	Y		
700	FTAL-702-SP	MBR-2 Flow Transmitter Alarm Low Setpoint	10	0-200	Open	Y		
GLOBAL	BKWSH-TIME-SP	Backwash Time Setpoint	120s	0-999 s	Open			
GLOBAL	RELAX-SP	Number of Relaxes Before Backwash	6	0-999	Open			
GLOBAL	PERM-PULL-TIME	Permeate Pull Time	9m	0-30m	Open			
GLOBAL	RELAX-TIME	Membrane Relax Time	60s	0-999 s	Open			
GLOBAL	FLUX-SP	High Flux Setpoint	75%	50-100%	Open		Reading based on LT-301	





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### System Setpoints

<u>Module</u>	<u>Tag</u>	<u>Description</u>	<u>Factory Setpoint</u>	<u>Setpoint Range and Units</u>	<u>Setpoint Change Control</u>	<u>Alarm setpoint (Y/N)</u>	<u>Notes</u>	<u>Setpoint Verification</u>
GLOBAL	SLUDGE-WASTE-TOD	Time of Day to Start Sludge Wasting	23hr	0-23 hr	Open			
GLOBAL	SLUDGE-WASTE-TIME	Duration of Sludge Wasting	60m	0-1000m	Open			





## System Outputs and Modes of Operation

Module	Tao / Mode	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	Amp Meter	HOA Control	Output Verification	Logic Verification
		Start/Stop	The system will start when the start button is pressed on the HMI.							
		Start/Stop	The system will automatically restart after recovery from a power failure after a 30 second delay, unless the Start button is pressed first.							
		Start/Stop	To stop the system press the stop button on the HMI display.							
		Start/Stop	The system will shut down under some alarm conditions, see the modules below for these specific circumstances.							
		Start/Stop	All equipment will have to be put in "AUTO" in order to operate with the exception of heaters, auto-drain valves, building fans or self-governed equipment (such as screw compressors, air dryers, etc.).							
		Start/Stop	<b>Note:</b> when components are put in "HAND" mode the "AUTO" logic described below will be bypassed and the component will run regardless of inputs (unless the emergency stop button is activated). This is done for on-site testing and troubleshooting purposes. When a soft HOA switch (a software based toggle switch present in remote telemetry or HMI based systems) is used, a 2 minute safety timer is used on all components to prevent running them dry or excessive flooding due to operator error. Hand Timers can be Overridden by touching the pressing and holding the newterra watermark on the Control Bar. By enabling the override the user assumes responsibility for operating the system outside the control parameters set by newterra. While override is enabled all Hand timers and interlocks are ignored.							
N/A	N/A	HMI Datalogging	DO and pH will be logged and displayed on the HMI on the same plot.							
N/A	N/A	HMI Datalogging	Flux and Permeability data will be logged and displayed on the HMI on the same plot.							





## System Outputs and Modes of Operation

<u>Module</u>	<u>Tao / Mode</u>	<u>Description</u>	<u>Control Logic</u>	<u>Alarm Interactions</u>	<u>Output Type</u>	<u>Hour Meter</u>	<u>Amp Meter</u>	<u>HOA Control</u>	<u>Output Verification</u>	<u>Logic Verification</u>
N/A	N/A	MBR-1 Enable	HMI will contain an MBR-1 Enable button. When selected, MBR-1 is enabled.							
N/A	N/A	MBR-2 Enable	HMI will contain an MBR-2 Enable button. When selected, MBR-2 is enabled.							
N/A	N/A	Flow Mode	HMI will contain a Flow Mode Enable button. When selected the permeate system will operate in Flow Mode.							
N/A	N/A	Vac Mode	HMI will contain a Vac Mode Enable button. When selected the permeate system will operate in Vac Mode.							
100	YC-101	Ready Contact	On when LSHH-101 / 102 / 103 and LSHH-201 / 202 and LSHH-203 are not ON	All LSHH's in the inlet area				HOA		
200	YC-201	Ready Contact	On when LSH-201 / 202 and LSHH-203 are not ON					HOA		
200	SCR-201	Inlet Screen	The inlet screen will be ON when influent flow is detected via flow transmitter FIT-201. The screen will run for 1 minute after influent flow has stopped via flow transmitter FIT-201. If the high high level switch LSHH-201 on the screen is ON then the inlet screen SCR-201 will be ON.		Discrete	Y		HOA		





## System Outputs and Modes of Operation

<u>Module</u>	<u>Tao / Mode</u>	<u>Description</u>	<u>Control Logic</u>	<u>Alarm Interactions</u>	<u>Output Type</u>	<u>Hour Meter</u>	<u>Amp Meter</u>	<u>HOA Control</u>	<u>Output Verification</u>	<u>Logic Verification</u>
200	SCR-202	Inlet Screen	Same as SCR-201		Discrete	Y		HOA		
200	P-201	Screen Transfer Pump	The pump will be ON when the LSH-203 turn on as long as LT-301 < LTH-301-sp setpoint the pump will turn off when the LSL-201 turns off	LAHH-301	Discrete	Y		HOA		
200	P-202	Screen Transfer Pump	This pump runs duty standby with P-201 with a 5:1 ratio	LAHH-301	Discrete	Y		HOA		
300	H-301	Tank Heater	On When TT-301 < 10C Off when TT-301 > 15C	LALL-301	Discrete					
300	H-302	Tank Heater	Same as H-301	LALL-301	Discrete					
300	P-301	EQ Transfer Pump	The EQ pump will be ON when the EQ level transmitter LT-301 > LT-301-SP and the aeration tank level transmitter LT-501 < LTH-501-SP The EQ pump will be OFF when the EQ level transmitter LT-301 < LT-301-SP OR LSL-301 = InActive OR the aeration tank level transmitter LT-501 > LTH-501-SP OR LSHH-401 is active Runs Duty with P-302 as Standby	Turns OFF LAHH-501 LAHH-401 LALL-301	Discrete	Y		HOA		
300	P-302	EQ Transfer Pump	This pump runs duty standby with P-201 with a 5:1 ratio			Y		HOA		
300	B-301	EQ Blower	The EQ blower will be ON when the System is in Run & LSL-301 is active.			Y		HOA		





## System Outputs and Modes of Operation

<u>Module</u>	<u>Tao / Mode</u>	<u>Description</u>	<u>Control Logic</u>	<u>Alarm Interactions</u>	<u>Output Type</u>	<u>Hour Meter</u>	<u>Amp Meter</u>	<u>HOA Control</u>	<u>Output Verification</u>	<u>Logic Verification</u>
300	B-302	EQ Blower	Runs Duty standby with B-301 switching every 120 hours		Discrete	Y		HOA		
400	P-401	Pre-Anox Mixing Pump	The pump will be ON when the System is in Run & LSLL-401 is active.	LALL-401 PUMP IS OFF	Discrete	Y		HOA		
400	P-402	Pre-Anox Mixing Pump	Runs Duty standby with P-401 switching every 120 hours		Discrete	Y		HOA		
400	H-401	Tank Heater	On when TSL-401 is OFF	LALL-401	Discrete					
400	H-402	Tank Heater	On when TSL-401 is OFF	LALL-401	Discrete					
6100	P-6102	Alum Dosing Pump	Alum Dosing Pump P-6102 be ON when FIT-701 has reached a user adjustable volume of permeate via FT-701-DOSE seipoint. P-6102 will be ON for one pulse.		Discrete			HOA		
6100	P-6101	Caustic Dosing Pump	Caustic Dosing Pump P-6101 will be ON when PH-501 < PH-501-SP. The pump will be ON for 30s and OFF for 30s and will operate in pause mode		Discrete			HOA		
500	H-501	Tank Heater	On when TSL-501 is OFF	LALL-501	Discrete					





## System Outputs and Modes of Operation

<u>Module</u>	<u>Tao / Mode</u>	<u>Description</u>	<u>Control Logic</u>	<u>Alarm Interactions</u>	<u>Output Type</u>	<u>Hour Meter</u>	<u>Amp Meter</u>	<u>HOA Control</u>	<u>Output Verification</u>	<u>Logic Verification</u>
500	H-502	Tank Heater	On when TSL-501 is OFF	LALL-501	Discrete					
500	P-503	Waste Activated Sludge Pump	The waste activated sludge pump will be ON at time of day setting SLUDGE-WASTE-TOD IF level switch LT501-SLUDGE-SP	LAHH-901: Pump will be OFF	Discrete			HOA		
500	H-503	Tank Heater	On when TSL-502 is OFF	LALL-502	Discrete					
500	H-504	Tank Heater	On when TSL-502 is OFF	LALL-502	Discrete					
500	P-501	Aeration Recirc Pump	The pump will run as long as LSL-501 is Active	LALL-502: Pump will be OFF	Discrete	Y		HOA		
500	P-502	Aeration Recirc Pump	Runs Duty standby with p-501 switching every 120 hours		Discrete	Y		HOA		
500	B-501	Aeration Tank Aeration Blower	ON - Always Runs via PID loop to maintain DO-501-SP Runs Duty/Standby 120 hours with B-502.		Direct	Y		HOA		
500	B-502	Aeration Tank Aeration Blower	Runs via same logic as B-501 Runs Duty/Standby every 120 hours with B-501.		Direct	Y		HOA		





## System Outputs and Modes of Operation

<u>Module</u>	<u>Tao / Mode</u>	<u>Description</u>	<u>Control Logic</u>	<u>Alarm Interactions</u>	<u>Output Type</u>	<u>Hour Meter</u>	<u>Amp Meter</u>	<u>HOA Control</u>	<u>Output Verification</u>	<u>Logic Verification</u>
550	P-553	Post Anox Mix Pump	The pump will run as long as LSSL-501 is Active	LALL-501: Pump will be OFF	Discrete	Y		HOA		
550	P-554	Post Anox Mix Pump	Runs Duty standby with p-501 switching every 120 hours		Discrete	Y		HOA		
6100	P-6103	Micro C Dosing Pump	Dosing Pump will be ON when FIT-701 or FT-702 has reached a user adjustable volume of permeate via DOSE setpoint.		Discrete			HOA		
550	P-551	Aeration Transfer Pump Feed to MBR-1	The aeration pump will feed MBR tank T-501. The pump will be ON when level transmitter LT-501 > LTL-501-SP and LSSL-501 = Active and LSSL-502 = Active and MBR-1 is Enabled. The aeration pump will be cycle ON/OFF when LT-501 < LTL-501-SP and be OFF if LSSL-501 = InActive OR LSSL-502 = InActive	LAHH-501: Pump will be OFF MBR-1 Disabled	Discrete	Y		HOA		
550	P-552	Aeration Transfer Pump Feed to MBR-2	The aeration pump will feed MBR tank T-502. The pump will be ON when level transmitter LT-501 > LTL-501-SP and LSSL-501 = Active and LSSL-502 = Active and MBR-2 is Enabled. The aeration pump will cycle ON/OFF when LT-501 < LTL-501-SP and be OFF if LSSL-501 = InActive OR LSSL-502 = InActive	LAHH-502: Pump will be OFF MBR-2 Disabled	Discrete	Y		HOA		
600	B-601	MBR Tank Blower	The membrane tank blower will be ON when the System is in Run. And the MBR 1 is enabled	MBR-1 Disabled	Discrete	Y		HOA		
600	B-602	MBR Tank Blower	The membrane tank blower will be ON when the System is in Run. And the MBR 2 is enabled	MBR-2 Disabled	Discrete	Y		HOA		





## System Outputs and Modes of Operation

Module	Tag / Mode	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	Amp Meter	HOA Control	Output Verification	Logic Verification
700	P-701	Permeate Transfer Pump	<p>The permeate pump will be ON when MBR-1 is Enabled &amp; level switch LSH-801 = Active &amp; LT-501 &gt; LT501-PERM-SP. The Pump will perform a PULL/RELAX Cycle. The pump will be ON for the duration specified by the PERM-PULL-TIME setpoint and then be OFF for the duration of the RELAX-TIME setpoint. This will generate one PULL/RELAX Cycle.</p> <p>The VFD Speed of the pump will operate based on the following:</p> <p>In FLOW MODE:</p> <p>The VFD Speed will operate based on a PID loop to maintain the flowrate setpoint FT-701-SP.</p> <p>IF the vacuum transmitter VT-701 &gt; -0.25 bar then the pump will switch to VAC MODE.</p> <p>IF the level transmitter LT-301 &gt; FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint FT-701-HFSP</p> <p>In VAC MODE:</p> <p>The VFD Speed will operate based on a PID loop to maintain the vacuum setpoint VT-701-SP.</p> <p>IF the level transmitter LT-301 &gt; FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint VT-701-HFSP</p> <p>P-701 will be OFF if P-501 is OFF.</p>	LT-701: Pump Will be Active	Communication	Y		HOA		
700	P-702	Permeate Transfer Pump	<p>The permeate pump will be ON when MBR-2 is Enabled &amp; level switch LSH-602 = Active &amp; LT-501 &gt; LT501-PERM-SP. The Pump will perform a PULL/RELAX Cycle. The pump will be ON for the duration specified by the PERM-PULL-TIME setpoint and then be OFF for the duration of the RELAX-TIME setpoint. This will generate one PULL/RELAX Cycle.</p> <p>The VFD Speed of the pump will operate based on the following:</p> <p>In FLOW MODE:</p> <p>The VFD Speed will operate based on a PID loop to maintain the flowrate setpoint FT-702-SP.</p> <p>IF the vacuum transmitter VT-702 &gt; -0.25 bar then the pump will switch to VAC MODE.</p> <p>IF the level transmitter LT-301 &gt; FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint FT-702-HFSP</p> <p>In VAC MODE:</p> <p>The VFD Speed will operate based on a PID loop to maintain the vacuum setpoint VT-702-SP.</p> <p>IF the level transmitter LT-301 &gt; FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint VT-702-HFSP</p> <p>P-702 will be OFF if P-502 is OFF.</p>	LT-703: Pump Will be Active	Communication	Y		HOA		
800	SV-801	Clean In Place Tank Fill Solenoid Valve	<p>The Solenoid Valve SV-801 will be Open (Energized) when level switch LSH-801 is InActive and MBR-1 OR MBR-2 are not in Backwash.</p> <p>The Solenoid Valve SV-801 will be Closed (De-Energized) when LSH-801 is Active or if MBR-1 OR MBR-2 are in Backwash.</p>		Discrete			HOA		
700	MV-701	Backwash Actuated Valve	<p>A Backwash is enabled once the permeate pumps for MBR-1 reach the number of PULL/RELAX cycles designated by the RELAX-SP on the HMI.</p> <p>The actuated valve will be OPEN when MBR-1 is in Backwash and level switch LSH-801 is Active.</p> <p>If MBR-2 is already in backwash, MBR-1 will complete 1 additional PULL/RELAX Cycle before starting a Backwash Cycle.</p>		Discrete			HOA		
700	MV-702	Backwash Actuated Valve	<p>A Backwash is enabled once the permeate pumps for MBR-2 reach the number of PULL/RELAX cycles designated by the RELAX-SP on the HMI.</p> <p>The actuated valve will be OPEN when MBR-2 is in Backwash and level switch LSH-801 is Active.</p> <p>If MBR-2 is already in backwash, MBR-1 will complete 1 additional PULL/RELAX Cycle before starting a Backwash Cycle.</p>		Discrete			HOA		





## System Outputs and Modes of Operation

<u>Module</u>	<u>Tao / Mode</u>	<u>Description</u>	<u>Control Logic</u>	<u>Alarm Interactions</u>	<u>Output Type</u>	<u>Hour Meter</u>	<u>Amp Meter</u>	<u>HOA Control</u>	<u>Output Verification</u>	<u>Logic Verification</u>
800	P-801	Backwash Transfer Pump	The backwash transfer pump will be ON when MBR-1 OR MBR-2 are in Backwash and level switch LSH-801 is Active The backwash transfer pump will be OFF after the duration of BKWSH-TIME-SP OR level switch LSL-801 becomes InActive.		Discrete			HOA		
7911	B-7911	Ventilation Blower	The continuous ventilation blower will always be ON. This blower is used as means to de-rate the screen building to a Class 1 Division 2 area. Air exchanges must be a minimum of 12 per hour.		Direct (not PLC controlled)					
7901	HT-7911	Heat Trace	Always on internally controlled		Direct (not PLC controlled)					
7901	HT-7912	Heat Trace	Always on internally controlled		Direct (not PLC controlled)					
7901	HT-7913	Heat Trace	Always on internally controlled		Direct (not PLC controlled)					
7901	H-7911	Building Heater	Always on internally controlled		Direct (not PLC controlled)					
7901	H-7912	Building Heater	Always on internally controlled		Direct (not PLC controlled)					
7904	B-7941	Aeration Exhaust Blower	On when B-501/502 is on OR B-601/602 is on		Discrete			Auto		
7904	H-7941	Building Heater	Always on internally controlled		Direct (not PLC controlled)					
7906	H-7961	Building Heater	Always on internally controlled		Direct (not PLC controlled)					





System Outputs and Modes of Operation

Module	Tao / Mode	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	Amp Meter	HOA Control	Output Verification	Logic Verification
7906	H-7962	Building Heater	Always on internally controlled		Direct (not PLC controlled)					
7906	H-7963	Building Heater	Always on internally controlled		Direct (not PLC controlled)					
7906	F-7963	Building Fan	Always on controlled by Wall Mount Thermostat		Direct (not PLC controlled)					





## System Alarms

<u>Module</u>	<u>Alarm</u>	<u>Alarm Description</u>	<u>Actuation Control</u>	<u>Delay</u>	<u>Email Notification (Y)</u>	<u>Self Resetting (Y)</u>	<u>System Shutdown (Y)</u>	<u>Notes</u>	<u>Alarm Verification</u>
100	FTAH-101	Flow Transmitter Alarm High	FIT-101 > FTAH-101-SP	60s					
100	LAHH-101	Level Alarm High High	LSHH-101 = Active	5s		Y			
100	LAHH-102	Level Alarm High High	LSHH-102 = Active	5s		Y			
100	LAHH-103	Level Alarm High High	LSHH-103 = Active	5s		Y			
200	FTAH-201	Flow Transmitter Alarm High	FIT-201 > FTAL-201-SP	60s					
200	LAHH-201	Level Alarm High High	LSHH-201 = Active	5s		Y			
200	LAHH-202	Level Alarm High High	LSHH-202 = Active	5s		Y			
200	LAHH-203	Level Alarm High High	LSHH-203 = Active	5s		Y			



## System Alarms

Module	Alarm	Alarm Description	Actuation Control	Delay	Email Notification (Y)	Self Resetting (Y)	System Shutdown (Y)	Notes	Alarm Verification
300	LAHH-301	Level Alarm High High	LSHH-301 = Active	5s		Y			
300	LALL-301	Level Alarm Low Low	LSLL-301 = Off	5s		Y			
400	LAHH-401	Level Alarm High High	LSHH-401 = Active	5s		Y			
400	LALL-401	Level Alarm Low Low	LSLL-401 = OFF	5s		Y			
500	LAHH-501	Level Alarm High High	LSHH-501 = Active	5s		Y			
500	LAHH-502	Level Alarm High High	LSHH-501 = Active	5s		Y			
500	PHAH-501	pH Alarm High	pH-501 > PHAH-501-SP	60s					
5800	PHAL-501	pH Alarm Low	pH-501 < PHAL-501-SP	60s					
500	DOAL-501	Dissolved Oxygen Alarm Low	DO-501 < DOAL-501-SP	15m					
500	DOALL-501	Dissolved Oxygen Alarm Low Low	DO-501 < DOAL-501-SP	4hrs					





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## System Alarms

<u>Module</u>	<u>Alarm</u>	<u>Alarm Description</u>	<u>Actuation Control</u>	<u>Delay</u>	<u>Email Notification (Y)</u>	<u>Self Resetting (Y)</u>	<u>System Shutdown (Y)</u>	<u>Notes</u>	<u>Alarm Verification</u>
500	TTAL-501	Low Temp TNK-501	TT-501 < TTAL-501-SP						
500	PAL-501	Pressure Alarm Low	PSL-501 = InActive	5s		Y			
500	VFDA-501	VFD Fault							
500	VFDA-502	VFD Fault							
500	LALL-501	Low Low Level TNK-501	LSLL-501 = OFF						
500	LALL-502	Low Low Level TNK-502	LSLL-502 = OFF						
600	LAHH-601	Level Alarm High High	LSHH-601 = Active	5s		Y		Membrane Tank	
600	LAHH-602	Level Alarm High High	LSHH-602 = Active	5s		Y		Membrane Tank	
600	PAL-601	Pressure Alarm Low	PSL-601 = InActive	5s		Y		Membrane Blowers	





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## System Alarms

<u>Module</u>	<u>Alarm</u>	<u>Alarm Description</u>	<u>Actuation Control</u>	<u>Delay</u>	<u>Email Notification (Y)</u>	<u>Self Resetting (Y)</u>	<u>System Shutdown (Y)</u>	<u>Notes</u>	<u>Alarm Verification</u>
600	PAL-602	Pressure Alarm Low	PSL-602 = InActive	5s		Y		Membrane Blowers	
700	VTAH-701	Vacuum Transmitter Alarm High	VT-701 < VTAH-701-SP	5s		Y			
700	VTAH-702	Vacuum Transmitter Alarm High	VT-702 < VTAH-702-SP	5s		Y			
700	VFDA-701	VFD Fault							
700	VFDA-702	VFD Fault							
700	FTAH-701	Flow Transmitter Alarm High	FIT-701 > FTAH-701-SP	60s					
700	FTAL-701	Flow Transmitter Alarm Low	FIT-701 < FTAL-701-SP	60s					
700	FTAH-702	Flow Transmitter Alarm High	FIT-702 > FTAH-702-SP	60s					



## System Alarms

Module	Alarm	Alarm Description	Actuation Control	Delay	Email Notification (Y)	Self Resetting (Y)	System Shutdown (Y)	Notes	Alarm Verification
700	FTAL-702	Flow Transmitter Alarm Low	FIT-702 < FTAL-702-SP	60s					
900	LAHH-901	Level Alarm High High	LSHH-901 = Active	5s		Y		Aerobic Digester Tank	
7910	PAL-7911	Pressure Alarm Low	PSL-7911 = InActive	5s		Y		Alarm indicates possible continuous ventilation failure, indicating risk that the room may become Class 1 Division 1 rated.	
7910	TALL-7911	Temperature Alarm Low Low	TSSL-7911 = Active	5s		Y			
7910	LAHH-7911	Level Alarm High High	LSHH-7911 = Active	Immediate					
7940	TALL-7941	Temperature Alarm Low Low	TSSL-7941 = Active	5s		Y			
7961	LAHH-7961	Level Alarm High High Sump	LSHH-7961 - OFF						
7960	TALL-7961	Low Low Temp Aslim	LSSL-7961 = Active						



## System Alarms

Module	Alarm	Alarm Description	Actuation Control	Delay	Email Notification (Y)	Self Resetting (Y)	System Shutdown (Y)	Notes	Alarm Verification
8200	ESA-8201	Emergency Stop Alarm	ESA-8201 = Active	Immediate		Y			
8200	PWR-FAIL	Power Failure		Immediate		Y			
8200	PLC FLT	PLC Fault Detected		Immediate		Y			
8200	PWR FLT	Phase Monitor Fault	JA-8201 = Active	Immediate		Y			



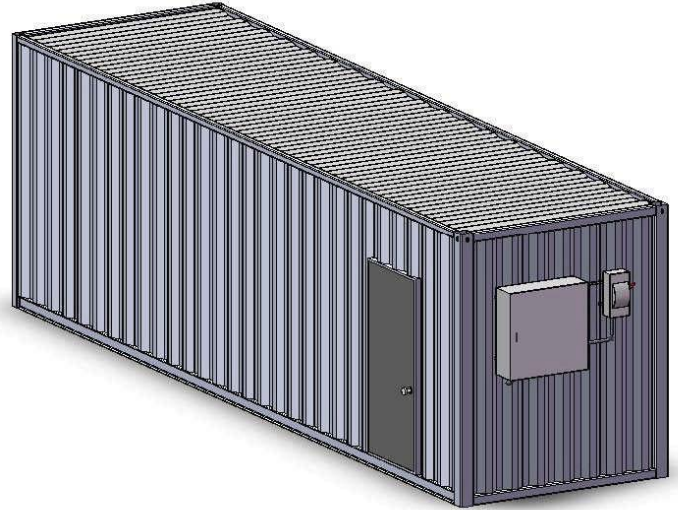
# CONTAINER ENCLOSURES – CNTR SERIES

## Application:

**newterra** Container Enclosures are a popular choice for housing large stationary systems. Containers are secure, cost effective and offer a wide range of options to customize appearance or functionality to suit customer requirements.

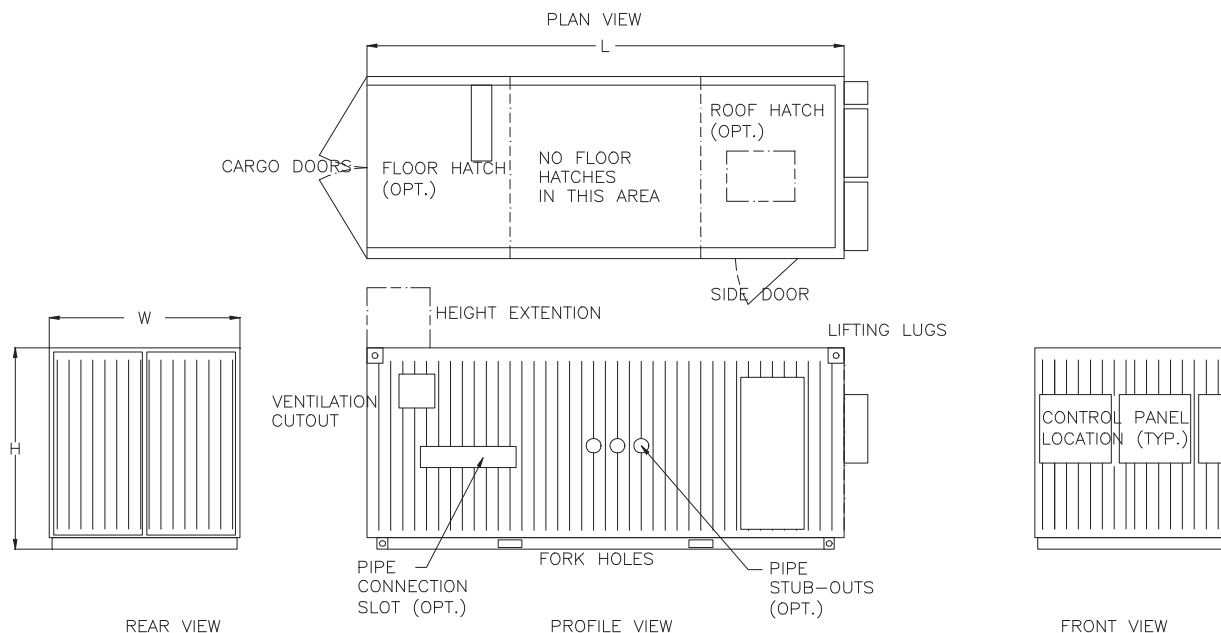
## Constructions:

Heavy corrugated steel shell and steel beam structure with wood-plank flooring. Heavy steel double doors on one end are standard. Twenty-foot and forty-foot are standard length, but a custom length can be obtained by cutting one of the standard length units.



## Standard Features:

- Painted exterior, plywood interior
- Waterproof sealed floor
- Double cargo doors on end (opening 89" H x 92" W); side door (32")
- Lifting lugs at roof for crane lifting; lifting lugs at base for boom/crane lifting fork holes in base (20ft only)





# CONTAINER ENCLOSURES – CNTR SERIES

**Dimension and Specification chart:**

Part Number	Length	Width	Height	Weight Empty (lbs)	Std Cap. (lbs)	Interior Dimensions		
						Length	Width	Height
CNTR10	10'	8'	8' 6"	3,000	9,000	9' 8"	7' 8"	7' 10"
CNTR12	12'	8'	8' 6"	3,800	10,800	11' 8"	7' 8"	7' 10"
CNTR16	16'	8'	8' 6"	4,500	14,400	15' 5"	7' 8"	7' 10"
CNTR20	20'	8'	8' 6"	5,000	18,000	19' 4"	7' 8"	7' 10"
CNTR24	24'	8'	8' 6"	5,800	21,600	22' 4"	7' 8"	7' 10"
CNTR28	28'	8'	8' 6"	6,400	25,200	27' 4"	7' 8"	7' 10"
CNTR32	32'	8'	8' 6"	7,200	28,800	31' 4"	7' 8"	7' 10"
CNTR36	36'	8'	8' 6"	8,000	32,400	35' 4"	7' 8"	7' 10"
CNTR40	40'	8'	8' 6"	8,800	36,000	39' 4"	7' 8"	7' 10"

**Options Table:**

Option	Description
PE approval of structural drawings	Professional Engineer-stamped, wind-load hold-down documentation in compliance with local building code
Exterior Steel Siding	Industrial steel siding exterior
EPDM Roof	High-quality EPDM membrane roof
Process heat exchanger exhaust	Exhaust hatches can be inserted in wall to diffuse heat outside of building
Extra louver for added ventilation	For added ventilation and air circulation a louver can be installed into building wall
Sound Insulation	Layer of sound-insulation material built into walls blocks out operational noise
Rubber flooring	¾" thick rubber floor mats
Sump	2" sump in floor to detect flooding
Floor cutout	Floor hatch can be cutout to allow pipe entrance from underground
Roof extension or hatch	For tall equipment, roof extensions or hatches can be built into roof
Pipe stub outs	Pipe stub outs can be mounted on side of building
Pipe connection slot	Pipe-connection slot can be mounted on side of building
Ventilation Fan	Properly sized ventilation fan with thermostat
Heater	Properly sized heater with thermostat
Lighting	Proper lighting to allow for acceptable amount of light for work inside of the container
Thermal insulation	R7.2 insulation in walls and ceiling



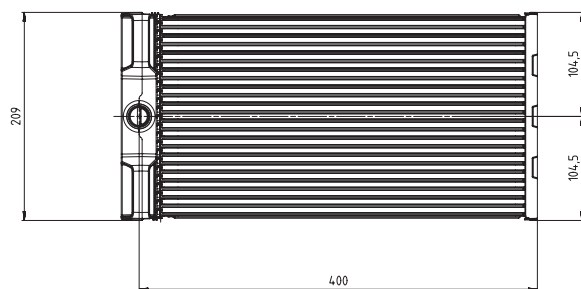
# MicroClear®

Technical Data Sheet **CASSETTE FILTER MCXL2** Article-No. 80200072

Completely welded filter cassette for the filtration of water. Typical applications:

Waste Water in membrane bioreactors, surface water. The cassette consists of:

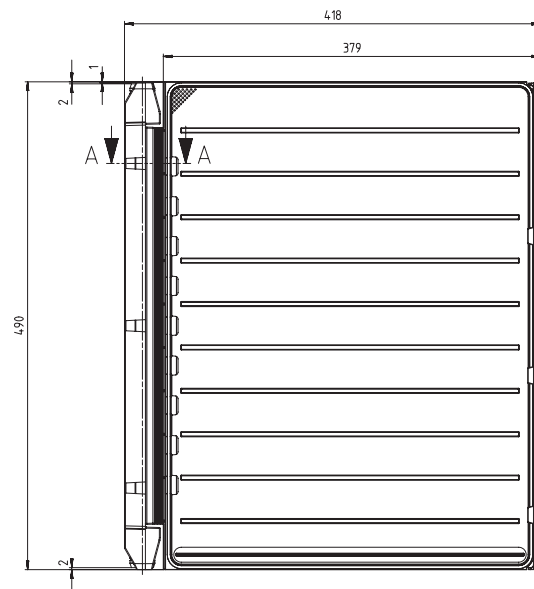
- housing and header made of polypropylene (FDA approved)
- 23 active filter plates made of polypropylene (FDA approved)
- 2 protective plates made of polypropylene (FDA approved)
- laser welded membrane made of Polyethersulfone (KTW approved)



Parameter	Unit	Value
dimension of filter housing (incl. flange for aeration)	L x W x H cm	209 x 418 x 490
outlet diameter	mm	25
protective plates		2
number of active plates		23
total membrane surface area	m <sup>2</sup>	8
possible flow <sup>1</sup>	l/m <sup>2</sup> h	
2 chemical cleanings/year		30
1 chemical cleaning/year		15
max. flow	l/m <sup>2</sup> h	50
membrane material <sup>2</sup>		PES/PVDF
pore size nom. <sup>2</sup>	µm	0.04-0.3
filtration pressure	bar	0.1-0.25
backflush pressure	bar	0.07-0.1
filter housing material		PP
weight	kg	approx. 11.5

<sup>1</sup> depending on wastewater characteristics

<sup>2</sup> membrane material selectable for specified applications or customers



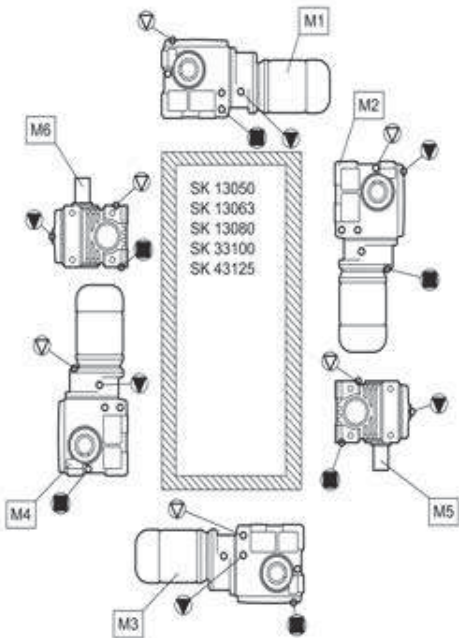
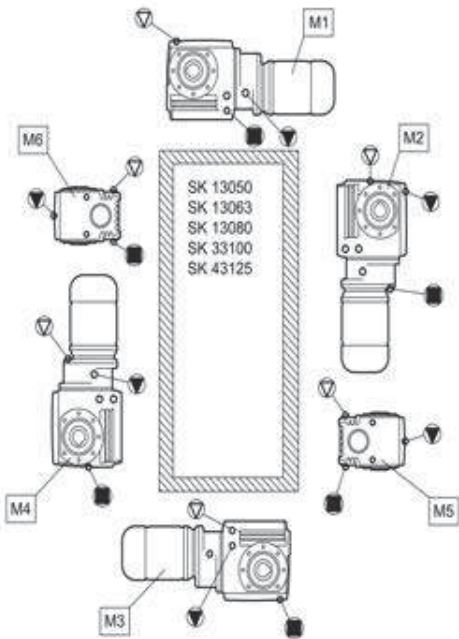
Revised: 13.01.2014

Design and specifications are subject to change without notice.

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## 6.2 Lubricants

With the exception of type SK 11282, SK 11382, SK 12382 and SK 9096.1 gear units, all gear units are filled with lubricant ready for operation in the required installation position when delivered. This initial filling corresponds to a lubricant from the column for the ambient temperatures (normal version) in the lubricant table.

### Roller bearing greases

This table shows comparable roller bearing greases from various manufacturers. The manufacturer can be changed for a given grease type. Getriebebau NORD must be contacted in case of change of grease type or ambient temperature range, as otherwise no warranty for the functionality of our gear units can be accepted.


Lubricant type	Ambient temperature					
Mineral oil-based grease	-30 ... 60 °C	Tribol GR 100-2 PD	Renolit GP 2 Renolit LZR 2 H	-	Mobilux EP 2	Gadus S2 V100 2
	-50 ... 40 °C	Optitemp LG 2	Renolit WTF 2	-	-	-
Synthetic grease	-25 ... 80 °C	Tribol GR 4747/220-2 HAT	Renolit HLT 2 Renolit LST 2	PETAMO GHY 133 N Klüberplex BEM 41-132	Mobiltemp SHC 32	
Biodegradable grease	-25 ... 40 °C	-	Plantogel 2 S	Klüberbio M 72-82	Mobil SHC Grease 102 EAL	Naturelle Grease EP2

Table 5: Roller bearing greases



### Lubricant table

This table shows comparable lubricants from various manufacturers. The manufacturer can be changed within a particular viscosity or lubricant type. Getriebebau NORD must be contacted in case of change of viscosity or lubricant type, as otherwise no warranty for the functionality of our gearboxes can be accepted.

Lubricant type	Details on type plate	DIN (ISO) / Ambient temperature						
Mineral oil	CLP 680	ISO VG 680 0...40 °C	Alpha EP 680 Alpha SP 680 Optigear BM 680 Optigear Synthetic 1100/680	Renolin CLP 680 Renolin CLP 680 Plus	Klüberoil GEM 1-680 N	Mobilgear 600 XP 680	Omala S2 G 680	Carter EP 680 Carter XEP 680
	CLP 220	ISO VG 220 -10...40 °C	Alpha EP 220 Alpha SP 220 Optigear BM 220 Optigear Synthetic 1100/220	Renolin CLP 220 Renolin CLP 220 Plus Renolin Gear 220 VCI	Klüberoil GEM 1-220 N	Mobilgear 600 XP 220	Omala S2 G 220	Carter EP 220 Carter XEP 220
	CLP 100	ISO VG 100 -15...25 °C	Alpha EP 100 Alpha SP 100 Optigear BM 100 Optigear Synthetic 1100/100	Renolin CLP 100 Renolin CLP 100 Plus	Klüberoil GEM 1-100 N	Mobilgear 600 XP 100	Omala S2 G 100	Carter EP 100
Synthetic oil (Polyglycol)	CLP PG 680	ISO VG 680 -20...40 °C	Alphasyn GS 680 Optigear Synthetic 800/680	Renolin PG 680	Klübersynth GH 6-680	Mobil Glygoyle 680	Omala S4 WE 680	Carter SY 680 Carter SG 680
	CLP PG 220	ISO VG 220 -25...80 °C	Alphasyn GS 220 Alphasyn PG 220 Optigear Synthetic 800/220	Renolin PG 220	Klübersynth GH 6-220	Mobil Glygoyle 220	Omala S4 WE 220	-
Synthetic oil (hydrocarbon)	CLP HC 460	ISO VG 460 -30...80 °C	Alphasyn EP 460 Optigear Synthetic PD 460	Renolin Unisyn CLP 460	Klübersynth GEM 4-460 N	Mobil SHC 634	Omala S4 GX 460	Carter SH 460
	CLP HC 220	ISO VG 220 -40...80 °C	Alphasyn EP 220 Optigear Synthetic PD 220	Renolin Unisyn CLP 220 Renolin Unisyn Gear VCI	Klübersynth GEM 4-220 N	Mobil SHC 630	Omala S4 GX 220	Carter SH 220
Bio-degradable oil	CLP E 680	ISO VG 680 -5...40 °C	-	Plantogear 680 S	-	-	-	-
	CLP E 220	ISO VG 220 -5...40 °C	Performance Bio GE 220 ESS Performance Bio GE 220 ESU	Plantogear 220 S	Klübersynth GEM 2-220	-	Naturelle Gear Fluid EP 220	-









Lubricant type	Details on type plate	DIN (ISO) / Ambient temperature						
Food grade oil	CLP PG H1 680	ISO VG 680 -5...40 °C	Optileb GT 1800/680	Cassida Fluid WG 680	Klübersynth UH1 6-680	Mobil Glygoyle 680		-
	CLP PG H1 220	ISO VG 220 -25...40 °C	Optileb GT 1800/200	Cassida Fluid WG 220	Klübersynth UH1 6-220	Mobil Glygoyle 220		Nevastane SY 220
	CLP HC H1 680	ISO VG 680 -5...40 °C	Optileb GT 680	Cassida Fluid GL 680	Klüberoil 4 UH1-680 N	-		-
	CLP PG H1 220	ISO VG 220 -25...40 °C	Optileb GT 220	Cassida Fluid GL 220	Klüberoil 4 UH1-220 N	Mobil SHC Cibus 220		Nevastane XSH 220
Gear unit fluid grease		-25 ... 60 °C	Tribol GR 100-00 PD Tribol GR 3020/1000-00 PD Spheerol EPL 00	Renolit Duraplex EP 00  Renolit LST 00	MICROLUBE GB 00  Klübersynth GE 46-1200	Mobil Chassis Grease LBZ  Mobil Glygoyle Grease 00	Alvania EP(LF)2  -	Multis EP 00  Marson SY 00

Table 6: Lubricant table

### 6.3 Lubricant quantities

#### Information

#### Lubricants

After changing the lubricant, and in particular after the initial filling, the oil level may change during the first few hours of operation, as the oil galleries and the hollow spaces only fill gradually during operation.

The oil level is still within the permissible tolerance.

If at the express request of the customer, an oil inspection glass is installed at an additional charge, we recommend that the customer corrects the oil level after an operating period of approx. 2 hours, so that when the gear unit is at a standstill and has cooled down, the oil level is visible in the inspection glass. Only then, is it possible to check the oil level by means of the inspection glass.

The filling quantities stated in the following tables are for guidance only. The precise quantities vary depending on the exact gear ratio. When filling, always observe the oil level screw hole as an indicator of the precise quantity of oil.

\* Gear unit types SK 11282, SK 11382, SK 11382.1, SK 12382 and SK 9096.1 are normally supplied without oil.



## 6.4 Helical gear unit





















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⇒ 6.1	M1	M2	M3	M4	M5	M6	⇒ 6.1	M1	M2	M3	M4	M5	M6
SK11E	0,25	0,50	0,65	0,50	0,40	0,40	SK11E F	0,30	0,50	0,50	0,45	0,40	0,40
SK21E	0,60	1,20	1,30	1,00	1,00	1,00	SK21E F	0,50	1,20	1,30	0,60	0,90	0,90
SK31E	1,10	2,00	2,20	1,70	1,50	1,50	SK31E F	0,90	1,80	1,65	1,30	1,25	1,25
SK41E	1,60	2,80	3,30	2,80	2,30	2,30	SK41E F	1,20	2,30	2,70	2,00	1,90	1,90
SK51E	1,80	3,50	4,10	4,00	3,80	3,80	SK51E F	1,80	3,50	4,10	3,00	3,80	3,80
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SK02	0,20	0,75	0,75	0,65	0,60	0,60	SK02 F	0,25	0,70	0,70	0,70	0,50	0,50
SK12	0,25	0,80	0,85	0,75	0,55	0,55	SK12 F	0,35	0,85	0,90	0,90	0,70	0,70
SK22	0,50	1,90	2,10	1,80	1,40	1,40	SK22 F	0,70	1,80	1,80	1,80	1,40	1,40
SK32	0,90	2,50	3,10	3,10	2,00	2,00	SK32 F	1,20	2,80	3,10	3,10	2,20	2,20
SK42	1,40	4,50	4,50	4,30	3,20	3,20	SK42 F	1,80	4,40	4,50	4,00	3,70	3,70
SK52	2,50	7,00	6,80	6,80	5,10	5,10	SK52 F	3,00	6,80	6,20	7,40	5,60	5,60
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SK62	6,50	15,00	13,00	16,00	15,00	15,00	SK62 F	7,00	15,00	14,00	18,50	16,00	16,00
SK72	10,00	23,00	18,00	26,00	23,00	23,00	SK72 F	10,00	23,00	18,50	28,00	23,00	23,00
SK82	14,00	35,00	27,00	44,00	32,00	32,00	SK82 F	15,00	37,00	29,00	45,00	34,50	34,50
SK92	25,00	73,00	47,00	76,00	52,00	52,00	SK92 F	26,00	73,00	47,00	78,00	52,00	52,00
SK102	36,00	79,00	66,00	102,00	71,00	71,00	SK102 F	40,00	81,00	66,00	104,00	72,00	72,00
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SK03	0,35	1,20	0,80	1,00	0,70	0,70	SK03 F	0,55	0,95	0,90	1,20	0,90	0,90
SK13	0,75	1,30	1,30	1,20	0,75	0,75	SK13 F	1,00	1,30	1,30	1,20	1,00	1,00
SK23	1,20	2,00	1,90	2,40	1,60	1,60	SK23 F	1,40	2,60	2,30	2,80	2,80	2,80
SK33N	1,75	3,00	3,40	4,00	2,30	2,30	SK33N F	2,20	3,00	3,40	4,20	2,30	2,30
SK43	3,00	5,60	5,20	6,60	3,60	3,60	SK43 F	3,50	5,70	5,00	6,10	4,10	4,10
SK53	4,50	8,70	7,70	8,70	6,00	6,00	SK53 F	5,20	8,40	7,00	8,90	6,70	6,70
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SK63	13,00	14,50	14,50	16,00	13,00	13,00	SK63 F	13,50	14,00	15,50	18,00	14,00	14,00
SK73	20,50	20,00	22,50	27,00	20,00	20,00	SK73 F	22,00	22,50	23,00	27,50	20,00	20,00
SK83	30,00	31,00	34,00	37,00	33,00	33,00	SK83 F	31,00	34,00	35,00	40,00	34,00	34,00
SK93	53,00	70,00	59,00	72,00	49,00	49,00	SK93 F	53,00	70,00	59,00	74,00	49,00	49,00
SK103	74,00	71,00	74,00	97,00	67,00	67,00	SK103 F	69,00	78,00	78,00	99,00	67,00	67,00

Table 7: Lubricant quantities for helical gear units



## NORDBLOC


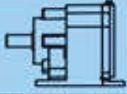
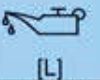
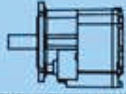

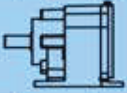
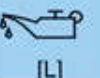
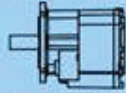

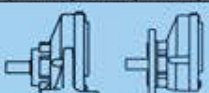

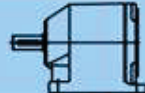




 [L]							 [L]						
	M1	M2	M3	M4	M5	M6		M1	M2	M3	M4	M5	M6
SK072.1	0,16	0,32	0,21	0,23	0,18	0,20	SK072.1 F	0,16	0,32	0,21	0,23	0,18	0,20
SK172.1	0,27	0,59	0,42	0,45	0,32	0,39	SK172.1 F	0,27	0,59	0,42	0,45	0,32	0,39
SK372.1	0,45	1,05	0,75	1,00	0,60	0,65	SK372.1 F	0,45	1,05	0,75	1,00	0,60	0,65
SK572.1	0,75	1,90	1,50	2,00	1,10	1,15	SK572.1 F	0,75	1,90	1,50	2,00	1,10	1,15
SK672.1	1,10	2,60	2,15	2,70	1,55	1,65	SK672.1 F	1,10	2,60	2,15	2,70	1,55	1,65
SK772.1	1,30	3,80	2,40	3,20	1,60	2,50	SK772.1 F	1,30	3,80	2,40	3,30	1,70	2,40
SK872.1	2,90	7,80	4,60	6,40	2,50	4,00	SK872.1 F	3,20	7,50	5,10	6,70	2,60	4,30
SK972.1	4,50	12,00	7,50	11,50	4,20	7,50	SK972.1 F	4,50	12,50	8,00	12,50	4,50	7,70
SK772.1VL	2,00	3,80	2,40	3,20	1,60	2,50	SK772.1VL F	2,00	3,80	2,40	3,30	1,70	2,40
SK872.1VL	5,00	7,80	4,60	6,40	2,50	4,00	SK872.1VL F	5,00	7,50	5,10	6,70	2,60	4,30
SK972.1VL	8,50	12,00	7,50	11,50	4,20	7,50	SK972.1VL F	8,50	12,50	8,00	12,50	4,50	7,70
 [L]							 [L]						
	M1	M2	M3	M4	M5	M6		M1	M2	M3	M4	M5	M6
SK373.1	0,45	1,05	0,75	1,00	0,60	0,65	SK373.1 F	0,45	1,05	0,75	1,00	0,60	0,65
SK573.1	0,75	1,90	1,50	2,00	1,10	1,15	SK573.1 F	0,75	1,90	1,50	2,00	1,10	1,15
SK673.1	1,10	2,60	2,15	2,70	1,55	1,65	SK673.1 F	1,10	2,60	2,15	2,70	1,55	1,65
SK773.1	2,30	3,80	3,30	3,20	2,40	3,10	SK773.1 F	2,00	3,50	3,20	2,90	2,30	3,00
SK873.1	4,20	7,80	5,90	6,40	4,10	5,90	SK873.1 F	4,10	7,60	6,90	6,60	5,00	6,60
SK973.1	7,50	12,00	10,50	11,50	7,50	10,50	SK973.1 F	7,40	12,20	11,10	11,60	8,00	10,90
SK773.1VL	2,30	3,80	3,30	3,20	2,40	3,10	SK773.1VL F	2,00	3,50	3,20	2,90	2,30	3,00
SK873.1VL	4,20	7,80	5,90	6,40	4,10	5,90	SK873.1VL F	4,10	7,60	6,90	6,60	5,00	6,60
SK973.1VL	7,50	12,00	10,50	11,50	7,50	10,50	SK973.1VL F	7,40	12,20	11,10	11,60	8,00	10,90
 [L]													
	M1	M2	M3	M4	M5	M6							
SK071.1/071.1F	0,18	0,40	0,38	0,40	0,30	0,30							
SK171.1/171.1F	0,22	0,40	0,36	0,40	0,33	0,33							
SK371.1/371.1F	0,35	0,58	0,55	0,58	0,49	0,49							
SK571.1/571.1F	0,48	0,86	0,80	0,92	0,68	0,68							
SK771.1/771.1F	0,90	1,50	1,20	1,70	1,16	1,16							

Table 8: Lubricant quantities for NORDBLOC



## NORDBLOC helical gear units

 [L]							 [L]						
⇒  6.1	M1	M2	M3	M4	M5	M6	⇒  6.1	M1	M2	M3	M4	M5	M6
SK172	0,35	0,50	0,50	0,50	0,50	0,50	SK172 F	0,35	0,50	0,50	0,50	0,50	0,50
SK272	0,60	1,00	1,00	1,00	1,00	1,00	SK272 F	0,60	1,00	1,00	1,00	1,00	1,00
SK372	0,60	1,00	1,00	1,00	1,00	1,00	SK372 F	0,60	1,00	1,00	1,00	1,00	1,00
SK472	1,00	1,90	1,90	2,00	1,80	1,80	SK472 F	1,00	1,90	1,90	1,90	1,90	1,50
SK572	1,00	1,90	1,90	2,00	1,80	1,80	SK572 F	1,00	1,90	1,90	1,90	1,90	1,50
SK672	1,40	3,40	3,10	3,15	1,45	3,15	SK672 F	1,15	3,40	2,70	2,80	1,25	2,70
SK772	2,00	3,30	3,50	4,20	2,70	3,30	SK772 F	1,60	3,30	3,50	3,30	3,10	3,10
SK872	3,70	9,60	9,10	7,30	4,70	8,00	SK872 F	3,50	9,00	7,90	7,70	3,90	7,20
SK972	6,50	16,00	15,70	14,70	8,50	14,00	SK972 F	6,50	15,00	13,00	13,50	6,50	12,00


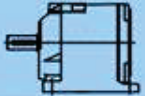

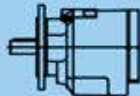
 [L]							 [L]						
SK273	0,62	1,10	1,10	1,10	1,10	1,10	SK273 F	0,62	1,10	1,10	1,10	1,10	1,10
SK373	0,55	1,10	1,10	1,10	1,10	1,10	SK373 F	0,55	1,10	1,10	1,10	1,10	1,10
SK473	1,30	2,50	2,10	2,40	2,10	2,10	SK473 F	1,25	2,40	2,10	2,50	2,10	2,10
SK573	1,30	2,50	2,10	2,40	2,10	2,10	SK573 F	1,25	2,40	2,10	2,50	2,10	2,10
SK673	1,80	3,80	3,20	3,40	2,90	3,00	SK673 F	1,70	3,80	3,00	3,20	3,00	3,00
SK773	2,50	4,50	3,70	4,60	3,30	3,30	SK773 F	2,30	5,00	3,60	4,50	3,90	3,90
SK873	6,20	8,40	7,50	9,10	7,50	7,50	SK873 F	5,00	8,80	7,60	8,00	8,00	8,00
SK973	11,00	15,80	13,00	16,00	13,30	13,00	SK973 F	10,30	16,50	13,00	16,00	14,00	14,00

Table 9: Lubricant quantities for NORDBLOC helical gear units



## Standard helical gear units

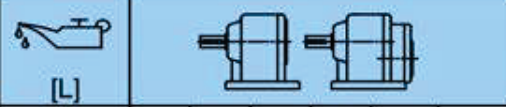
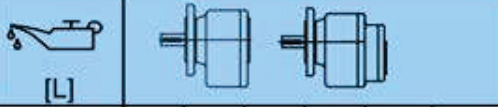













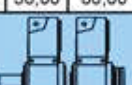


													
[L]	M1	M2	M3	M4	M5	M6	[L]	M1	M2	M3	M4	M5	M6
⇒ 6.1 SK20	0,55	1,00	0,55	1,00	0,55	0,55	⇒ 6.1 SK20 F	0,35	0,60	0,35	0,60	0,35	0,35
SK0	0,13	0,22	0,13	0,22	0,13	0,13	SK0 F	0,13	0,22	0,13	0,22	0,13	0,13
SK01	0,22	0,38	0,22	0,38	0,22	0,22	SK01 F	0,22	0,38	0,22	0,38	0,22	0,22
SK25	0,50	1,00	0,50	1,00	0,50	0,50	SK25 F	0,50	1,00	0,50	1,00	0,50	0,50
SK33	1,00	1,60	1,00	1,60	1,00	1,00	SK33 F	1,00	1,50	1,00	1,50	1,00	1,00
SK30	0,90	1,30	0,90	1,30	0,90	0,90	SK30 F	0,70	1,10	0,70	1,10	0,70	0,70
SK300	1,20	2,00	1,20	2,00	1,20	1,20	SK300 F	1,25	1,50	1,20	1,80	1,30	0,95
SK330	1,80	2,80	1,80	2,80	1,80	1,80	SK330 F	1,60	2,50	1,60	2,90	1,90	1,40
SK200	0,80	1,30	0,80	1,30	0,80	0,80	SK200 F	0,65	0,95	0,70	1,10	0,80	0,50
SK010	0,38	0,60	0,38	0,60	0,38	0,38	SK010 F	0,35	0,65	0,40	0,74	0,50	0,30
SK250	1,20	1,50	1,20	1,50	1,20	1,20	SK250 F	0,90	1,40	1,00	1,60	1,30	0,80
SK000	0,24	0,40	0,24	0,41	0,24	0,24	SK000 F	0,24	0,41	0,24	0,41	0,24	0,24

Table 10: Lubricant quantities for standard helical gear units



## Parallel shaft gear units


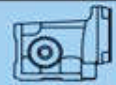







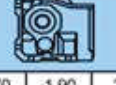






 [L]							 [L]								
	⇒ 6.1	M1	M2	M3	M4	M5		M6	⇒ 6.1	M1	M2	M3	M4	M5	M6
	SK0182NB A	0,40	0,55	0,55	0,40	0,40	0,40								
	SK0282NB A	0,70	1,10	0,80	1,10	0,90	0,90								
								SK1382NB A	1,40	2,30	2,20	2,20	2,00	2,00	
 [L]							 [L]								
	SK1282 A	0,95	1,30	0,90	1,30	1,00	1,00	SK2382 A	2,30	2,70	2,10	3,20	2,00	2,00	
	SK2282 A	1,70	2,30	1,70	2,20	1,90	1,90	SK3382 A	3,80	4,30	3,00	5,50	3,00	3,00	
	SK3282 A	2,80	4,00	3,30	3,80	3,00	3,00	SK4382 A	6,10	6,90	4,90	8,40	5,00	5,00	
	SK4282 A	4,20	5,40	4,40	5,00	4,20	4,20	SK5382 A	12,50	12,00	6,70	14,00	8,30	8,30	
	SK5282 A	7,50	8,80	7,50	8,80	7,20	7,20	SK1382 A	1,45	1,60	1,15	1,70	1,10	1,10	
 [L]							 [L]								
	SK6282 A	17,00	15,50	12,50	17,50	11,00	14,00	SK6382 A	16,00	13,00	10,00	18,00	14,00	12,50	
	SK7282 A	25,50	21,00	20,50	27,00	16,00	21,00	SK7382 A	22,00	21,00	16,00	25,00	23,00	22,00	
	SK8282 A	37,50	33,00	30,50	44,00	31,00	31,00	SK8382 A	34,50	32,50	25,00	38,00	35,00	30,00	
	SK9282 A	74,50	70,00	56,00	80,00	65,00	59,00	SK9382 A	73,50	70,00	43,00	74,50	65,00	60,00	
 [L]							 [L]								
	SK10282 A	90	90	40	90	60	82	SK10382 A	85	90	73	100	80	80	
	SK11282 A	165	160	145	195	100	140	SK11382 A	160	155	140	210	155	135	
								SK12382 A	160	155	140	210	155	135	
								SK10382.1 A	76,0	80,0	71,0	92,5	71,5	66,5	
								SK11382.1 A	127	133	118	194	124	112	

\* For further information see page 58

Table 11: Lubricant quantities for parallel shaft gear units



# Bevel gear units

 [L] 6.1							 [L] 6.1						
	M1	M2	M3	M4	M5	M6		M1	M2	M3	M4	M5	M6
SK92072	0,40	0,60	0,50	0,55	0,40	0,40	SK92072 A	0,40	0,60	0,55	0,55	0,40	0,40
SK92172	0,60	0,90	1,00	1,10	1,10	0,80	SK92172 A	0,50	1,00	0,90	1,05	0,90	0,60
SK92372	0,90	1,60	1,50	1,90	1,50	0,90	SK92372 A	1,20	1,60	1,50	1,90	1,30	1,30
SK92672	1,80	3,50	3,60	3,40	2,60	2,60	SK92672 A	1,60	2,80	2,50	3,30	2,40	2,40
SK92772	2,30	4,50	4,60	5,30	4,10	4,10	SK92772 A	2,80	4,40	4,50	5,50	3,50	3,50
 [L] 6.1							 [L] 6.1						
	M1	M2	M3	M4	M5	M6		M1	M2	M3	M4	M5	M6
SK92072.1	0,26	0,49	0,42	0,54	0,29	0,31	SK93072.1	0,39	0,93	0,79	1,02	0,49	0,62
SK92172.1	0,34	0,61	0,52	0,67	0,42	0,48	SK93172.1	0,60	1,17	0,94	1,22	0,65	0,85
SK92372.1	0,43	0,92	0,73	0,83	0,55	0,61	SK93372.1	1,00	1,97	1,65	2,14	1,12	1,34
SK92672.1	0,85	1,60	1,20	1,50	1,02	1,02	SK93672.1	1,80	3,23	2,71	3,80	2,02	2,45
SK92772.1	1,30	2,65	1,86	2,45	1,60	1,60	SK93772.1	2,72	4,63	3,70	5,40	2,93	3,25
SK920072.1	0,21	0,47	0,36	0,34	0,28	0,28	SK930072.1	0,28	0,65	0,56	0,54	0,39	0,39
 [L] 6.1							 [L] 6.1						
	M1	M2	M3	M4	M5	M6		M1	M2	M3	M4	M5	M6
SK9012.1	0,70	1,70	1,90	2,10	1,10	1,50	SK9012.1 A	1,00	1,90	1,90	2,20	1,20	1,70
SK9016.1	0,70	1,70	1,90	2,10	1,10	1,50	SK9016.1 A	1,00	1,90	1,90	2,20	1,20	1,70
SK9022.1	1,30	2,90	3,30	3,80	1,70	2,80	SK9022.1 A	1,60	3,50	3,50	4,20	2,30	2,80
SK9032.1	1,80	5,40	6,10	6,80	3,00	4,60	SK9032.1 A	2,10	4,80	6,40	7,10	3,30	5,10
SK9042.1	4,40	9,00	10,00	10,70	5,20	7,70	SK9042.1 A	4,50	10,00	10,00	11,50	6,50	8,20
SK9052.1	6,50	16,00	19,00	21,50	11,00	15,50	SK9052.1 A	7,50	16,50	20,00	23,50	11,50	18,00
SK9062.1	10,00	27,50	32,00	36,00	18,00	24,00	SK9062.1 A	12,00	27,50	33,00	38,50	19,00	26,00
SK9072.1	10,00	27,50	32,00	36,00	18,00	24,00	SK9072.1 A	12,00	27,50	33,00	38,50	19,00	26,00
SK9082.1	17,00	51,50	62,50	71,50	33,00	46,50	SK9082.1 A	21,00	54,00	66,00	80,00	38,00	52,00
SK9086.1	29,00	73,00	85,00	102,00	48,00	62,00	SK9086.1 A	36,00	78,00	91,00	107,00	53,00	76,00
SK9092.1	41,00	157,00	170,00	172,00	80,00	90,00	SK9092.1 A	40,00	130,00	154,00	175,00	82,00	91,00
SK9096.1	70,00	187,00	194,00	254,00	109,00	152,00	SK9096.1 A	80,00	187,00	193,00	257,00	113,00	156,00
 [L] 6.1							 [L] 6.1						
	M1	M2	M3	M4	M5	M6		M1	M2	M3	M4	M5	M6
SK9013.1	1,35	2,10	2,15	2,75	1,00	1,80	SK9013.1 A	1,45	2,30	2,10	2,80	1,05	1,80
SK9017.1	1,30	2,00	2,10	2,70	1,00	1,70	SK9017.1 A	1,45	2,30	2,10	2,80	1,05	1,80
SK9023.1	2,20	3,20	3,60	4,70	2,20	2,90	SK9023.1 A	2,30	3,50	3,80	5,30	2,20	3,40
SK9033.1	3,10	5,70	6,30	8,00	3,40	4,80	SK9033.1 A	3,70	5,70	6,70	8,60	3,60	5,30
SK9043.1	5,00	10,10	11,00	13,30	5,70	8,10	SK9043.1 A	6,50	10,50	11,90	14,70	6,70	9,30
SK9053.1	10,00	17,00	20,00	24,50	11,50	16,50	SK9053.1 A	13,00	18,00	21,50	26,50	13,00	17,00

\* For further information see page 58

Table 12: Lubricant quantities for bevel gear units



## Helical worm gear units








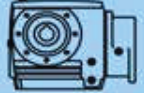

 [L]							 [L]							 [L]						
⇒ 6.1																				
	M1	M2	M3	M4	M5	M6		M1	M2	M3	M4	M5	M6		M1	M2	M3	M4	M5	M6
SK02040	0,40	0,80	0,75	0,65	0,50	0,50	SK02040 A	0,40	0,70	0,65	0,65	0,55	0,55	SK02040 A	0,45	1,40	1,15	1,10	0,75	0,75
SK02050	0,40	1,40	1,10	1,30	0,70	0,70	SK02050 A	0,45	1,40	1,15	1,10	0,75	0,75	SK02050 A	0,45	1,40	1,15	1,10	0,75	0,75
SK12063	0,60	1,80	1,20	1,60	1,00	1,00	SK12063 A	0,55	1,45	1,60	1,60	1,10	1,10	SK12063 A	0,55	1,45	1,60	1,60	1,10	1,10
SK12080	0,90	3,10	2,40	3,00	1,80	1,80	SK12080 A	0,80	3,10	3,20	2,80	1,80	1,80	SK12080 A	0,80	3,10	3,20	2,80	1,80	1,80
SK32100	1,50	6,30	5,60	5,50	3,60	3,60	SK32100 A	1,50	5,60	5,60	5,30	4,00	4,00	SK32100 A	1,50	5,60	5,60	5,30	4,00	4,00
SK42125	2,80	11,80	10,20	10,00	6,20	6,20	SK42125 A	3,00	12,50	10,80	10,80	6,50	6,50	SK42125 A	3,00	12,50	10,80	10,80	6,50	6,50
 [L]							 [L]							 [L]						
SK13050	0,75	1,75	1,30	1,75	0,75	0,75	SK13050 A	0,90	1,80	1,30	1,65	1,30	1,30	SK13050 A	0,90	1,80	1,30	1,65	1,30	1,30
SK13063	1,00	2,30	1,50	2,20	1,10	1,10	SK13063 A	1,05	2,10	1,80	2,10	1,40	1,40	SK13063 A	1,05	2,10	1,80	2,10	1,40	1,40
SK13080	1,70	3,50	3,50	3,50	2,00	2,00	SK13080 A	1,60	3,60	2,90	3,75	2,00	2,00	SK13080 A	1,60	3,60	2,90	3,75	2,00	2,00
SK33100	2,40	6,40	5,40	6,50	3,40	3,40	SK33100 A	2,60	6,00	5,80	6,00	3,50	3,50	SK33100 A	2,60	6,00	5,80	6,00	3,50	3,50
SK43125	4,25	13,00	10,50	13,50	7,20	7,20	SK43125 A	4,60	13,60	11,40	14,30	7,60	7,60	SK43125 A	4,60	13,60	11,40	14,30	7,60	7,60
 [L]							 [L]							 [L]						
SK02040 F	0,40	0,70	0,65	0,65	0,55	0,55	SK13050 F	0,75	1,80	1,50	1,70	1,05	0,90	SK13050 F	0,75	1,80	1,50	1,70	1,05	0,90
SK02050 F	0,40	1,50	1,25	1,20	0,90	0,75	SK13063 F	1,00	2,30	1,90	2,20	1,35	1,10	SK13063 F	1,00	2,30	1,90	2,20	1,35	1,10
SK12063 F	0,50	1,95	1,70	1,75	1,20	0,95	SK13080 F	1,60	3,80	3,50	3,90	2,70	2,50	SK13080 F	1,60	3,80	3,50	3,90	2,70	2,50
SK12080 F	0,90	3,70	3,20	3,40	2,50	2,30	SK33100 F	2,65	7,20	6,40	7,60	4,30	3,80	SK33100 F	2,65	7,20	6,40	7,60	4,30	3,80
SK32100 F	1,40	6,30	6,10	6,10	4,00	3,60	SK43125 F	4,70	15,00	13,00	16,00	9,00	7,70	SK43125 F	4,70	15,00	13,00	16,00	9,00	7,70
SK42125 F	3,00	11,50	11,50	11,00	8,40	7,30														

Table 13: Lubricant quantities for Helical worm gear units



## 6.5 Torque values

Dimensions	Bolt Torques [Nm]					
	Screw connections in the strength classes			Cover screws	Threaded pin on coupling	Screw connections on protective covers
	8.8	10.9	12.9			
M4	3.2	5	6	-	-	-
M5	6.4	9	11	-	2	-
M6	11	16	19	-	-	6.4
M8	27	39	46	11	10	11
M10	53	78	91	11	17	27
M12	92	135	155	27	40	53
M16	230	335	390	35	-	92
M20	460	660	770	-	-	230
M24	790	1150	1300	80	-	460
M30	1600	2250	2650	170	-	-
M36	2780	3910	4710	-	-	1600
M42	4470	6290	7540	-	-	-
M48	6140	8640	16610	-	-	-
M56	9840	13850	24130	-	-	-
G½	-	-	-	75	-	-
G¾	-	-	-	110	-	-
G1	-	-	-	190	-	-
G1¼	-	-	-	240	-	-
G1½	-	-	-	300	-	-

Table 14: Torque values

### Assembling the hose fittings

Oil the thread of the union nut, the cutting ring and the screw neck. Tighten the union nut with the wrench until the point where the union nut can only be turned with considerably more force. Turn the union nut of the screw fitting approx. 30° to 60° further but not more than 90°. For this the screw neck must be held with a wrench. Remove excess oil from the screw fitting



## 6.6 Troubleshooting



### WARNING

#### Injury to persons

There is a slipping hazard in case of leaks.

Clean the soiled floor and machine components before starting troubleshooting.



### WARNING

#### Injury to persons

Risk of injury due to rapidly rotating and hot machine components.

Troubleshooting must only be performed when gear units are at a standstill and have cooled down. The drive must be isolated and secured to prevent accidental start-up.

### NOTICE

#### Gear unit damage

Damage to the gear unit is possible in case of faults.

Shut down the drive unit immediately in case of any faults in the gear unit.

Gear unit malfunctions		
Fault	Possible cause	Remedy
Unusual running noises, vibrations	Oil too low or bearing damage or gear wheel damage	Consult NORD Service
Oil escaping from the gear unit or motor	Defective seal	Consult NORD Service
Oil escaping from pressure vent	Incorrect oil level or incorrect, contaminated oil or unfavourable operating conditions	Oil change, use oil expansion tank (Option OA)
Gear unit becomes too hot	Unfavourable installation conditions or gear unit damage	Consult NORD Service
Shock when switching on, vibrations	Defective motor coupling or loose gear unit mounting or defective rubber element	Replace elastomer gear rim, tighten motor and gear unit fastening bolts, replace rubber element
Output shaft does not rotate although motor is running	Fracture in gear unit or defective motor coupling or shrink disc slippage	Consult NORD Service

Table 15: Overview of malfunctions



## 6.7 Leaks and seals

Gear units are filled with oil or grease to lubricate the moving parts. Seals prevent the escape of lubricants. A complete seal is not technically possible, as a certain film of moisture, for example on the radial shaft sealing rings is normal and advantageous for a long-term seal. In the region of vents, moisture due to oil may be visible due to the escape of oil mist because of the function. In the case of grease-lubricated labyrinth seals, e.g. Taconite sealing systems, used grease emerges from the sealing gap due to the principle of operation. This apparent leak is not a fault.

According to the test conditions as per DIN 3761, the leak is determined by the medium which is to be sealed, which in test bench tests exceeds the function-related moisture in a defined test period and which results in dripping of the medium which is to be sealed. The measured quantity which is then collected is designated as leakage.

Definition of leakage according to DIN 3761 and its appropriate use					
Term	Explanation	Shaft sealing ring	Location of leak		
			in IEC adapter	Housing joint	Venting
Sealed	No moisture apparent	No reason for complaint	No reason for complaint	No reason for complaint	No reason for complaint
Damp	Moisture film locally restricted (not an area)	No reason for complaint	No reason for complaint	No reason for complaint	No reason for complaint
Wet	Moisture film beyond the extent of the component	No reason for complaint	No reason for complaint	Repair if necessary	No reason for complaint
Measurable leakage	Recognisable stream, dripping	Repair recommended	Repair recommended	Repair recommended	Repair recommended
Temporary leakage	Temporary malfunction of the sealing system or oil leak due to transport *)	No reason for complaint	No reason for complaint	Repair if necessary	No reason for complaint
Apparent leakage	Apparent leakage, e.g. due to soiling, sealing systems which can be re-lubricated	No reason for complaint	No reason for complaint	No reason for complaint	No reason for complaint

**Table 16: Definition of leaks according to DIN 3761**

\*) Previous experience has shown that moist or wet radial shaft sealing rings stop leaking later. Therefore, under no circumstances can replacement be recommended at this stage. The reason for momentary moisture may be e.g. small particles under the sealing lip.



## 6.8 Repair information

For enquiries to our technical and mechanical service departments, please have the precise gear unit type (type plate) and if necessary the order number (type plate) to hand.

### 6.8.1 Repairs

The device must be sent to the following address if it needs repairing:

**Getriebebau NORD GmbH & Co. KG**

**Service Department**

Getriebebau-Nord-Straße 1

22941 Bargteheide

No guarantee can be given for any attachments, such as encoders or external fans, if a gear unit or geared motor is sent for repair.

Please remove all non-original parts from the gear unit or geared motor.



### Information

### Reason for return

If possible, the reason for returning the component or device should be stated. If necessary, at least one contact should be stated in case of queries.

This is important in order to keep repair times as short and efficient as possible.

### 6.8.2 Internet information

In addition, the country-specific operating and installation instructions in the available languages can be found on our Internet site: [www.nord.com](http://www.nord.com)

## 6.9 Abbreviations

<b>2D</b>	Dust explosion protected gear units zone 21	<b>FA</b>	Axial force
<b>2G</b>	Explosion protected gear units with ignition protection class "c"	<b>IE1</b>	Motors with standard efficiency
<b>3D</b>	Dust explosion protected gear units zone 22	<b>IE2</b>	Motors with high efficiency
<b>ATEX</b>	<b>AT</b> mospheres <b>EX</b> plosibles	<b>IEC</b>	International Electrotechnical Commission
<b>B5</b>	Flange fastening with through holes	<b>NEMA</b>	National Electrical Manufacturers Association
<b>B14</b>	Flange fastening with threaded holes	<b>IP55</b>	International Protection
<b>CW</b>	Clockwise, right-hand direction of rotation	<b>ISO</b>	International Standardisation Organisation
<b>CCW</b>	Counter-clockwise, left-hand direction of rotation	<b>pH</b>	pH value
<b>°dH</b>	Water hardness in German hardness degrees: 1°dH = 0.1783 mmol/l	<b>PPE</b>	Personal Protective Equipment
<b>DIN</b>	German standards institute	<b>RL</b>	Directive
<b>EC</b>	European Community	<b>VCI</b>	Volatile Corrosion Inhibitor
<b>EN</b>	European standard	<b>WN</b>	Getriebebau NORD factory standard
<b>FR</b>	Radial transverse force		



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## **NORD DRIVESYSTEMS Group**

**Headquarters and Technology Center**  
in Bargteheide close to Hamburg, Germany

**Innovative drive solutions**  
for more than 100 branches of industries

**Mechanical products**  
Parallel shaft-, helical gear-, bevel gear- and worm gear units

**Electrical products**  
IE2/IE3/IE4-Motors

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Centralized and decentralized frequency inverters  
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**7 state-of-the-art production plants**  
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**Subsidiaries in 36 countries on 5 continents**  
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**More than 3,200 employees around the world**  
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**[www.nord.com/locator](http://www.nord.com/locator)**

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**Member of the NORD DRIVESYSTEMS Group**



E-1347



TNK-101/2 - Tank, Closed Top, Cylindrical, 2100 gal, Norwesco - no drain, PN 40241  
TNK-901 - Tank, Closed Top, Cylindrical, 2100 gal, Norwesco - no drain, PN 40241



## **Liquid Storage Tanks**

*Think Tanks. Think Norwesco.*

*2004 Edition*





NORWESCO tanks are manufactured to strict quality guidelines to ensure years of high-performance use. Rugged, impact-resistant, one-piece seamless polyethylene construction makes our tanks suitable for the storage and/or transport of most liquid fertilizers, herbicides, insecticides and fungicides as well as a wide range of industrial chemicals. NORWESCO tanks are manufactured using resins that meet FDA specifications to ensure safe storage of potable water.

Quality, price, product line and leading edge technology make NORWESCO North America's largest manufacturer of rotationally molded tanks. Standard NORWESCO tanks will be delivered to you with a fitting installed when applicable. NORWESCO tanks may be ordered without a fitting as well.

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## Vertical Storage Tanks

Vertical storage tanks are most frequently used for bulk storage and mobile nursing applications. NORWESCO vertical tanks feature tie-down slots, built-in graduated gallon indicators, an offset fill-well and a self-vented, slosh-proof lid.

All NORWESCO vertical tanks are equipped with an outlet fitting and siphon tube.

Gallon Capacity	Diameter	Height	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White	Heavy Weight Part No. Blue
25 ∞	18"	29"	5"	3/4"	41867	—
50 ∞	18"	53"	5"	3/4"	41865	—
65 ∞	23"	42"	8"	1 1/4"	45192	—
75	23"	50"	8"	1 1/4"	41863	—
100	28"	43"	8"	1 1/4"	41861	—
105	23"	63"	8"	2"	40803	—
150	30"	56"	8"	1 1/4"	41859	—
165	31"	55"	16"	2"	40281	—
200	30"	72"	8"	2"	41856	—
210	31"	69"	16"	2"	47401	—
250	30"	89"	8"	2"	41854	—
300	36"	78"	16"	2"	40213	—
305	46"	49"	16"	2"	40302	—
500	48"	72"	16"	2"	40148	40150
550	67"	42"	16"	2"	40023	—
750	48"	102"	16"	2"	40606	—
1000	64"	79"	16"	2"	40152	40154
1100	87"	51"	16"	2"	40070	40081
1350	71"	87"	16"	2"	40861	—
1500	64"	115"	16"	2"	40144	40146
1550	87"	65"	16"	2"	40235	40236
1700	87"	72"	16"	2"	40010	40012
2100	87"	87"	16"	2"	40178	40241
2100	102"	69"	16"	2"	41399	—
2500	95"	89"	16"	2"	40051	40052
3000	95"	107"	16"	2"	40754	40755
4000	102"	125"	16"	3 1/2"	40312	—
4200	102"	131"	16"	2"	41403	—
5000	102"	152"	16"	3 1/2"	40164	40166
5800	141"	97"	16"	3 1/2"	40071	—
6000	102"	182"	16"	3 1/2"	40226	40233
6100	120"	139"	16"	3 1/2"	40659	40661
6500	120"	150"	16"	3 1/2"	40224	40232
7800	120"	176"	16"	3 1/2"	40663	40665
9000	141"	146"	16"	3 1/2"	40543	40231
10000	141"	160"	16"	3 1/2"	40545	40353
12000	141"	192"	16"	3" *	40539	40541
15000	141"	244"	16"	3" *	41334	41336

∞ Within UPS dimensional limits

\*316 Stainless Steel Bolted Fitting



## Horizontal Leg Tanks

With the broadest leg tank line available, NORWESCO manufactures a size that will fit your needs. Used primarily for transport and nursing applications, NORWESCO'S leg tanks feature molded-in legs that act as "baffles" to reduce sloshing. Please refer to page 4 for support bands.

Gallon Capacity	Diameter	Length	Fill Opening	Outlet/Drain Specification	No. of Bands	Premium Weight Part No. White	Heavy Weight Part No. Blue
35 ∞	20"	29"	5"	3/4"	2 optional	45223	—
55 ∞	23"	33"	5"	3/4"	2 optional	41873	—
65 ∞	23"	43"	5"	3/4"	2 optional	45191	—
125	32"	41"	8"	2"	2 optional	40298	—
225	38"	49"	8"	2"	2 optional	40299	—
325	38"	68"	16"	2"	2 optional	40217	—
525	49"	71"	16"	2"	2 optional	40181	40193
725 *	49"	101"	16"	2"	3 required	40180	40194
1025 *	49"	139"	16"	2"	4 required	40089	40131
1325 *	66"	99"	16"	2"	4 required	41875	41877
5025 *	92"	190"	16" **	3"/2"	4 required	41879	41881

∞ Within UPS dimensional limits      \*Require full length support and bands      \*\*16" hinged lid



**325 Gallon Horizontal Leg**



**1025 Gallon Horizontal Leg**



Sloped For Complete Drainage **▲ 1010 Gallon Drainable Leg**

## Drainable Leg Tanks

When complete drainage is necessary, these are the tanks of choice. They are designed primarily for use on fertilizer and chemical nurse trailers. All NORWESCO drainable tanks require full length bottom support as well as support bands. Please refer to page 4 for support bands.

Gallon Capacity	Width	Height	Length	Fill Opening	Outlet/Drain Specification	No. of Bands	Premium Weight Part No. White	Heavy Weight Part No. Blue
710 (horizontal)	47"	47"	104"	16"	2"	3 required	40655	40657
1010 (horizontal)	47"	47"	140"	16"	2"	4 required	40393	40395
1310 (horizontal)	66"	76"	99"	16"	—	4 required	41871	41872
1610 (elliptical)	69"	63"	140"	16"	—	4 required	40806	40808
2610 (elliptical)	90"	70"	140"	16"*	—	4 required	41382	41383
3210 (elliptical)	92"	74"	178"	16"*	—	4 required	40822	40824

\*16" hinged lid

## Elliptical Leg Tanks

This elliptical tank style is designed to provide the greatest capacity with the lowest center of gravity, making it the best design available for transporting larger volumes. NORWESCO elliptical tanks feature molded-in legs and flow-through baffles which work together to reduce sloshing and provide increased stability during transport. All NORWESCO elliptical leg tanks require full length bottom support as well as support bands. Please refer to page 4 for support bands.

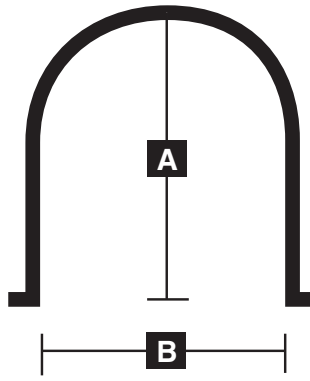
Gallon Capacity	Width	Height	Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White	Heavy Weight Part No. Blue
1035	79"	53"	89"	16"	2"	40191	—
1235	65"	52"	128"	16"	2"	40239	—
1635	71"	57"	142"	16"	2"	40387	40388
2035	84"	55"	142"	16"	2"	40618	40623
2635	90"	71"	140"	16"	3"/2"	40547	40283
3135	88"	76"	151"	16"	3"/2"	40686	40688
4035	92"	77"	192"	16" *	3"/2"	41267	41269

\*16" hinged lid



**2035 Gallon Elliptical Leg**





## Steel Supports and Accessories

NORWESCO bands are custom fabricated to support the NORWESCO tanks and are galvanized or powder coated for added corrosion protection. Whether using the tank in a stationary position or for transport, bands are necessary to ensure that the tank retains its shape and integrity.

### Horizontal Leg Tank Bands

Tank Size (Gallon)	A	B	No. of Bands	Part No.
35 ∞	18½"	18½"	2 optional	60520
55 ∞	22"	22"	2 optional	61745
65 ∞	22"	22"	2 optional	61745
125 ∞	30¾"	30½"	2 optional	61744
225 ∞	36¾"	36½"	2 optional	60478
325 ∞	36¾"	36½"	2 optional	60478
525	47¾"	47½"	2 optional	60057
725	47¾"	47½"	3 required	60057
1025	47¾"	47½"	4 required	60057
1325	64"	64"	3 required	63282
5025	90"	89½"	4 required	63284

∞ Within UPS dimensional limits

### Drainable Leg Tank Bands

Tank Size (Gallon)	A	B	No. of Bands	Part No.
710	46¼"	45"	3 required	60584 short
1010 *	46¼"	45"	2 required	60584 short
1010 *	48"	45"	2 required	60585 long
1310	64"	64"	3 required	63282
1610	49"	66"	4 required	62434
2610 *	58"	87½"	2 required	63044 short
2610 *	62"	87½"	2 required	63045 long
3210 *	56"	89½"	2 required	62347 short
3210 *	60"	89½"	2 required	62348 long

\* 2 short and 2 long bands are required for 1 tank

### Elliptical Leg Tank Bands

Tank Size (Gallon)	A	B	No. of Bands	Part No.
1035	47¼"	77"	3 required	60325
1235	47¾"	64¾"	4 required	60477
1635	51"	68"	4 required	60586
2035	51¼"	81½"	4 required	62079
2635	65¼"	87½"	4 required	60353
3135	75¼"	85½"	4 required	62097
4035	70¼"	89½"	4 required	62832

## Skid

Description	Part No.
Skid for 2610	63217
Skid for 3210 drainable leg tank	62906
Bolt Kit for 3210 (optional)	63024

## Ladders

Description	Tank Size (Gallon)	Part No.
Ladder (optional)	2635 & 3135	60354
Ladder (optional)	2610 & 3210	63047
Ladder (optional)	4035	63033
Adaptor kit for ladder Δ	3135	62301

Δ This kit is required when using the ladder on the 3135 gallon tank





## Mini Bulk Tanks

NORWESCO mini bulk tanks are available in two sizes and are most frequently used for chemical dispensing. The tanks can be mounted on forklift accessible pads for ease of movement. A 2" polypropylene fitting is installed directly across from the manway.

Gallon Capacity	Diameter	Height	Fill Opening	Fitting	Premium Weight Part No. White
120	38"	29"	5"	2"	40318
220	42"	42"	5"	2"	40320

## Pickup Truck Tanks

Designed to fit full-size, American-made pickups, the 325 and 425 sizes have low profiles for better rear vision. They feature fill openings offset to the side of the tank for safety and easy access. A tough circular design adds strength. The 210 gallon tank fits both "mini" pickups and full-size models.

Gallon Capacity	Top Width or Diameter	Bottom Width or Diameter	Overall Height	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White
210	60"/51"	48"/39"	28"	8"	2"	40300
325	62"	49"	32"	8"	2"	40160
425	65"	49"	37"	8"	2"	40102



## PCO Tanks

A multi-purpose tank, the PCO is well suited for nursery, agricultural and lawn care applications. These tanks feature self-supporting legs and do not require any saddles or steel supports. Flat spots are molded into both ends to provide mounting areas for agitation equipment.



Gallon Capacity	Width	Height	Length	Fill Opening	Premium Weight Part No. White
30 ∞	19"	22"	25"	5"	41254
50 ∞	19"	20"	38"	8"	40664
100	30"	26"	38"	8"	40668
150	36"	26"	48"	8"	40669
200	36"	35"	48"	8"	41413
300	36"	37"	69"	16"	41381

∞ Within UPS dimensional limits



## Elliptical Tanks

Designed for larger volume applicator needs, the NORWESCO elliptical tanks feature a low profile design and a low center of gravity for excellent visibility in the field and increased stability when towed. A deep sump permits complete drainage and the tanks feature an 8" or 16" fill-well. Please refer to information below for steel supports.



**750 Gallon Elliptical**

Gallon Capacity	Width	Height	Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White
200	40"	28"	66"	8"	1¼" & 1¼"	41252
300	48"	32"	70"	16"	1¼" & 1¼"	40327
500	57"	38"	82"	16"	1¼" & 1¼"	40328
750	69"	44"	88"	16"	2"	40329
1000	78"	51"	90"	16"	2"	40330
1600 *	78"	49"	138"	16"	2"	47111
2550 **	88"	69"	142"	16"	3"	47677

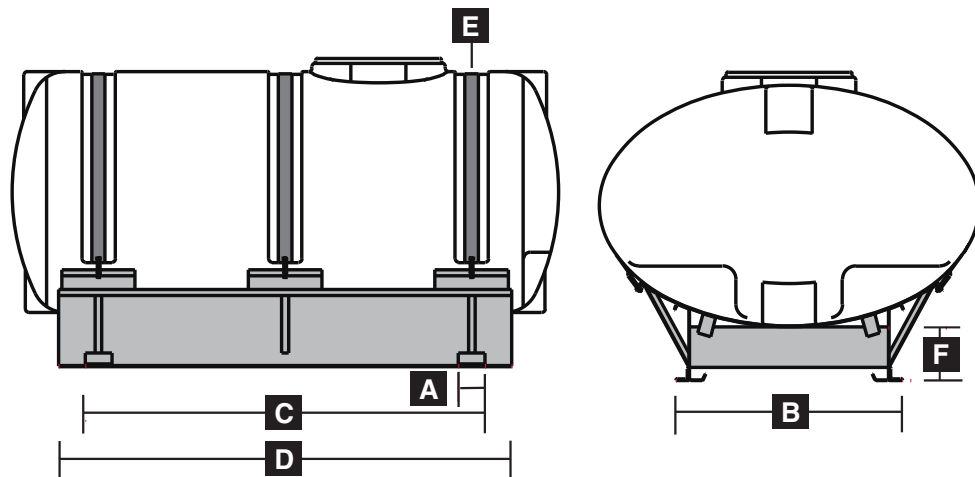
\* Includes 1 stainless steel baffle    \*\* The 2550 requires support bands

## Elliptical Tank Skids (See dimensional drawings below.)

Tank Size (Gallon)	Tank Part No.	A	B	C	D	E	F	Part No.
200	41252	4"	24"	52"	57"	2" x 68"	8"	63015
300	40327	4"	34"	46¼"	54¼"	2" x 76"	8"	63016
500	40328	4"	34"	60"	68"	2" x 94"	8"	63018
750	40329	4"	38"	69½"	78"	2" x 112"	8"	60371
1000	40330	4"	46"	60"	72"	2" x 130"	8"	60372
1600	47111	10½"	40"	114½"	118¼"	3½" x 126"	6½"	67428
2550 *	47677	—	—	—	—	—	—	67456

\* Band only, no skid. The 2550 requires 4 support bands, part #67456.

Replacement bands and hardware are available. Please contact NORWESCO Customer Service for details.





## Applicator Tanks, Inductor Tanks and Spot Sprayers

Whether you're looking for a new or replacement tank, you'll find it in the NORWESCO line. All NORWESCO applicator tanks feature a lid which threads directly into the fill-well of the tank to prevent the sloshing or leaking of tank contents during transport or application. The inductor tanks are suitable for mixing chemicals when filling a tank and are available in three sizes. The spot sprayers feature threaded inserts on the bottom of the tank for mounting purposes, on one side for wand/gun placement and on the top for a 12 volt pump. Please refer to page 8 for steel supports.



**12 Gallon Applicator**



**150 Gallon x 32" Applicator**



**200 Gallon x 32" Applicator**



**500 Gallon Applicator**

### Applicator Tanks

Gallon Capacity	Diameter	Height/Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White
12 ∞	14" wide	12"/18"	5"	3/4"	60521
20 ∞	15"	31"	5"	3/4"	61737
30 ∞	23"	21"	5"	3/4"	41799
55 ∞	23"	34"	5"	3/4"	45193
85	23"	52"	5"	3/4"	45105
110	30"	41"	8"	1 1/4" & 1 1/4"	45053
150	30"	58"	8"	1 1/4" & 1 1/4"	40648
150	32"	46"	8"	1 1/4" & 1 1/4"	45117

∞ Within UPS dimensional limits

Gallon Capacity	Diameter	Height/Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White
200	32"	62"	8"	1 1/4" & 1 1/4"	45059
200	38"	47"	8"	1 1/4" & 1 1/4"	45061
300	38"	68"	8"	1 1/4" & 1 1/4"	40135
400	42"	74"	8"	1 1/4" & 1 1/4"	40137
500	48"	75"	8"	1 1/4" & 1 1/4"	40274
150 Slim Line	28"	40"/50"	8"	1 1/4" & 1 1/4"	40777
200 Slim Line	24"	46"/61"	8"	1 1/4" & 1 1/4"	41305
200 Slim Line	31"	44"/48"	8"	1 1/4" & 1 1/4"	40780

### Inductor Tanks

Gallon Capacity	Diameter	Height/Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White
15 ∞	19"	23"	8"	2"	60214
35 ∞	23"	27"	8"	2"	45098
60	31"	31"	16"	2"	62205

∞ Within UPS dimensional limits



**35 Gallon Inductor**

### Spot Sprayers

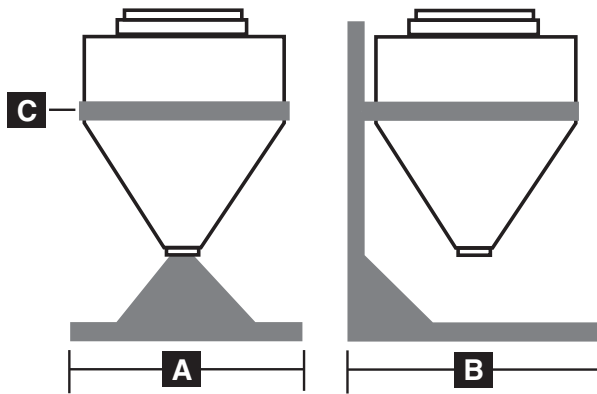
Gallon Capacity	Width	Height/Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White
14 ∞	14"	11"/31"	5"	—	45115
25 ∞	18"	16"/36"	5"	—	62080

∞ Within UPS dimensional limits



**14 and 25 Gallon Spot Sprayer**





## Applicator Saddle Assemblies and Inductor Stands

Designed to provide necessary support for the applicator/inductor tank during use. NORWESCO saddles include polyester straps, buckles and bolts to secure tanks, and inductor stands are supplied with all necessary hardware.

### Inductor Tank Stands (See dimensional drawings above.)

Tank Size (Gallon)	Tank Part No.	A	B	C	Part No.
15 ∞	60214	26"	15"	2" x 56"	60313
35 ∞	45098	25"	18"	1½" x 35" (2)	65517
60 ∞	62205	33"	24"	1½" x 46" (2)	62204

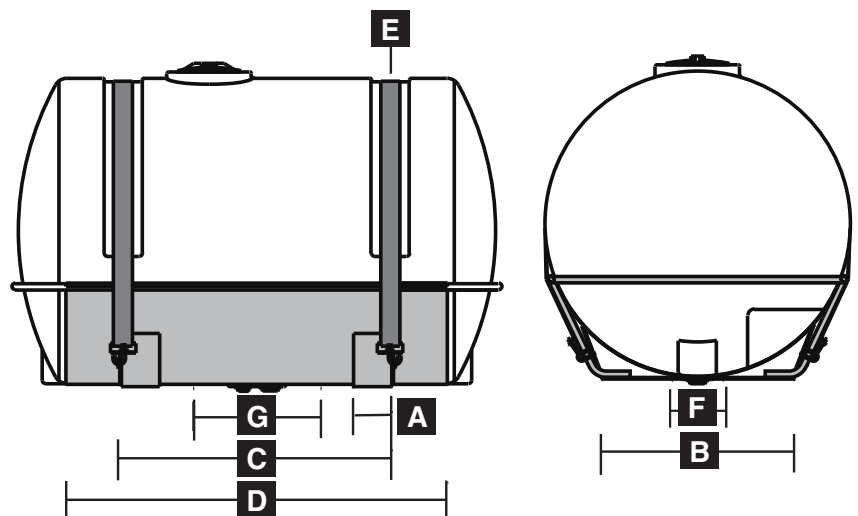
∞ Within UPS dimensional limits

### Applicator Tank Saddle Assemblies (See dimensional drawings below.)

Tank Size (Gallon)	Tank Part No.	A	B	C	D	E	F	G	Part No.
30 ∞	41799	3"	19"	13½"	13½"	2" x 54"	8"	7¾"	60321
55 ∞	45193	6"	18⅞"	24"	24"	2" x 48"	—	12"	60303
110 ∞	45053	6"	23¾"	28¾"	34¾"	2" x 72"	—	10¾"	60315
150 - 32" ∞	45117	6"	23¾"	28¾"	34¾"	2" x 72"	—	10¾"	60315
200 - 32"	45059	6"	24⅞"	36"	60"	2" x 96"	8"	13¼"	63019
200 - 38"	45061	6"	24¾"	34"	42"	2" x 96"	—	13¼"	63020
300 - 38"	40135	6"	24¾"	34"	60"	3" x 96"	8"	12"	63021
400 - 42"	40137	6"	30⅞"	42½"	60"	3" x 96"	8"	12"	63022
500 - 48"	40274	6"	30⅞"	42½"	60"	3" x 132"	8"	12"	63023

∞ Within UPS dimensional limits

Replacement bands and hardware are available. Please contact NORWESCO Customer Service for details.





## Cone Bottom Tanks

NORWESCO offers a full range of cone bottom tanks designed for a variety of applications. The conical bottoms enable quick and complete drainage. As with all NORWESCO tanks, the cone bottom tanks are molded of rugged, high density polyethylene and are both impact and chemical resistant. Please refer to page 10 for polyethylene or steel stands.

Gallon Capacity	Diameter	Height	Slope	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White	Heavy Weight Part No. Blue
175 w/stand*	42"	49"/10"†	30°	16"	2"	60113	—
300 w/stand*	48"	60"/9"†	30°	16"	2"	62343	—
310 w/stand*	42"	71"/10"†	30°	8"	2"	62441	—
500 w/stand*	48"	85"/9"†	30°	16"	2"	40289	—
750	72"	55"	20°	16"	2"	40811	—
750 w/stand*	72"	65"/10"†	20°	16"	2"	40809	—
1050	72"	74"	20°	16"	2"	40356	—
1050 w/stand*	72"	85"/11"†	20°	16"	2"	40359	—
1600	88"	83"	30°	16"	2"	40817	40819
1600 w/stand*	88"	94"/11"†	30°	16"	2"	40813	40815
2500	95"	104"	30°	16"	2"	40066	40129
2500 w/stand*	95"	114"/10"†	30°	16"	2"	40672	40674
3000	95"	121"	30°	16"	2"	40170	40172
3000 w/stand*	95"	131"/10"†	30°	16"	2"	40797	40799
3000 15° slope**	91"	119"	15°	16"	3"/2"	45141	—
5500	118"	146"	30°	16"	3"/2"	40549	40316
6000	102"	195"	15°	16"	3"/2"	40931	40933
7500	141"	149"	30°	16"	3"/2"	40551	40409

\*Polyethylene stand    \*\*Stand not available for this tank    †Distance from bottom of cone to ground



**500 Gallon  
Cone Bottom  
with Polyethylene  
Stand**

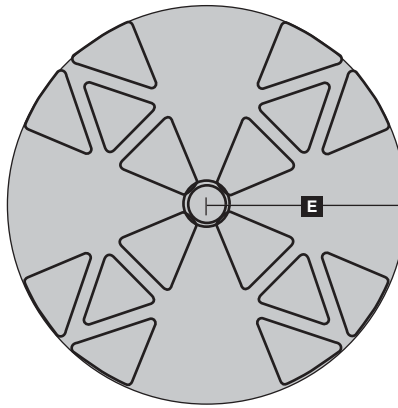
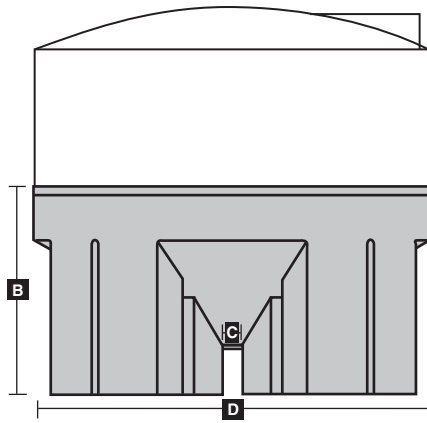


**1600 Gallon Cone Bottom  
with Polyethylene Stand**



**3000 Gallon Cone Bottom  
with Heavy Duty Stand**





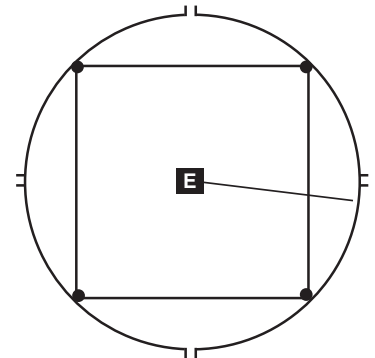
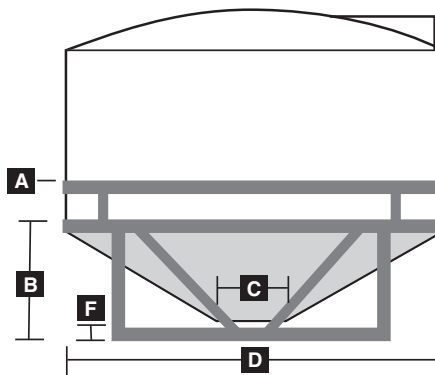
## Polyethylene Cone Bottom Stands

Maintenance free, lightweight NORWESCO polyethylene stands offer unequalled corrosion resistance.

Tank Size (Gallon)	A	B	C	D	E
175	—	31½"	8"	42"	21"
300	—	32"	8"	48"	24⅝"
310	—	31½"	8"	42"	21"
500	—	32"	8"	48⅝"	24⅝"
750	—	34"	10"	72⅝"	36⅝"
1050	—	34"	10"	72⅝"	36⅝"
1600	—	46"	10"	88"	44"
2500/3000 (30°)	—	47"	10"	96⅝"	48⅝"

## Heavy Duty Cone Bottom Stands

NORWESCO heavy duty cone bottom stands are manufactured from structural steel and offer a full dish for uniform support. An optional top band is available for the 2500/3000 steel stand when additional support is needed.



Tank Size (Gallon)	A	B	C	D	E	F	Part No.
2500/3000 (30°)	—	36"	11"	96"	48"	11"	60059
5500	—	45"	11"	119"	59½"	12½"	60358
6000	—	25"	13"	102"	51"	12⅝"	62473
7500	—	49"	11"	140"	70"	10¾"	61860
2500/3000 (30°)	Optional Top Band Assembly	—	—	—	—	—	60359



# Specialty Tanks

## Horizontal Box Tanks

The low profile design of this tank makes it ideal for use on trailers or in the back of a truck. The slosh reduction ribs provide excellent structural support. It can also be used as a stationary water storage tank.

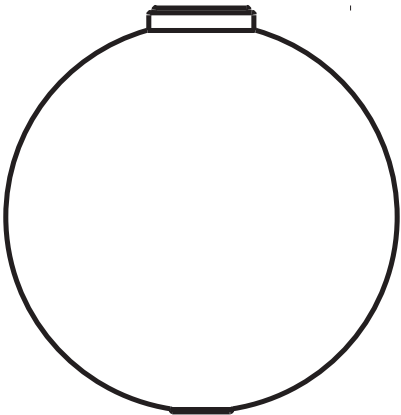


Gallon Capacity	Width	Height	Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White
2400	90"	50"	150"	16"	2"	40912

## Sphere

The 1000 gallon sphere is one of our more specialized tanks that is used on trailers/nurse trailers. The advantage of using this type of tank and trailer combination is that it has a shorter wheel-base which means less sloshing and the design of the tank allows for easy mixing of product.

Gallon Capacity	Diameter	Height	Fill Opening	Outlet/Drain Specification	Premium Weight Part No.
1000	78"	82"	16"	—	41277



## Specialty Water Tanks

These tanks have been specifically designed with residential and commercial applications in mind. The dimensions of the 375 or 400 gallon allow it to fit through a conventional doorway. The design of the 400 gallon tank allows it to be freestanding/self-supporting and eliminates the need for a steel support frame. The 375 comes standard with a steel support frame. The 1250 and 1500 gallon low profile tanks may be used for storage or transport. They are an excellent choice when height limitations are a factor and are the perfect height for putting under your cottage or cabin.

Gallon Capacity	Width	Height	Length	Fill Opening	Outlet/Drain Specification	Premium Weight Part No. White
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### Free Standing Water Tank

300	29"	49"	62"	16"	1¼"	41869
400	29"	65"	62"	16"	1¼"	41247

### Water Tank With Frame

375	30"	60"	62"	16"	1¼"	40480
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### Low Profile Water Tank

1250	80"	35"	132"	16"	2"	40756
1500	81"	41"	130"	16"	2"	41392



375 Gallon Tank with Frame



300 and 400 Gallon Freestanding Tank



1250 and 1500 Gallon Low Profile Tank





A



B



C



D



E

## High Density Polyethylene Lids

Description	Item Code	Part No.
16" Lid and ring with 4" center lid/air vent		60038
16" Lid with 4" center lid/air vent	A	60011
16" Ring only		60012
16" Lid, ventless with ring		60367
16" Lid, ventless	B	60365
Gasket for 16" non-hinged lid		62941
4" Lid (air vent assembly for 16" lid)		60019
8" Lid, ring and air vent		60032
8" Lid with air vent	C	60002
8" Ring only		60003
Air vent for 8" lid only (snap on)		61727
5" Lid with ball check air vent (for tanks manufactured after 2/1/00)	D	62801
5" Lid with ball check air vent (for tanks manufactured prior to 2/1/00)	D	60322
5" Lid (for tanks manufactured after 2/1/00)	E	62476
5" Lid with 2" FPT		63264
Gasket for 5" lid, 60322, 62801 and 63264		60366
2" MPT vent cap with poly screen		63266
18" lanyard for 8" lid and 16" non-hinged lid (tethers lid to tank)		62531
Stainless steel screws for 8" and 16" rings		60081

## Hinged Lid

This lid is manufactured from a co-polymer material for strength, durability and excellent chemical resistance. Our unique locking tab allows you to easily slip a padlock through it and secure your lid from theft or spills. The lid is interchangeable with a standard 16" lid and ring assembly if you choose to replace your existing lid.

- Easy open/close – opens a full 180 degrees
- Comes complete with a baffle vent assembly, allowing for adequate venting when bottom filling your tank.
- Unique locking tab
- All parts of lid may be ordered as repair parts

Description	Part No.
Complete lid assembly	62532

## Hinged Lid Repair Parts

16" hinged lid with vent assembly, without ring	62826
Vent assembly	62827
Ring assembly	62828
Hinge assembly	62829
EPDM O-ring for lid	62830
Neoprene O-ring for ring	62831



## Polyethylene Tank Repair Kits

The tank repair kit (welding gun and rod) includes a specially formulated welding wire containing copolymers and adhesives. Wire may be used to effectively repair linear polyethylene. Easy to use and requires only 110 volt power. The poly patch kit is ideal for repairing pinholes, hairline cracks and holes up to 1/2" in diameter. For best results, surface to be repaired should be above 32° F. The kit consists of epoxy, a small brush to apply the epoxy, a small piece of sandpaper to "roughen" the area to be patched, a piece of mastic to temporarily fill the hole/crack and a piece of fiberglass.

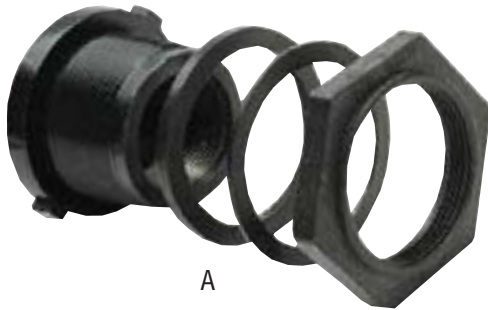
	Part No.
Poly welding gun & rod	60221
Poly welding rod 30'	61879
Poly patch kit	67412



## Polypropylene Bulkhead Fittings / EPDM Or Viton Gaskets

NORWESCO'S polypropylene fittings come standard with an EPDM gasket.

Viton gaskets are available as an option when EPDM may not be suitable for your application.



A



B

C

Description	Hole Size Required in Tank for Installation	Part No.	Item Code
1/2" Heavy duty double threaded polypropylene fitting	1 3/8"	62834	A
3/4" Double threaded polypropylene fitting	1 3/8"	60401	A
EPDM gasket for 1/2" and 3/4" (60401)		60402	
Viton gasket for 1/2" and 3/4" (60401)		60360	
3/4" Heavy duty double threaded polypropylene fitting	1 3/8"	62798	A
EPDM gasket 3/4" (62798)		62799	
Viton gasket for 3/4" (62798)		62800	
1" Double threaded polypropylene fitting	2 1/4"	60427	A
1 1/4" Double threaded polypropylene fitting	2 1/4"	60403	A
1 1/4" Anti-vortex polypropylene fitting		63065	
EPDM gasket for 1" and 1 1/4"		60404	
Viton gasket for 1" and 1 1/4"		60361	
Anti-vortex adapter for 1 1/4"		62398	
1 1/2" Double threaded polypropylene fitting	3"	60124	A
Siphon tube, 1 1/2" x 12" long		63279	
2" Double threaded polypropylene fitting	3"	60405	A
2" Double threaded 316 stainless steel fitting, less gasket	3"	61767	
EPDM gasket for 1 1/2" and 2" (60405 and 61767)		60406	
Type B Viton gasket for 1 1/2" and 2" (60405 and 61767)		60523	
2" Heavy duty double threaded polypropylene fitting with siphon tube	3 1/4"	60337	B
EPDM gasket for 2" (60337)		60336	
Type B Viton gasket for 2" (60337)		60008	
Siphon tube, 2" short		60335	
Siphon tube, 2" x 12" long		63262	
2" MPT vent cap, anti-vortex, with poly screen		63266	
2" MPT vent cap, anti-vortex, without screen		63316	
Anti-vortex adapter for 2" Bulkhead fitting		62399	
2" Polypropylene dust plug		60021	
3" Double threaded polypropylene fitting (hex nut as shown in photo C)	4 5/8" *	62299	
3" Double threaded polypropylene fitting with 2" reducer and siphon tube	4 5/8" *	60339	C
EPDM gasket for 3"		60331	
Type B Viton gasket for 3"		60351	
2" Polypropylene reducer for 3"		60330	
Siphon tube, 3" short		60327	
Siphon tube, 3" x 12" long		63263	
4" Double threaded polypropylene fitting (hex nut as shown in photo C)	5 3/4"	62171	
EPDM gasket for 4"		62785	
Viton gasket for 4"		62786	
Siphon tube for 4"		62714	

\*When installing fitting, use 4 1/2" hole saw if tank is cold.



## Bolted Fittings

### Polypropylene Bolted Fittings / EPDM or Viton Gaskets (Require two gaskets.)

Bolted polypropylene fittings are equipped with 316 stainless steel bolts and come standard with EPDM gaskets.

Viton gaskets are available as an option for the fittings.

Description	Part No.	Item Code
¾" Polypropylene bolted fitting with ss bolts and EPDM gaskets	60502	A
1" Polypropylene bolted fitting with ss bolts and EPDM gaskets	60505	A
EPDM gasket for ¾" and 1"	60498	
Type B Viton gasket for ¾" and 1"	60355	
1½" Polypropylene bolted fitting with ss bolts and EPDM gaskets	60513	A
2" Polypropylene bolted fitting with ss bolts and EPDM gaskets	60516	A
EPDM gasket for 1½" and 2"	60497	
Type B Viton gasket for 1½" and 2"	60356	
3" Polypropylene bolted fitting with ss bolts and EPDM gaskets	62471	
EPDM gasket for 3"	62048	
Type B Viton gasket for 3"	60602	



A

### Stainless Steel Double Threaded Bolted Fittings

Bolts are threaded into the back plate of the fitting so there are no welds or bolt holes that can be potential points of leakage. These fittings come standard without a gasket (with the exception of the 4") and require a single gasket that is installed on the inside of the tank. Available gaskets are cross-linked polyethylene, EPDM or Viton (4" fitting comes standard with a cross-linked polyethylene gasket).

Description	Part No.	Item Code
½" 316 Stainless steel double threaded bolted fitting less gasket	63216	B
¾" 316 Stainless steel double threaded bolted fitting less gasket	63035	B
1" 316 Stainless steel double threaded bolted fitting less gasket	62948	B
EPDM gasket for ½", ¾" & 1" (1 required)	63205	
Type B Viton gasket for ½", ¾" & 1" (1 required)	63224	
Cross-linked polyethylene gasket for ½", ¾" & 1" (1 required)	62950	
1¼" 316 Stainless steel double threaded bolted fitting less gasket	63036	B
Cross-linked polyethylene gasket for 1¼" (1 required)	63041	
1½" 316 Stainless steel double threaded bolted fitting less gasket	63037	B
Cross-linked polyethylene gasket for 1½" (1 required)	63042	
2" 316 Stainless steel double threaded bolted fitting less gasket	63038	B
EPDM gasket for 1¼", 1½" and 2" (1 required)	63206	
Type B Viton gasket for 1¼", 1½" and 2" (1 required)	63225	
Cross-linked polyethylene gasket for 2" (1 required)	62848	
3" 316 Stainless steel double threaded bolted fitting less gasket	63039	C
EPDM gasket for 3" (1 required)	63223	
Type B Viton gasket for 3" (1 required)	63226	
Cross-linked polyethylene gasket for 3" (1 required)	63043	
4" 316 Stainless steel 8-bolt double threaded bolted fitting with gasket	63069	
Cross-linked polyethylene gasket for 4" (1 required)	63070	



B

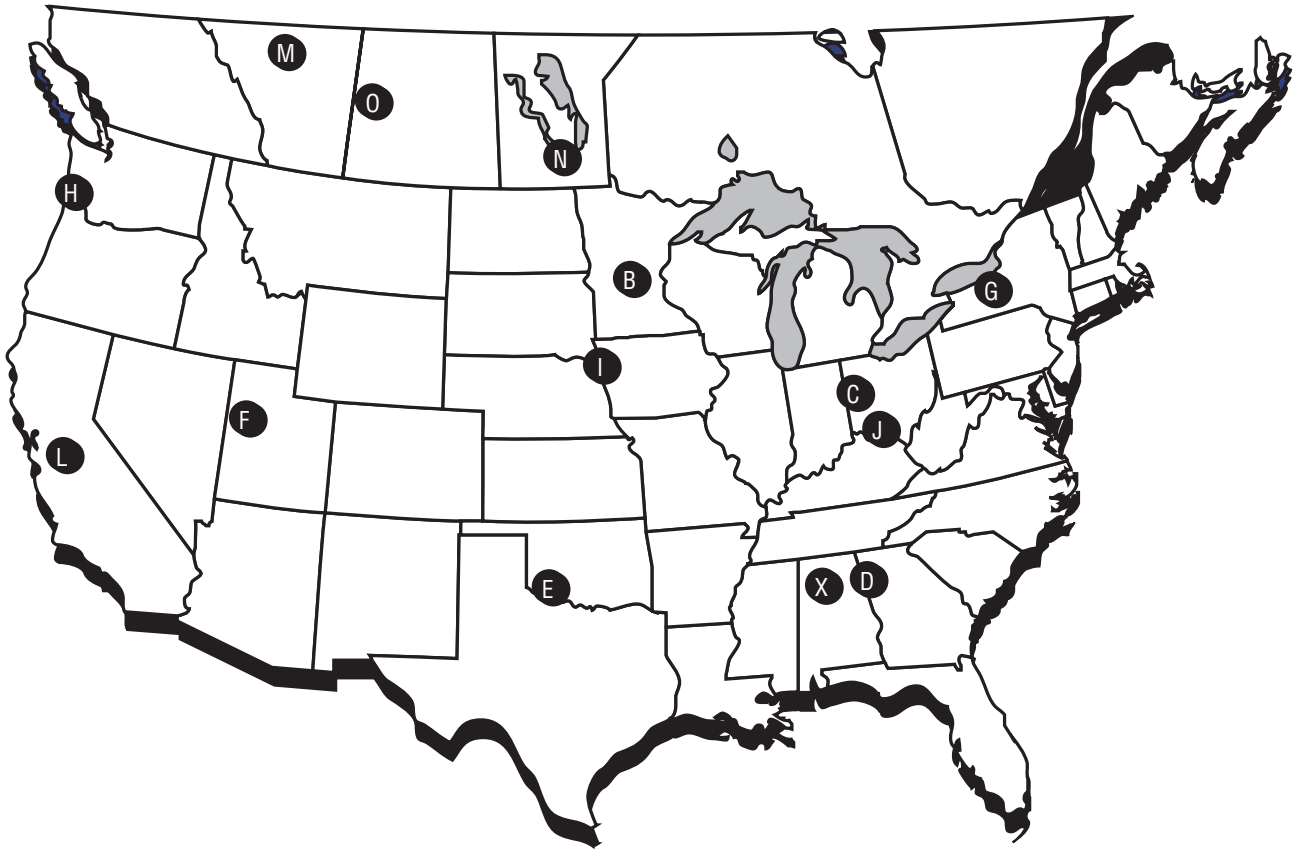


C

### Stainless Steel Single Threaded Bolted Fittings

Description	Part No.
2" 316 Stainless steel single threaded bolted fitting less gasket	62847
EPDM gasket for 1¼", 1½" and 2" (1 required)	63206
Type B Viton gasket for 1¼", 1½" and 2" (1 required)	63225
Cross-linked polyethylene gasket for 2" (1 required)	62848
3" 316 Stainless steel single threaded bolted fitting less gasket	63233
EPDM gasket for 3" (1 required)	63223
Type B Viton gasket for 3" (1 required)	63226
Cross-linked polyethylene gasket for 3" (1 required)	63043





### Manufacturing and Distribution

B. St. Bonifacius, Minnesota	G. Owego, New York	M. Edmonton, Alberta-Canada
C. Lancaster, Ohio	H. Washougal, Washington	N. Winnipeg, Manitoba-Canada
D. Griffin, Georgia	I. Sheldon, Iowa	X. Albertville, Alabama
E. Shawnee, Oklahoma	L. Hanford, California	O. Saskatoon, Saskatchewan-Canada
F. Tooele, Utah		

Tank dimensions and capacities may vary slightly and are subject to change without notice.

### Warranty

NORWESCO offers a three year warranty from date of manufacture on all premium weight tanks and a five year warranty on all heavy weight tanks. Should a defect appear within the warranty period NORWESCO will supply a new, equivalent tank in replacement thereof. NORWESCO'S liability is limited to the value of the tank itself and specifically excludes the cost of installation and/or removal or consequential damages. Please contact your chemical supplier or NORWESCO Customer Service for chemical resistance information.



Norwesco, INC.

4365 Steiner Street  
P.O. Box 439  
St. Bonifacius, MN 55375-0439  
Tel (952) 446-1945  
Fax (800) 874-2371

[www.norwesco.com](http://www.norwesco.com)



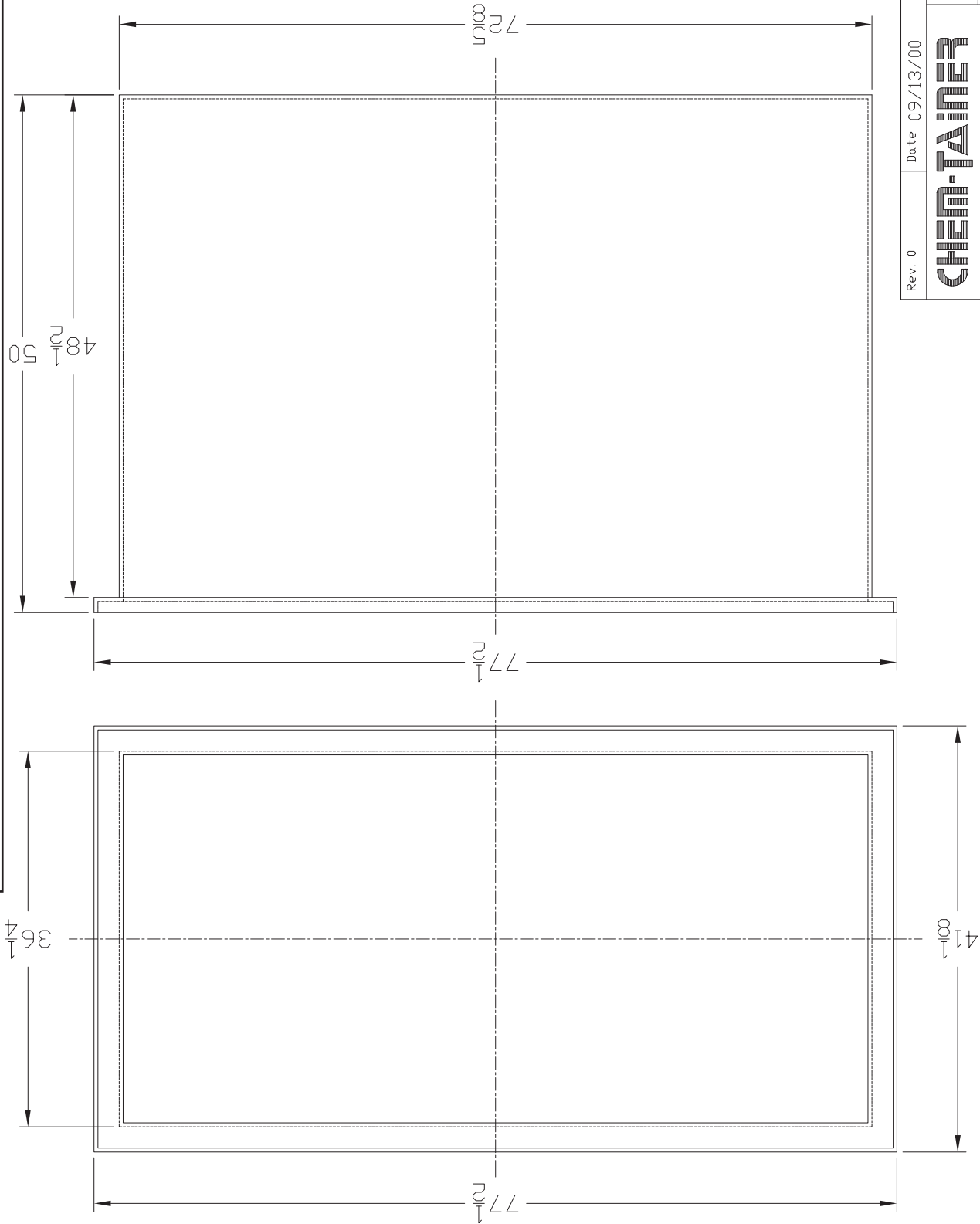
## MATERIALS LIST

TOP VIEW





TNK-201 - Tank, Open Top, Rectangular, 192 gal, 540 US Gal 72x36x48



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ALL DIMENSIONS SHOWN ARE OUTSIDE PART DIMENSIONS IN INCHES, AND VARY BY THE STANDARD ROTATIONAL MOLDING TOLERANCE OF +2/-3%.

Rev. 0	Date 09/13/00	File Name 367248-5
<b>CHEM-TAINER</b>		
Industries Inc.		Date 09/13/00
361 Neptune Ave. W.Babylon, NY 11704		Mold Location CA
(631) 661-8300		Drawn By: IIA
(631) 661-8209		Cust. Rep.
TITLE 540 GAL. RECTANGULAR TANK		
Part # R367248AB/CD		Dwg. # C- <del>E31365</del> 48-15



# ELMRIDGE® Liqui-Jet® Mixing Eductors

## ME Series

**KEEPING SOLIDS IN SUSPENSION / DISPERSING CHEMICALS / MAINTAINING TANK CONCENTRATIONS / ELIMINATING THERMAL GRADIENTS**

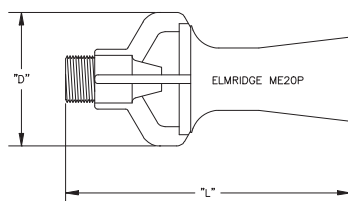
ELMRIDGE 'ME Series' Liqui-Jet Mixing Eductors vigorously and efficiently circulate the liquid contents of tanks without powered impellers or other insertion-type rotating mechanical devices. ELMRIDGE 'ME Series' Liqui-Jet Mixing Eductors operate on the same principle as our standard line of liquid-powered Jet-Apparatus. Liquid is pumped through the Eductor nozzle, emerging at a relatively high velocity, creating a localized zone of lower pressure. Tank contents are drawn to this lower pressure zone, where the momentum of the motive liquid is transferred to the tank liquid, causing the tank liquid to be 'pumped' and circulated. For every gallon of liquid pumped through the Eductor nozzle, up to five gallons of liquid is circulated. Note that Eductors can actually be 'aimed' at specific areas in the vessel. Operating characteristics (Water Motive / Water Suction), for standard models are shown below, and special units are also available to meet your specifications. Standard materials of construction are Glass Reinforced Polypropylene, PVDF, PVC, CPVC, Teflon®, Cast Iron, 316 Stainless Steel, Alloy 20, and Hastelloy C®. Other materials are available upon request. Threaded, flanged, or socket weld connections (except Cast Iron).



**Table 1**

Nozzle and Circulated Flow (usgpm) for ME Series Liqui-Jet Tank Mixing Eductors using 70 deg. F Water

Model Number	Flow Type	Operating Water Pressure (psi)								
		10	15	20	25	30	35	40	50	60
ME05P	Nozzle Flow	3.2	3.9	4.5	5.0	5.5	5.9	6.3	7.1	7.8
	Circ. Flow	16	20	23	25	28	30	32	36	39
ME10P	Nozzle Flow	7.5	9.2	10.6	11.9	13.0	14.0	15	17	18
	Circ. Flow	38	46	53	59	65	70	75	84	92
ME20P	Nozzle Flow	13.5	17	19	21	23	25	27	30	33
	Circ. Flow	68	83	95	107	117	126	135	151	165
ME30P	Nozzle Flow	20	24	28	32	35	37	40	45	49
	Circ. Flow	100	122	141	158	173	187	200	224	245
ME40P	Nozzle Flow	33	40	47	52	57	62	66	74	81
	Circ. Flow	165	202	233	261	286	309	330	369	404
ME10	Nozzle Flow	8.2	10	12	13	14	15	16	18	20
	Circ. Flow	33	40	46	52	57	61	66	73	80
ME20	Nozzle Flow	12	15	17	19	21	22	24	27	29
	Circ. Flow	48	59	68	76	83	90	96	107	118
ME30	Nozzle Flow	21	26	30	33	36	39	42	47	51
	Circ. Flow	84	103	119	133	145	157	168	188	206
ME40	Nozzle Flow	35	43	49	55	61	65	70	78	86
	Circ. Flow	140	171	198	221	242	262	280	313	343
ME50	Nozzle Flow	55	67	78	87	95	103	110	123	135
	Circ. Flow	275	337	389	435	476	514	550	615	674
ME60	Nozzle Flow	126	154	178	199	218	236	252	282	309
	Circ. Flow	630	772	891	996	1091	1179	1260	1409	1543
ME70	Nozzle Flow	285	349	403	451	494	533	570	637	698
	Circ. Flow	1425	1745	2015	2253	2468	2666	2850	3186	3491
ME80	Nozzle Flow	590	723	834	933	1022	1104	1180	1319	1445
	Circ. Flow	2950	3613	4172	4664	5110	5519	5900	6596	7226
ME90	Nozzle Flow	1062	1301	1502	1679	1839	1987	2124	2375	2601
	Circ. Flow	5310	6503	7509	8396	9197	9934	10620	11874	13007



**Dimensions**

Model Number	Pressure Connection	D (inches)	L (inches)
ME05P	1/4" Male*	1-1/2"	3-1/8"
ME10P	3/8" Male*	2-1/8"	4-1/2"
ME20P	3/4" Male*	3"	6-3/8"
ME30P	1" Male*	3-13/16"	8-1/16"
ME40P	1-1/2" Male*	4-5/8"	9-7/8"
ME10M	3/8" Male*	1-3/4"	4-1/2"
ME20M	3/4" Male*	2-3/8"	6-3/4"
ME30M	1" Male*	2-7/8"	7-5/8"
ME40M	1-1/2" Male*	4-5/8"	9-7/8"
ME40	1-1/2" Female*	3-3/4"	9-1/2"
ME50	2" **	5-5/8"	12-1/4"
ME60	3" **	8-1/2"	17-5/8"
ME70	4" **	12-1/2"	26-1/4"
ME80	6" ***	17-1/4"	36-1/2"
ME90	8" ***	22"	48-5/8"

\* NPT or BSPT

\*\* NPT or BSPT Female or 150# ANSI FF Flange

\*\*\* 150# ANSI FF Flange only

**TANK MIXING**



## APPLICATION EXAMPLES

## EXAMPLE 1:

The volume of a rectangular process tank is 5,000 US gallons (approximately 10'W x 15'L x 4.5'H). In order that the contents of the tank remain in homogenous solution, it is necessary that the tank volume be completely turned over (ie. completely recirculated), in a period of approx. 8 minutes. It has further been determined that eductor spacing not exceed 3' in order to utilize the eductor outlet plume to further agitate the bottom corners of the tank. There is an existing single header of sufficient capacity centered longitudinally along the bottom of the tank, and a pump that will supply sufficient volume at 30 psig.

1. Four eductors spaced on 3' centers on each side of the header pipe will meet the necessary spacing requirements.

2. The number of eductors required is:

$$4 \times 2 \text{ sides} = 8 \text{ eductors}$$

3. Total required recirculation flowrate is:

$$5000 / 8 \text{ min.} = 625 \text{ usgpm}$$

4. Required recirculation flowrate per eductor is:

$$625 / 8 \text{ eductors} = 78.1 \text{ usgpm}$$

5. An ME20 eductor has a circulated flowrate of 83 usgpm at 30 psig., therefore a quantity of (8) ME20 eductors could be used.

6. The nozzle flow of an ME20 eductor at 30 psig is 21 usgpm, therefore, the pump must be able to supply:

$$8 \times 21 = 168 \text{ usgpm at 30 psig}$$

## EXAMPLE 2:

A steam-jacketed hot oil (S.G. = 1.21), preheat tank is 20' high and 10' in diameter (approx. 11750 usgal). It is desired that a single eductor using a portion of the total oil inflow turn over the contents of the tank in approx. 12 minutes in order to reduce temperature gradients within the tank. Pump pressure must also be approximated; assume inflow rate is sufficient.

1. The static discharge pressure that the pump must overcome is:

$$\begin{aligned} 20 \times 1.21 &= 24.2 \text{ feet of water} \\ &= 10.5 \text{ psig} \end{aligned}$$

2. Total required recirculation flowrate is:

$$11750 / 12 = 979 \text{ usgpm}$$

4. An ME60 eductor has a circulated flowrate of 1091 usgpm at 30 psig, however, the pump must be sized to supply the ME60 nozzle flowrate of  $218 \times \text{SQRT}(1/1.21) = 198 \text{ usgpm at}$ :

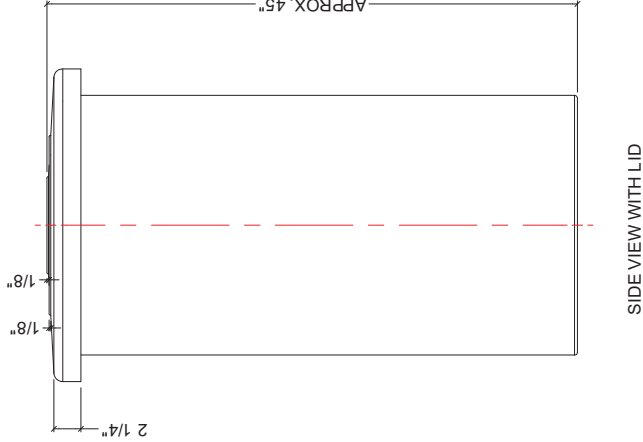
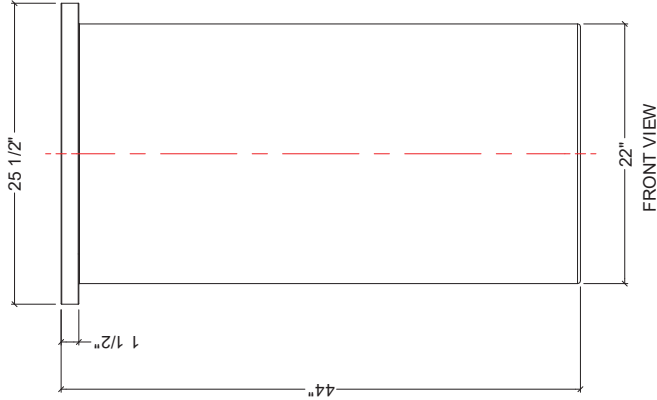
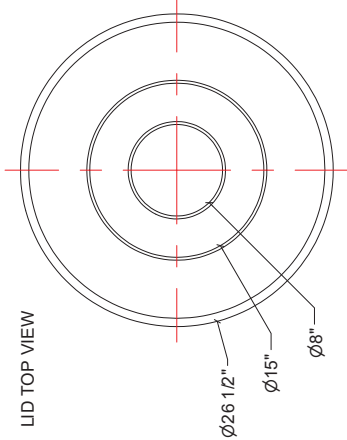
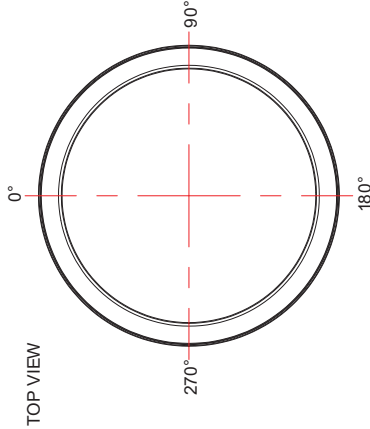
$$30 + 10.5 = 40.5 \text{ psig}$$



TNK-801 - Tank, Open Top, Cylindrical, 60 Imp gal, OT-60

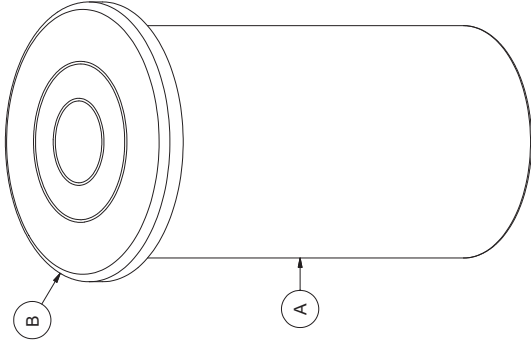
NOTES:

1. TANK IS MANUFACTURED TO ASTM-D-1998 STANDARD.
2. ALL DIMENSIONS ARE APPROXIMATE.



MATERIALS LIST

ITEMS	DESCRIPTION	NOTES
A	OT-60 OPEN TOP TANK	
B	LID FOR OT-60	



REV	DATE	DESCRIPTION	BY	APPD	REV/D
CUSTOMER					
TITLES					
ACO JOB NO.					
PURCHASE ORDER NO.					
WITH LID					
PURCHASERS EQUIP. NO.					
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ENGINEERS SEAL					
ACO CONTAINER SYSTEMS LTD.					
ACO CONTAINER SYSTEMS LTD.					
784 MCKAY RD.					
PILLOWING - ONTARIO, CANADA					
TEL. 905-685-8222					
FAX 905-685-2869					
DATE					
27-05-09					
DWG No.					
OT-60-1368					
REV					
0					



## A19 Series

# Remote Bulb Control

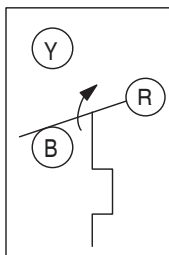
## Description

The A19 Series are single-stage temperature controls that incorporate environmentally friendly liquid-filled sensing elements.

## Features

- wide temperature ranges available
- constant differential throughout the entire range
- compact enclosure
- fixed or adjustable differential available
- variety of sensing element styles
- unaffected by cross-ambient conditions

A19 Series



Action on Increase of Temperature

a19.eps



A19ABC-24

## Applications

The A19 is suitable for temperature control in heating, ventilating, air conditioning, and refrigeration.

A19 Series  
Terminal Arrangement for SPDT

## Selection Charts

### A19 Series Remote Bulb Control<sup>1</sup>

Code Number	Switch Action	Range °F (°C)	Diff °F (°C)	Bulb and Capillary	Bulb Well No. (order separately)	Range Adjuster	Max. Bulb Temp. °F (°C)
<b>Adjustable Differential (Wide Range)</b>							
A19ABA-40C <sup>2</sup>	SPST Open Low	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver Slot	140 (60)
A19ABC-4C	SPDT	50 to 130 (10 to 55)	3 1/2 to 14 (1.9 to 8)	3/8 in. x 5 in., 8 ft. Cap.	WEL14A-603R	Knob	170 (77)
A19ABC-24C <sup>3</sup>	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 8 ft. Cap.	WEL14A-602R	Convertible	140 (60)
A19ABC-36C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 20 ft. Cap.	WEL14A-602R	Convertible	140 (60)
A19ABC-37C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ABC-74C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
<b>Fixed Differential</b>							
A19AAF-12C	SPDT	25 to 225 (-4 to 107)	3 1/2 (1.9)	3/8 in. x 3 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	275 (135)
<b>Fixed Differential (Case Compensated)</b>							
A19AAC-4C	SPDT	0 to 80 (-18 to 27)	5 (2.8)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19AAD-12C	SPST Open Low	-30 to 50 (-34 to 10)	2 1/2 (1.4)	3/8 in. x 4 in., 7 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
<b>Fixed Differential (Close)</b>							
A19AAD-5C <sup>4</sup>	SPST Open Low	30 to 50 (-1 to 10) (Bulk Milk Cooler)	2 1/2 (1.4)	3/8 in. x 2 5/8 in., 6 ft. Cap.	WEL16A-601R	Screwdriver slot	190 (88)
A19AAF-20C	SPDT	-30 to 100 (-34 to 38)	2 1/2 (1.4)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19AAF-21C	SPDT	40 to 90 (4 to 32)	1 1/2 (0.8)	3/8 in. x 5 3/4 in., 6 ft. Cap.	WEL14A-603R	Screwdriver slot	140 (60)
<b>Manual Reset</b>							
A19ACA-14C	SPST Open Low	-30 to 100 (-34 to 38)	Manual Reset	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ACA-15C	SPST Open Low	-30 to 100 (-34 to 38)	Manual Reset	3/8 in. x 4 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ADB-1C	SPST Open High	100 to 240 (38 to 116)	Manual Reset	3/8 in. x 3 1/2 in., 6 ft. Cap.	WEL14A-602R	Knob	290 (143)
A19ADN-1C	SPST Open High	100 to 240 (38 to 116)	Manual Reset	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	290 (143)

1. Specify the control model code number, packing nut code number (if required), and bulb well code number (if required).

2. Replaces White-Rodgers 1609-101

3. Replaces White-Rodgers 1609-12, -13; Ranco 010-1408, -1409, -1410, -1490, 060-110; Honeywell L6018C-1006, L6021A-1005, T675A-1011, -1508, -1516, -1821, T4301A-1008, T6031A-1011, T6031A-1029

4. Case-Compensated



---

## **Operation and Maintenance Manuel - Arsenic Water Treatment Plant, Version 2**

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# **Operation & Maintenance Manual Sewage Treatment Plant (STP)**

Prepared by:  
Agnico Eagle Mines Limited – Meadowbank Division – Whale Tail Pit Project



## **EXECUTIVE SUMMARY**

Agnico Eagle has prepared the following document which summarizes the operational and maintenance procedures to be followed at the Sewage Treatment Plant (STP).

This report documents the stand alone Operation & Maintenance Manual – Sewage Treatment Plant, includes the following requirements:

- The manual was prepared in accordance with the “Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996”, and adapted for the use of a mechanical contact water treatment facility;
- The manual includes contingency measures in the event of a plant malfunction; and
- The manual includes sludge management procedures.



## **IMPLEMENTATION SCHEDULE**

This Plan will be implemented upon Board approval and subject to any modifications proposed by the NWB as a result of the review and approval process.

## **DISTRIBUTION LIST**

Agnico Eagle Internal:

- Energy & Infrastructures Services Superintendent
- Energy & Infrastructures Services General Foreman
- Environmental Superintendent
- Senior environmental Coordinator
- Environmental Compliance Counselor
- Sewage Treatment Plant Operator



## DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	2018/12/30			Operation and Maintenance Manual
2	2019/02/19			Comment from ECCC, CIRNAC

Prepared By:

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DN : cn=Alain Parent  
Date : 2019.02.18  
15:50:46 -05'00'

Approved by:

Alain Parent  
Amaruq project Construction Superintendent



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## **1 INTRODUCTION**

---

### **1.1 PURPOSE**

This Sewage Treatment Plant (STP) Operation and Maintenance Manual (OMM) for the Whale Tail Gold Project (the Project) has been prepared based on the “*Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996, prepared by the Department of Municipal and Community Affairs, NWT*”. The OMM has been adapted for the use of a mechanical contact water treatment facility.

This manual is a component of the Whale Tail Environmental Management System. The objectives of this plan are summarized as follows:

1. To define the location, design and operating procedures to be used in the treatment of sewage generated at the Project; and
2. To provide monitoring requirements for the STP.

The STP purpose is to treat domestic sewage from the camp and adjacent building which are not connected to the STP directly (sucker truck will discharge sewage from this building directly into the STP).

### **1.2 BRIEF DESCRIPTION OF THE PROJECT**

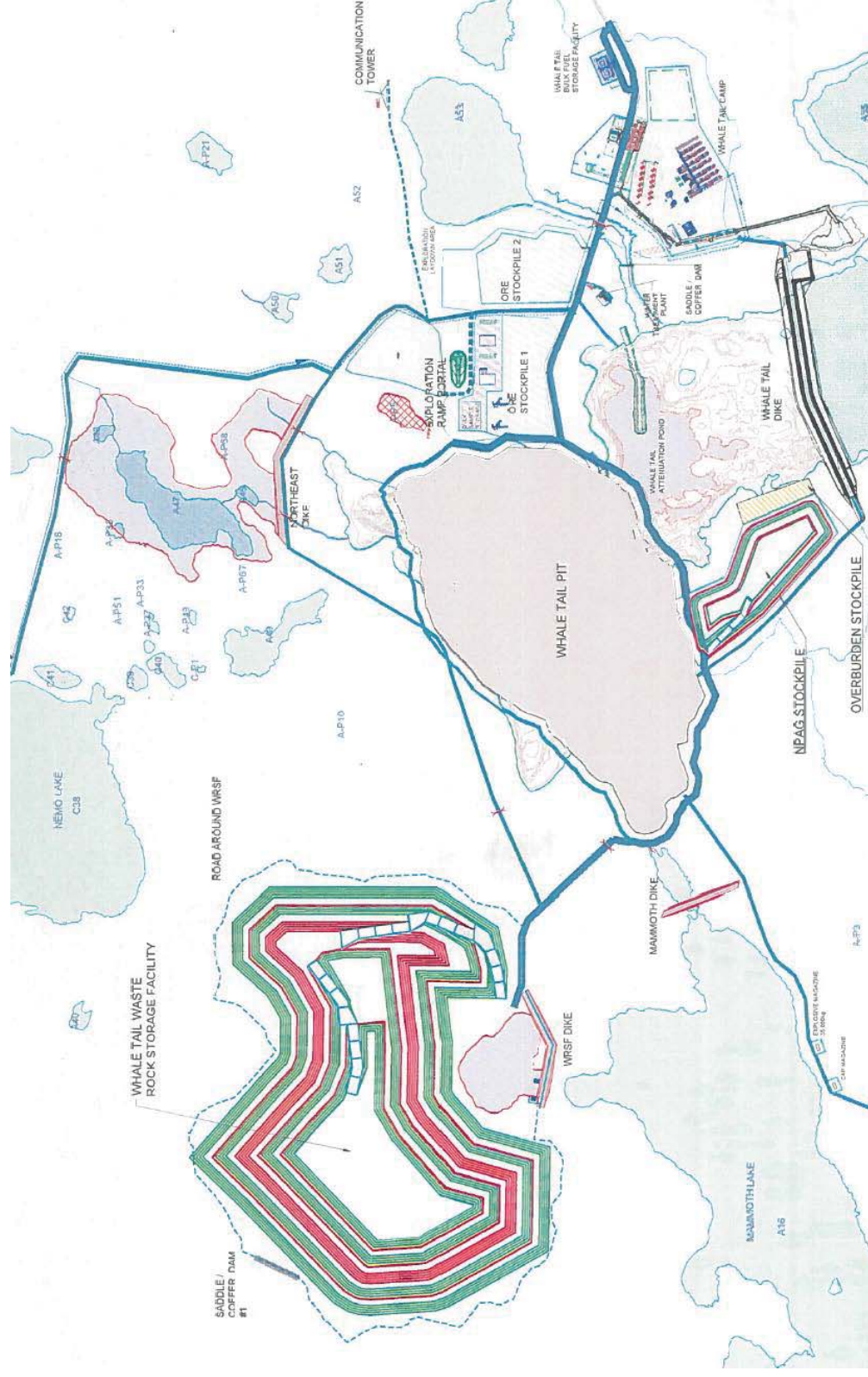
Agnico Eagle Mines Limited—Meadowbank Division (Agnico Eagle) is developing Whale Tail Pit and Haul Road Project, approximately 55 km north of the Meadowbank mine, on a satellite deposit located on the Amaruq property in the Kivalliq Region of Nunavut (65°24'25" N, 96°41'50" W), to extend mine operations and milling at Meadowbank Mine. The 99,878-hectare Amaruq property is located on Inuit-owned and federal crown land.

A conventional open pit mining operation is forecasted on the Whale Tail deposit. Access to the site is via a 64-kilometer road from Meadowbank mine. On-site facilities will include a power plant, maintenance facilities, tank farm for fuel storage, Arsenic water treatment plant, sewage treatment plant (STP), drinking water treatment plant, as well as accommodation and kitchen facilities for approximately 400 people.

Figures 1, 2 and 3 illustrate the location and general arrangement of the STP.



February 2019



### Figure 1 – Site Layout



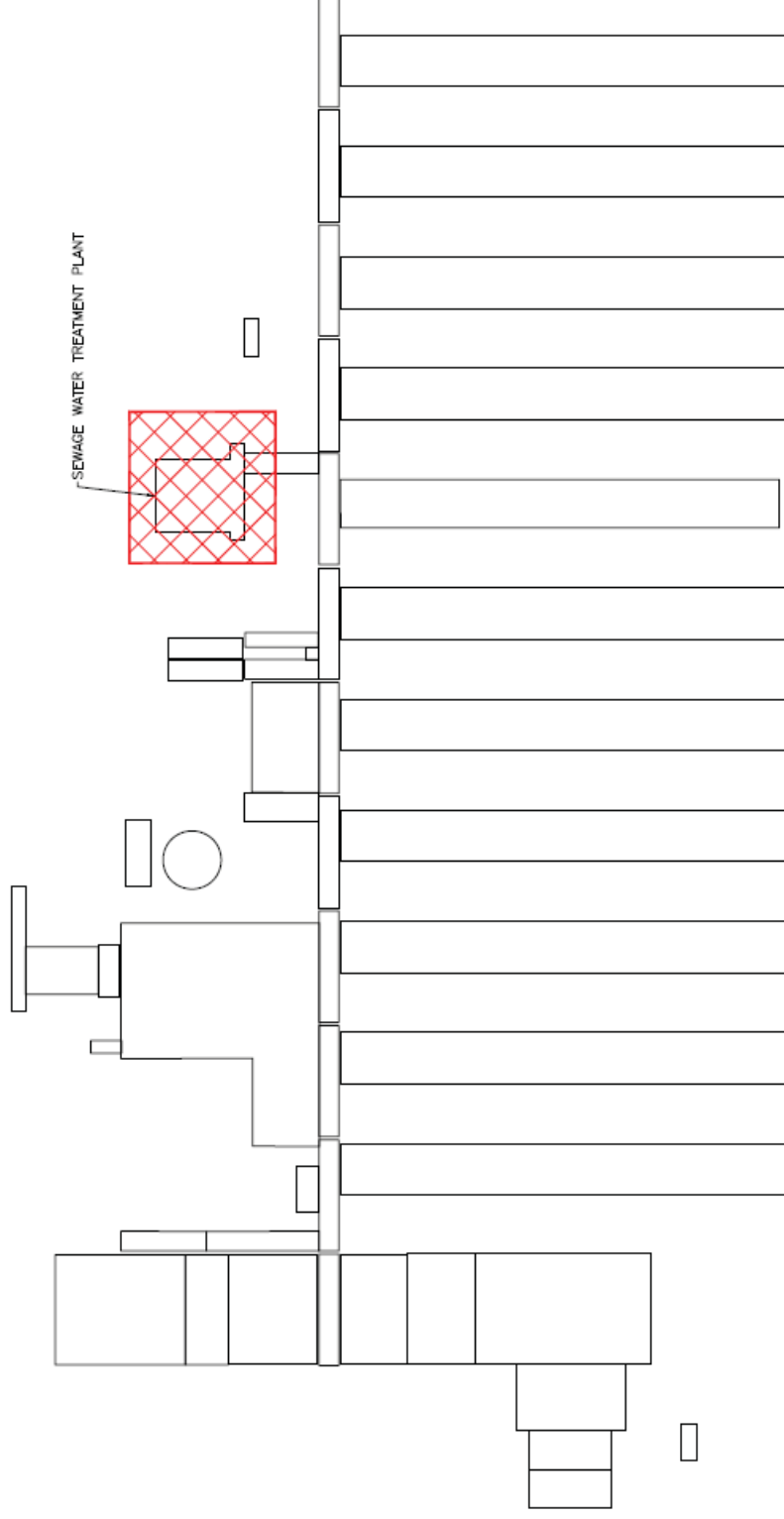


Figure 2 – Location of STP in the Whail Tail Camp



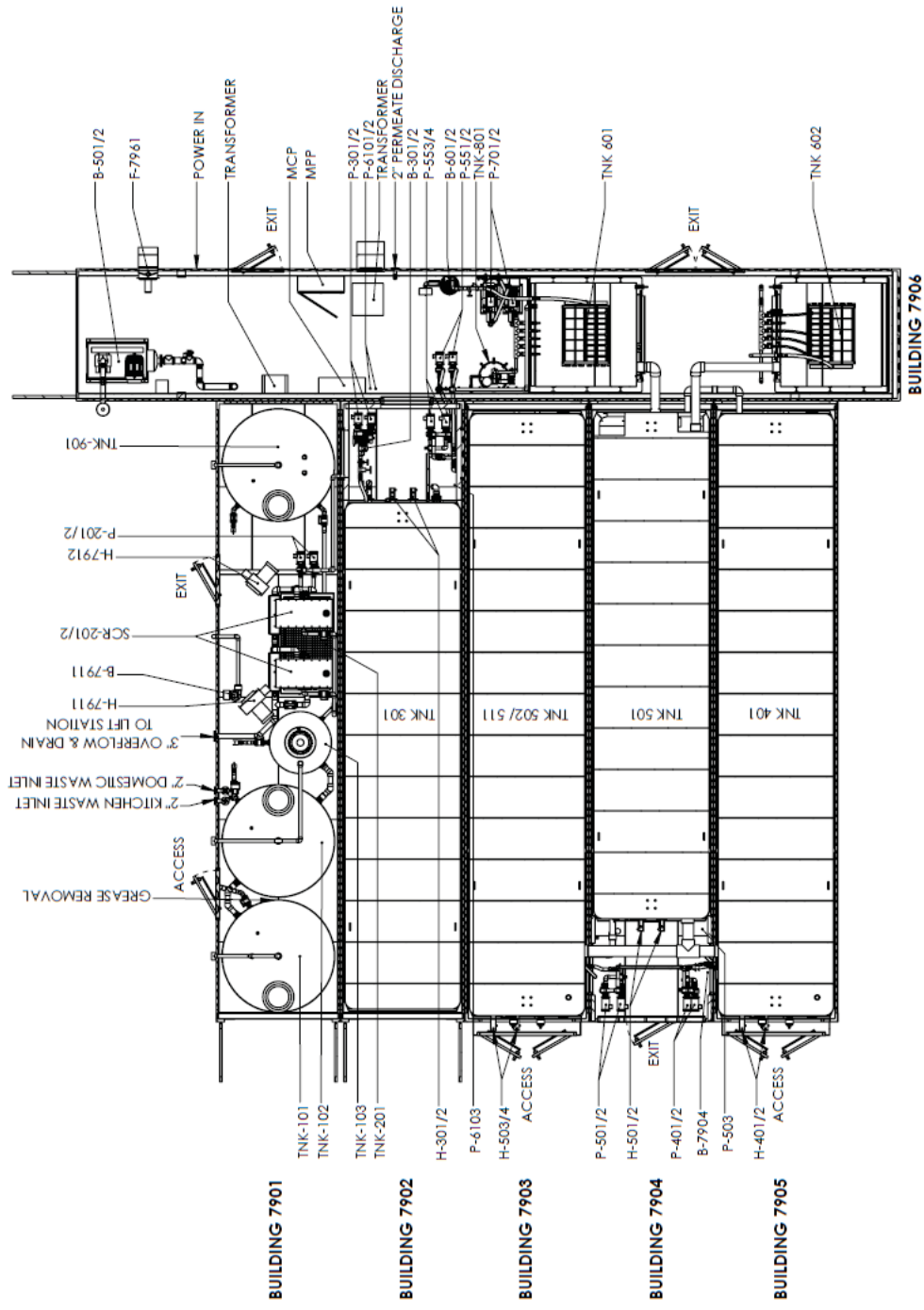


Figure 3 – General Arrangement of STP



### **1.3 CONTACT INFORMATION**

The individuals responsible for the operation of the sewage treatment plant for the Project are the following:

Energy and Infrastructure Superintendent  
Energy and Infrastructure Supervisors

819-856-3073  
819 759-3555 ext 6731 or 6902



## 2 DESCRIPTION

### 2.1 SEWAGE TREATMENT PLANT (STP)

The plant is designed based on the occupation maximum of the camp for 400 persons (240L per day and per person). The design flows are presented in Table 1.

**Table 1: Design flow rate**

Parameters	Design Value	Unit
Per capita design flow	240	L/p/d
Number of persons	400	People
Average daily flow (ADF)	96	m <sup>3</sup> /d
Maximum Daily Flow (MDF)	192	m <sup>3</sup> /d
Peak Hourly Flow (PHF)	24	m <sup>3</sup> /h
Overall time for speak to occur	2	hours
Maximum number of peak events per day	2	Qty

Table 2 presents the typical sewage composition used for the design (based on Meadowbank sewage quality).

**Table 2: Sewage typical chemical composition**

Parameters	Unit	Design Value
Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	952
Total Suspended Solids (TSS)	mg/L	300
Total Kjeldahl Nitrogen (TKN)	mg/L	130
Ammonia nitrogen (NH <sub>3</sub> -N)	mg/L	130
Oil and Grease	mg/L	30
pH	-	6 to 9.5
Water Temperature	°C	10 to 25
Alkalinity	mg/L as CaCO <sub>3</sub>	471.1

#### 2.1.1 Process summary

The sewage treatment plant receives two streams of sewage as presented in Figure 4 (basic flowsheet of the STP). The first source is domestic sewage, which is fed directly to the fine screening process to remove any fibers or debris that might damage the membranes. The second source is kitchen sewage which is pre-treated in the oil and grease tanks to remove oil and grease prior to being fed into the fine



screens. The combined screened sewage is pumped to the equalization tank. The equalization tank buffers variability in the influent flow rate and concentrations of influent constituents, maintaining a consistent flow rate and sewage strength through the membrane bioreactor (MBR) system. Sewage is then pumped from the equalization tank to the pre-anoxic tank for denitrification.

In the pre-anoxic tank, screened sewage containing organics is combined with recycled mixed liquor from the aeration tank containing nitrates. Bacteria use some of the organics to drive the denitrification process, converting nitrate into nitrogen gas. This process occurs in an anoxic environment where there is minimal oxygen. As such a pump and eductors are used to mix the tank to prevent addition of oxygen. The denitrification process is used to meet the effluent nitrate operational target, reduce oxygen requirements and to recover alkalinity, thus reducing chemical consumption.

Mixed liquor from the anoxic tank flows by gravity to the first aerobic tank followed by the second aeration tank for aerobic biological degradation of the influent constituents (organics and ammonia). In the aerobic tanks, the nitrification process converts ammonia to nitrate in order to meet the effluent ammonia operational target. This process consumes alkalinity, so a caustic soda or soda ash dosing pump is used to control the pH. Additionally, liquid alum is dosed into the anoxic zone to precipitate phosphorus in order to meet the effluent phosphorus operational target. Mixed liquor flows by gravity from the second aeration tank to the post-anoxic tank for final denitrification polishing. In the post-anoxic tank there are minimal dissolved influent organics to drive the denitrification process. As such, an external carbon source in the form of MicroC is dosed to supplement the organics and drive the denitrification process.

Mixed liquor is pumped from the post-anoxic tank to the membrane tanks. The membrane tanks serve as additional volume for aerobic biological treatment to remove any excess MicroC (which would otherwise increase BOD in the effluent) and house the membrane filters used for solid-liquid separation. A treated effluent is drawn through the membranes by vacuum pumps.

Since the solid-liquid separation process results in an accumulation of solids in the membrane tank, the mixed liquor (containing both solids and filtrate) is continuously recycled to the first aeration tank. This prevents excessive solids build-up in the membrane tank, and maintains sufficient biomass in the anoxic and aeration tanks. The solids that accumulate in the system consist of biomass that has grown from the influent organics and ammonia, as well as non-biodegradable solids from the influent sewage. In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank to the sludge holding tank. Wasted sludge in the sludge holding tank is thickened by decanting supernatant back to the screen tank. Thickened sludge accumulates in the sludge holding tanks until it is eventually pumped out for disposal.

The STP general flow diagram is illustrated in Figure 4 and Piping and Instrumentation Diagram (PID) in Figures 5 to 8. The following sections describe the STP components.





# AGNICO EAGLE

## Operation & Maintenance Manual Sewage treatment plant

February 2019

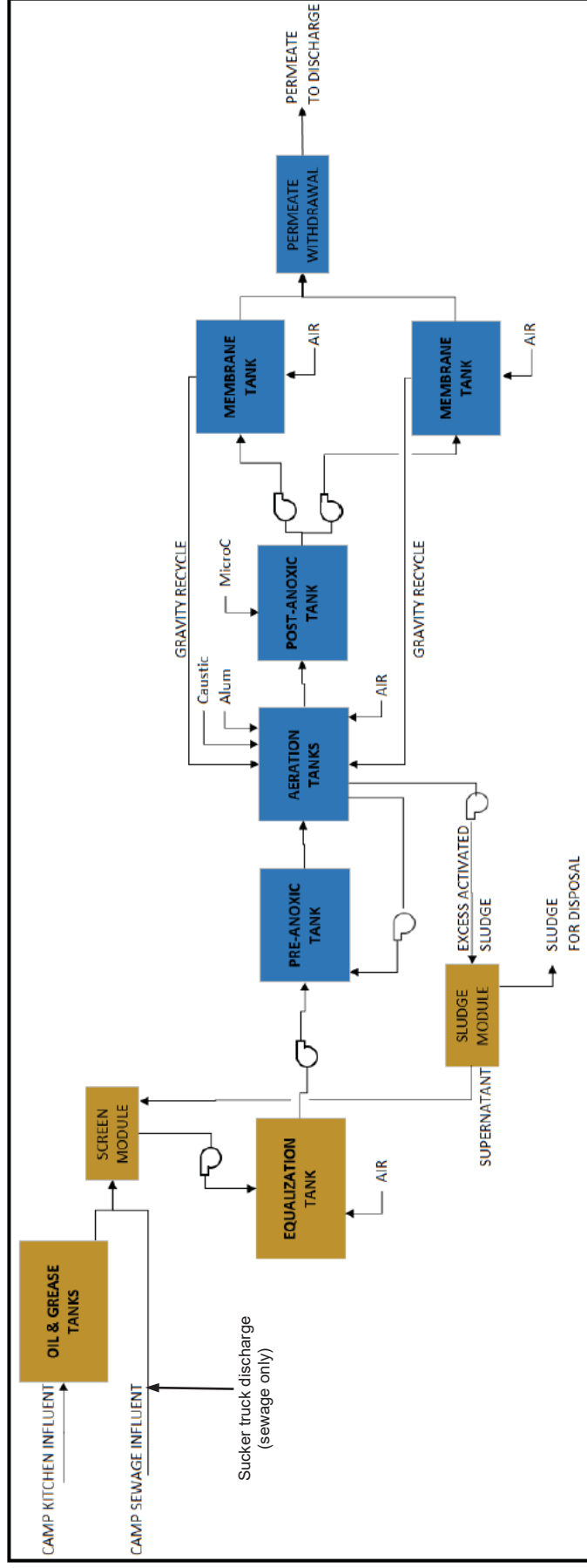


Figure 4 – Flowsheet



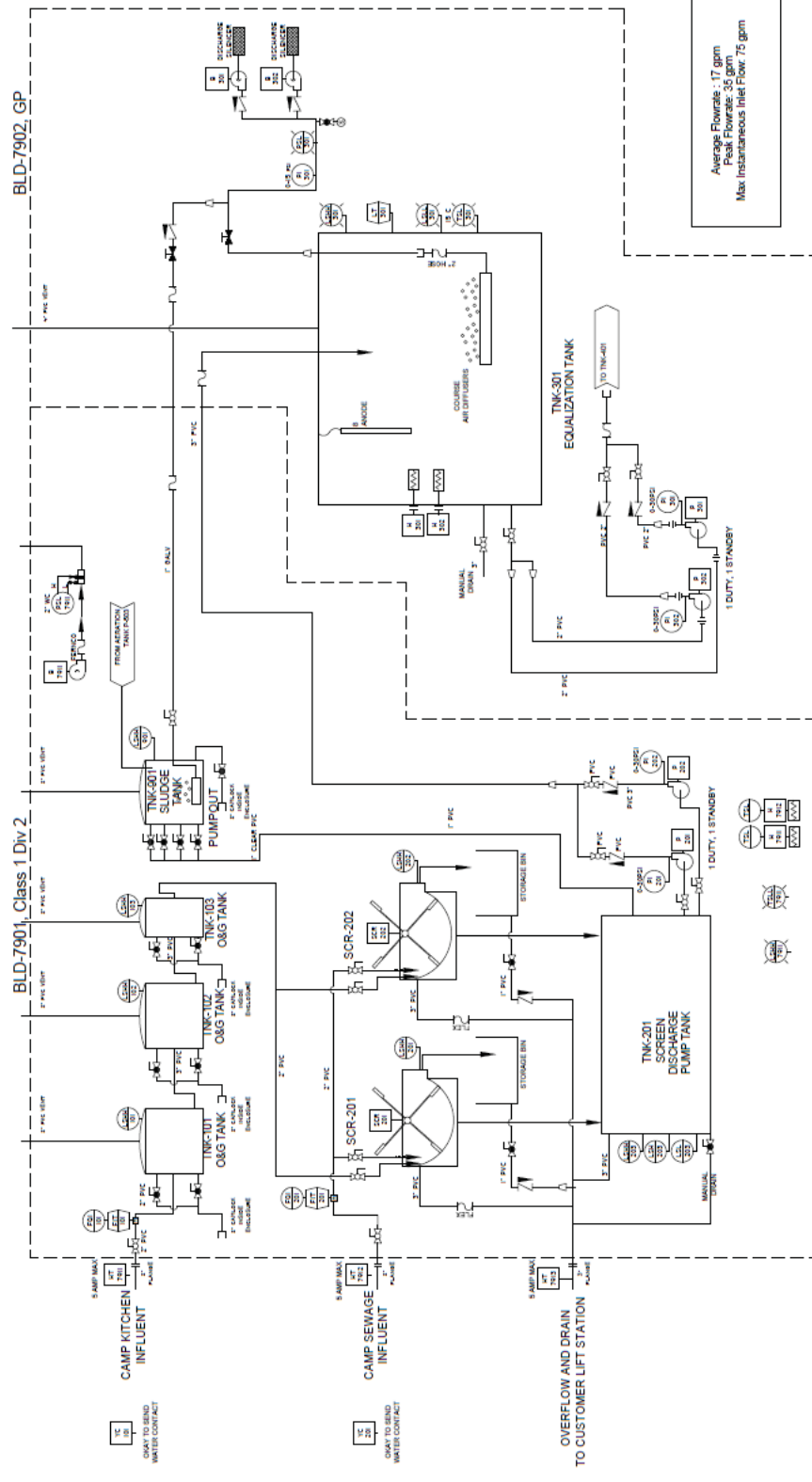


Figure 5 – Oils and grease removal, screening and equalization's tank







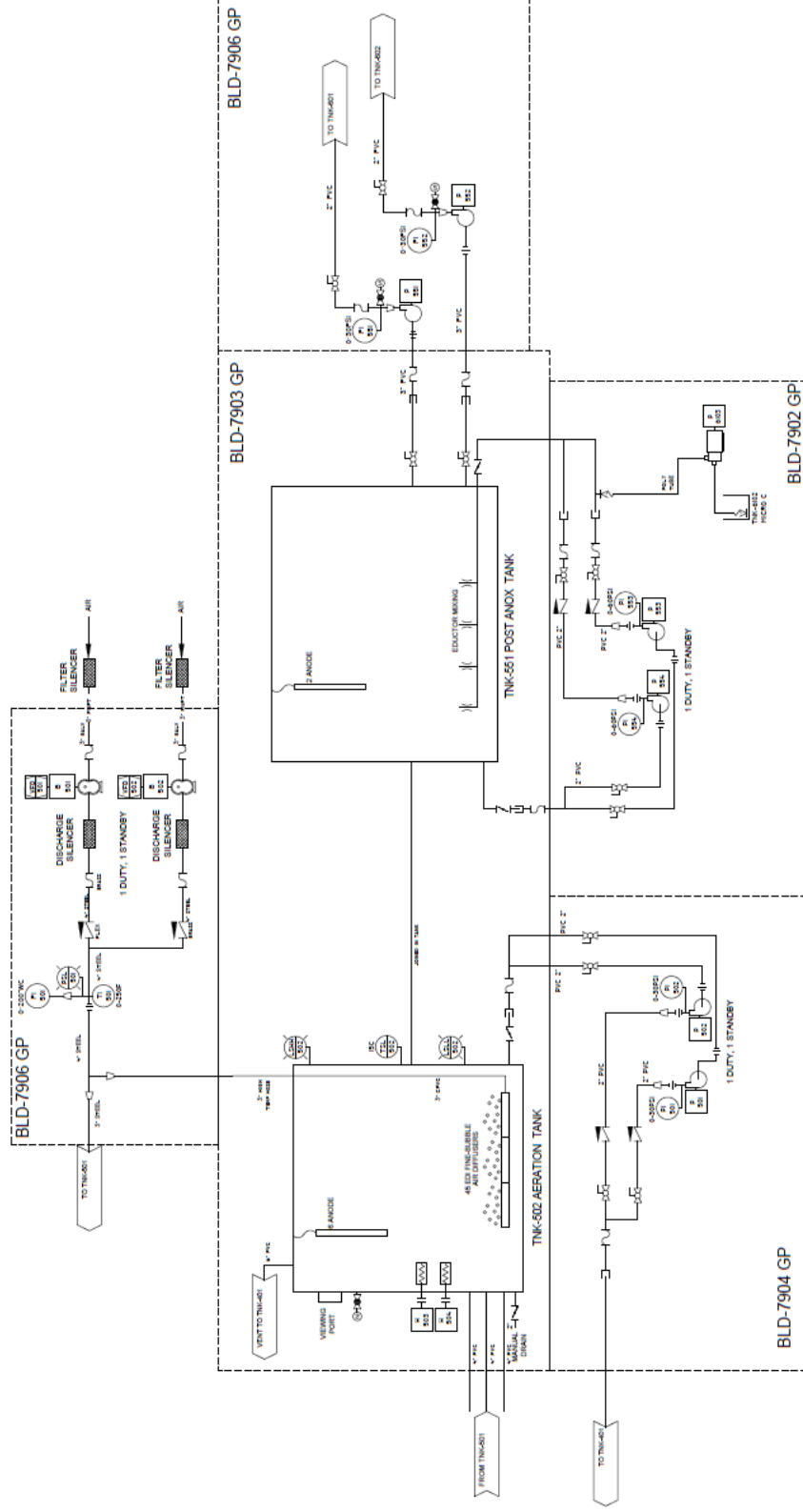
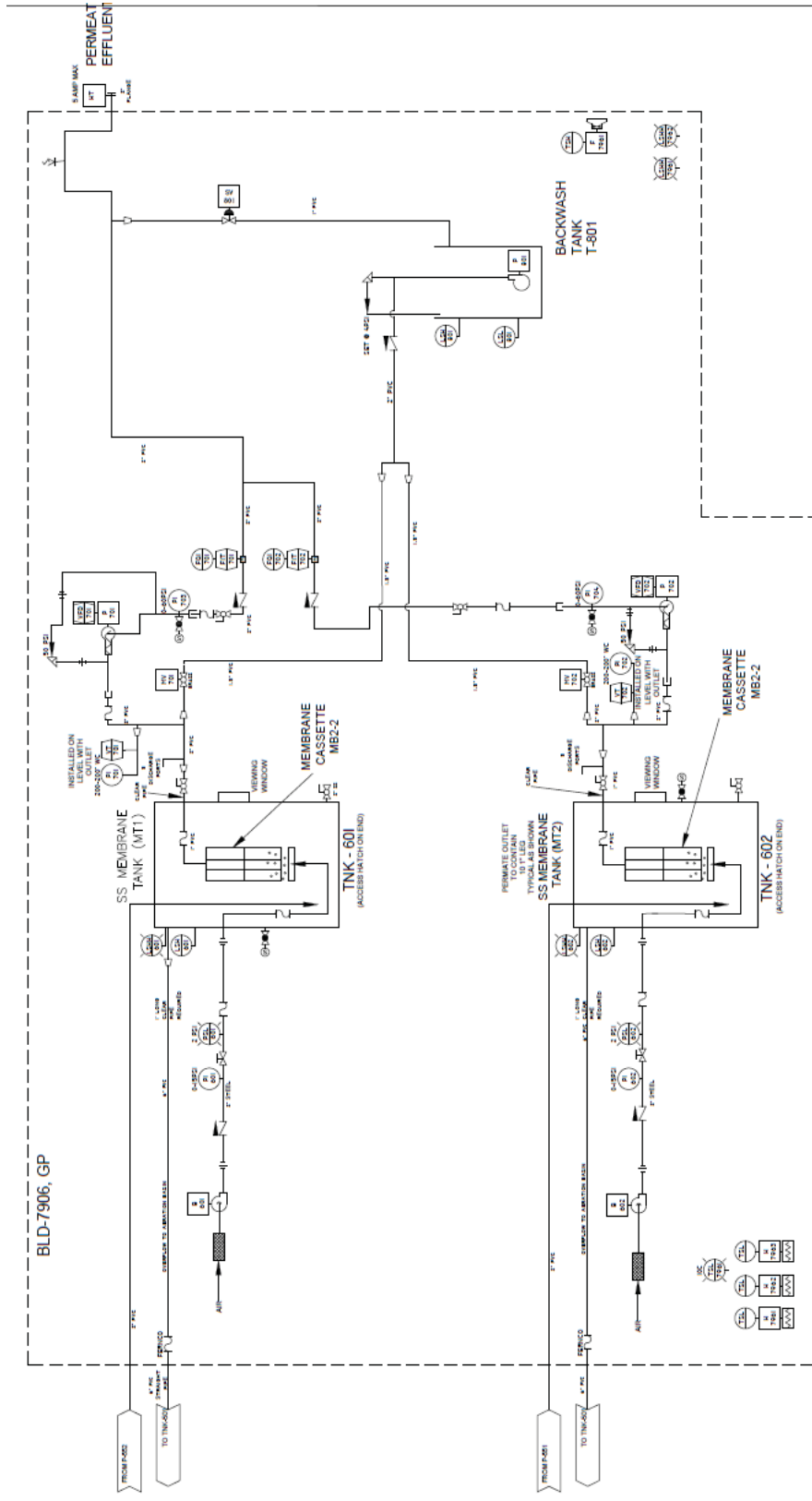


Figure 7 – Post Biological treatment



February 2019



**Figure 8 – Membrane filtration step**



### **2.1.2 Process description**

#### **Oil and Grease (O/G) removal**

Raw sewage from the kitchens entering the system can contain high levels of fats, oils and grease that can damage equipment and membranes downstream. To remove the oil and grease from the system a double trap grease interceptor is installed prior to the kitchen sewage entering the fine screen. Floating grease is removed via a vacuum truck hookup that will be used when the sludge tank is emptied. A pipe and vacuum truck hookup are also used to remove any debris that sunk to the bottom of the tanks. Vacuumed debris, oil and grease are to be disposed at the Meadowbank's tailings storage facility (TSF).

#### **Fine Screening**

Raw sewage entering the MBR system contains particulates and solids that could damage the equipment and membranes downstream. 0.5mm wedge wire fine screening protects the downstream equipment by removing large solids and fibrous material. Two screens are used for redundancy so that no unscreened influent enters the EQ tank. Redundant pumps are used to move the screened influent to the equalization tank.

#### **Flow-Equalization**

Throughout the day the flow and strength of the sewage will vary. To accommodate this, an equalization tank will buffer the flow and homogenize the loading. The equalization tank is aerated to maintain an aerobic environment to reduce odors and to maintain suspension of solids and pumps transfer sewage to biological treatment. This tank is provided with tank heaters. All wetted materials in this tank are either stainless steel or polypropylene to eliminate the possibility of corrosion. In addition, the tank has two liners, one primary, one secondary, with interstitial monitoring, providing the protection of a double wall tank.

#### **Biological Treatment**

In the anoxic zone, the pre-treated sewage is combined with return activated sludge from the aerobic tank and is kept mixed while maintaining a low level of dissolved oxygen (DO). Denitrification occurs as specific microorganisms convert nitrates to nitrogen gas – reducing the total nitrogen (TN) in the mixed liquor. Additionally, the anoxic stage optimizes the biological treatment process, which recovers alkalinity, aids in stabilizing pH, and improves energy efficiency by reducing overall aeration demand. In the aerobic zone, fine bubble diffusers create an aerobic environment where the organics contributing to biological oxygen demand (BOD) and ammonia are oxidized by the biology. Dissolved oxygen is continuously measured and aeration blowers controlled to maintain it in the range of 2 to 3 mg/L for process optimization and energy savings. In the post-anoxic zone, return activated sludge from the aerobic tank is kept mixed while maintaining a low level of dissolved oxygen (DO). The denitrification process continues in the post anoxic zone to reduce the TN even further.

#### **Phosphorous Reduction**

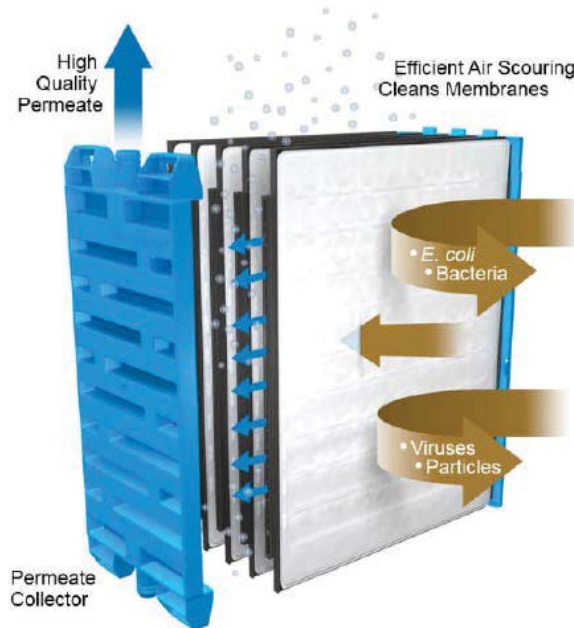
Chemical precipitation is used to remove inorganic phosphate. An aluminum sulphate or "Alum" solution is dosed into the mixed liquor causing dissolved phosphate to precipitate and coagulate. The suspended phosphate cannot pass through the Newterra MicroClearUltra Filtration membrane (UF), and the phosphate is eventually removed from the system as a solid with the waste activated sludge (WAS).

#### **Membrane Filtration**

After being treated biologically, the treated effluent is separated from the mixed liquor and solids by the Newterra MicroClear membrane modules and the permeate extraction system. The membrane



modules are continually air scoured to induce flow of mixed liquor over the flat sheet membrane surface and prevent fouling and buildup of solids on the membrane surface without the use of chemicals. The mixed liquor is then transferred to the inlet of the biological treatment to maintain even distribution of solids throughout the system and to introduce activated biology to the raw sewage. Newterra MicroClear membranes are produced with true ultrafiltration membrane material with 0.04  $\mu\text{m}$  pore size, which blocks all bacteria and most viruses. Secondary disinfection is not required to exceed effluent requirements. Figure 9 presents a schematic view of the UF process.



**Figure 9 – Membrane filtration concept**

### **2.1.3 Sludge Management Strategy**

As solid-laden sewage enters the system and solid-free effluent is discharged, the suspended solids concentration in the mixed liquor suspended solids (MLSS) will increase. To maintain the proper level of MLSS, solids must be removed from the system as Waste Activated Sludge (WAS) which is mixed liquor discharged from the aerobic tank at approximately 0.8% dry. WAS is discharged to a tank for holding and decanting. The holding tank is aerated to maintain an aerobic environment to reduce odors. In the decanting process the WAS is allowed to settle and supernatant is pumped off, and returned to the MBR, thickening the sludge in the holding tank. By thickening the sludge to approximately 2% dry solids by weight, the total volume that must be disposed of is decreased, extending holding time and reducing operational costs. Level control in the tank indicates when the tank should be decanted or a vacuum truck should be scheduled to dispose of the WAS.



### **3 OPERATION AND MAINTENANCE**

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#### **3.1 PUMPING**

The system includes several pumps for the operation of the STP. All pumps are regularly inspected by the Operator who will ensure the pumps continue to operate efficiently and will address any deficiencies. If the pumps require maintenance, the Operator will report the situation and take appropriate action. Some of the pumps are installed with a standby unit that allows the Operator to switch from one pump to the other if necessary. In some specific situations, it may be necessary to temporarily shutdown the STP for servicing of the equipment.

A preventative maintenance program, as recommended by the pump supplier, will be followed to ensure the pumps are always kept in good working order.

#### **3.2 SEWAGE COLLECTION**

The sewage from the kitchen must pass through a grease trap (or similar facility for grease/fat removal). The large amount of oil and fat can harm treatment facility (e.g., clogging pumps and piping and cause foaming in the aeration tank). To avoid premature membrane fouling, maximum O/G concentrations should not exceed 30 mg/L.

The raw wastewater should not contain any of the following substances:

- Hydrocarbons – lubricants, gasoline, diesel, etc.;
- Paints, solvents, silica, silicon and polymers;
- Antibacterial solutions and products with quaternary ammonia;
- Large quantities of chemicals such as water softener, disinfectants, strong acids & alkalis, pesticides or photographic chemicals;
- Silicone based defoamers;
- Non-biodegradable solid waste (plastic, rubber products, disposable diapers, etc.);
- High amount of metals, such as iron, magnesium, calcium, barium and strontium.

#### **3.3 SLUDGE DISPOSAL**

Sludge will be disposed at Amaruq or Meadowbank site in the Waste Rock Storage Facility or the Tailings Storage Facility (Meadowbank only) or in a landfarm as a nutrient amendment as per the Water License Part F Item 3.

#### **3.4 CONTROL**

MBR (Membrane Bioreactor) treatment technology is an effective combination of an activated sludge biological treatment process with MBR membrane filtration technology. The STP can be operated in either manual or automatic mode. The system is designed to always run in auto mode. The manual option is provided mainly for maintenance purposes.

STP's control and automation system is based on several instruments measuring key parameter of the process, combined with a PLC. The STP don't require continuous operator intervention except for daily inspection and maintenance. The user interface can be accessed on-site from the control panel mounted touch-screen HMIs or remotely from a computer. Alarm messages can be set up to alert operators to issues.



The STP PLC is programmed to:

- Receive analogue and digital input signals from the switches and transmitters being controlled;
- Process the information using the structure and rules entered into the program;
- Generate outputs that control the equipment - turn equipment OFF or ON.
- Generate alarms if critical conditions are present
- Provide a HMI (Human Machine Interface) touch-screen for use of operator process monitoring and control.

More information are provided in the Operation and Maintenance Manual in Appendix.

### 3.5 REAGENTS

Some chemicals are required for treatment operation and also for Membrane cleaning. Chemicals will be used according to the MSDS recommendation. MSDS are provided in Appendix. Table 3 presents the estimated chemical consumption per year.

**Table 3: Chemical consumption**

Consumable		Usage Rate			
Purpose	Name	Value	Unit	Value	Unit
Supplemental Alkalinity	Dry Soda Ash	6.28	kg/d	2292	Kg/year
Phosphorus Removal	Liquid Alum, 48%	14.6	L/d	5346	L/year
Nitrate Removal	MicroC 2000	16.5	L/d	6025	L/year
Membrane Cleaning	Sodium Hypochlorite, 12%	-	L/d	150	L/year

**Sodium Carbonate** (Soda Ash) is used for pH adjustment in case there is a deficiency in alkalinity in influent sewage and pH drops. It is hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation (lung irritant).

**Sodium hypochlorite** (NaOCl) and **Citric Acid** (C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>) are used for cleaning the membranes.

- Sodium hypochlorite is a common disinfectant, which can be an irritant or corrosive, depending on its concentration. It cannot be mixed with organics, ammonia compounds or acids. Contact with acids produces highly toxic chlorine gas. It has to be mixed only with pure water.
- Citric Acid is hazardous in case of skin contact (irritant, sensitizers), or ingestion, eye contact (irritant) and inhalation (lung irritants).

**Aluminum Sulfate** (Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>) is used for Phosphorus Removal. Mild to moderate irritation can occur from unprotected contact. Aluminum is very poorly absorbed through the skin and toxic effects would not be expected following short-term skin contact. Inhalation of mists can be irritating to the respiratory tract and lungs.

**MicroC 2000** is used for nitrate removal. Exposure to eyes may cause slight irritation. Exposure to Skin may cause slight irritation. Inhalation of high mist concentrations may cause irritation of respiratory tract.



### 3.6 BIOLOGICAL OPERATION

The following table presents target parameters required for a good operation of the STP.

**Table 4: Biological system targets operational parameters**

Parameter	Recommended	Range	Notes
MLSS (mg/L): Mixed Liquor Suspended Solids	10,000	8,000 – 15,000	Never operate the membranes if MLSS < 3,000 mg/l. Sludge wasting should be undertaken as required to maintain target MLSS
Temperature (°C)	15 - 35	10 – 35	Avoid sudden changes in temperature. Minimum operating temperature is 15 °C
pH	6.8 - 8.5	6.0 – 9.0	Membrane module can handle a change in pH. However it is recommended to keep pH between 6.8 - 8.5
Aeration Tank, DO (mg/L)	≥ 2.0	1.0 – 8.0	This can be maintained by adjusting the volume of air supplied to the aeration tank
Viscosity (mPa-s)	Not applicable	0 – 300	
Aeration Tank to Anoxic Tank Recirculation	400%	200 – 500%	
Membrane Tank to Aeration Tank Recirculation	400%	200 – 600%	
F:M (kg BOD/kg MLSS/d)	0.1	0.03 – 0.2	$F:M = \frac{\text{Flow (m}^3/\text{d)} \times \text{BOD conc (mg/l)}}{\text{[Process volume (m}^3) \times \text{MLSS conc (mg/l)]}}$
F:M (kg COD/kg MLSS/d)	0.15	0.05 – 0.3	$F:M = \frac{\text{Flow (m}^3/\text{d)} \times \text{COD conc (mg/l)}}{\text{[Process volume (m}^3) \times \text{MLSS conc (mg/l)]}}$
SRT : sludge retention time (days)	> 15	12 – 50	

### 3.7 MEMBRANE OPERATION

This section outlines the operating conditions that are required for proper sewage treatment, and longevity of the membranes.

Generally, the following points can be used to operate the MBR system properly:

- The MBR system is designed to treat wastewater with specified influent characteristics.
- Never operate the MBR tank below the minimum membrane submerged level. It is necessary to maintain a minimum of 250 mm liquid level above the membrane modules to ensure they are wet at all times and to allow for proper filtration.
- Always supply the required amount of air for scouring to the membrane module.
- Always filter sewage at or below design flow rate.
- Periodically, relax the membranes by ending filtration while allowing the membrane aeration scour to operate continuously and initiate backwash operation during membrane relaxation (default relaxation mode preset in PLC - permeation continues for 9 min and stops for 1 min).
- Always operate the MBR in accordance with the parameters listed in the supplier O&M Manual.
- Clean the membranes in-place with a dilute chemical in accordance with the supplier O&M Manual.



### 3.8 MEMBRANE CLEANING

In order to enhance life duration of the membrane, several cleaning are required as presented below.

#### **In-situ Chemically Enhanced Backflush (CEB)**

It is recommended that in-situ CEB be carried out before the trans membrane pressure (TMP) exceeds 0.25 bar (or permeability drops rapidly to 50 LMH/bar) This is typically done once every couple weeks/months depending on biomass characteristics and system operating condition. On certain occasions, membrane module/cassette may need to be physically inspected for membrane integrity if membrane permeability performance is not recovered after the cleaning (i.e., suspect of membrane deterioration). Hypochlorite is used for organic fouling and citric acid for inorganic acid.

#### **Membrane Recovery Cleaning**

The membrane recovery cleaning is to be done once a year at a minimum. On certain occasions, membrane cassette may need to be inspected for membrane integrity (suspect of membrane deterioration, membrane permeability performance does not recover after the cleaning, etc.).

- **Cleaning with High pH Solution:** This step is to be done if membrane fouling is a result of high fat, oil and grease. Sodium hydroxide can be used for this cleaning (400 mg/L, pH 12, 1 to 2 hours).
- **Cleaning with Sodium Hypochlorite** (500 mg/L free Cl<sub>2</sub>, 12 hours)
- **Cleaning with Citric Acid** only in case of inorganic fouling (2 to 20 g/L during 2 h).
- **Checking Permeability.**

### 3.9 SERVICE WATER

For better cleaning performance, it is recommended to use:

- Potable water (permeate is acceptable if potable water is unavailable for the CEB cleaning),
- Water temperature is above 20°C.

### 3.10 OPERATIONNAL PERFORMANCE TARGETS

The plant is designed to meet the following criteria presented in Table 5. Note that the treated water from STP is not directly discharged to the environment. The target concentrations presented in the following table for the treated water from STP, are set to limit effect on the receiving Environment after mixing with surface water into the Whale Tail attenuation pond and treatment in the AsWTP. There are no Water Licence criteria for the STP treated water. Reaching these values assure Agnico Eagle to operate the STP at a highest level of efficiency.



**Table 5: STP treated water quality operational target**

Parameters	Unit	Effluent
pH	s.u.	6.5 – 9.5
Oil, Grease	mg/L	<5
Biological Oxygen Demand (BOD)	mg/L	<25
Total Suspended Solids (TSS)	mg/L	<25
Total Kjeldahl Nitrogen (TKN)	mgN/L	-
Unionized Ammonia Nitrogen (NH <sub>3</sub> -N)	mgN/L	<1.25
Nitrate Nitrogen (NO <sub>3</sub> -N)	mgN/L	<5
Total Phosphorus (TP)	mgP/L	<0.5
Fecal Coliform	CFU/100 ml	<200
Total Residual Chlorine	mg/L	<0.02

### 3.11 GENERAL OPERATION & MAINTENANCE, SAMPLING PROCEDURES AND FREQUENCY

To ensure efficiency of STP, samples of water must be collected periodically. Table 6 presents sampling schedule to assess that STP performance comply with operational target values.

More samples can be taken at different locations in the plant to assess any default on STP operation.

Visual inspection is also important to verify STP operation. The following sign must be reported as soon as possible:

- Plant Visual Checks Noise**  
 During normal operation, there is a uniform humming sound at the plant. In case of an unusual noise, it could be an indication that the blower needs maintenance or repairs
- Smell**  
 The MBR is an aerobic system. During normal operation, the system has an earthy smell similar to that of a well-maintained compost pile. If other odors are noticed, the aeration process may not be operating or the system has been overloaded. Check the DO manually and the blower to verify the proper operation.
- Effluent Aspect**  
 Normally, the effluent is reasonably clear, colorless, and odorless. If the effluent becomes turbid, there is a pin hole in the membrane or a leakage in the piping. Take the unit out of operation and investigate. Check uniformity of membrane air distribution periodically to ensure air scouring is effective across all membrane plates.



**Table 6: Monitoring program for operational efficiency assessment.**

Parameters	Sewage	Aeration tank	Membrane tank	Effluent
Flow	daily			daily
Oil and Grease	As required			As required
Alkalinity	As required			
Biological Oxygen Demand	Weekly			Weekly
Total Suspended Solids	Weekly			Weekly
Total Kjeldahl Nitrogen / Total Nitrogen	Monthly			As required
Ammonia Nitrogen				As required
Nitrate				As required
Total Phosphorus	Weekly			Weekly
Mixed Liquor Suspended Solids (MLSS)			Weekly	
Mixed Liquor Volatile Suspended Solids (MLVSS)			As required	
Temperature		daily		
pH	As required	daily		Weekly
Dissolved Oxygen		daily		
Filterability			3 times weekly	
Turbidity				As required
Fecal Coliform / E-Coli				Weekly

Table 7 summarizes also Routine Operation and Maintenance Checkups. More details are provided in the supplier O&M Manual.

According to the water licence, Group 1 Parameters shall be analyzed four times per calendar year during operation and closure. The parameters are presented herein:

- pH, turbidity, hardness, alkalinity, chloride, fluoride, sulphate, total dissolved solids (TDS), total suspended solids (TSS), ammonia nitrogen, nitrite, nitrate, orthophosphate, total phosphorus, Total Metals (aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium and zinc).



**Table 7: Routine Operation and Maintenance Checkups**

Location	Item	Action	Comments
Grease trap	Periodic cleaning	As needed	Waste sent to Meadowbank TSF
Process	Visual check	Daily	Performance evaluation
	Flow rate in and out	Daily	
	Sampling	Daily / as requested	For water quality and performance evaluation
	Vacuum pressure on membrane	Daily	Evaluate Membrane fouling
	Inspect Membrane	Weekly	
Mechanical & process	Sensor cleaning and calibration	Weekly / yearly	
	Valves, fittings	Weekly	Prevent spill
	Membrane Cleaning	Quarterly/Yearly	Permeability recovery
	Aeration diffuser	Yearly	Process efficiency
	Pumps	Quarterly	Prevent spill
	Blower	Monthly	Process efficiency
	Screening device	Daily/ Weekly/ Quarterly	Prevent clogging, remove solid waste and dispose it
	Dosing pumps	Quarterly	Prevent spill
	Fan and heaters	Yearly	Health and safety of operator
	Leads	Quarterly	Health and safety of operator and Process efficiency
	Panel fan filter, inspection breaker, fuses, motor bold, clean dust	Monthly	Health and safety of operator Process efficiency
Electrical	PLC functionality	Weekly	Process efficiency

### 3.12 TROUBLESHOOTING AND MAINTENANCE PROCEDURES

MBR operation relies critically on the ability of the membrane unit to pass all flow incoming to the plant. If membrane permeability is impaired, the MBR plant cannot process all flow with potentially negative results even though effluent quality remains consistently high. Membrane fouling (and associated reduction of flux or increase of TMP) remains as an operational challenge.

Membrane fouling in MBR is a result of the interaction between the incoming water quality, mixed liquor filterability, system operation condition, and membrane material. There are four categories of membrane fouling.



**Microbial/Biological Fouling**

Microbial fouling is a result of the formation of biofilms on membrane surfaces. This structure protects bacterial cells from hydraulic shearing and from chemical attacks of biocides such as chlorine. Chemical cleaning would be required to restore permeability.

**Particulate/Colloid Fouling**

This type of fouling may be associated with high concentrations of colloidal solids present in mixed liquor. In most cases, particles and colloids do not really foul the membrane because the flux decline caused by their accumulation on the membrane surface is largely reversible by hydraulic cleaning measures such as backwash and air scouring. However, the accumulation of solids between the membranes can create increased membrane resistance to permeation and permanent physical membrane damage.

**Inorganic Fouling**

Inorganic fouling or precipitative fouling is caused by the accumulation of inorganic precipitates such as metal hydroxides, and “scales” on membrane surface or within pore structure. Chemical cleaning will be required in that case.

**Organic Fouling**

Organic fouling is the attachment of materials such as oil or grease to the membrane surface. Oil and grease trap will prevent this type of fouling and chemical cleaning is also achievable to restore permeability.

Excessive foaming (white foam accumulating over the liquid surface) in aeration and/or membrane tanks could also reduce performance of the STP. Remediation should be taken to eliminate foaming agent or restore design parameters of the plant.

Permeate bad quality can also indicate default in MBR membrane and operation.

Finally, biological system can also indicate default in operation.

- Black color of biomass indicates a lack of aeration,
- Increase of bacteria quantity in the reactor indicates a low sludge wasting,
- Unpleasant odor can indicate overload of the system, blower failure, etc.
- Water quality not achieved: Mixed liquor characteristics are not within proper operating standards.

Further details are available in the manufacturer’ operating manuals in Appendix.

### **3.13 RECORD KEEPING**

Records of the operational, maintenance and sampling procedures will be kept daily in order to assist in the evaluation of the effectiveness of the STP.

The following will be recorded on a daily basis:

- Volume of effluent discharged to the whale tail attenuation pond;
- Sewage volume collected;
- Details of any maintenance undertaken at site;
- Volume of sewage sludge removed from the STP;
- Locations and methods of sewage sludge disposal;
- Water quality parameter results required to follow the STP performance.



The record sheets will be kept in the STP office.

### **3.14 SAFETY PROCEDURES FOR OPERATORS**

Operators working in the STP facility must be trained prior to work so that they are aware of the health and safety risks as well as the operational procedures associated with the STP. The following are important safety considerations:

- The wastewater contains a mixture of viable bacteria and other biological organisms. A wastewater treatment plant poses a number of bacterial hazards and consequently potential health risk. Immunization protects operator against infection. The use of proper hygiene measures, protective equipment, good housekeeping and common sense prevent contact with pathogens. Ensure that hands are washed with an antibacterial soap and warm water and dried by disposable towels on a regular basis, especially prior eating. Do not expose cuts or open sores to wastewater. Any concern about possible infection should be brought to the attention of medical physician immediately.
- Follow local laws and regulations with respect to entering a confined space.
- Working within the plant, especially with chemicals, requires adequate personal protective equipment (PPE) for Operators. This includes wearing steel toed boots, hard hat, rubber aprons, safety glasses with side shields and gloves.
- Operators are required to conduct good housekeeping of the working area to minimize the risk of incidents.
- Lock-out/tag-out procedures must be applied when servicing equipment.
- The MSDS for reagents used in the STP will be readily available for the operator at all times.
- Eyewash stations are located within proximity of reagent systems in the STP.

### **3.15 CONTROLLING ACCESS TO THE STP**

Access to the STP will be restricted to authorized personnel only. Signs will be posted at the STP entrance.



## **4 EMERGENCY RESPONSE**

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### **4.1 FIRE**

In case of fire at the STP, the on-site emergency response team (ERT) will be notified as per Agnico Eagle's protocol. Instructions from the on-site emergency response team will be followed by all personnel at the STP. Further details of fire response are provided in the "*Risk Management & Emergency Response Plan*". The STP will include the necessary fire safety protection measures in accordance with the Nunavut and North West Territories Mine Act.

### **4.2 SPILL**

In the event of a spill at the STP, the Environment Department will be notified immediately and provide support, as required. In the event of a large spill, the on-site ERT will be notified as per Agnico Eagle's protocol. Instructions from the ERT will be followed by all personnel at the STP. All spill will be reported and treated according to the "*Spill Contingency Plan*".

### **4.3 PLANT MALFUNCTION**

If there is a major problem or failure in the STP it would be most likely due to changes in the influent (raw sewage) (i.e. high strength sewage (BOD high) killing bacteria in the STP) or membrane failure. In this case, there would be visible effluent problems (part of daily operational checks), poor water quality, and increased odours that the operator would note. If this occurs, a sample will be taken to try to determine the source of the problem.

The following other contingent measures can be applied by Agnico Eagle in the event of a malfunction at the STP:

- Cut back on allowable camp water until the malfunction is corrected and use the equalization tank to retard the peak flow;
- Shut down the malfunctioning unit until the malfunction is repaired and use only one of the two parallel units until repairs are completed (for equipment in parallel);
- Bypassing untreated STP influent around the malfunctioning unit. Sucker truck can collect sewage from the equalization tank and carry it to Meadowbank facilities. Sewage would then be stored into the Tailing storage facility or would be treated into the sewage treatment plant (STP) at Meadowbank depending on the available capacity remaining.
- Shut down temporarily all water use in the camp until the repairs are completed;



## **Appendix A: Reagent MSDS Sheets**

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# SAFETY DATA SHEET

NC00525  
MICROC 2000

Preparation Date: 09/Mar/2018

Version: 1

## 1. IDENTIFICATION

### Product identifier

**Product Name** MICROC 2000

### Other means of identification

**Product Code(s)** NC00525

**Synonyms** none

### Recommended use of the chemical and restrictions on use

**Recommended Use** Reducing agent for biological purposes

**Restricted Uses** No information available

### Initial Supplier Identifier

Univar Canada Ltd.  
9800 Van Horne Way  
Richmond, BC V6X 1W5  
Telephone: 1-866-686-4827

### Emergency telephone number

**24 Hour Emergency Phone Number (CANUTEC):** 1-888-226-8832 (1-888-CAN-UTEC)

## 2. HAZARD IDENTIFICATION

### Hazardous Classification of the substance or mixture

none

### Label elements

**Hazard pictograms** None

### Hazard statements





# SAFETY DATA SHEET

SDS00221  
Sodium Hypochlorite 12%

Preparation Date: 09/Feb/2018

Version: 4

## 1. IDENTIFICATION

### Product identifier

**Product Name** Sodium Hypochlorite 12%

### Other means of identification

**Product Code(s)** SDS00221

**Synonyms** Sodium oxychloride; Soda bleach liquor; Javel water; Clorox; Javex.

### Recommended use of the chemical and restrictions on use

**Recommended Use** Chemical intermediate Bleaching agent Laboratory reagent. Pulp and paper.  
Water treatment. Disinfectant

**Restricted Uses** No information available

### Initial Supplier Identifier

Univar Canada Ltd.  
9800 Van Horne Way  
Richmond, BC V6X 1W5  
Telephone: 1-866-686-4827

### Emergency telephone number

**24 Hour Emergency Phone Number (CANUTEC): 1-888-226-8832 (1-888-CAN-UTEC)**

## 2. HAZARD IDENTIFICATION

### Hazardous Classification of the substance or mixture

Corrosive to metals	Category 1
Skin corrosion/irritation	Category 1
Sub-category B	
Serious eye damage/eye irritation	Category 1

### Label elements



**Hazard pictograms****Signal Word: Danger****Hazard statements**

May be corrosive to metals

Causes severe skin burns and eye damage

**Precautionary Statements****Prevention**

Do not breathe dust/fume/gas/mist/vapors/spray

Wash face, hands and any exposed skin thoroughly after handling

Wear protective gloves/protective clothing/eye protection/face protection

Immediately call a POISON CENTER or doctor

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do.

Continue rinsing

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower

Wash contaminated clothing before reuse

IF INHALED: Remove person to fresh air and keep comfortable for breathing

IF SWALLOWED: Rinse mouth. DO NOT induce vomiting

**Storage**

Store locked up

Store in a well-ventilated place. Keep container tightly closed

**Disposal**

Dispose of contents/container to an approved waste disposal plant

Very toxic to aquatic life with long lasting effects

**3. COMPOSITION/INFORMATION ON INGREDIENTS****Substance**

Not applicable.

**Mixture**

Chemical Name	CAS No	Weight-%	Synonyms
Water	7732-18-5	80 - 90%	Water
Sodium Hypochlorite, Solution	7681-52-9	10 - 20%	Sodium Hypochlorite, Solution



## 4. FIRST AID

### Description of first aid measures

#### **General advice**

Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.

#### **Inhalation**

Remove to fresh air. If breathing has stopped, give artificial respiration. Get medical attention immediately. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, (trained personnel should) give oxygen. Delayed pulmonary edema may occur.

#### **Eye contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

#### **Skin contact**

Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention.

#### **Ingestion**

Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Get immediate medical advice/attention.

#### **Self-protection of the first aider**

Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Avoid contact with skin, eyes or clothing. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Wear personal protective clothing (see section 8).

#### **Most important symptoms and effects, both acute and delayed:**

Causes irritation of the mouth, nose and throat. Corrosive Causes burns to the mouth, throat and stomach. May cause severe skin irritation. Corrosive to the respiratory passage. Corrosive to eye tissue and may cause severe damage and blindness. Causes vomiting, nausea, and diarrhea. Repeated and/or prolonged exposures may cause productive cough, running nose, bronchopneumonia, pulmonary edema (fluid build-up in lungs) and reduction of pulmonary function. Coma, shock and death may occur. May cause whitening or bleaching of the skin. If mixed with acids or warmed to temperatures greater than 40 °Celsius, Sodium hypochlorite solutions release chlorine gas. This gas can cause severe irritation of the nose and throat. Exposures to high levels of chlorine gas may result in severe lung damage. Prolonged contact may lead to burns and blisters and may aggravate dermatitis.

#### **Indication of any immediate medical attention and special treatment needed:**

#### **Note to physicians**

Due to the severely irritating or corrosive nature of the material, swallowing may lead to ulceration and inflammation of the upper alimentary tract with hemorrhage and fluid loss. Also, perforation of the esophagus or stomach may occur, leading to mediastinitis or peritonitis and the resultant complications.

## 5. FIRE-FIGHTING MEASURES

#### **Suitable Extinguishing Media**

Use extinguishing media appropriate for surrounding fire.

#### **Specific hazards arising from the substance or mixture**

Closed containers may explode in fire. Keep containers cool to prevent rupture and release of material. Spilled material may cause floors and contact surfaces to become slippery.



**Hazardous combustion products**

Chlorine. Oxides of sodium. Oxygen. When heated to decomposition, it emits acrid smoke and irritating fumes.

**Special protective equipment for fire-fighters**

Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

**6. ACCIDENTAL RELEASE MEASURES****Personal precautions, protective equipment and emergency procedures**

Attention! Corrosive material. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.

**Environmental precautions**

Prevent further leakage or spillage if safe to do so. Should not be released into the environment. Do not allow to enter into soil/subsoil. Prevent product from entering drains.

**Methods and materials for containment and cleaning up**

Prevent further leakage or spillage if safe to do so.

**7. HANDLING AND STORAGE****Precautions for safe handling**

For industrial use only. Handle and open containers with care. Avoid contact with eyes, skin and clothing. Do not ingest. Avoid inhalation of chemical. Empty containers may contain hazardous product residues. Keep the containers closed when not in use. Protect against physical damage. Use appropriate personnel protective equipment. When diluting, add this product to water in small amounts to avoid spattering. Never add water to this material.

**Conditions for safe storage, including any incompatibilities**

Store in a cool, dry, well ventilated area, away from heat and ignition sources. Keep away from direct sunlight. Do not freeze. Store away from organic chemicals, strong bases, metal powders, carbides, sulfides, and any readily oxidizable material. Storage area should be equipped with corrosion-resistant floors, sumps and should have controlled drainage to a recovery tank. Store below 29 °C. Store in a sealed polyethylene lined container.

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION****Control parameters****Exposure Limits**

This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Chemical Name	Alberta OEL	British Columbia OEL	Ontario	Quebec OEL	Exposure Limit - ACGIH	Immediately Dangerous to Life or Health - IDLH
Water	Not available	Not available	Not available	Not available	Not available	Not available
7732-18-5	Not available	Not available	Not available	Not available	Not available	Not available
Sodium	Not available	Not available	Not available	Not available	Not available	Not available



Hypochlorite, Solution 7681-52-9						
--	--	--	--	--	--	--

Consult local authorities for recommended exposure limits

### Appropriate engineering controls

#### **Engineering controls**

Local exhaust ventilation as necessary to maintain exposures to within applicable limits. Make up air should always be supplied to balance air exhausted (either generally or locally). Ventilation required when spraying or applying in a confined area. Ventilation should be explosion proof. Eliminate ignition sources.

### Individual protection measures, such as personal protective equipment

#### **Eye/face protection**

Chemical safety goggles and/or full face shield to protect eyes and face, if product is handled such that it could be splashed into eyes.

#### **Hand protection**

Nitrile gloves. Neoprene gloves. Impervious gloves. Rubber gloves.

#### **Skin and body protection**

Neoprene coated apron or chemical resistant clothing. Impervious boots.

#### **Respiratory protection**

NIOSH approved supplied air respirator when airborne concentrations exceed exposure limits. Wear a NIOAH approved full facepiece respirator for acid gases or a self-contained breathing apparatus for air concentration levels up to 5 ppm.

#### **General hygiene considerations**

Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### Information on basic physical and chemical properties

#### **Appearance**

<b>Physical state</b>	Liquid
<b>Color</b>	Clear Green to yellow.
<b>Odor</b>	Chlorine
<b>Odor threshold</b>	No information available

<u>PROPERTIES</u>	<u>Values</u>	<u>Remarks • Method</u>
pH	11.5 - 13	
Melting point / freezing point	-25 °C / -13 °F	
Initial boiling point/boiling range	No data available	None known
Flash point	No data available	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		
Upper flammability limit:	No data available	
Lower flammability limit:	No data available	
Vapor pressure	17.5 mmHg	
Relative vapor density	No data available	None known



Specific Gravity	1.175	
Water solubility	Soluble in water	
Solubility in other solvents	No data available	
Partition coefficient	No data available	
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	No data available	None known
Dynamic viscosity	No data available	None known
Explosive properties	No information available.	
Oxidizing properties	No information available.	
Molecular weight	No information available	
VOC Percentage Volatility	No information available	
Liquid Density	No information available	
Bulk density	No information available	

## 10. STABILITY AND REACTIVITY

### Reactivity/Chemical Stability

Unstable above 40°C / 104 °F.

### Possibility of hazardous reactions

Hypochlorites may react with primary amines to form nitrogen trichloride which explodes spontaneously in air. Hypochlorite bleach reacts with urea to form nitrogen trichloride which explodes spontaneously in air. Some metals accelerate the decomposition of Sodium Hypochlorite. Nickel. Copper. Tin. Iron and its alloys. Manganese.

### Hazardous polymerization

Will not occur.

### Conditions to avoid

High temperatures. Exposure to light.

### Incompatible materials

Strong oxidizers. Acids. Reducing agents. Ammonia. Metals.

### Hazardous decomposition products

Chlorine. Oxides of sodium. Oxygen. When heated to decomposition, it emits acrid smoke and irritating fumes.

## 11. TOXICOLOGICAL INFORMATION

### Information on likely routes of exposure

#### Inhalation

Causes irritation of the mouth, nose and throat. Corrosive to the respiratory passage. Repeated and/or prolonged exposures may cause productive cough, running nose, bronchopneumonia, pulmonary edema (fluid build-up in lungs) and reduction of pulmonary function. If mixed with acids or warmed to temperatures greater than 40 °Celsius, Sodium hypochlorite solutions release chlorine gas. This gas can cause severe irritation of the nose and throat. Exposures to high levels of chlorine gas may result in severe lung damage.

#### Eye contact

Corrosive to eye tissue and may cause severe damage and blindness.

#### Skin contact

Corrosive. May cause severe skin irritation. May cause whitening or bleaching of the skin. Prolonged contact may lead to burns and blisters and may aggravate dermatitis.



**Ingestion**

Causes burns to the mouth, throat and stomach. Corrosive. Causes vomiting, nausea, and diarrhea. Coma, shock and death may occur.

**Information on toxicological effects****Symptoms**

Corrosive effects on the skin and eyes may be delayed, and damage may occur without the sensation or onset of pain. Aspiration may cause lung damage.

**Numerical measures of toxicity****Acute toxicity**

The following values are calculated based on chapter 3.1 of the GHS document .

ATEmix (oral) 68,333.00 mg/kg

ATEmix (dermal) 83,417.00 mg/kg

Unknown acute toxicity No information available

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Water 7732-18-5	> 90 mL/kg ( Rat )	Not available	Not available
Sodium Hypochlorite, Solution 7681-52-9	= 8.91 g/kg ( Rat )	> 10000 mg/kg ( Rabbit )	Not available

**Delayed and immediate effects as well as chronic effects from short and long-term exposure****Skin corrosion/irritation**

Corrosive. May cause severe skin irritation. May cause whitening or bleaching of the skin. Prolonged contact may lead to burns and blisters and may aggravate dermatitis.

**Serious eye damage/eye irritation**

Corrosive to eye tissue and may cause severe damage and blindness.

**Respiratory or skin sensitization**

No information available.

**Germ cell mutagenicity**

No information available.

**Carcinogenicity**

No information available.

The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Water 7732-18-5	Not available	Not available	Not available	Not available
Sodium Hypochlorite, Solution 7681-52-9	Not available	Group 3	Not available	Not available

**Legend**

IARC (International Agency for Research on Cancer)

Group 3 - Not Classifiable as to Carcinogenicity in Humans

**Reproductive toxicity**

No information available.

**Specific target organ systemic toxicity - single exposure**



No information available.

### Specific target organ systemic toxicity - repeated exposure

No information available.

### Aspiration hazard

No information available.

## 12. ECOLOGICAL INFORMATION

### Ecotoxicity

Chemical Name	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Fish Species Data	Toxicity to microorganisms	Crustacea
Water 7732-18-5	Not available	Not available	Not available	Not available
Sodium Hypochlorite, Solution 7681-52-9	Not available	0.06 - 0.11 mg/L LC50 (Pimephales promelas) 96 h flow-through 4.5 - 7.6 mg/L LC50 (Pimephales promelas) 96 h static 0.4 - 0.8 mg/L LC50 (Lepomis macrochirus) 96 h static 0.28 - 1 mg/L LC50 (Lepomis macrochirus) 96 h flow-through 0.05 - 0.771 mg/L LC50 (Oncorhynchus mykiss) 96 h flow-through 0.03 - 0.19 mg/L LC50 (Oncorhynchus mykiss) 96 h semi-static 0.18 - 0.22 mg/L LC50 (Oncorhynchus mykiss) 96 h static	Not available	EC50: 0.033 - 0.044mg/L (48h, Daphnia magna)

**Persistence and degradability** No information available.

**Bioaccumulation** No information available.

Chemical Name	Partition coefficient
Water 7732-18-5	Not available
Sodium Hypochlorite, Solution 7681-52-9	Not available

**Other adverse effects** No information available.

## 13. DISPOSAL CONSIDERATIONS

### Waste treatment methods

Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.



Do not reuse empty containers.

## 14. TRANSPORT INFORMATION

### TDG (Canada):

UN Number UN1791  
 Shipping name HYPOCHLORITE SOLUTION  
 Class 8  
 Packing Group III  
 Marine pollutant Not available.

### DOT (U.S.)

UN Number UN1791  
 Shipping name HYPOCHLORITE SOLUTION  
 Class 8  
 Packing Group III  
 Marine pollutant Not available

## 15. REGULATORY INFORMATION

**Safety, health and environmental regulations/legislation specific for the substance or mixture**

NSF International



### Additional information

Maximum use for potable water 95 mg/L. Only products bearing the NSF Mark on the product, product packaging, and/or documentation shipped with the product are Certified.

### U.S. Regulatory Rules

Chemical Name	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Water - 7732-18-5	Not Listed	Not Listed	Not Listed
Sodium Hypochlorite, Solution - 7681-52-9	Not Listed	Listed	Not Listed

### International Inventories

TSCA Complies  
 DSL/NDSL Complies

### Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory

DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

## 16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

**NFPA:** Health hazards 3 Flammability 0 Instability 0 Physical and chemical properties -  
**HMIS Health Rating:** Health hazards 3 Flammability 0 Physical hazards 0 Personal protection X



**Legend** Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

**Prepared By:** The Environment, Health and Safety Department of Univar Canada Ltd.

**Preparation Date:** 09/Feb/2018

**Revision Date:** 09/Feb/2018

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**End of Safety Data Sheet**



The mixture does not meet the criteria for classification.

**Prevention**

Wash hands thoroughly after handling

Wear protective gloves/protective clothing/eye protection/face protection

In case of inadequate ventilation wear respiratory protection

**Response**

Read the label and safety data sheet before use.

Flush eyes with plenty amounts of water.

If eye irritation persists: Get medical advice/attention

Wash skin with plenty of water.

If skin irritation occurs: Get medical advice/attention

Move person to fresh air.

Do NOT induce vomiting. Never give anything by mouth to an unconscious or convulsing person. Seek immediate medical attention. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs.

**Storage**

Store in accordance with good industrial practices.

**Disposal**

Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

**Substance**

Not applicable.

**Mixture**

Chemical Name	CAS No	Weight-%	Synonyms
Glycerine	56-81-5	70 - 80%	Glycerine
Water	7732-18-5	20 - 30%	Water
Sodium Chloride	7647-14-5	0 - 10%	Sodium Chloride
Methanol	67-56-1	0 - 10%	Methanol

### 4. FIRST AID

**Description of first aid measures****Inhalation**

Remove to fresh air.

**Eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

**Skin contact**

Wash skin with soap and water.



**Ingestion**

Clean mouth with water and drink afterwards plenty of water.

**Most important symptoms and effects, both acute and delayed:**

May cause slight eye irritation Symptoms include pain, redness and tearing. May cause slight skin irritation. Prolonged or repeated contact may cause discomfort and local redness. High concentrations of mist or vapor may cause irritation of the respiratory tract. May be harmful if swallowed

**Indication of any immediate medical attention and special treatment needed:****Note to physicians**

Treatment based on sound judgment of physician and individual reactions of patient.

## 5. FIRE-FIGHTING MEASURES

**Suitable Extinguishing Media**

Use extinguishing agent suitable for type of surrounding fire. Water spray. Alcohol foam. Dry chemical or CO2. Water or Foam may cause frothing.

**Specific hazards arising from the substance or mixture**

No information available.

**Hazardous combustion products**

See section 10 for more information.

**Special protective equipment for fire-fighters**

Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

## 6. ACCIDENTAL RELEASE MEASURES

**Personal precautions, protective equipment and emergency procedures**

Ensure adequate ventilation. Avoid breathing vapors or mists.

**Environmental precautions**

See Section 12 for additional Ecological Information.

**Methods and materials for containment and cleaning up**

Prevent further leakage or spillage if safe to do so. Eliminate all ignition sources.

## 7. HANDLING AND STORAGE

**Precautions for safe handling**

Handle in accordance with good industrial hygiene and safety practice. Avoid contact with skin, eyes or clothing. Avoid breathing vapors or mists. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

**Conditions for safe storage, including any incompatibilities**

Keep containers tightly closed in a cool, well-ventilated place. Keep away from sources of ignition.



## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### Control parameters

#### Exposure Limits

Chemical Name	Alberta OEL	British Columbia OEL	Ontario	Quebec OEL	Exposure Limit - ACGIH	Immediately Dangerous to Life or Health - IDLH
Glycerine 56-81-5	TWA: 10 mg/m <sup>3</sup>	TWA: 10 mg/m <sup>3</sup> TWA: 3 mg/m <sup>3</sup>	Not available	TWA: 10 mg/m <sup>3</sup>	Not available	Not available
Water 7732-18-5	Not available	Not available	Not available	Not available	Not available	Not available
Sodium Chloride 7647-14-5	Not available	Not available	Not available	Not available	Not available	Not available
Methanol 67-56-1	TWA: 200 ppm TWA: 262 mg/m <sup>3</sup> STEL: 250 ppm STEL: 328 mg/m <sup>3</sup> Skin	TWA: 200 ppm STEL: 250 ppm Skin	TWA: 200 ppm STEL: 250 ppm Skin	TWA: 200 ppm TWA: 262 mg/m <sup>3</sup> STEL: 250 ppm STEL: 328 mg/m <sup>3</sup> Skin	250 ppm STEL 200 ppm TLV-TWA	6000 ppm

Consult local authorities for recommended exposure limits

### Appropriate engineering controls

#### Engineering controls

Showers  
Eyewash stations  
Ventilation systems.

### Individual protection measures, such as personal protective equipment

#### Eye/face protection

Chemical goggles; also wear a face shield if splashing hazard exists.

#### Hand protection

Use gloves chemically resistant to this material, examples of preferred glove barrier materials include: Nitrile gloves.

#### Skin and body protection

Skin contact should be prevented through the use of suitable protective clothing, gloves and footwear, selected for conditions of use and exposure potential. Consideration must be given both to durability as well as permeation resistance.

#### Respiratory protection

If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator.

#### General hygiene considerations

Handle in accordance with good industrial hygiene and safety practice.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

### Information on basic physical and chemical properties

#### Appearance

Physical state	Liquid
Color	Light brown



Odor MUSTY to Sweet  
 Odor threshold No information available

<b>PROPERTIES</b>	<b>Values</b>	<b>Remarks • Method</b>
pH	4 - 11	
Melting point / freezing point	No data available	None known
Initial boiling point/boiling range	No data available	None known
Flash point	No data available	None known
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		
Upper flammability limit:	No data available	
Lower flammability limit:	No data available	
Vapor pressure	No data available	None known
Relative vapor density	No data available	None known
Specific Gravity	1.225@ 20°C	
Water solubility	Soluble in water	
Solubility in other solvents	No data available	None known
Partition coefficient	No data available	
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	45 cPs @ 20C	
Dynamic viscosity	No data available	None known
Explosive properties	No information available.	
Oxidizing properties	No information available.	
Molecular weight	No information available	
VOC Percentage Volatility	No information available	
Liquid Density	No information available	
Bulk density	10.22 lbs/gal	

## 10. STABILITY AND REACTIVITY

### Reactivity/Chemical Stability

Stable under normal conditions

### Possibility of hazardous reactions

None under normal processing.

### Conditions to avoid

Heat, flames and sparks.

### Incompatible materials

Oxidizing agents. Nitric acid. Peroxides. Chromates.

### Hazardous decomposition products

Oxides of carbon.

## 11. TOXICOLOGICAL INFORMATION

### Information on likely routes of exposure

#### Inhalation

High concentrations of mist or vapor may cause irritation of the respiratory tract.



**Eye contact**

May cause slight eye irritation.

**Skin contact**

May cause slight skin irritation.

**Ingestion**

May be harmful if swallowed.

**Information on toxicological effects****Symptoms**

Prolonged exposure may cause headaches, nausea, dizziness, eye, skin and respiratory irritation.

**Numerical measures of toxicity****Acute toxicity**

The following values are calculated based on chapter 3.1 of the GHS document .

ATEmix (oral) 13,548.00 mg/kg

ATEmix (dermal) 13,903.00 mg/kg

Unknown acute toxicity No information available

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Glycerine 56-81-5	= 12600 mg/kg ( Rat )	> 10 g/kg ( Rabbit )	> 570 mg/m <sup>3</sup> ( Rat ) 1 h
Water 7732-18-5	> 90 mL/kg ( Rat )	Not available	Not available
Sodium Chloride 7647-14-5	= 3 g/kg ( Rat )	Not available	> 42 g/m <sup>3</sup> ( Rat ) 1 h
Methanol 67-56-1	= 6200 mg/kg ( Rat )	= 15840 mg/kg ( Rabbit )	= 22500 ppm ( Rat ) 8 h

**Delayed and immediate effects as well as chronic effects from short and long-term exposure****Skin corrosion/irritation**

May cause slight irritation with discomfort and local redness.

**Serious eye damage/eye irritation**

Symptoms include pain, redness and tearing.

**Respiratory or skin sensitization**

No information available.

**Germ cell mutagenicity**

No information available.

**Carcinogenicity**

No information available.

Chemical Name	ACGIH	IARC	NTP	OSHA
Glycerine 56-81-5	Not available	Not available	Not available	Not available
Water 7732-18-5	Not available	Not available	Not available	Not available
Sodium Chloride 7647-14-5	Not available	Not available	Not available	Not available
Methanol 67-56-1	Not available	Not available	Not available	Not available



**Reproductive toxicity**

No information available.

**Specific target organ systemic toxicity - single exposure**

No information available.

**Specific target organ systemic toxicity - repeated exposure**

No information available.

**Aspiration hazard**

No information available.

**12. ECOLOGICAL INFORMATION****Ecotoxicity**

Chemical Name	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Fish Species Data	Toxicity to microorganisms	Crustacea
Glycerine 56-81-5	Not available	51 - 57 mL/L LC50 (Oncorhynchus mykiss) 96 h static	Not available	Not available
Water 7732-18-5	Not available	Not available	Not available	Not available
Sodium Chloride 7647-14-5	Not available	5560 - 6080 mg/L LC50 (Lepomis macrochirus) 96 h flow-through 12946 mg/L LC50 (Lepomis macrochirus) 96 h static 6020 - 7070 mg/L LC50 (Pimephales promelas) 96 h static 7050 mg/L LC50 (Pimephales promelas) 96 h semi-static 6420 - 6700 mg/L LC50 (Pimephales promelas) 96 h static 4747 - 7824 mg/L LC50 (Oncorhynchus mykiss) 96 h flow-through	Not available	EC50: =1000mg/L (48h, Daphnia magna) EC50: 340.7 - 469.2mg/L (48h, Daphnia magna)
Methanol 67-56-1	Not available	28200 mg/L LC50 (Pimephales promelas) 96 h flow-through 100 mg/L LC50 (Pimephales promelas) 96 h static 19500 - 20700 mg/L LC50 (Oncorhynchus mykiss) 96 h flow-through 18 - 20 mL/L LC50 (Oncorhynchus mykiss) 96 h static 13500 - 17600 mg/L LC50 (Lepomis macrochirus) 96 h flow-through	Not available	Not available

**Persistence and degradability** No information available.**Bioaccumulation** No information available.



**Component Information**

Chemical Name	Partition coefficient
Glycerine 56-81-5	-1.76
Water 7732-18-5	Not available
Sodium Chloride 7647-14-5	Not available
Methanol 67-56-1	-0.77

**Other adverse effects** No information available.

### 13. DISPOSAL CONSIDERATIONS

**Waste treatment methods**

Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Do not reuse empty containers.

### 14. TRANSPORT INFORMATION

**TDG (Canada):**

<b>UN Number</b>	Not applicable
<b>Shipping name</b>	Not regulated
<b>Class</b>	Not applicable
<b>Packing Group</b>	Not applicable
<b>Marine pollutant</b>	Not available.

**DOT (U.S.)**

<b>UN Number</b>	Not applicable
<b>Shipping name</b>	Not regulated
<b>Class</b>	Not applicable
<b>Packing Group</b>	Not applicable
<b>Marine pollutant</b>	Not available

### 15. REGULATORY INFORMATION

**Safety, health and environmental regulations/legislation specific for the substance or mixture**

**U.S. Regulatory Rules**

Chemical Name	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Glycerine - 56-81-5	Not Listed	Not Listed	Not Listed
Water - 7732-18-5	Not Listed	Not Listed	Not Listed
Sodium Chloride - 7647-14-5	Not Listed	Not Listed	Not Listed
Methanol - 67-56-1	Not Listed	Listed	Listed

**International Inventories**

<b>TSCA</b>	Complies
<b>DSL/NDL</b>	Complies

**Legend:**

**TSCA** - United States Toxic Substances Control Act Section 8(b) Inventory



DSL/NDL - Canadian Domestic Substances List/Non-Domestic Substances List

**16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION**

<b>NFPA:</b>	Health hazards 0	Flammability 0	Instability 0	Physical and chemical properties -
<b>HMIS Health Rating:</b>	Health hazards 0	Flammability 0	Physical hazards 0	Personal protection X

**Legend** Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

**Prepared By:** The Environment, Health and Safety Department of Univar Canada Ltd.**Preparation Date:** 09/Mar/2018**Revision Date:** 09/Mar/2018**Disclaimer****NOTICE TO READER:**

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**End of Safety Data Sheet**





# SAFETY DATA SHEET

SDS00404  
ALS Aluminum Sulphate

Preparation Date: 07/Nov/2017

Version: 3

## 1. IDENTIFICATION

### Product identifier

**Product Name** ALS Aluminum Sulphate

### Other means of identification

**Product Code(s)** SDS00404

**Synonyms** none

### Recommended use of the chemical and restrictions on use

**Recommended Use** Water treatment (potable and waste water). Paper applications.

**Restricted Uses** No information available

### Initial Supplier Identifier

Univar Canada Ltd.  
9800 Van Horne Way  
Richmond, BC V6X 1W5  
Telephone: 1-866-686-4827

### Emergency telephone number

**24 Hour Emergency Phone Number (CANUTEC):** 1-888-226-8832 (1-888-CAN-UTEC)

## 2. HAZARD IDENTIFICATION

### Hazardous Classification of the substance or mixture

Corrosive to metals	Category 1
Serious eye damage/eye irritation	Category 1

### Label elements

**Hazard pictograms**





**Signal Word: Danger**

**Hazard statements**

May be corrosive to metals  
Causes serious eye damage

**Precautionary Statements**

**Prevention**

Wash face, hands and any exposed skin thoroughly after handling  
Keep only in original container  
Wear eye/face protection

**Response**

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing  
If eye irritation persists: Get medical advice/attention  
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower  
IF SWALLOWED: Call a POISON CENTER or doctor if you feel unwell  
Rinse mouth

In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish

**Storage**

Store locked up  
Store in a well-ventilated place. Keep container tightly closed

**Disposal**

Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations

**Other Information**

**Unknown acute toxicity** No information available

### 3. COMPOSITION/INFORMATION ON INGREDIENTS

**Substance**

Chemical Name	CAS No	Weight-%	Synonyms
Sulfuric acid, aluminum salt	10043-01-3	20 - 30%	Sulfuric acid, aluminum salt

### 4. FIRST AID

**Description of first aid measures**



**General advice**

Show this safety data sheet to the doctor in attendance.

**Inhalation**

Remove to fresh air.

**Eye contact**

Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

**Skin contact**

Wash with soap and water. Take off contaminated clothing and wash before reuse. Get medical attention if irritation develops and persists.

**Ingestion**

Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Call a physician.

**Most important symptoms and effects, both acute and delayed:**

May cause digestive tract irritation. May cause respiratory tract irritation May cause moderate skin irritation. Direct contact may cause moderate irritation.

**Indication of any immediate medical attention and special treatment needed:****Note to physicians**

Treatment based on sound judgment of physician and individual reactions of patient.

## 5. FIRE-FIGHTING MEASURES

**Suitable Extinguishing Media**

Use extinguishing media appropriate for surrounding fire.

**Specific hazards arising from the substance or mixture**

Use water spray to cool fire-exposed containers and structures. Under fire conditions, toxic, corrosive fumes are emitted.

**Hazardous combustion products**

Thermal decomposition: after completely dry and heated to decomposition will produce sulphur oxides and aluminum oxides.

**Special protective equipment for fire-fighters**

Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

## 6. ACCIDENTAL RELEASE MEASURES

**Personal precautions, protective equipment and emergency procedures**

Use personal protective equipment as required. Wash thoroughly after handling.

**Environmental precautions**

Prevent further leakage or spillage if safe to do so. Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. Consult local authorities.

**Methods and materials for containment and cleaning up**



Small spills: soak up with absorbent material and scoop into containers. Large spills : prevent contamination of waterways. Dike and pump into suitable containers. Clean up residual with absorbent material, place in appropriate container and flush with water. Neutralize with lime or limestone powder.

## 7. HANDLING AND STORAGE

### Precautions for safe handling

Empty containers may contain hazardous product residues. Use appropriate personnel protective equipment. Wash thoroughly after handling. Avoid contact with eyes, skin and clothing.

### Conditions for safe storage, including any incompatibilities

Place away from incompatible materials. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid). Suitable material: Stainless steel, rubber-coated steel, plastic, plastic with fiberglass reinforcement. Unsuitable material: Common metal. Do not store in aluminum, copper, copper alloys and galvanized containers. Shelf life: 12 months in original, sealed container. Keep at temperatures between 0 and 30 °C. Reason: Quality.

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### Control parameters

#### **Exposure Limits**

Chemical Name	Alberta OEL	British Columbia OEL	Ontario	Quebec OEL	Exposure Limit - ACGIH	Immediately Dangerous to Life or Health - IDLH
Sulfuric acid, aluminum salt 10043-01-3	TWA: 2 mg/m <sup>3</sup>	Not available	Not available	TWA: 2 mg/m <sup>3</sup>	Not available	Not available

Consult local authorities for recommended exposure limits

### Appropriate engineering controls

#### **Engineering controls**

Local exhaust ventilation as necessary to maintain exposures to within applicable limits.

### Individual protection measures, such as personal protective equipment

#### **Eye/face protection**

Chemical goggles; also wear a face shield if splashing hazard exists.

#### **Hand protection**

Appropriate chemical resistant gloves should be worn.

#### **Skin and body protection**

Skin contact should be prevented through the use of suitable protective clothing, gloves and footwear, selected for conditions of use and exposure potential. Consideration must be given both to durability as well as permeation resistance.

#### **Respiratory protection**

If exposure exceeds occupational exposure limits, use an appropriate NIOSH-approved respirator.



**General hygiene considerations**

Handle in accordance with good industrial hygiene and safety practice.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

**Information on basic physical and chemical properties****Appearance**

<b>Physical state</b>	Liquid
<b>Color</b>	Colorless Clear
<b>Odor</b>	Slight ACIDIC
<b>Odor threshold</b>	No information available

<b>PROPERTIES</b>	<b>Values</b>	<b>Remarks • Method</b>
<b>pH</b>	<2.5	
<b>Melting point / freezing point</b>	-13 °C / 9 °F	
<b>Initial boiling point/boiling range</b>	110 °C / 230 °F	None known
<b>Flash point</b>	No data available	None known
<b>Evaporation rate</b>	similar to water	
<b>Flammability (solid, gas)</b>	No data available	None known
<b>Flammability Limit in Air</b>		None known
<b>Upper flammability limit:</b>	No data available	
<b>Lower flammability limit:</b>	No data available	
<b>Vapor pressure</b>	40 mmHg @ 35°C	
<b>Relative vapor density</b>	No data available	None known
<b>Specific Gravity</b>	1.2 - 1.36	
<b>Water solubility</b>	Completely soluble	
<b>Solubility in other solvents</b>	No data available	
<b>Partition coefficient</b>	No data available	None known
<b>Autoignition temperature</b>	No data available	None known
<b>Decomposition temperature</b>	No data available	None known
<b>Kinematic viscosity</b>	No data available	None known
<b>Dynamic viscosity</b>	No data available	None known
<b>Explosive properties</b>	No information available.	
<b>Oxidizing properties</b>	Not oxidizing.	
<b>Molecular weight</b>	No information available	
<b>VOC Percentage Volatility</b>	No information available	
<b>Liquid Density</b>	No information available	
<b>Bulk density</b>	No information available	

## 10. STABILITY AND REACTIVITY

**Reactivity/Chemical Stability**

Stable under normal conditions

**Possibility of hazardous reactions**

No additional remark.

**Conditions to avoid**

Avoid contact with mineral acids, excessive heat and bases/alkalis.

**Incompatible materials**

Metals such as iron or steel which are subject to corrosion. Carbon steel, aluminum, carbon, brasses and nylon.

**Hazardous decomposition products**



Thermal decomposition: after completely dry and heated to decomposition will produce sulphur oxides and aluminum oxides. Decomposition : 650 °C/ 1202 °F.

## 11. TOXICOLOGICAL INFORMATION

### Information on likely routes of exposure

#### **Inhalation**

May cause respiratory tract irritation.

#### **Eye contact**

Direct contact may cause moderate irritation.

#### **Skin contact**

May cause moderate skin irritation.

#### **Ingestion**

May cause digestive tract irritation.

### Information on toxicological effects

#### **Symptoms**

No additional information available.

### Numerical measures of toxicity

#### **Acute toxicity**

The following values are calculated based on chapter 3.1 of the GHS document .

**ATEmix (oral)** 1,930.00 mg/kg

**Unknown acute toxicity** No information available

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Sulfuric acid, aluminum salt 10043-01-3	= 1930 mg/kg ( Rat )	Not available	Not available

### Delayed and immediate effects as well as chronic effects from short and long-term exposure

#### **Skin corrosion/irritation**

May cause moderate skin irritation.

#### **Serious eye damage/eye irritation**

Direct contact may cause moderate irritation.

#### **Respiratory or skin sensitization**

No information available.

#### **Germ cell mutagenicity**

No information available.

#### **Carcinogenicity**

No information available.

Chemical Name	ACGIH	IARC	NTP	OSHA
Sulfuric acid, aluminum salt 10043-01-3	Not available	Not available	Not available	Not available



**Reproductive toxicity**

No information available.

**Specific target organ systemic toxicity - single exposure**

No information available.

**Specific target organ systemic toxicity - repeated exposure**

No information available.

**Aspiration hazard**

No information available.

**12. ECOLOGICAL INFORMATION****Ecotoxicity**

May lower pH of waterways and adversely effect aquatic life.

Chemical Name	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Fish Species Data	Toxicity to microorganisms	Crustacea
Sulfuric acid, aluminum salt 10043-01-3	Not available	Not available	Not available	Not available

**Persistence and degradability** No information available.**Bioaccumulation** No information available.

Chemical Name	Partition coefficient
Sulfuric acid, aluminum salt 10043-01-3	Not available

**Other adverse effects** No information available.**13. DISPOSAL CONSIDERATIONS****Waste treatment methods**

Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Do not reuse empty containers.

**14. TRANSPORT INFORMATION****TDG (Canada):**

<b>UN Number</b>	UN3264
<b>Shipping name</b>	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (ALUMINUM SULPHATE)
<b>Class</b>	8
<b>Packing Group</b>	III
<b>Marine pollutant</b>	Not available.

**DOT (U.S.):**

<b>UN Number</b>	UN3264
<b>Shipping name</b>	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S. (ALUMINUM SULPHATE)
<b>Class</b>	8



Packing Group  
Marine pollutant

III  
Not available

## 15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

NSF International



### Additional information

Maximum use for potable water 400 mg/L. Only products bearing the NSF Mark on the product, product packaging, and/or documentation shipped with the product are Certified.

### U.S. Regulatory Rules

Chemical Name	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Sulfuric acid, aluminum salt - 10043-01-3	Not Listed	Listed	Not Listed

### International Inventories

TSCA Complies  
DSL/NDSL Complies

### Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory

DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

## 16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION

**NFPA:** Health hazards 1 Flammability 0 Instability 0 Physical and chemical properties -  
**HMIS Health Rating:** Health hazards 1 Flammability 0 Physical hazards 0 Personal protection X

### Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA TWA (time-weighted average) STEL STEL (Short Term Exposure Limit)  
Ceiling Maximum limit value \* Skin designation

**Prepared By:** The Environment, Health and Safety Department of Univar Canada Ltd.

**Preparation Date:** 07/Nov/2017

**Revision Date:** 07/Nov/2017

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**End of Safety Data Sheet**





# SAFETY DATA SHEET

SDS00256  
SODA ASH 58% DENSE

Preparation Date: 10/Jan/2018

Version: 2

## 1. IDENTIFICATION

### Product identifier

**Product Name** SODA ASH 58% DENSE

### Other means of identification

**Product Code(s)** SDS00256

**Synonyms** Sodium carbonate, anhydrous. Carbonic acid, disodium salt; Disodium carbonate; Soda ash

### Recommended use of the chemical and restrictions on use

**Recommended Use** Soda salts. Manufacture of glass. Soap Cleaners and water softeners. Pulp and paper. Photographical agent. Water treatment. pH adjustment

**Restricted Uses** No information available

### Initial Supplier Identifier

Univar Canada Ltd.  
9800 Van Horne Way  
Richmond, BC V6X 1W5  
Telephone: 1-866-686-4827

### Emergency telephone number

**24 Hour Emergency Phone Number (CANUTEC): 1-888-226-8832 (1-888-CAN-UTEC)**

## 2. HAZARD IDENTIFICATION

### Hazardous Classification of the substance or mixture

Serious eye damage/eye irritation	Category 1
Specific target organ toxicity (single exposure)	Category 3

### Label elements



**Hazard pictograms****Signal Word: Danger****Hazard statements**

Causes serious eye damage  
May cause respiratory irritation

**Precautionary Statements****Prevention**

Do not breathe dust/fume/gas/mist/vapors/spray  
Wash face, hands and any exposed skin thoroughly after handling  
Wear protective gloves/protective clothing/eye protection/face protection

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower

IF INHALED: Remove person to fresh air and keep comfortable for breathing

IF SWALLOWED: Rinse mouth. DO NOT induce vomiting

**Storage**

Store locked up  
Store in a well-ventilated place. Keep container tightly closed

**Disposal**

Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations

Direct skin contact may cause slight or mild, transient irritation. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

**Unknown acute toxicity**                      No information available

**3. COMPOSITION/INFORMATION ON INGREDIENTS****Substance**

Chemical Name	CAS No	Weight-%	Synonyms
Sodium Carbonate	497-19-8	90 - 100%	Sodium Carbonate

**4. FIRST AID****Description of first aid measures****General advice**

Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.



**Inhalation**

Remove to fresh air. If breathing has stopped, give artificial respiration. Get medical attention immediately. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. If breathing is difficult, (trained personnel should) give oxygen. Delayed pulmonary edema may occur.

**Eye contact**

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Keep eye wide open while rinsing. Do not rub affected area. Remove contact lenses, if present and easy to do. Continue rinsing. Get immediate medical advice/attention.

**Skin contact**

Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get immediate medical advice/attention.

**Ingestion**

Do NOT induce vomiting. Clean mouth with water and drink afterwards plenty of water. Never give anything by mouth to an unconscious person. Get immediate medical advice/attention.

**Self-protection of the first aider**

Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Avoid contact with skin, eyes or clothing. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Wear personal protective clothing (see section 8).

**Most important symptoms and effects, both acute and delayed:**

May cause gastrointestinal irritation, nausea, vomiting and diarrhea. May cause severe eye irritation. Symptoms include redness, swelling, itching and pain. Material is irritating to mucous membrane and upper respiratory tract. Exposure can cause coughing, chest pains and difficulty in breathing. Effects may include pain, marked redness and swelling.

**Indication of any immediate medical attention and special treatment needed:****Note to physicians**

Treatment based on sound judgment of physician and individual reactions of patient.

## 5. FIRE-FIGHTING MEASURES

**Suitable Extinguishing Media**

Use extinguishing media appropriate for surrounding fire. Does not burn.

**Specific hazards arising from the substance or mixture**

Not flammable.

**Hazardous combustion products**

Carbon dioxide. Decomposition temperature: >400°C / 752 °F.

**Special protective equipment for fire-fighters**

Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

## 6. ACCIDENTAL RELEASE MEASURES

**Personal precautions, protective equipment and emergency procedures**

Attention! Corrosive material. Avoid contact with skin, eyes or clothing. Ensure adequate ventilation. Use personal protective equipment as required. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak.

**Environmental precautions**



Prevent further leakage or spillage if safe to do so. Should not be released into the environment. Do not allow to enter into soil/subsoil. Prevent product from entering drains.

#### **Methods and materials for containment and cleaning up**

Stop leak if you can do it without risk. Shovel, sweep up or use industrial vacuum cleaner to pick up. Sweep up and place in an appropriate closed container. Avoid raising dust.

## **7. HANDLING AND STORAGE**

#### **Precautions for safe handling**

Use good personal hygiene. Avoid prolonged contact with eyes or prolonged skin contact. Avoid breathing in dust. When dissolving, add to water cautiously while stirring; solutions can get hot.

#### **Conditions for safe storage, including any incompatibilities**

Store in a cool, dry, well ventilated area. Prolonged storage may cause product to cake and become damp from atmospheric moisture. Store away from acids.

## **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

#### **Control parameters**

##### **Exposure Limits**

This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Chemical Name	Alberta OEL	British Columbia OEL	Ontario	Quebec OEL	Exposure Limit - ACGIH	Immediately Dangerous to Life or Health - IDLH
Sodium Carbonate 497-19-8	Not available	Not available	Not available	Not available	Not available	Not available

Consult local authorities for recommended exposure limits

#### **Appropriate engineering controls**

##### **Engineering controls**

Local exhaust ventilation as necessary to maintain exposures to within applicable limits.

#### **Individual protection measures, such as personal protective equipment**

##### **Eye/face protection**

Safety glasses with side shields or chemical goggles.

##### **Hand protection**

Appropriate chemical resistant gloves should be worn. Break through time >8 hours. Butyl rubber gloves. Natural rubber gloves. Neoprene gloves. Nitrile gloves. Polyvinylchloride (PVC) gloves. Viton gloves. Silver Shield (R). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials as well as the instructions/specifications provided by the glove supplier.

##### **Skin and body protection**

As a minimum, wear long-sleeve shirts, trousers, and gloves for routine product use.



**Respiratory protection**

For dusty or misty conditions, wear NIOSH-approved dust or mist respirator.

**General hygiene considerations**

Avoid contact with skin, eyes or clothing. Wear suitable gloves and eye/face protection. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing and gloves, including the inside, before re-use. Contaminated work clothing should not be allowed out of the workplace. Regular cleaning of equipment, work area and clothing is recommended. Wash hands before breaks and immediately after handling the product.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

**Information on basic physical and chemical properties****Appearance**

<b>Physical state</b>	Solid
<b>Color</b>	White
<b>Odor</b>	Odorless
<b>Odor threshold</b>	No information available

**PROPERTIES****Values****Remarks • Method**

<b>pH</b>	11.3-11.4 (1% solution), 11.6 (5% solution), 11.7 (10% solution) @ 20°C	
<b>Melting point / freezing point</b>	851 °C / 1563.8 °F	
<b>Initial boiling point/boiling range</b>	No data available	None known
<b>Flash point</b>	No data available	None known
<b>Evaporation rate</b>	No data available	None known
<b>Flammability (solid, gas)</b>	No data available	None known
<b>Flammability Limit in Air</b>		
<b>Upper flammability limit:</b>	No data available	
<b>Lower flammability limit:</b>	No data available	
<b>Vapor pressure</b>	No data available	None known
<b>Relative vapor density</b>	No data available	None known
<b>Specific Gravity</b>	2.533 @ 20°C	
<b>Water solubility</b>	Soluble in water	
<b>Solubility in other solvents</b>	No data available	
<b>Partition coefficient</b>	No data available	
<b>Autoignition temperature</b>	No data available	None known
<b>Decomposition temperature</b>	>400°C/752°F	
<b>Kinematic viscosity</b>	No data available	None known
<b>Dynamic viscosity</b>	No data available	None known
<b>Explosive properties</b>	No information available.	
<b>Oxidizing properties</b>	No information available.	
<b>Molecular weight</b>	105.99	
<b>VOC Percentage Volatility</b>	No information available	
<b>Liquid Density</b>	No information available	
<b>Bulk density</b>	No information available	

## 10. STABILITY AND REACTIVITY

**Reactivity/Chemical Stability**

Stable

**Possibility of hazardous reactions**

Contact with acids will release carbon dioxide gas. Can react violently with red hot aluminum metal; fluorine gas; lithium; and 2,4,6-trinitrotoluene.



**Hazardous polymerization**

Will not occur.

**Conditions to avoid**

Hygroscopic (absorbs moisture from the air). Simultaneous exposure to soda ash and lime dusts (CaO). In the presence of moisture (i.e. perspiration) the two materials combine to form corrosive caustic soda (NaOH) which may cause burns.

**Incompatible materials**

Acids. Soda Ash is corrosive to aluminum, lead, and zinc and zinc brasses when in solution and to aluminum when high humidity is present. Silver nitrate. Magnesium. Fluorine. Lithium. Calcium hypochlorite.

**Hazardous decomposition products**

Carbon dioxide. Decomposition temperature: >400°C / 752 °F.

**11. TOXICOLOGICAL INFORMATION****Information on likely routes of exposure****Inhalation**

Material is irritating to mucous membrane and upper respiratory tract. Exposure can cause coughing, chest pains and difficulty in breathing.

**Eye contact**

Causes serious eye damage. Effects may include pain, marked redness and swelling.

**Skin contact**

Symptoms include redness, swelling, itching and pain.

**Ingestion**

May cause gastrointestinal irritation, nausea, vomiting and diarrhea.

**Information on toxicological effects****Symptoms**

Excessive contact may produce "soda ulcers" on hands and perforation of the nasal septum. Sensitivity reactions may occur from prolonged and repeated exposure.

**Numerical measures of toxicity****Acute toxicity**

The following values are calculated based on chapter 3.1 of the GHS document .

ATEmix (oral) 4,098.00 mg/kg

Unknown acute toxicity No information available

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Sodium Carbonate 497-19-8	= 4090 mg/kg ( Rat )	Not available	= 2300 mg/m <sup>3</sup> ( Rat ) 2 h

**Delayed and immediate effects as well as chronic effects from short and long-term exposure****Skin corrosion/irritation**

Symptoms include redness, swelling, itching and pain.

**Serious eye damage/eye irritation**

Causes serious eye damage. Effects may include pain, marked redness and swelling.

**Respiratory or skin sensitization**



No information available.

**Germ cell mutagenicity**

No information available.

**Carcinogenicity**

No information available.

Chemical Name	ACGIH	IARC	NTP	OSHA
Sodium Carbonate 497-19-8	Not available	Not available	Not available	Not available

**Reproductive toxicity**

No information available.

**Specific target organ systemic toxicity - single exposure**

May cause respiratory irritation.

**Specific target organ systemic toxicity - repeated exposure**

No information available.

**Aspiration hazard**

No information available.

**12. ECOLOGICAL INFORMATION****Ecotoxicity**

Chemical Name	Ecotoxicity - Freshwater Algae Data	Ecotoxicity - Fish Species Data	Toxicity to microorganisms	Crustacea
Sodium Carbonate 497-19-8	Not available	310 - 1220 mg/L LC50 (Pimephales promelas) 96 h static 300 mg/L LC50 (Lepomis macrochirus) 96 h static	Not available	EC50: =265mg/L (48h, Daphnia magna)

**Persistence and degradability** No information available.

**Bioaccumulation** No information available.

Chemical Name	Partition coefficient
Sodium Carbonate 497-19-8	Not available

**Other adverse effects** No information available.

**13. DISPOSAL CONSIDERATIONS****Waste treatment methods**

Disposal of all wastes must be done in accordance with municipal, provincial and federal regulations.

Do not reuse empty containers.

**14. TRANSPORT INFORMATION**



**TDG (Canada):**

UN Number	Not applicable
Shipping name	Not regulated
Class	Not applicable
Packing Group	Not applicable
Marine pollutant	Not available.

**DOT (U.S.)**

UN Number	Not applicable
Shipping name	Not regulated
Class	Not applicable
Packing Group	Not applicable
Marine pollutant	Not available

**15. REGULATORY INFORMATION****Safety, health and environmental regulations/legislation specific for the substance or mixture**

NSF International

**Additional information**

Only products bearing the NSF Mark on the product, product packaging, and/or documentation shipped with the product are Certified. Maximum use of potable water 100 mg/L.

**U.S. Regulatory Rules**

Chemical Name	CERCLA/SARA - Section 302:	SARA (311, 312) Hazard Class:	CERCLA/SARA - Section 313:
Sodium Carbonate - 497-19-8	Not Listed	Not Listed	Not Listed

**International Inventories**

TSCA	Complies
DSL/NDSL	Complies

**Legend:**

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory

DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

**16. OTHER INFORMATION, INCLUDING DATE OF PREPARATION OF THE LAST REVISION**

<b>NFPA:</b>	Health hazards 3	Flammability 0	Instability 0	Physical and chemical properties -
<b>HMIS Health Rating:</b>	Health hazards 3	Flammability 0	Physical hazards 0	Personal protection X

**Legend** Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Prepared By: The Environment, Health and Safety Department of Univar Canada Ltd.

Preparation Date: 10/Jan/2018

Revision Date: 10/Jan/2018



**Disclaimer****NOTICE TO READER:**

Univar expressly disclaims all express or implied warranties of merchantability and fitness for a particular purpose, with respect to the product or information provided herein, and shall under no circumstances be liable for incidental or consequential damages.

Do not use ingredient information and/or ingredient percentages in this SDS as a product specification. For product specification information refer to a Product Specification Sheet and/or a Certificate of Analysis. These can be obtained from your local Univar Sales Office.

All information appearing herein is based upon data obtained from the manufacturer and/or recognized technical sources. While the information is believed to be accurate, Univar makes no representations as to its accuracy or sufficiency. Conditions of use are beyond Univar's control and therefore users are responsible to verify this data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product, or from the publication or use of, or reliance upon, information contained herein. This information relates only to the product designated herein, and does not relate to its use in combination with any other material or in any other process.

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**End of Safety Data Sheet**





# MATERIAL SAFETY DATA SHEET

Revision date: 06/15/2011

Revision number: 3

## 1. PRODUCT AND COMPANY IDENTIFICATION

**Product Name** BioRemove 5895

**Contact Manufacturer** Novozymes Biologicals Inc.  
5400 Corporate Circle  
Salem, VA, USA 24153

**Information Telephone Number** 1-540-389-9361

**Emergency Telephone Number** 1-800-424-9300 (Chemtrec) 24 hours every day

Health Hazard	1
Fire Hazard	0
Reactivity	0



## 2. HAZARDS IDENTIFICATION

### CAUTION

#### Emergency Overview

Contact may cause eye and skin irritation

**Appearance** Opaque

**Physical State** Liquid

**Odor** Slight fermentation odor

### Potential Health Effects

**Principle Routes of Exposure** Eye contact, Skin contact, Inhalation

#### Acute Effects

**Eyes**

May cause slight irritation

**Skin**

Substance may cause slight skin irritation

**Inhalation**

May cause irritation of respiratory tract

**Ingestion**

Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhoea

#### Chronic Effects

**Chronic Toxicity** No information available

See Section 11 for additional Toxicological information.

**Aggravated Medical Conditions** No information available

**Potential Environmental Effects** There is no known ecological information for this product  
See Section 12 for additional Ecological information

## 3. COMPOSITION/INFORMATION ON INGREDIENTS

### Hazardous Components

Chemical Name	CAS-No	Weight %
Water	7732-18-5	95-100%
Viable Bacteria Cultures	Not Applicable	1-5%

Ingredients not listed are either non-hazardous or under reportable concentrations

## 4. FIRST AID MEASURES

<b>Eye Contact</b>	Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician
<b>Skin Contact</b>	Wash off immediately with soap and plenty of water
<b>Inhalation</b>	Move to fresh air
<b>Ingestion</b>	Clean mouth with water and afterwards drink plenty of water
<b>Notes to Physician</b>	Treat symptomatically



## 5. FIRE-FIGHTING MEASURES

<b>Flammable Properties</b>	Slightly flammable according to HMIS criteria
<b>Suitable Extinguishing Media</b>	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
<b>Unsuitable Extinguishing Media</b>	None
<b>Hazardous Combustion Products</b>	None
<b>Specific Hazards Arising from the Chemical</b>	May cause allergic respiratory reaction.
<b>Protective Equipment and Precautions for Firefighters</b>	Self-contained breathing apparatus and standard turn-out apparel

## 6. ACCIDENTAL RELEASE MEASURES

<b>Personal Precautions</b>	For personal protection see section 8
<b>Environmental Precautions</b>	Spilled preparation should be removed immediately to avoid formation of dust from dried preparation. Take up by mechanical means preferably by a vacuum cleaner equipped with a high efficiency filter. Flush remainder carefully with plenty of water. Avoid splashing and high pressure washing (avoid formation of aerosols). Ensure sufficient ventilation. Wash contaminated clothing. .
<b>Methods for cleaning up</b>	Avoid formation of dust and aerosols Spilled preparation should be removed immediately to avoid formation of dust from dried preparation. Take up by mechanical means preferably by a vacuum cleaner equipped with a HEPA (High Efficiency Particulate Air) filter. Flush remainder carefully with plenty of water. Avoid splashing, high pressure washing or compressed air cleaning to avoid formation of aerosols. Ensure sufficient ventilation. Wash contaminated clothing.
For personal protection see section 8	



## 7. HANDLING AND STORAGE

<b>Handling</b>	Avoid formation of dust and aerosols  Ensure adequate ventilation
<b>General Precautions</b>	The Substance should be handled under conditions of good industrial hygiene and in conformity with any local regulations in order to avoid unnecessary exposure..
<b>Storage</b>	Keep tightly closed in a dry and cool place.
<b>Temperature</b>	Keep in a dry, cool and well-ventilated place.
<b>Storage Conditions</b>	In unbroken packaging - dry and protect from the sun. The product has been formulated for optimal stability. Extended storage or adverse conditions such as higher temperatures or higher humidity may lead to a higher dosage requirement.
<b>Conditions To Avoid</b>	Avoid Temperatures above 45 C to preserve biological stability. Avoid freezing temperatures. Strong Acids or alkali compounds may inactivate biological cultures. Avoid strong oxidizing agents.
<b>Incompatible Materials</b>	Strong acids or alkali compounds may inactivate biological cultures

## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

### Occupational exposure controls

<b>Engineering Controls</b>	Ensure adequate ventilation, especially in confined areas Maintain good conditions of industrial hygiene. Some processes may require enclosures, local exhaust ventilation, or other engineering controls to control airborne levels. Additional handling and healthy/safety information is available upon request
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### Personal Protective Equipment

<b>Respiratory Protection</b>	In case of insufficient ventilation wear suitable respiratory equipment that meets HEPA/P100 specifications
<b>Eye Protection</b>	Safety glasses with side-shields
<b>Skin Protection</b>	Long sleeved clothing
<b>Hand Protection</b>	Protective gloves
<b>General Hygiene Considerations</b>	Handle in accordance with good industrial hygiene and safety practices
<b>Environmental exposure controls</b>	Local authorities should be advised if significant spillages cannot be contained



## 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Opaque
Physical State	Liquid
Odor	Slight fermentation odor
pH	7.0-8.0
Boiling Point/Range	No information available
Melting Point/Range	No information available
Flash Point	No information available
Flammability (solid, gas)	No information available
Explosive Properties	No information available
Oxidizing Properties	No information available
Vapor Pressure	No information available
Relative density	No data available
Solubility	No information available
Partition Coefficient (n-octanol/water)	No information available

The physical data presented above are typical values and should not be construed as a specification

## 10. STABILITY AND REACTIVITY

Chemical stability	Stable under recommended storage conditions
Conditions to Avoid	Stable under normal conditions Excessive temperature variations below 32F or above 155F
Materials to avoid	None
Hazardous Decomposition Products	None
Possibility of Hazardous Reactions	None

## 11. TOXICOLOGICAL INFORMATION

### Acute Toxicity

Ingestion, LD50 Rat Oral (mg/kg):	Not Determined
Inhalation, LC50 Rat inhalation (mg/l/4hr)	Not Determined
Skin, LD50 Rat Dermal (mg/kg)	Not Determined
Eye Irritation	Not Determined

### Chronic Toxicity

Sensitization	According to our experience and to the information provided to us, the product does not have any harmful effects if it is used and handled as specified
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This product is formulated using a range of microorganisms specially selected from the natural environment



## 12. ECOLOGICAL INFORMATION

### Ecotoxicity

This product is not expected to pose an environmental hazard. No Toxicity Data is available specifically for soil organisms, plants and terrestrial animals.

<b>Environmental Effects</b>	The data available do not support any environmental hazard
<b>Persistence/Degradability</b>	The organic components of the product are biodegradable.
<b>Bioaccumulative Potential</b>	According to experience not expected
<b>Mobility</b>	Not available
<b>Other adverse effects</b>	No known effect

## 13. DISPOSAL CONSIDERATIONS

<b>Waste Disposal Method</b>	Dispose of contents/container in accordance with local regulation.
<b>Contaminated Packaging</b>	Dispose of wastes in an approved waste disposal facility.

## 14. TRANSPORT INFORMATION

<b>Transport Regulations</b>	Not dangerous goods
<b>IMDG/IMO</b>	Not regulated
<b>RID</b>	Not regulated
<b>ADR</b>	Not regulated
<b>ICAO</b>	Not regulated
<b>IATA</b>	Not regulated
<b>DOT</b>	Not regulated



## 15. REGULATORY INFORMATION

### International Inventories

TSCA	Complies
PICCS	Complies
KECL	Complies
ENCS	Complies
CHINA	Complies
AICS	Complies
DSL/NDSL	Complies

### USA, Federal Regulations

#### **SARA 313**

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and 40 CFR Part 372.

#### **SARA 311/312 Hazardous Categorization**

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

### USA, State Regulations

#### **California Proposition 65**

This product contains the following Proposition 65 chemicals:

### Canada

#### **WHMIS Hazard Class**

Controlled product hazard class D2 A (respiratory sensitizer)

#### **WHMIS Statement**

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all the information required by the CPR.



## 16. OTHER INFORMATION

### Disclaimer

The information provided on this MSDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text. Furthermore, as the conditions of use are beyond the control of Novozymes, it is the responsibility of the customer to determine the conditions of safe use of these products.



### Report version

1 / ANSI / English

**End of Material Safety Data Sheet**





**AGNICO EAGLE**

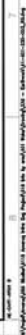
Operation & Maintenance Manual  
Sewage Treatment Plant

December 2018

## **Appendix B: Drawings**

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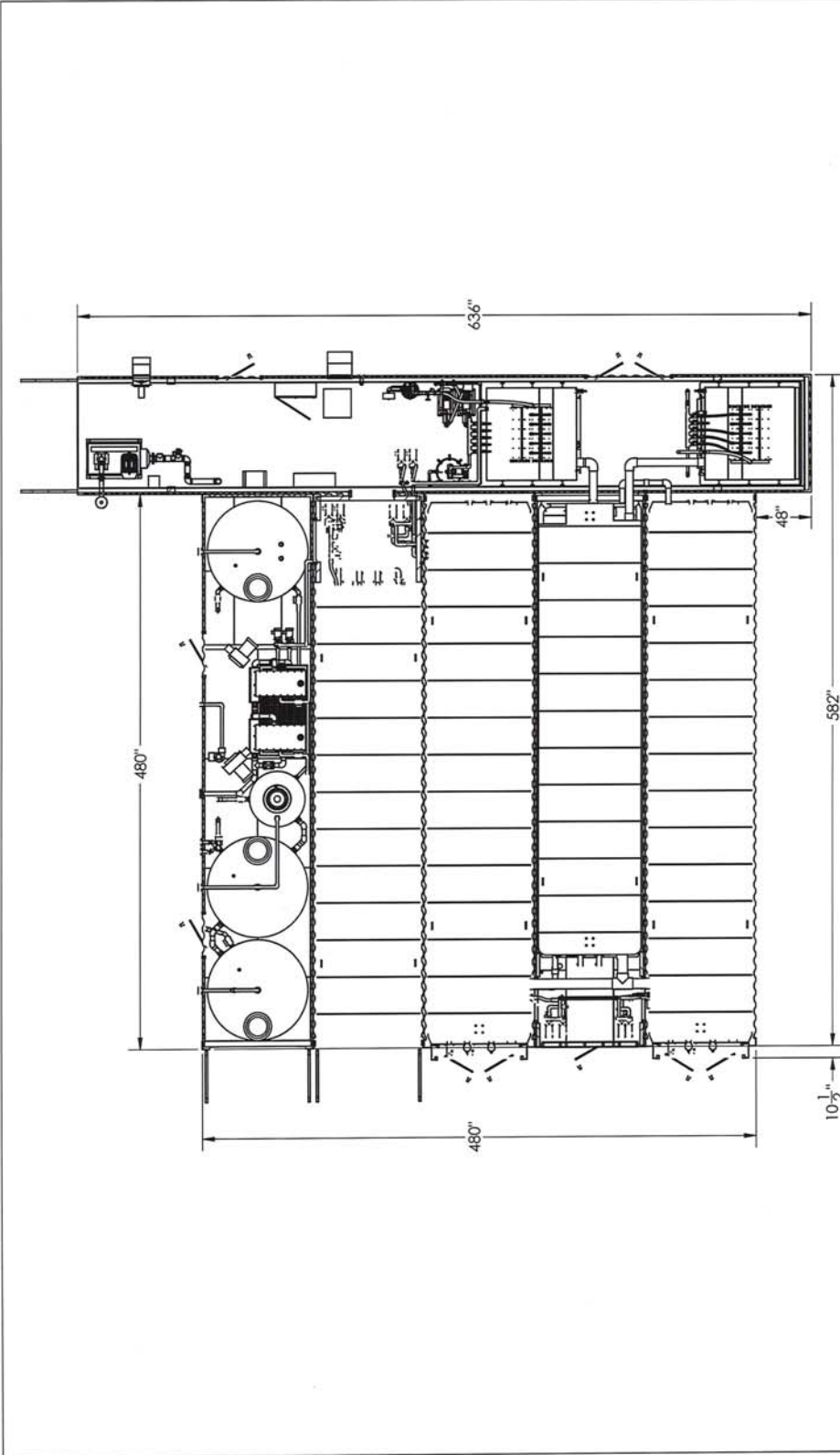






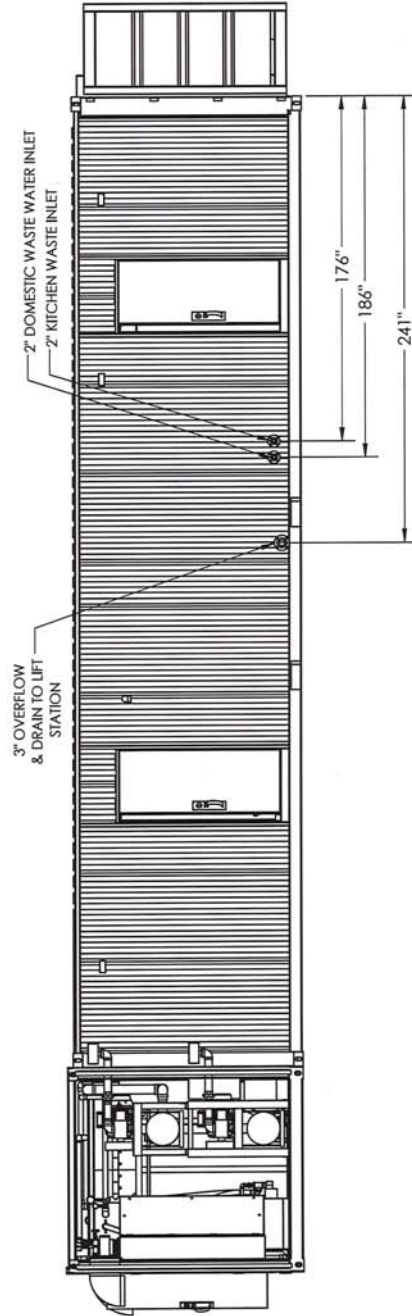






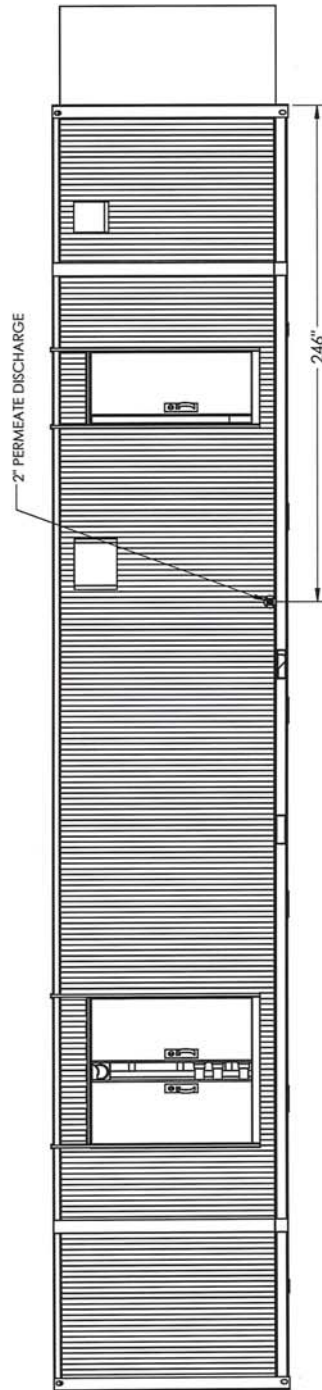
 <b>newterra</b> CONSTRUCTION UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES AND DECIMALS ARE TO REMAIN AND CANNOT BE REDUCED OR REPRODUCED WITHOUT WRITTEN CONSENT.	GENERAL TOLERANCES				DWG. NO:		PROJECT NUMBER	
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	$XX \pm \frac{1}{4}''$							
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	1	26/05/17	GH	FOR PRODUCTION			CUSTOMER:	AGNICO EAGLE
	B	26/05/17	GH	FOR PRODUCTION			DATE:	19/05/17
	A2	26/05/17	GH	REVISED LAYOUT			SHEET	2 OF 4
	A	19/03/2017	GH	FOR REVIEW				
		LEVEL/DATE		BY	REVISION			





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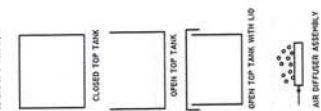




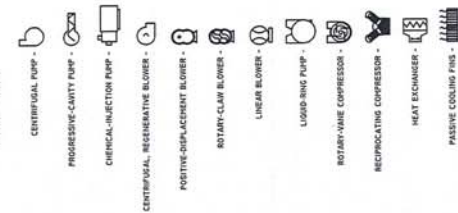
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# EQUIPMENT



# EQUIPMENT



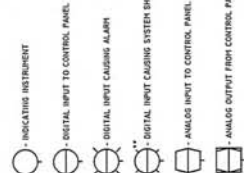
# INSTRUMENT DESIGNATION

INPUT	1st MODIFIER	2nd MODIFIER	3rd MODIFIER	OUTPUT	1st MODIFIER
A - CYCLE					B - BLOWER
B - FLOW					C - COMPRESSOR
C - GAS (L.E.)					D - AIR DRYER
D - CURRENT					E - FAN
E - LEVEL					F - HEATER
F - PRESSURE					G - MOTORISED
G - SPEED					H - PNEUMATIC
H - TEMPERATURE					I - SOLENOID
I - POSITION					J - VALVE
J - POSITION					K - VALVE
K - POSITION					L - VALVE
L - POSITION					M - VALVE
M - POSITION					N - VALVE
N - POSITION					O - VALVE
O - POSITION					P - VALVE
P - POSITION					Q - VALVE
Q - POSITION					R - VALVE
R - POSITION					S - VALVE
S - POSITION					T - VALVE
T - POSITION					U - VALVE
U - POSITION					V - VALVE
V - POSITION					W - VALVE
W - POSITION					X - VALVE
X - POSITION					Y - VALVE
Y - POSITION					Z - VALVE

# SYSTEM POSITION DESIGNATION

- 1000 - LIFT STATION
- 2000 - INLET SCREEN
- 3000 - EQUALIZATION TANK
- 4000 - AERATION TANK
- 5000 - AERATION TANK
- 6000 - MBR TANK
- 7000 - MBR TANK
- 8000 - MBR TANK
- 9000 - MBR TANK
- 10000 - MBR TANK
- 11000 - MBR TANK
- 12000 - MBR TANK
- 13000 - MBR TANK
- 14000 - MBR TANK
- 15000 - MBR TANK
- 16000 - MBR TANK
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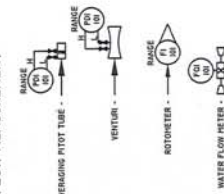
# INSTRUMENT IDENTIFICATION



# EQUIPMENT

- AV - ACTIVATED VALVE
- B - BLOWER
- H - HEATER
- HY - HYDRAULIC
- IN - INSULATED
- IS - ISOLATED
- SV - SOLID VALVE
- TR - TANK
- UL - ULTRAVIOLET LIGHT
- VFD - VARIABLE FREQUENCY DRIVE

# FLOW MEASUREMENT



# NOTES

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www.newterra.com

D	1-401 MAX PIPE SIZE
C	AS-BUILT
B	PRODUCTION
A2	SUBMITTAL REVISIONS
A	SUBMITTAL
LEVEL	REVISION

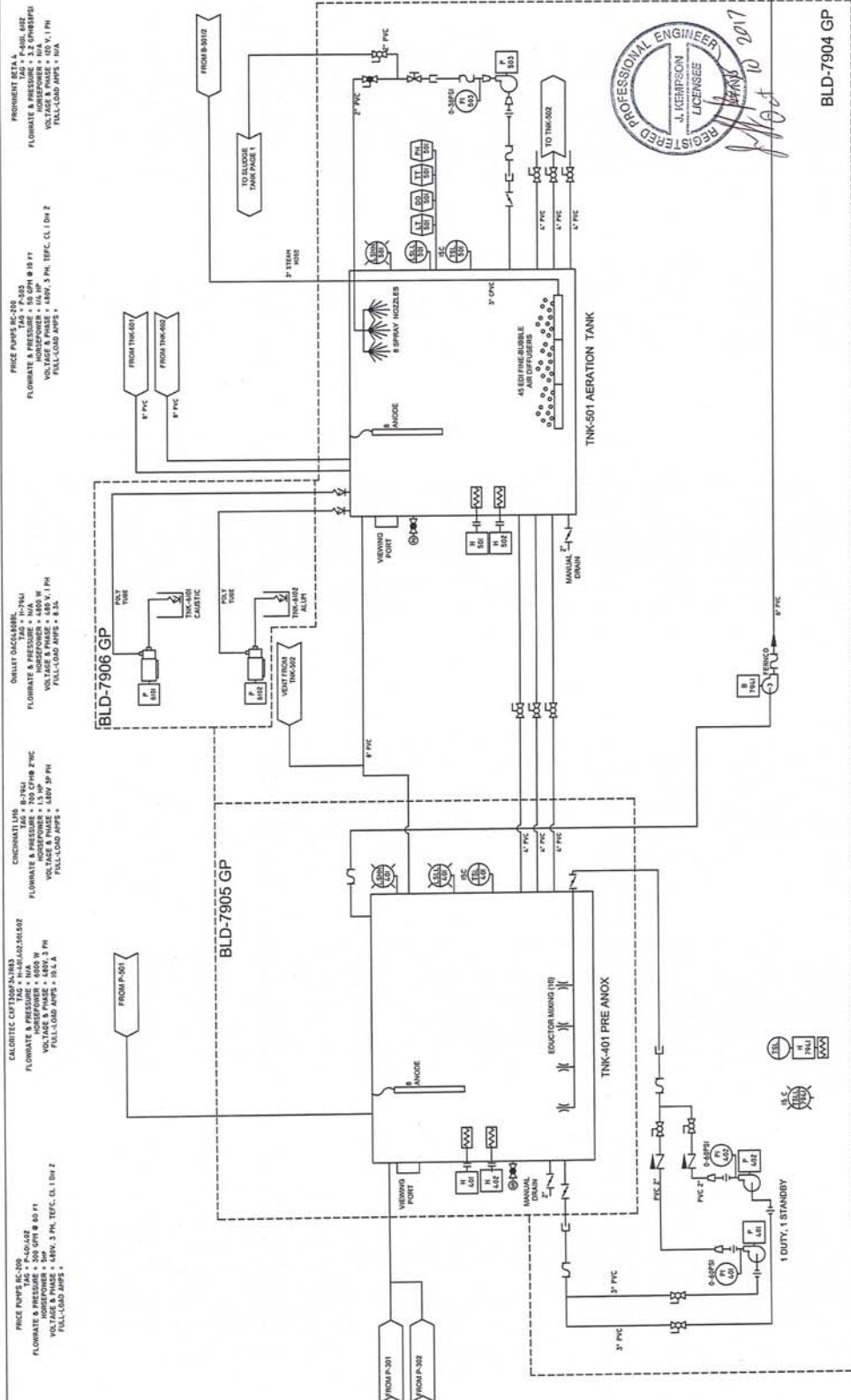
PROJECT NUMBER	1704432
TITLE AND LOCATION	AMARUQ MINE
CLIENT	AGNICO EAGLE MINE
DESIGNER	NEWTERRA
DATE	DATE
BY	BY

PROPERTY	MH
DATE	DATE
BY	BY







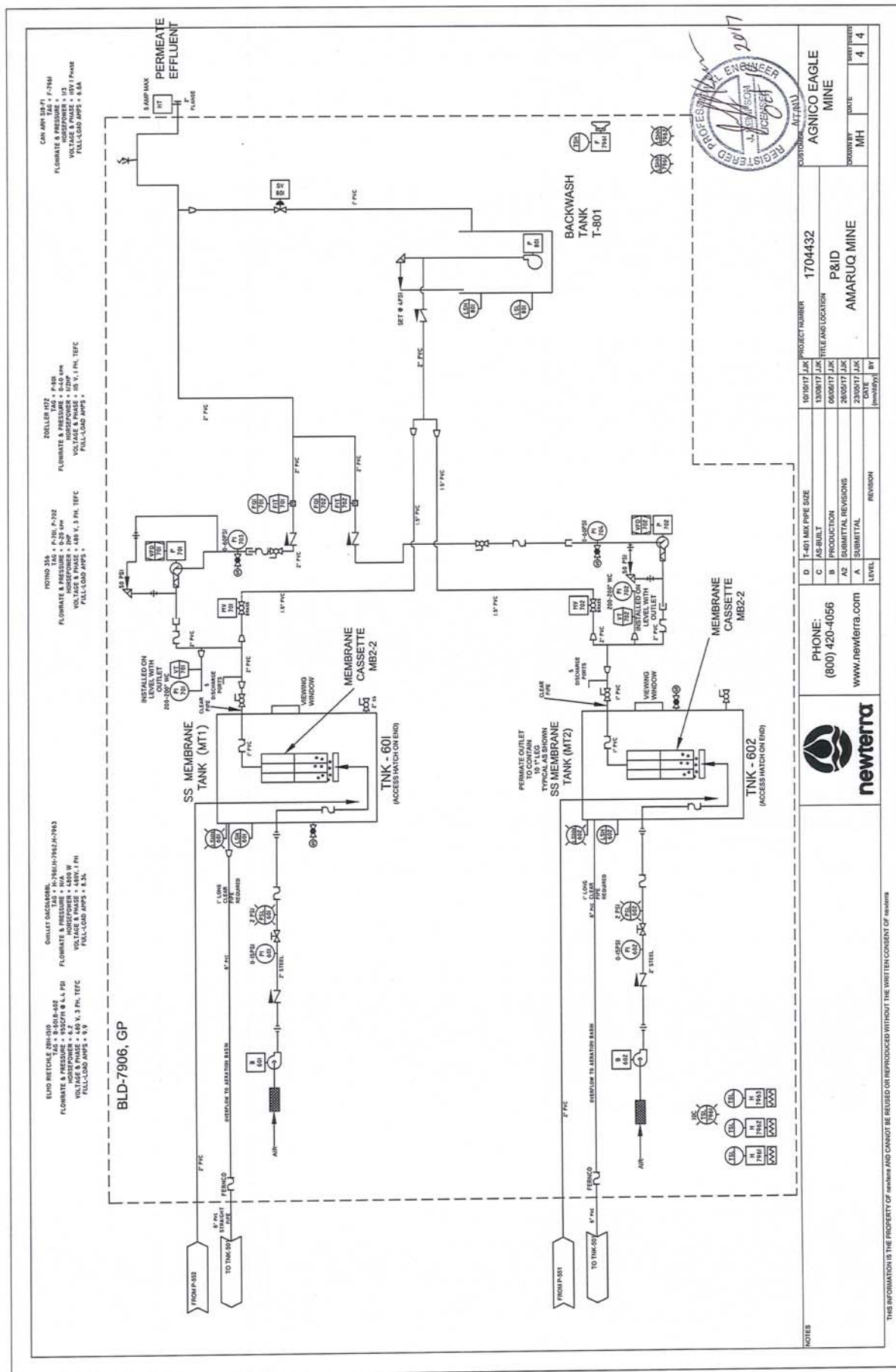


NOTES	<div></div> <div><b>newterra</b></div>	PHONE: (800) 420-4056  www.newterra.com	D	T-401 MIX PIPE SIZE	10/01/17	JAK	PROJECT NUMBER  1704432  TITLE AND LOCATION  P&ID  AMARUQ MINE	PORTOWNER  AGNICO EAGLE MINE
			C	AS-BUILT	13/06/17	JAK		
			B	PRODUCTION	06/06/17	JAK		
			AZ	SUBMITTAL REVISIONS	26/05/17	JAK		
			A	SUBMITTAL	23/05/17	JAK		
	LEVEL	REVISION	DATE (mm/dd/yyyy)	BY	THROWBY MH	DATE	SHEET COUNT 2 / 4	













**AGNICO EAGLE**

Operation & Maintenance Manual  
Sewage Treatment Plant

December 2018

## **Appendix C: Newterra Operation and Maintenance Manual**

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# **newterra MBR Wastewater Treatment Plant OPERATION AND MAINTENANCE MANUAL**

<b>System:</b>	<b>newterra MBR WWTP</b>
<b>Location:</b>	<b>Amaruq mine, Kivalliq District of Nunavut</b>
<b>Client:</b>	<b>Agnico Eagle</b>
<b>Project:</b>	<b>1704432</b>
<b>Rev.:</b>	<b>1</b>
<b>Date:</b>	<b>August 2017</b>







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Appendix E	Technical Specs and Brochures for Parts and Equipment
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Appendix H	Biological Treatment & Monitoring Parameters
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## 1.0 INTRODUCTION

The purpose of this manual is to provide necessary information for the Installation, Operation and Maintenance of the Wastewater Treatment Plant equipment.

	<p><b>The newterra MicroClear™ MBR wastewater treatment plant (WWTP) functions optimally if the operating procedures described in this manual are followed. If you have any questions after reading through this manual, please contact newterra ltd.</b></p>
---	---

- This O&M Manual must be kept on-site and available to employees at all time.
- It is **IMPERATIVE** that employees read the manual **BEFORE** working in the plant.
- Employees must read **Section 2** – Health and Safety.
- Technical Support Department contacts are provided in **Section 9**.



***WARNING: Failure to comply with the instructions provided in this manual can cause equipment & property damage or severe personal injury, and will render the warranty null and void.***







## 2.0 SAFETY

### 2.1 Introduction

This section provides general personal and environmental safety information for newterra MBR WWTP operators.

***Always refer to local codes and regulations.***

Specific equipment and parts safety information can be found in Appendix E. Material Safety Data Sheets (MSDSs) include detailed information regarding health & safety of chemicals used in wastewater treatment process and are presented in Appendix F. These are sample MSDS sheets and need to be replaced by the actual vendor MSDS sheets.

Information and guidelines outlined in this manual **must** be followed at all times prior to system installation and during operation and maintenance.

#### **ESSENTIAL FOR SAFE OPERATION:**

- Installation and operation of the newterra system must only be carried out by **trained and qualified** personnel.
- All necessary **safety precautions must** be carefully exercised, including but not limited to proper use of personal protective equipment considering given working environment and conditions.
- All **electrical installations and troubleshooting must** only be carried out by licensed electricians.
- All **plumbing work must** only be carried out by licensed plumbers or qualified personnel.
- Please keep in mind that trees and shrubs taller than two meters located in close proximity to the newterra system may become a safety concern at the time of installation or service.

#### **DEFINITION OF SAFETY AND WARNING SIGNS USED IN THE MANUAL**



##### **ATTENTION SYMBOL**

Special attention is required to ensure compliance with instructions concerning correct operating sequences to prevent damage to the plant or its function.



##### **GENERAL WARNING SIGN**

This symbol accompanies all important instructions or warnings associated with risks of injury as well as possible equipment damage.





**WARNING**

### **CRITICAL WARNING SIGN**

Warns against an unsafe situation or practice associated with severe injury as well as major equipment damage.

## **2.2 Personal Protective Equipment (PPE)**

Personal protective equipment (PPE) refers to protective clothing, gloves, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. "Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, masks, and others.

The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective to reduce these risks to acceptable levels. PPE is needed when there are hazards present. PPE has the serious limitation that it does not eliminate the hazard at source and may result in employees being exposed to the hazard if the equipment fails.

The following list includes the minimum scope of PPE that should be available to system operators:

### **2.2.1 Head protection**

Hard hats, bump caps, or helmets are types of protection that should be considered if there is a hazard of head injury. Head injuries can occur under various circumstances including as the result of a slip or fall, working in confined areas or where there are low ceilings, where there may be falling objects. Hard hats should be worn at all times when overhead work is being conducted.

### **2.2.2 Eye and Face Protection**

Eye protection with side shields should be used at all times while inside the newterra system as there may be a danger of flying objects, particles, liquids, sprays or other matter entering the eyes. Protection can take many forms including:

- safety glasses,
- goggles, or
- full face protection. This should be used if handling chemicals, waste product or working around pressurized lines (air of liquid).



### 2.2.3 Foot Protection

Foot protection should be used at all times within the newterra system. Foot protection is usually in the form of steel-toed work boots, with a steel shank to protect the bottom of the foot from puncture wounds. In wet environments, steel-toed boots that are waterproof and slip-resistant may be necessary.

### 2.2.4 Hand Protection

Hand protection should be worn within the newterra system. The workplace can create many hazards for hands, whether from chemicals, cuts or burns. No single glove can provide appropriate protection for every work situation, so it is important to assess the risk for each task and select a glove that provides specialized protection.

The following is a list of gloves and their suggested appropriate application:

- Coated fabric gloves: This type of glove can provide protection against some moderate concentrated chemicals. They can be used in laboratory work provided they are strong enough to protect against the specific chemical being handled.
- Rubber, plastic or synthetic gloves: These types of glove can be used when cleaning or working with oils, solvents and other chemicals.
- Leather gloves: These should be used when welding, as the leather can resist sparks and moderate heat. The risk of cuts and abrasions also can be minimized by wearing leather gloves.
- Kevlar gloves: These have a wide variety of industrial applications. They are cut- and abrasion-resistant and provide protection against both heat and cold.
- Chemical/liquid-resistant gloves: Several types of gloves help protect against specific chemicals:
  - Butyl rubber gloves: nitric acid, sulfuric acid, hydrochloric acid and peroxide
  - Natural latex/rubber gloves: water solutions or acids, alkalis, salts, and ketones
  - Neoprene gloves: hydraulic fluids, gasoline, alcohols and organic acids
  - Nitrile rubber gloves: chlorinated solvents

### 2.2.5 Body Protection

Body protection may be required in various situations including dusty environments or when spraying liquid pesticides or handling dangerous chemicals. The hazard to be controlled will determine the type of protection that is most appropriate, for example, an apron, coveralls or a full rain suit. As a minimum, the operator should be wearing work coveralls.



## 2.2.6 Hearing Protection

Hearing protection should be worn in work environments where noise levels exceed 85 decibels – such as around blowers and air compressors. There are many types of hearing protection, including earplugs or muffs. Hearing protection that is suitable for the work environment and provides adequate noise reduction should be chosen. Disposable ear plugs or headset style are acceptable.

## 2.3 Bacterial Safety

The wastewater contains a mixture of viable bacteria and other biological organisms. A wastewater treatment plant poses a number of bacterial hazards and consequently potential health risk. Immunization protects operator against infection. The use of proper hygiene measures, protective equipment, good housekeeping and common sense prevent contact with pathogens.

**These measures prevent infection!**



**Ensure that hands are washed with an antibacterial soap and warm water and dried by disposable towels on a regular basis, especially prior eating!**

**Do not expose cuts or open sores to wastewater!**

**Use personal protective equipment (PPE) at all times in wastewater treatment facility!**

**Any concern about possible infection should be brought to the attention of medical physician immediately!**

## 2.4 Chemical Safety

The following chemicals are used in operation of newterra MBR WWTP:

- **Sodium Carbonate (Soda Ash)** is used for pH adjustment, in case there is a deficiency in alkalinity in influent sewage and pH drops. It is hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation (lung irritant).
- **Sodium hypochlorite (NaOCl)** and **Citric Acid (C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>)** are used for cleaning the membranes.
  - **Sodium hypochlorite (NaOCl)** is a common disinfectant, which can be an irritant or corrosive, depending on its concentration. It cannot be mixed with organics, ammonia compounds or acids. **Contact with acids produces highly toxic chlorine gas. It has to be mixed only with pure water.**
  - **Citric Acid (C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>)** is hazardous in case of skin contact (irritant, sensitizer), or ingestion, eye contact (irritant) and inhalation (lung irritant).



- **Aluminium Sulphate ( $\text{Al}_2(\text{SO}_4)_3$ )** is used for Phosphorus Removal. Mild to moderate irritation can occur from unprotected contact. Aluminum is very poorly absorbed through the skin and toxic effects would not be expected following short-term skin contact. Inhalation of mists can be irritating to the respiratory tract and lungs.
- **MicroC 2000** is used for nitrate removal.
  - Exposure to eyes may cause slight irritation
  - Exposure to Skin may cause slight irritation
  - Inhalation of high mist concentrations may cause irritation of respiratory tract.

When handling chemicals, it is important to wear proper personal protective equipment such as chemical goggles with combination full face shield, protective clothing with chemical splash apron and chemical-resistant rubber gloves.



The above descriptions are preliminary warnings only. The MSDSs for each of the chemicals should be consulted prior to using or handling any of the chemicals.

Sample MSDSs for chemicals used in the PWTP process can be found in Appendix F of this Manual.



WARNING

Mixing chemicals can result in dangerous reactions, including violent splashing, fires, explosions and release of toxic gases!  
Chemicals should only be used for their intended uses!

## 2.5 Electrical Safety

Power may be supplied to control panels from various sources. Even if the disconnect is in the OFF position, certain electrical components inside the panel may be energized and servicing should not be conducted unless all incoming power is disconnected. Refer to the electrical drawings in Appendix A of this manual.

Ensure that the system is properly grounded before applying power to the system. Installation and servicing is only to be performed by **qualified authorized personnel**.

### 2.5.1 Lockout Procedures

Lockout procedures must be followed prior to performing mechanical or electrical maintenance to ensure that equipment has been de-energized. All relevant local guidelines and procedures must be applied. The person who locked out the device, should be the only person to remove the lockout.



When equipment is to be locked out, employers, supervisors and workers should follow accepted lockout principles, including:

- Pre-planning for the lockout by identifying all energy sources, switches, etc.
- Where lockout is complex, a written sequence in checklist form should be prepared for equipment access, lockout/tagout, clearance, release and start-up.
- All workers affected by the lockout should be notified.
- Equipment should be shut down by normal means by turning of switches and closing valves etc.
- Equipment should be isolated from energy sources by disconnecting or blocking the sources of energy.
- Lockout and tag the energy isolating devices by padlock or some other locking device that the worker has control over as well as a tag indicating that the equipment has been shut down.
- Verify that all energy sources have been isolated by attempting to cycle the equipment prior to working on it.
- When work is completed, release equipment from lockout.
- Test equipment

## 2.6 Confined Spaces

**"confined space"** means a fully or partially enclosed space:

- that is not both designed and constructed for continuous human occupancy, and
- in which atmospheric hazards may occur because of its construction, location or contents or because of work that is done in it.

If you have a space that is fully or partially enclosed, the two conditions – (a) and (b) above – must both apply before the space can be considered a "confined space".

**"atmospheric hazards"** means:

- the accumulation of flammable, combustible or explosive agents,
- an oxygen content in the atmosphere that is less than 19.5 per cent or more than 23 per cent by volume, or
- the accumulation of atmospheric contaminants, including gases, vapours, fumes, dusts or mists, that could,
  - result in acute health effects that pose an immediate threat to life, or
  - interfere with a person's ability to escape unaided from a confined space.

**Follow local laws and regulations with respect to entering a confined space.**



If a workplace includes a confined space that workers may enter to perform work, it is highly recommended that written program for the confined space is developed and maintained in accordance with this local regulations and policies before a worker enters the confined space. A confined space program is a written document that would include: a method for recognizing each confined space to which the program applies; a method for assessing the hazards to which workers may be exposed; a method for the development of confined space entry plans; a method for training workers; and, an entry permit system.

## 2.7 Fire Safety

Exposed hot surfaces can create potential burn/ignition hazards. Blowers and air compressors compress ambient air, causing heat to be generated. This heat can bring the temperature of the air compressor head and blower piping to a level that can cause burns to exposed flesh.

**Follow local laws and regulations with respect to Fire Safety and regulations.**

## 2.8 Responsibility for Safety

### 2.8.1 Management

Management is responsible for providing a safe working environment. This is accomplished partly by:

- Ensuring that all facilities and equipment are built and maintained in accordance with the appropriate safety standards
- Providing adequate funds for equipment and plant maintenance
- Establishing, promoting, and enforcing a **safety policy**
- Establishing a safety training program
- Supplying easy accessible eyewash and first-aid stations and proper personal protective equipment (PPE) for personnel servicing wastewater treatment facility.

### 2.8.2 Worker

- To develop a positive and professional attitude towards safety.
- To avoid mistakes caused by indifference to safety, poor work habits, lack of attentiveness, rushing the job, failure to observe established safety procedures and poor physical condition.



***Remember the “ABC” of accident prevention:  
ALWAYS BE CAREFUL!!!***



In addition to **“being careful”**, it is the responsibility of all workers to:

- Work in accordance with established safety procedures
- Follow the established safety rules
- Wear appropriate personal protective equipment (PPE)
- Report all accidents, no matter how minor
- Report potential safety hazards
- Participate in safety programs

### 2.8.3 Plant Safety – Simple Rules to Follow



#### **ATTENTION**

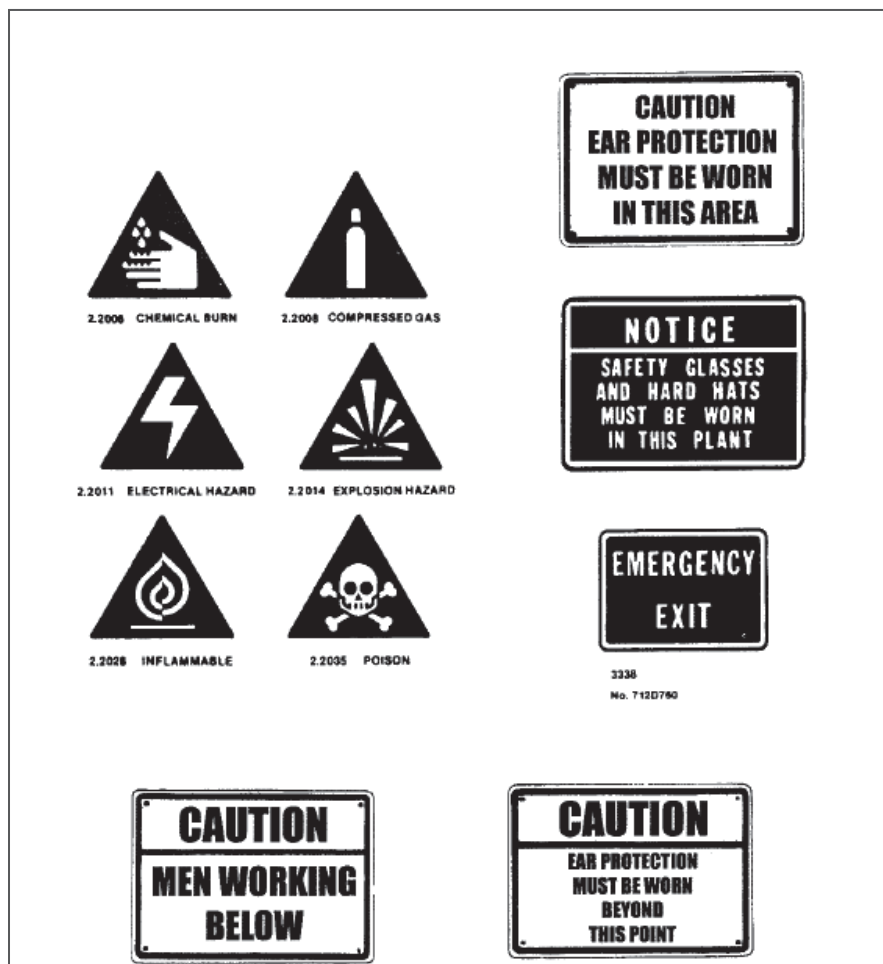
**Common sense plays a very important part in the safe operation of any type of plant!**

- Wear the appropriate personal protective equipment at all times.
- Keep walkways clear of snow and ice, and loose objects such as pails, shovels, tools, etc.
- Clean up spills of oil, grease, chemicals, or other substances immediately.
- Keep all tools and similar equipment clean, in good condition, and properly stored when not in use.
- Replace all manhole covers, access trap doors, etc. as soon as possible. Erect a safety barrier if it is necessary to leave the opening uncovered.
- Wear a safety belt whenever there is the possibility of falling even a short distance, or when working over water.
- Lock out and tag electrical equipment before working on it or the associated equipment.
- Ensure that moving machinery is properly guarded. Wear ear protection in noisy environments.
- Ensure that fire-fighting equipment is in good working condition.



## 2.9 Hazard Warning Signs/Symbols

Below is a sample of possible hazard warning signs/symbols that may be provided with the newterra system. It is recommended that the operator become familiar with the warning signs in the system.





## **2.10 First aid**

First aid is emergency care given immediately to an injured person. The purpose of first aid is to minimize injury and future disability. In serious cases, first aid may be necessary to keep the victim alive.

It often consists of a one-time, short-term treatment and requires little technology or training to administer. First aid can include cleaning minor cuts, scrapes, or scratches; treating a minor burn; applying bandages and dressings; drinking fluids to relieve heat stress, etc.

Operators must know the location of emergency telephone number(s), First Aid Kits, emergency eye wash stations and first aid attendant(s).

In over 98% of locations in the United States and Canada, dialing "9-1-1" from any telephone will link the caller to an emergency dispatch office—called a Public-Safety Answering Point (PSAP) by the telecom industry—which can send emergency responders to the caller's location in an emergency. In approximately 96 percent of the U.S., the Enhanced 9-1-1 system automatically pairs caller numbers with a physical address.

**Follow local laws and regulations with respect to First Aid procedures and reporting.**




## 2.10.1 CPR Poster

# CPR for an Adult or Child


1

- Check the scene to ensure it is safe. If it is safe to do so, check the person and the person's ABCs (Airway, Breathing, Circulation).
- Call EMS/9-1-1 and get an AED or have someone else do this.




2


- Place the heel of one hand on the middle of the chest. Place the other hand on top.
- Do 30 compressions. Push hard, push fast.



3


- Open the airway by tilting the head back and lifting the chin. Pinch the nostrils closed and give 2 breaths.
- Repeat the cycle of 30 compressions and 2 breaths.
- Continue CPR until an AED arrives or more advanced care takes over.





The information on this poster does not replace formal First Aid & CPR training.

To find a Red Cross First Aid course in your area scan the QR code, or:  
[redcross.ca/firstaid](http://redcross.ca/firstaid) | 1.877.356.3226









### 3.0 WASTEWATER TREATMENT PLANT DESIGN BASIS

This section presents the design basis of the newterra MicroClear™ Membrane Bioreactor (MBR) Wastewater Treatment Plant (WWTP), including the influent constituent loading rates, hydraulic capacity and specifications for the membrane module and cassettes used. This section also includes a list of prohibited chemicals that should not be added to the influent wastewater and chemicals that should not come in contact with the membranes. The system is designed to meet effluent discharge criteria presented in this section below.

#### 3.1 newterra MicroClear™ MBR Process Specification

Design loading	SI Units
Design Hydraulic Load	96 m <sup>3</sup> /d
Organic Load	87.1 kgBOD/d
TKN Load	12.5 kgTKN/d
Phosphorus Load	1.15 kgTP/d
Process Tanks	SI Units
Three (3) Oil & Grease Tanks (TNK-101/TNK-102/TNK-103) with a total volume	12 m <sup>3</sup>
One (1) Equalization Tank (TNK-301) with effective volume	40 m <sup>3</sup>
One (1) Pre-Anoxic Tank (TNK-401) with effective volume	46 m <sup>3</sup>
Two (2) Aeration Tanks (TNK-501/TNK-502) with total effective volume	76.5 m <sup>3</sup>
One (1) Post-Anoxic Tank (TNK-401) with effective volume	8.6 m <sup>3</sup>
Two (2) Membrane Tanks (TNK-601/TNK-602) each with effective volume	8.0 m <sup>3</sup>
Two (2) Sludge Holding Tank (TNK-901) each with effective volume	7.0 m <sup>3</sup>
<b>Membrane Bioreactor (MBR) including anoxic tanks, aeration tanks and membrane tanks - total effective volume</b>	<b>147.1 m<sup>3</sup></b>
Design Hydraulic Retention Time (HRT)	36.8 h
Sludge Age	26.5 d
Mixed Liquor Return Ratio - from Membrane Tank to Aerobic Tanks	5 x
Mixed Liquor Return Ratio - from Aerobic Tanks to Pre-Anoxic Tank	8 x
Design net flux (average)	13 LMH
Design Sludge Wasting Rate	5.36 m <sup>3</sup> /d
<b>Minimum design operating temp</b>	<b>10 °C</b>

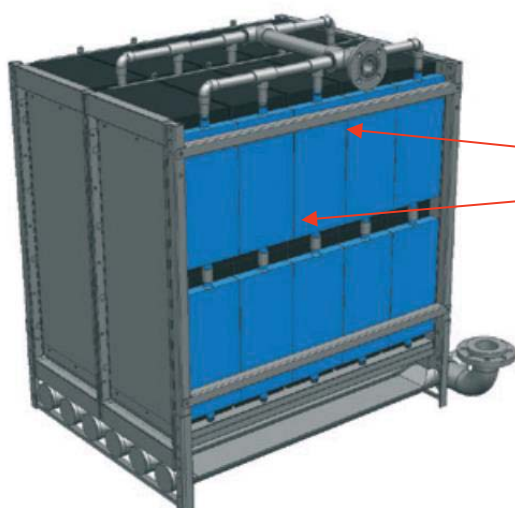


### 3.2 MicroClear™ MB2-2 Membrane Module Characteristics

MicroClear™ MB2-2 membrane module	SI Units
MB2-2 modules in MBR	2
MCXL cassettes in MB2-2 module	20
Total Area of MB2-2 module	160 m <sup>2</sup>
MB2-2 Module Dimensions (L x W x H)	1.302 m x 1.124 m x 1.379 m
Housing materials	Stainless steel

### 3.3 MicroClear™ MCXL Membrane Cassette Characteristics

MicroClear™ MCXL membrane cassette	
Membrane Material	Polyethersulfone (PES)
Individual Cassette Area	8 m <sup>2</sup>
Pore Size	0.04 µm
Cut Off	150 kDalton
Filtration Pressure	0.1 – 0.25 bar
Backwash Pressure	0.07 – 0.1 bar
Cassette Dimension	0.416 m x 0.209 m x 0.490 m



**MicroClear™ MB2-2  
membrane module**



**MicroClear™ MCXL  
membrane cassette**



### 3.4 Influent/Effluent Wastewater Characteristics

The newterra MBR shall treat wastewater from the mine camp with the following characteristics upon entering the newterra MBR.

Parameters	Unit	Influent*	Effluent
pH	s.u.	6 - 9	6.5 – 8.5
Fat, Oil, Grease (FOG)	mg/L	< 30	< 5
Biological Oxygen Demand (BOD)	mg/L	907.5	< 25
Total Suspended Solids (TSS)	mg/L	262.5	< 25
Total Kjeldahl Nitrogen (TKN)	mgN/L	130	-
Unionized Ammonia Nitrogen (NH <sub>3</sub> -N)	mgN/L	-	< 1.25
Nitrate Nitrogen (NO <sub>3</sub> -N)	mgN/L	-	< 5
Total Phosphorus (TP)	mgP/L	12	< 0.5
Fecal Coliform	CFU/100mL	-	< 200**
Total Residual Chlorine	mg/L	-	< 0.02
Alkalinity (assumed)	mg/L as CaCO <sub>3</sub>	471	-
Total Dissolved Solids(TDS)	mg/L	< 1,200	-

### 3.5 Estimated Chemical Consumption

Consumable		Usage Rate			
Purpose	Name	Value	Unit	Value	Unit
Supplemental Alkalinity	Dry Soda Ash	6.28	kg/d	2292	kg/year
Phosphorus Removal	Liquid Alum, 48%	14.6	L/d	5346	L/year
Nitrate Removal	MicroC 2000	16.5	L/d	6025	L/year
Membrane Cleaning	Sodium Hypochlorite, 12%	-	L/d	150	L/year



### 3.6 Prohibited Items

The raw wastewater should not contain any of the following substances:

- Hydrocarbons – lubricants, gasoline, diesel, etc.;
- Paints, solvents, silica, silicones and polymers;
- Antibacterial solutions, and products with quaternary ammonia;
- Large quantities of chemicals such as water softener, disinfectants, strong acids & alkalis, pesticides or photographic chemicals;
- Silicone based defoamers;
- Non-biodegradable solid waste (plastic, rubber products, disposable diapers, etc.);
- High amount of metals, such as iron, magnesium, calcium, barium and strontium.



**TOXIC MATERIALS SHOULD NOT BE THROWN INTO THE DRAIN!**

### 3.7 Removal of Oily Materials

The wastewater must pass through a grease trap (or similar facility for grease/fat removal), if there is kitchen usage onsite. The large amount of oil and fat can harm treatment facility (e.g., clogging pumps and piping and cause foaming in the aeration tank). To avoid premature membrane fouling, maximum FOG concentrations should not exceed 30 mg/L.



**Fats, oils and grease (FOG) must be removed prior to MBR. Removing of FOG significantly reduces membrane fouling, foaming potential and increases aeration efficiency.**

The raw wastewater should also comply with the following compatibility chart. The lipophilic substances concentration must be lower than **50 mg/L**.



### 3.8 MicroClear™ Membrane Compatibility Chart

Group	Substances	Compatibility
Chlorinated solvents	Methylene Chloride, Chloroform, Carbon Tetrachloride, Chlorobezene, Trichloroethane (<1%)	<b>Not recommended</b>
Esters	Ethyl Acetate, Butyl Acetate, Butyl Acrylate (<1%)	<b>Not recommended</b>
Ethers	Ethyl Ether, Polyethylene Oxide (<1%)	<b>Not recommended</b>
H <sub>2</sub> O <sub>2</sub>	<2000 ppm	Very good
Inorganic acids	HF, HCl, H <sub>2</sub> SO <sub>4</sub>	pH 0 - 14
Ketones	Acetone, Methyl Ethyl Ketone	<b>Not recommended</b>
NaOCl	100,000 ppm x h	Very good
Organic acids	Sulfamic Acid, Formic Acid, Oleic Acid, Sulfonic Acid, Acetic Acid, Acrylic Acid, Lactic Acid	pH 0 - 14
Phenols		<b>Not recommended</b>
Silicones		<b>Not recommended</b>
Alcohols	Ethanol, Butanol, Isopropanol (<50%)	Good
Aldehydes	Formaldehyde (<1%)	Very good
Alkali		pH 0 - 14
	Dimethyl Formamide, Dimethyl, Acetamid Dioxane, N-Methyl, Pyrrolidone, Tetramethyl Acetamide	<b>Not recommended</b>
Aprotic Solvents	Benzene, Toluene, Xylene, Anthracene, Naphatalene, Gasoline	<b>Not recommended</b>
Aromatic hydrocarbon	Methoxyethanol, Ethoxyethanol, Buthoxyethanol	unknown



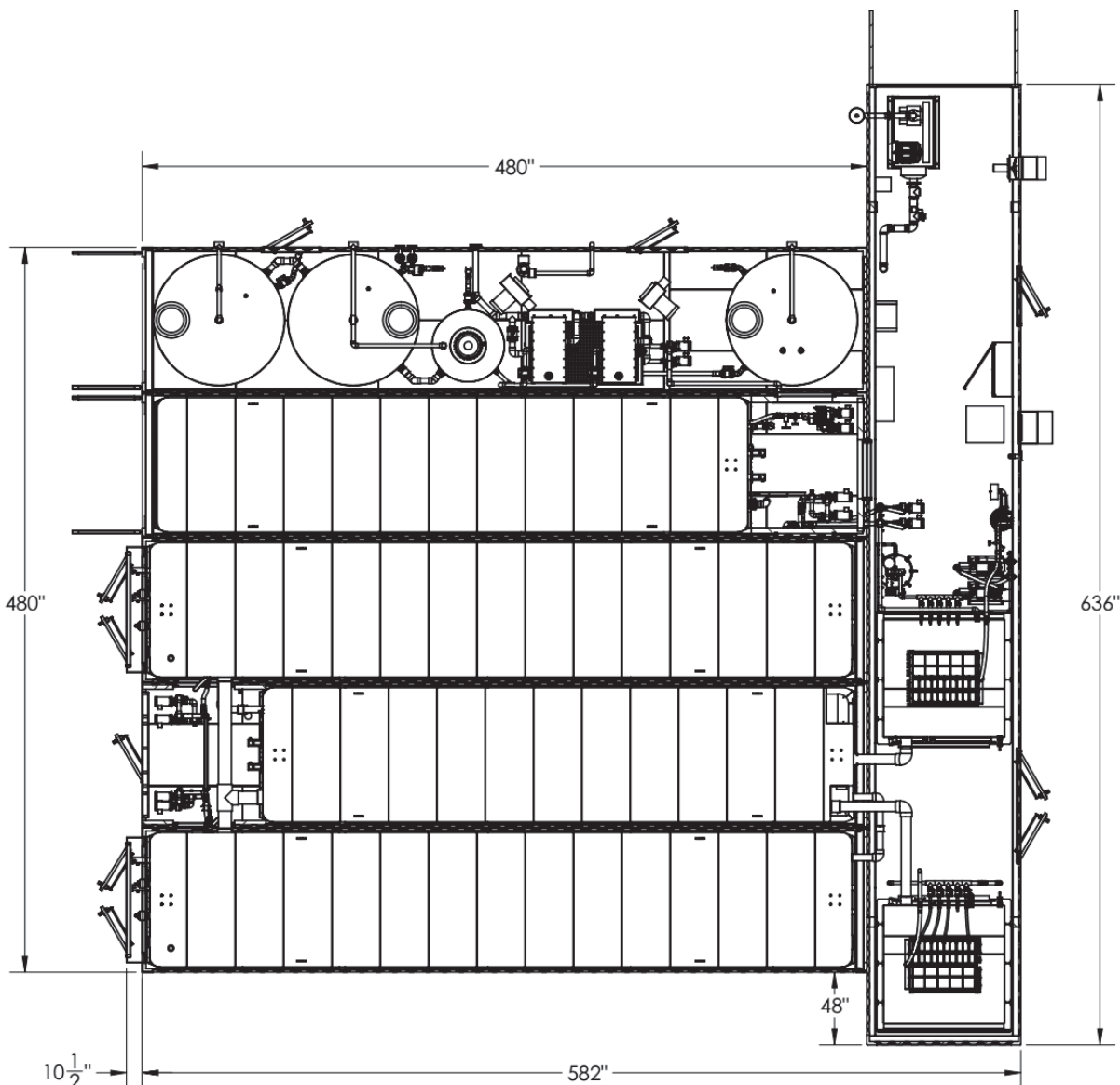




## 4.0 PLANT INSTALLATION, INSPECTION, AND TESTING

### 4.1 System Overview

The **newterra** MicroClear™ MBR WWTP is 96m<sup>3</sup>/day MBR for for the Amaruq Mine located in Nunavut. The system consists of five (5) modified 40 foot High Cube ISO shipping containers and one (1) modified 53 foot High Cube ISO shipping container. See below. .





## 4.2 Site Conditions Requirements

- Installation site for the **newterra** MicroClear™ MBR WWTP should be close to the sewer drain and have a sufficient power source (refer to Electrical Drawings in Appendices B-F).
- Location must permit easy access for equipment capable of transporting, offloading, and handling of the designed loads.
- There should be adequate space around the containers for safe operation and maintenance.
- The firm base (foundation) must be built to support the full operating weight of the plant to prevent buildings from shifting and pipe/electrical conduit connection failure – pilings are recommended.



**The firm base for the container must be level and must be capable of supporting the operating weight.**



**WARNING:** *Always check with the local utility companies for the location of water lines, electrical and telephone cables, or any additional hazards below grade, prior to excavation. Failure to do so could result in severe bodily injury or death.*

## 4.3 Inspection upon Delivery

The **newterra** MicroClear™ MBR WWTP is carefully manufactured, checked, and tested at the manufacturing plant. All equipment is pre-wired, pre-piped, mounted inside the enclosures and factory tested. Upon receiving the system, please perform the following:

- Place the container onto the prepared firm base to avoid sagging, equipment vibration, and shifting. When lifting the containers, ensure that lifting equipment is clear of overhead obstructions such as power lines, trees or rooftops. Be careful during this procedure!
- Be careful when offloading the containers to prevent damage to the internal pipe work.
- Check the containers for any signs of shipping damages.



- Inspect the containers to ensure that no components or parts are missing (refer to the Packing List – see Appendix B). Also, inspect for visual damage of the tanks, pumps, blowers, piping, and control panel.
- If the containers, equipment inside and any parts shipped loose are free of damage, proceed with the installation.

For any damages or loss of equipment, **please notify newterra ltd. at (800) 420-4056 immediately.**

#### 4.4 Plant Initial Set up



**WARNING:** *The installer must ensure that the installation site is safe from hazards. These could include excavations left open overnight, debris left lying around, and tanks & equipment not properly blocked. Provisions must be made to eliminate the potential hazards by roping off and proper shoring around the excavations, cleaning up at the end of each workday, and proper storage of equipment. Failure to do so could result in severe injury or death.*

##### 4.4.1 Installation Checklist

At Appendix C is the installation and commissioning checklist for the system. Below is a summary of installation activities.

##### 4.4.1.1 Customer's Scope List

- Placement and anchoring (if required) of equipment
- Interconnecting piping supply and installation
- Interconnecting electrical and controls supply and installation including connection inside newterra's control panel
- Electrical power supply to our electrical panel, lightning, grounding, etc.
- Permitting
- Potable water supply to the plant site for plant hydraulic test during startup
- Seed sludge
- Wastewater testing
- Chemicals supply and storage
- Treated effluent and waste sludge disposal
- All site civil work including design



#### 4.4.1.2 Civil Checklist

- Ensure that a potable water supply is available (used for hydraulic testing during start-up, membrane cleaning, washing hands and for performing onsite testing).
- Ensure availability of on-site emergency eyewash station and personal protection equipment.
- Remove hatch covers from the interconnecting ports.
- All doors are closing, latching and locking
- Weather stripping has been installed around each door
- Door sweeps have been installed on each door
- Louvers and hoods have been installed and sealed
- Install Liquid Rubber Container Seal as per drawing at Appendix C.

#### 4.4.1.2 Electrical Checklist

- Connect electrical power to the Main Disconnect from available source ensuring correct phase rotation (See Electrical Drawings at Appendix A for power source specifications).
- Connect electrical power to the Control Panel (See System Layout drawing in Appendices A for locations)
- Ensure that proper electrical grounding and lightning protection is available.
- Switch Main Switch Panel's isolator to the ON position.
- Check all internal lighting and heating for correct operation.
- Install packed external lighting into brackets above the doorways.
- All internal electrical connections have been terminated
- Confirm Phase Monitor is not in alarm
- Site voltage measured:
  - L1/L2 - L2/L3 - L3/L1 - L1/GRD - L2/GRD - L3/GRD:
- Check field wiring and piping as per drawings
- Check panel for loose wiring, Correct as required
- Check voltage on AC transformer
- Check voltage on DC transformer
- Check I.S. barrier is grounded as per input drawing



#### 4.4.1.3 Mechanical Checklist


- All hoses and mechanical connections have been hooked up
- Ensure all unions and fittings are tight, as some are loosened to prevent stress in shipping
- Check alignment of motors, Correct as required
- Check all motor belt tensions, Correct as required
- Check alignment of pulleys for all belt driven blowers
- Verify membrane modules are secure within the membrane tanks – i.e. verify wheel chocks are in the correct location and that there is no lateral movement (less than an inch) of the membrane modules on the wheel tracks in the tanks.
- Confirm Tank Diffusers and Educators have not moved during shipping
- Calibrate pH sensor

#### 4.4.2 System Electrical Specifications

Verify site power per system design criteria. Additional detail is at Appendix A.

ELECTRICAL SPECIFICATIONS	
VOLTAGE	600V
PHASE	3Ø
FREQUENCY	60 Hz
FULL LOAD AMPS	172A
MAIN DISCONNECT SIZE	400A - FUSED @ 250A
SCCR SYMMETRICAL (kAMPS)	10
SYSTEM APPROVAL AND CLASSIFICATION	cMET - CL1Div2
PANEL APPROVAL AND CLASSIFICATION	cMETus to UL698A

Please refer to the as-built electrical drawings in Appendices A of this manual.

	<p><b>Only trained and certified electricians should make the electrical connections.</b></p>
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## 4.5 Plant Initial Testing

The newterra MicroClear<sup>™</sup> MBR WWTP (except the membrane modules) undergoes electrical and leakage tests in our manufacturing facility prior to shipment; however, fittings could shift during shipment, so it is our standard practice to perform initial testing on the plant after installation, including **dry and hydraulic tests**.

The following subsection is presented for one single process train; if multiple trains are provided, performing the dry test and hydraulic test for each train is identical.

### 4.5.1 Dry Test

The following tasks have to be performed **before** potable water is introduced into the system:

- Ensure that all tanks are clean and free of any dirt or debris (this is to prevent obstruction or damage to the piping, pumps, and membranes).
- Ensure that all connections have been provided and joints have been tightened.
- Check the placement of the air diffusers in the equalization tank(s) and the aeration tank(s) if incorrectly positioned, proper adjustment has to be performed.
- Ensure that a functional check of the electrical and control system has been performed (please refer to the newterra Commissioning Checklist presented in Appendix H).
- Confirm heater/fan and air conditioner operations

### 4.5.2 Hydraulic Test

The hydraulic test is performed using potable water to:

- Check for and fix any leakage;
- Check the setting of level switches/transmitters;
- Check the hydraulic flow through the plant;
- Check if all the ancillary equipment and controls of the plant function as per design;
- Recalibrate instruments (if applicable);
- Perform clean water test on membranes.
- Perform clean water test on the chemical distribution system.



#### 4.5.2.1 EQ, Anox and Aeration Tanks

- Fill the tanks in order - TNK-301, 401, 501, 502, 551, 601, 602 with potable water, run the pumps and check for any signs of leakage.
- Perform electrical and instrumentation (E&I) functional checks and adjustment of level switches.
- Turn on the air blower(s) for the blower(s) for aeration tank(s), and check for:
  - Buoyancy of air diffusers and if this occurs, empty the tank and fix;
  - Air leakages: if this occurs, tighten up the fittings;
- Manually check water temperature and DO (dissolved oxygen): with a hand-held DO meter and adjust air flow to keep it up to 0.5 – 1 mg/L for equalization tank(s) and 2 - 3 mg/L for aeration tank(s); check the DO readings on the touch screen.
- DO Control System: check automatic ON/OFF of Aeration Tank air blowers at low and high settings of DO without the return of aerated water from the membrane tanks to aeration tanks (i.e. turn off transfer pump(s) from aeration tank(s) to membrane tank(s) and turn of recirculation pump(s) from membrane tank(s) to aeration tank(s), if included), and record blower ON/OFF duration.

#### 4.5.2.2 Membrane Tank

- Enable membrane operation using the HMI
- Start the transfer pump(s) from the aeration tank(s) to the membrane tank(s) and fill the membrane tank(s) with potable water.
- Start the air blowers for the membrane tank(s) and check for an even distribution of air across the membrane filter area and air bubble uniformity above the membrane module/cassette.
- Check hydraulic flow pattern through the membranes and between membrane module/ cassette and tank wall.
- Make a clean copy of the **Clean Water Testing Sheet** presented in **Appendix J** of this O&M Manual.
- Record all checked parameters in the **Clean Water Testing Sheet**.
- Start the permeate (vacuum) pumps.
- Record the vacuum (TMP) on the gauge(s) on the permeate line [for clean water could be 0.05 to 0.07 bar (20" to 29" WC)].
- Record water temperature and DO with a hand-held DO meter.
- Gradually increase the permeate flow while recording the vacuum (TMP) on the gauges up to the anticipated peak wastewater flow.

Forward a complete **Clean Water Testing Sheet** to **newterra** for analysis.



#### 4.5.2.3 O&G and 901 Tanks

- Fill the tanks in order - TNK-101, 102, 103 and 901 with potable water, run the pumps and check for any signs of leakage.
- Confirm diffuser operation in TNK-901. Adjust as necessary.



## 5.0 OPERATION of newterra MicroClear™ MBR

MBR (Membrane Bioreactor) treatment technology is an effective combination of an activated sludge biological treatment process with MicroClear MBR membrane filtration technology.

This section provides a description of the treatment process and how it is controlled. For a more complete understanding, review the **Process & Instrumentation Diagram** and **System Layout** provided in **Appendix A** of this manual as well. The detailed Control Narrative with factory setpoints, alarms and logic, please see **Appendix K**.

Most of the equipment in the **newterra** WWTP can be operated in either manual or automatic mode. The system is designed to always run in auto mode. The manual option is provided mainly for maintenance purposes.

### 5.1 Control System – Main SCADA Control, PLCs and HMIs

The **newterra** MicroClear™ MBR is controlled by a PLC (Programmable Logic Controller). The system is programmed to:

- Receive analog and digital input signals from the switches and transmitters being controlled;
- Process the information using the structure and rules entered into the program;
- Generate outputs that control the equipment - turn equipment OFF or ON.
- Generate alarms if critical conditions are present
- Provide a HMI (Human Machine Interface) touch-screen for ease of operator process monitoring and control.

#### 5.1.2 HMI Control Screen

An example of an HMI Control Screen is provided below:





## System Operation

- (RUNNING/STOPPED) Indicates whether the system is currently in the **RUN** mode or turned off
- **START** button puts the system in **RUN** mode as long as there are no alarms preventing the start up of the system
- **STOP** button stops the system operation
- **RESET** button is used to clear alarms after they have been addressed
- Clarifier blowers, equalization tank blowers and the building fan if on, continue to run even after the **STOP** button has been pressed

The MBR will always remain in auto run mode, unless the kill switch is pressed or power is down.

The MBR will automatically restart after power failure.

A menu to navigate through the process and data information screens is provided at the bottom right corner of the HMI screen.

When the **MENU** button is pressed, it shows a list of individual screens with a scroll bar.

- To go to any of the listed screens, touch the icon.
- To go back to the main screen, touch the **X** button.





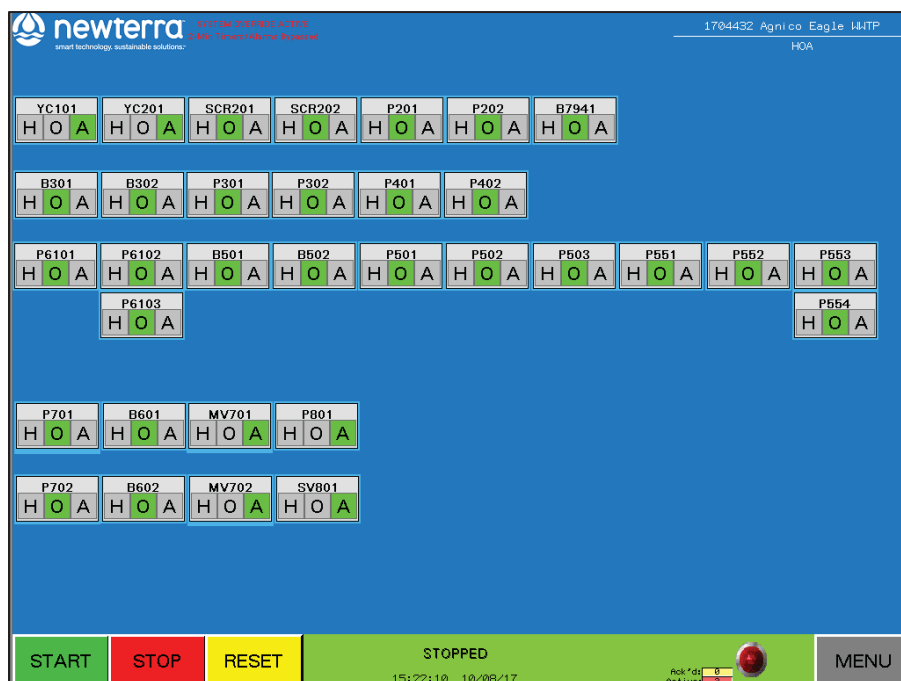
## ATTENTION

Screen-shots presented in this manual are for example only and may not be representative of ideal operation.

### 5.1.3 HOA (Hand/Off/Auto) Screen

This screen displays all devices controlled by the PLC. Under normal operation (auto mode), all devices are set in the AUTO position.

- Each PLC controlled motor or valve in the system has a Hand/Off/Auto (HOA) Switch to control its operation.
- The HAND (H) position of a switch is used for testing and troubleshooting of the system. As a safety precaution to prevent damage to equipment, the equipment will operate for two minutes in hand mode and will then turn OFF and revert to the (O) position. Operators must be present when equipment is operated in the manual mode.





### 5.1.4 Process Screens

The main process screens are accessed from the main menu of the HMI control screen. These process screens are:

- Inlet
- EQ & Anox
- Aeration
- MBR

Note: In the following sections are the detailed descriptions of the main processes.



Switches are indicated on the HMI as follows:

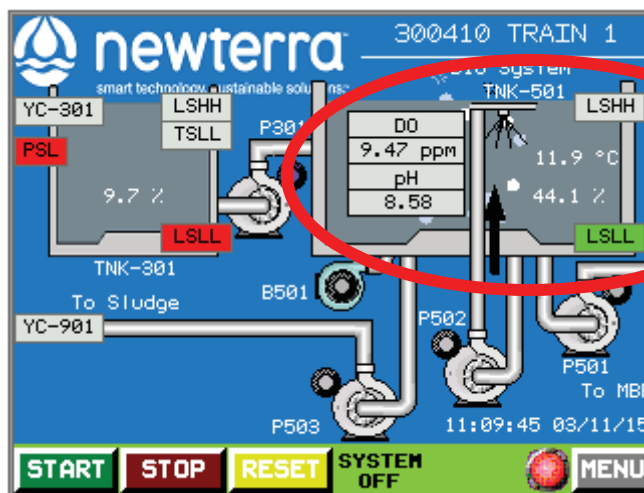
- LSHH – level switch high high
- LSH – level switch high
- LSL – level switch low
- LSLL – level switch low low
- TSL – temperature switch low
- TSL – temperature switch low low
- PSL – pressure switch low

Status of the switches are indicated as follows:

**Grey** when **OFF**  
**Green** when **ON**  
**RED** when in Alarm



Tank levels are indicated by level switch positions and percent full values where level transmitters are provided. For example, the following screen shows LSHH as green, LSHH as grey and the percent full as 44.1% in TNK-501. This indicates that the tank is 44.1% full, and the water level is above LSHL and below LSHH.



**NOTE:** Touching a device on the process screen will open an HOA popup for that device.

- The device status indicator color coding is as follows:

Indicator Color	Operational Status
Yellow	Manual operation
Orange	Interlock
Red	Failure
Green	ON / OK
Purple	Interlock / Communication failure
Pink	Unknown
Black	Faulty contactor
Grey	Off



### 5.1.5 HMI Alarm Screen

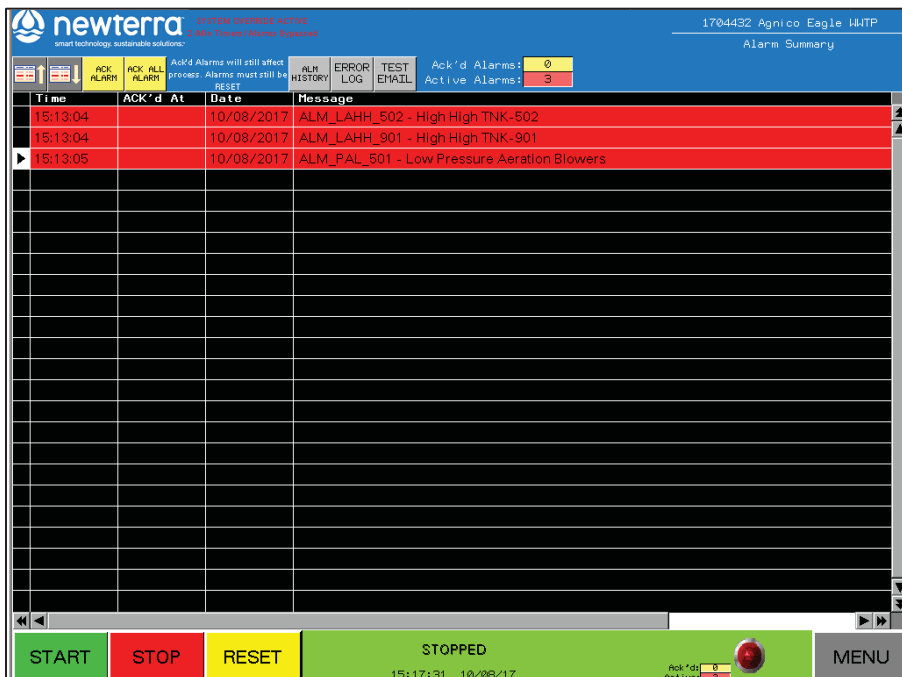
- When the **ALARMS** button is flashing red, it indicates an alarm is present in the system. Press the **ALARMS** button to be routed to the Active Alarms Screen.
- To clear alarms, first press the yellow **RESET** button then press the flashing **ALARMS** button to verify that the condition causing the alarm has been cleared.

All alarms are visually indicated on a beacon stack on the roof of the exterior of the container and an alarm light on the system control panel:

- Green – System OK
- Red Solid – Warning Alarm
- Red Flashing – Critical Alarm
- No Light – Loss of Power








**newterra** smart technology. sustainable solutions. 1704432 Agnico Eagle HHTP  
Alarm Summary

ACK'd Alarms: 0  
Active Alarms: 3

Time	ACK'd	At	Date	Message
15:13:04			10/08/2017	ALM_LAHH_502 - High High TNK-502
15:13:04			10/08/2017	ALM_LAHH_901 - High High TNK-901
15:13:05			10/08/2017	ALM_PAL_501 - Low Pressure Aeration Blowers

START STOP RESET STOPPED 15:17:31 10/08/17 MENU



**newterra** smart technology. sustainable solutions. 1704432 Agnico Eagle HHTP  
Alarm History

Save to USB

Time	ACK'd	At	Date	Message
15:13:04			10/08/2017	ALM_LAHH_502 - High High TNK-502
15:13:04			10/08/2017	ALM_LAHH_901 - High High TNK-901
15:13:05			10/08/2017	ALM_PAL_501 - Low Pressure Aeration Blowers

START STOP RESET STOPPED 15:17:52 10/08/17 MENU

**NOTE: All high level alarms (identified as LSHH on P&ID and HMI) indicate a critical situation for imminent tank overflow** and could result in pump(s) shutting off to avoid overflow situations.



## 5.2 WWTP Buildings/Utilities

### 5.2.1 Power Supply

A power monitor has been installed in the main power distribution panel to ensure proper power and phase rotation is delivered to the system.

#### Alarms

<u>Alarm</u>	<u>Alarm Description</u>	<u>Actuation Control</u>	<u>Delay</u>	<u>Self Resetting (Y)</u>
ESA-8201	Emergency Stop Alarm	ESA-8201 = Active	Immediate	Y
PWR-FAIL	Power Failure		Immediate	Y
PLC FLT	PLC Fault Detected		Immediate	Y
PWR FLT	Phase Monitor Fault	JA-8201 = Active	Immediate	Y

### 5.2.2 E-Stop

Emergency stop buttons are located:



- On the Main Control Panel in each of the Screen Buildings
- On the Control Panel installed in each process train
- On the Main Control Panel in the Sludge Building
- Main Control Panel in each of the Receiving Stations
- There is an E-Stop PLC alarm if pressed.

### 5.2.3 Building Temperature Control

The electric heaters respond to the temperature set point set on the individual heater TSL temperature switches. If the building temperature falls below the temperature switch settings, electric heaters will turn on.

#### 5.2.3.1 Logic

<u>TAG</u>	<u>Description</u>	<u>Control Logic</u>	<u>Output Type</u>
H-7911	Building Heater	Always on internally controlled	Direct (not PLC controlled)
H-7912	Building Heater	Always on internally controlled	Direct (not PLC controlled)
H-7941	Building Heater	Always on internally controlled	Direct (not PLC controlled)
H-7961	Building Heater	Always on internally controlled	Direct (not PLC controlled)
H-7962	Building Heater	Always on internally controlled	Direct (not PLC controlled)
H-7963	Building Heater	Always on internally controlled	Direct (not PLC controlled)



### 5.2.3.2 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
TALL-7911	Temperature Alarm Low Low	TSLL-7911 = Active	5s	Y
TALL-7941	Temperature Alarm Low Low	TSLL-7941 = Active	5s	Y
TALL-7961	Low Low Temp Alarm	LSLL-7961 = Active		

### 5.2.4 Ventilation

A single fan (F-7963) located in the MBR Process container acts to exhaust the container during the warmer months. Temperature is monitored by the temperature sensor and a high setpoint turns the exhaust fan on. There are also exhaust blowers to de-rate classified areas.

#### 5.2.4.1 Logic

Tag / Mode	Description	Control Logic	Output Type	HOA Control
B-7911	Ventilation Blower	The continuous ventilation blower will always be ON. This blower is used as means to de-rate the screen building to a Class 1 Division 2 area. Air exchanges must be a minimum of 12 per hour,	Direct (not PLC controlled)	
B-7941	Aeration Exhaust Blower	On when B-501/502 is on OR B-601/602 is on	Discrete	Auto
F-7963	Building Fan	Always on controlled by Wall Mount Thermostat	Direct (not PLC controlled)	

#### 5.2.4.2 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)	Notes
PAL-7911	Pressure Alarm Low	PSL-7911 = InActive	5s	Y	Alarm indicates possible continuous ventilation failure, indicating risk that the room may become Class 1 Division 1 rated.







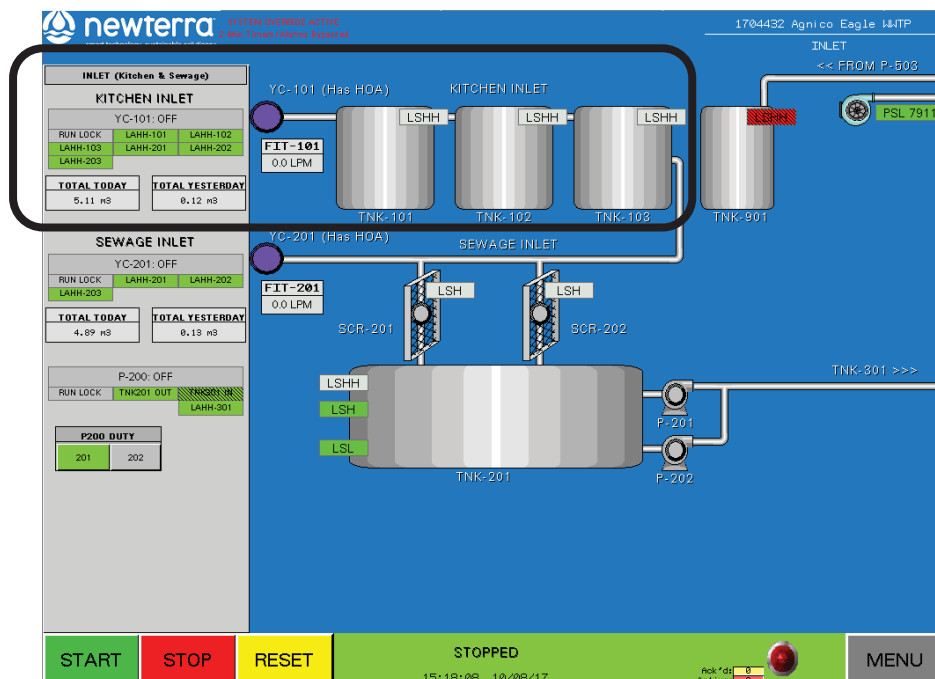
Mixed liquor is pumped from the post-anoxic tank to the membrane tanks (TNK-601 and TNK-602). The membrane tanks serve as additional volume for aerobic biological treatment to remove any excess MicroC (which would otherwise cause BOD in the effluent) and house the membrane filters used for solid-liquid separation. Treated effluent is drawn through the membranes by vacuum pumps.

Since the solid-liquid separation process results in an accumulation of solids in the membrane tank, the mixed liquor (containing both solids and filtrate) is continuously recycled to the first aeration tank (TNK-501). This prevents excessive solids build-up in the membrane tank, and maintains sufficient biomass in the anoxic and aeration tanks. The solids that accumulate in the system consist of biomass that have grown from the influent organics and ammonia, as well as non-biodegradable solids from the influent wastewater. In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank (TNK-501) to the sludge holding tank (TNK-901). Wasted sludge in the sludge holding tank is thickened by decanting supernatant back to the screen tank. Thickened sludge accumulates in the sludge holding tanks until it is eventually pumped out for disposal.



## 5.4 Kitchen Inlet Module (TNK-101/2/3) Module

A schematic of the Kitchen Inlet Module is located on the INLET HMI screen and shown below.



### 5.4.1 Function

The Waste Water Treatment Plant accepts waste water from the local kitchen which contains kitchen oils and greases. These need to be removed prior to being fed into the fine screens. This is done by using TNK-101/2/3 as grease traps. The kitchen waste water enters TNK-101, the solid food particles sink to the bottom, while lighter grease and oil floats to the top. The relatively grease-free water is then fed into TNK-102 where the process is repeated to further separate the oils and greases from the waste water. The same applies to TNK-103. The waste water is then fed to the fine screens.

### 5.4.2 Inputs

TAG	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)
FIT-101	Flow Indicating Transmitter	Analog	GPM	0-760lpm	0-760lpm	Y	Y
FQI-101	Flow Totalizer	Discrete N.O.	Pulse/Gal	1 liter/Pulse			
LSHH-101	Level Switch High High	Discrete N.C.					
LSHH-102	Level Switch High High	Discrete N.C.					
LSHH-103	Level Switch High High	Discrete N.C.					



### 5.4.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
FTAH-101-SP	Flow Transmitter Alarm High Setpoint	75	0-200 GPM	Open	Y

### 5.4.4 Logic

TAG	Description	Control Logic	Alarm Interactions	HOA Control
YC-101	Ready Contact	On when LSHH-101 / 102 / 103 and LSHH-201 / 202 and LSHH-203 are not ON	All LSHH's in the inlet area	HOA

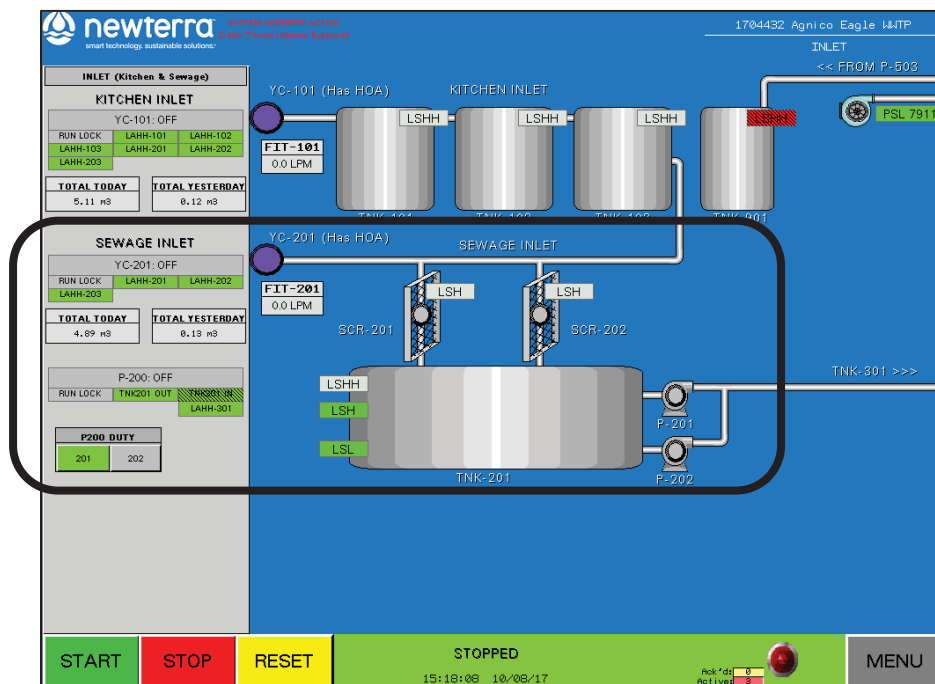
### 5.4.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
FTAH-101	Flow Transmitter Alarm High	FIT-101 > FTAH-101-SP	60s	
LAHH-101	Level Alarm High High	LSHH-101 = Active	5s	Y
LAHH-102	Level Alarm High High	LSHH-102 = Active	5s	Y
LAHH-103	Level Alarm High High	LSHH-103 = Active	5s	Y



## 5.5 Fine Screens (SCR-201/202) Module

A schematic of the Fine Screens are located on the INLET HMI screen and shown below.



### 5.5.1 Function

Camp domestic and kitchen wastewater is into the fine screens (SCR-201/202). The screening process is provided to remove hair, and fibrous materials from the supplied wastewater that might damage the membranes. The screening are collected in burlap bags that need to be removed daily. The waste water is then pumped to the EQ Tank.

### 5.5.2 Inputs

TAG	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)
FIT-201	Flow Indicating Transmitter	Analog	GPM	0-760lpm	0-760lpm	Y	Y
FQI-201	Flow Totalizer	Discrete N.O.	Pulse/Gal	1 liter/Pulse			
LSHH-201	Level Switch High High	Discrete N.C.					
LSHH-202	Level Switch High High	Discrete N.C.					
LSHH-203	Level Switch High High	Discrete N.C.					
LSH-203	Level Switch High	Discrete N.C.					
LSL-203	Level Switch Low Low	Discrete N.O.					



### 5.5.3 Setpoints

TAG	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
FTAH-201-SP	Flow Transmitter Alarm High Setpoint	75	0-200 GPM	Open	Y

### 5.5.4 Logic

TAG	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
YC-201	Ready Contact	On when LSH-201 / 202 and LSHH-203 are not ON				HOA
SCR-201	Inlet Screen	The inlet screen will be ON when influent flow is detected via flow transmitter FIT-201. The screen will run for 1 minute after influent flow has stopped via flow transmitter FIT-201. If the high high level switch LSHH-201 on the screen is ON then the inlet screen SCR-201 will be ON.		Discrete	Y	HOA
SCR-202	Inlet Screen	Same as SCR-201		Discrete	Y	HOA
P-201	Screen Transfer Pump	The pump will be ON when the LSH-203 turn on as long as LT-301 < LTH-301-sp setpoint the pump will turn off when the LSL-201 turns off	LAHH-301	Discrete	Y	HOA
P-202	Screen Transfer Pump	This pump runs duty standby with P-201 with a 5:1 rato	LAHH-301	Discrete	Y	HOA

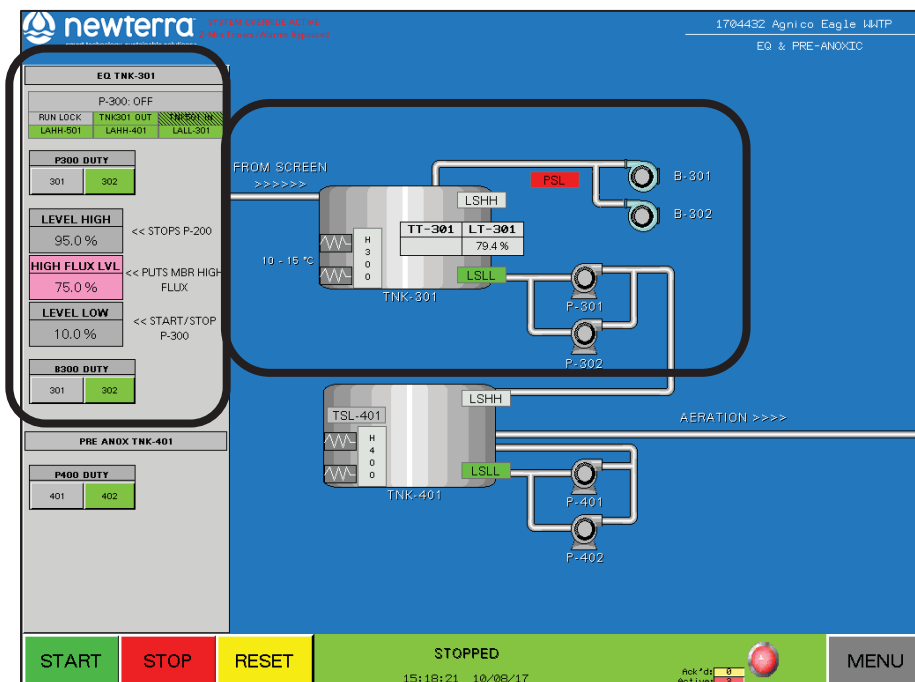
### 5.5.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
FTAH-201	Flow Transmitter Alarm High	FIT-201 > FTAL-201-SP	60s	
LAHH-201	Level Alarm High High	LSHH-201 = Active	5s	Y
LAHH-202	Level Alarm High High	LSHH-202 = Active	5s	Y
LAHH-203	Level Alarm High High	LSHH-203 = Active	5s	Y



## 5.6 Equalization Tank (TNK-301) Module

A schematic of the Equalization Tank (TNK-301) is located on the EQ & PRE-ANOXIC HMI screen and shown below.



### 5.6.1 Function

The EQ Tank (TNK-301) buffers variability in the influent flow rate to maintain a consistent flow rate through the membranes and to reduce concentration fluctuations of influent constituents (i.e. BOD, TSS etc.) through the MBR treatment system. Wastewater entering the newterra MBR will first have undergone pre-treatment by fine screens and grease traps (kitchen waste). The waste water is then pumped to the Pre-Anox Tank.

### 5.6.2 Inputs

Tag	Description	Input Type	HMI Display Units	Device Range and Units	Device Span/PLC Scale	Datalog (Y)	Trending (Y)	Notes
LSHH-301	Level Switch High High	Discrete N.C.						
LT-301	Level Transmitter	Analog	%	0-10 ftWC	0-10 ftWC	Y	Y	
TT-301	Temperature Transmitter	Analog	°C	0-100c	0-100c	n	n	Added to System
LSLL-301	Level Switch Low Low	Discrete N.O.						Must be above all immersion heaters in Tank
PSL-301	Pressure Switch Low	Discrete N.C.		9-85"WC				



### 5.6.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes
LTL-301-SP	Level Transmitter Low Setpoint	10%	0-100%	Open		
LTHFLUX-301-SP	High Flux Level Setting	50%	0-100%			Puts the MBR Permeate pumps into High Flux Mode
LTH-301-SP	Level Transmitter High Setpoint	80%	50-100%	Open		

### 5.6.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
H-301	Tank Heater	On when TT-301 < 10C Off when TT-301 > 15C	LALL-301	Discrete		
H-302	Tank Heater	Same as H-301	LALL-301	Discrete		
P-301	EQ Transfer Pump	The EQ pump will be ON when the EQ level transmitter LT-301 > LTL-301-SP and the aeration tank level transmitter LT-501 < LTH-501-SP The EQ pump will be OFF when the EQ level transmitter LT-301 < LTL-301-SP OR LSLL-301 = InActive OR the aeration tank level transmitter LT-501 > LTH-501-SP OR LSHH-401 is active Runs Duty with P-302 as Standby	Turns OFF LAHH-501 LAHH-401 LALL-301	Discrete	Y	HOA
P-302	EQ Transfer Pump	This pump runs duty standby with P-201 with a 5:1 ratio		Discrete	Y	HOA
B-301	EQ Blower	The EQ blower will be ON when the System is in Run & LSLL-301 is active.		Discrete	Y	HOA
B-302	EQ Blower	Runs Duty standby with B-301 switching every 120 hours		Discrete	Y	HOA



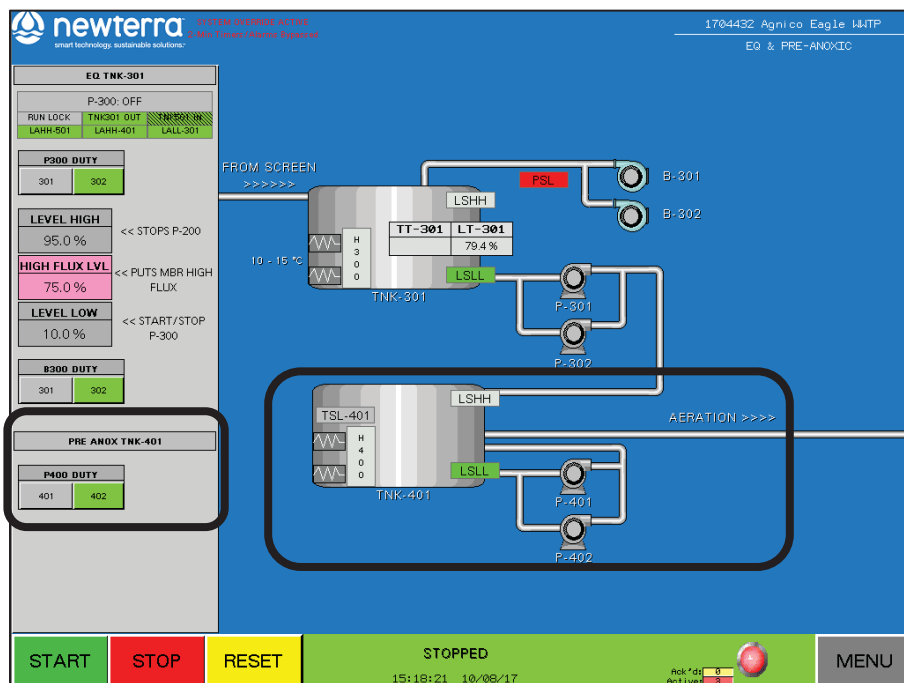
### 5.6.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
LAHH-301	Level Alarm High High	LSHH-301 = Active	5s	Y
LALL-301	Level Alarm Low Low	LSLL-301 = Off	5s	Y



## 5.7 Pre-Anox Tank (TNK-401) Module

A schematic of the Pre-Anox Tank (TNK-401) is located on the EQ & PRE-ANOXIC HMI screen and shown below.



### 5.7.1 Function

In the pre-anoxic tank (TNK-401), the wastewater containing organics is combined with recycled mixed liquor from the aeration tank containing nitrates. Bacteria use some of the organics to drive the denitrification process, converting nitrate into nitrogen gas. This process occurs in an anoxic environment where there is minimal oxygen. As such, a pump and eductors are used to mix the tank to prevent addition of oxygen. The denitrification process is used to meet the effluent nitrate limit, reduce oxygen requirements and to recover alkalinity, thus reducing chemical consumption.

### 5.7.2 Inputs

Tag	Description	Input Type
LSHH-401	Level Switch High High	Discrete N.C.
TSL-401	Temperature Switch Low	Discrete N.C.
LSLL-401	Level Switch Low Low	Discrete N.O.



### 5.7.3 Setpoints

None

### 5.7.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
P-401	Pre-Anox Mixing Pump	The pump will be ON when the System is in Run & LSSL-401 is active.	LALL-401 PUMP IS OFF	Discrete	Y	HOA
P-402	Pre-Anox Mixing Pump	Runs Duty standby with P-401 switching every 120 hours		Discrete	Y	HOA
H-401	Tank Heater	On when TSL-401 is OFF	LALL-401	Discrete		
H-402	Tank Heater	On when TSL-401 is OFF	LALL-401	Discrete		

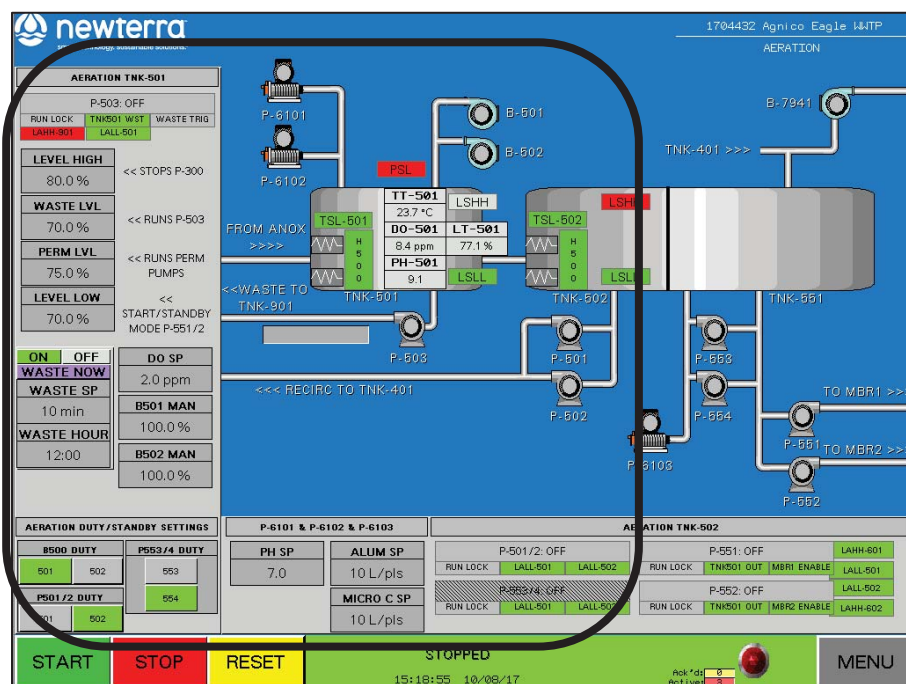
### 5.7.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
LAHH-401	Level Alarm High High	LSHH-401 = Active	5s	Y
LALL-401	Level Alarm Low Low	LSSL-401 = OFF	5s	Y



## 5.8 Aeration Tanks (TNK-501/502) - Biological Treatment Module

The schematic of the Aeration Tanks (TNK-501/502) is located on the AERATION HMI screen and shown below.



### 5.8.1 Function

Mixed liquor from the anoxic tank (TNK-401) flows by gravity to the first aerobic tank (TNK-501) followed by the second aeration tank (TNK-502) for aerobic biological degradation of the influent constituents (organics and ammonia). In the aerobic tanks (TNK-501/502), the nitrification process converts ammonia to nitrate in order to meet the effluent ammonia limit. This process consumes alkalinity, so caustic is dosed into TNK-501 (by pump P-6101) to control the pH. Additionally, liquid alum is dosed (by pump P-6102) into the anoxic zone to precipitate phosphorus in order to meet the effluent phosphorus limit.

pH measured by a pH probe (PH-501) in TNK-501.

Blowers (B-501/502) supply air to the submerged fine-bubble diffusers to ensure sufficient dissolved oxygen (DO) is available for biological oxidation and to keep solids in the water suspended. Dissolved Oxygen (DO) is measured by a DO Probe (DO-501) in TNK-501.

In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank (TNK-501) to the sludge holding tank (TNK-901) by P-503.



## 5.8.2 Inputs

Tag	Description	Input Type	HMI Display Units	Device Range and Units	Datalog (Y)	Trending (Y)
LSHH-501	Level Switch High High	Discrete N.C.				
LSLL-501	Level Switch Low Low	Discrete N.O.				
PH-501	pH Transmitter	Analog		0-14 pH	Y	Y
DO-501	Dissolved Oxygen Transmitter	Modbus	ppm	0-10	Y	Y
TT-501	Temperature Transmitter	Modbus	°C	0-100		
LT-501	Level Transmitter	Analog	%	0-10 ft	Y	Y
PSL-501	Pressure Switch Low	Discrete N.C.		9-85"WC		
LSHH-502	Level Switch High High	Discrete N.C.				
LSLL-502	Level Switch Low Low	Discrete N.O.				
TSL-502	Temperature Switch Low	Discrete N.C.				

## 5.8.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
LTL-501-SP	Level Transmitter Low Setpoint	70%	0-100%	Open	
LTH-501-SP	Level Transmitter High Setpoint	80%	0-100%	Open	
LT501-SLUDGE-SP	Waste Level for P-503	75%	0-100%	Open	
LT501-PERM-SP	Level Control for Permeate Pumps	75%	0-100%	Open	
P503 WASTE HOUR	When P-503 will waste	12pm	0-23		
P503 WASTE SP	Time that P-503 wastes for	10min	0-99		
PH-501-SP	pH Normal Setpoint	7 pH	6-8pH	Open	
PHAH-501-SP	pH Alarm High Setpoint	8 pH	7 - 14 pH	Open	Y



Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
PHAL-501-SP	pH Alarm Low Setpoint	6 pH	0-7 pH	Open	Y
DO-501-SP	Dissolved Oxygen Normal Setpoint	2 ppm	0-6 ppm	Open	
B500 I SP	Integral Gain setting DO PID Loop	10s	0-99		
B500 P SP	Proportional Gain setting DO PID Loop	100%	0-99		
B501 MAN SP	Manual Speed B-501	50%	0-100		
B502 MAN SP	Manual Speed B-502	50%	0-100		
DOAL-501-SP	Dissolved Oxygen Alarm Low Setpoint	0.5 ppm	0-6 ppm	Open	Y
ALUM DOSE	Alum Dose setting (xGal per Pulse)	10 Gallons	0-99 Gallons	Open	
MICROC DOSE	Micro C Dose setting (xGal per Pulse)	10 Gallons	0-99 Gallons	Open	
TALL-501-SP	Temperature Alarm Low Low	10 deg C	5 - 25 deg C	Password	Y
TTL-501-SP	Temperature Transmitter Low Setpoint	15 deg C	5-25 deg C	Open	
PAL-501-SP	Pressure Alarm Low Setpoint	28"WC (1PSIG)		On Device	Y
TALL-502-SP	Temperature Alarm Low Low	10 deg C	5 - 25 deg C	Password	Y

#### 5.8.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
P-6102	Alum Dosing Pump	Alum Dosing Pump P-6102 be ON when FIT-701 has reached a user adjustable volume of permeate via FT-701-DOSE setpoint. P-6102 will be ON for one pulse.		Discrete		HOA
P-6101	Caustic Dosing Pump	Caustic Dosing Pump P-6101 will be ON when PH-501 < PH-501-SP. The pump will be ON for 30s and OFF for 30s and will operate in pause mode		Discrete		HOA
H-501	Tank Heater	On when TSL-501 is OFF	LALL-501	Discrete		



Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
H-502	Tank Heater	On when TSL-501 is OFF	LALL-501	Discrete		
P-503	Waste Activated Sludge Pump	The waste activated sludge pump will be ON at time of day setting SLUDGE-WASTE-TOD IF level switch LT501-SLUDGE-SP	LAHH-901: Pump will be OFF	Discrete		HOA
H-503	Tank Heater	On when TSL-502 is OFF	LALL-502	Discrete		
H-504	Tank Heater	On when TSL-502 is OFF	LALL-502	Discrete		
P-501	Aeration Recirc Pump	The pump will run as long as LSSL-501 is Active	LALL-502: Pump will be OFF	Discrete	Y	HOA
P-502	Aeration Recirc Pump	Runs Duty standby with p-501 switching every 120 hours		Discrete	Y	HOA
B-501	Aeration Tank Aeration Blower	ON - AlwaysRuns via PID loop to maintain DO-501-SPRuns Duty/Standby 120 hours with B-502.		Direct	Y	HOA
B-502	Aeration Tank Aeration Blower	Runs via same logic as B-501. Runs Duty/Standby every 120 hours with B-501.		Direct	Y	HOA



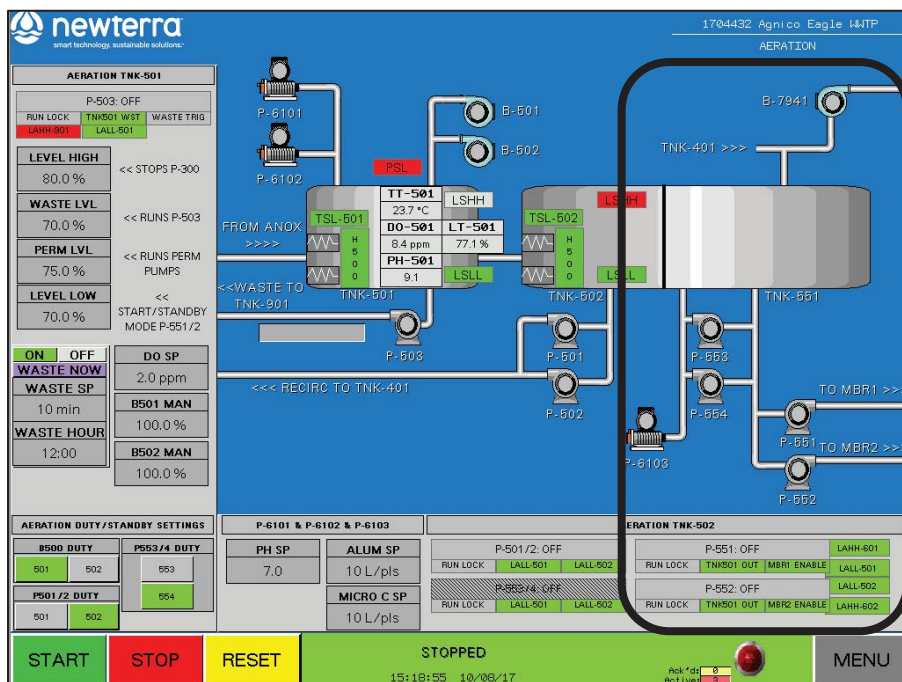
### 5.8.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
LAHH-501	Level Alarm High High	LSHH-501 = Active	5s	Y
LAHH-502	Level Alarm High High	LSHH-501 = Active	5s	Y
PHAH-501	pH Alarm High	pH-501 > PHAH-501-SP	60s	
PHAL-501	pH Alarm Low	pH-501 < PHAL-501-SP	60s	
DOAL-501	Dissolved Oxygen Alarm Low	DO-501 < DOAL-501-SP	15m	
DOALL-501	Dissolved Oxygen Alarm Low Low	DO-501 < DOAL-501-SP	4hrs	
TTAL-501	Low Temp TNK-501	TT-501 < TTAL-501-SP		
PAL-501	Pressure Alarm Low	PSL-501 = InActive	5s	Y
VFDA-501	VFD Fault			
VFDA-502	VFD Fault			
LALL-501	Low Low Level TNK-501	LSLL-501 = OFF		
LALL-502	Low Low Level TNK-502	LSLL-502 = OFF		



## 5.9 Post-Anox Tank (TNK-551) Module

The schematic of the Post-Anox Tank (TNK-551) is located on the AERATION HMI screen and shown below.



### 5.9.1 Function

Mixed liquor flows by gravity from the second aeration tank (TNK-502) to the post-anoxic tank (TNK-551) for final denitrification polishing. In the post-anoxic tank, there are minimal dissolved influent organics to drive the denitrification process. As such, an external carbon source in the form of Micro C is dosed (by P-6103) to supplement the organics and drive the denitrification process.

### 5.9.2 Inputs

None

### 5.9.3 Setpoints

None



### 5.9.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
P-553	Post Anox Mix Pump	The pump will run as long as LSLL-501 is Active	LALL-501: Pump will be OFF	Discrete	Y	HOA
P-554	Post Anox Mix Pump	Runs Duty standby with p-501 switching every 120 hours		Discrete	Y	HOA
P-6103	Micro C Dosing Pump	Dosing Pump will be ON when FIT-701 or FT-702 has reached a user adjustable volume of permeate via DOSE setpoint.		Discrete		HOA
P-551	Aeration Transfer Pump Feed to MBR-1	The aeration pump will feed MBR tank T-601. The pump will be ON when level transmitter LT-501 > LTL-501-SP and LSLL-501 = Active and LSLL-502 = Active and MBR-1 is Enabled. The aeration pump will be cycle ON/OFF when LT-501 < LTL-501-SP and be OFF if LSLL-501 = InActive OR LSLL-502 = InActive	LAHH-601: Pump will be OFF MBR-1 Disabled	Discrete	Y	HOA
P-552	Aeration Transfer Pump Feed to MBR-2	The aeration pump will feed MBR tank T-602. The pump will be ON when level transmitter LT-501 > LTL-501-SP and LSLL-501 = Active and LSLL-502 = Active and MBR-2 is Enabled. The aeration pump will cycle ON/OFF when LT-501 < LTL-501-SP and be OFF if LSLL-501 = InActive OR LSLL-502 = InActive	LAHH-602: Pump will be OFF MBR-2 Disabled	Discrete	Y	HOA

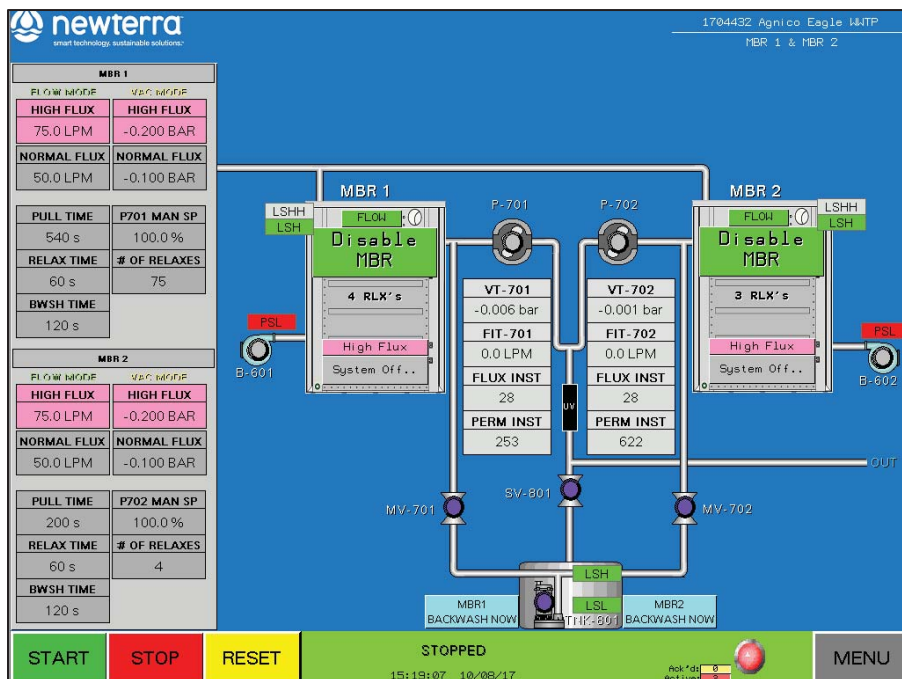
### 5.9.5 Alarms

None



## 5.10 Membrane and Permeate Module

The schematic of the Membrane (TNK-601/602) and Permeate (P-701/702) Module is located on the MBR 1 & MBR 2 HMI screen and shown below.



### 5.10.1 Function

Mixed liquor filtration and supplemental biological oxidation.

Since the solid-liquid separation process results in an accumulation of solids in the membrane tank, the mixed liquor (containing both solids and filtrate) is continuously recycled to the first aeration tank (TNK-501). This prevents excessive solids build-up in the membrane tank, and maintains sufficient biomass in the anoxic and aeration tanks. The solids that accumulate in the system consist of biomass that have grown from the influent organics and ammonia, as well as non-biodegradable solids from the influent wastewater.

Vacuum pumps (P-701 and P-702) draw the water through the membranes under a low vacuum of 0.07 to 0.25 bar.



### 5.10.2 Inputs

Tag	Description	Input Type	HMI Display Units	Device Range and Units	Datalog (Y)	Trending (Y)
LSHH-601	Level Switch High High	Discrete N.C.				
LSH-601	Level Switch High	Discrete N.O.				
LSHH-602	Level Switch High High	Discrete N.C.				
LSH-602	Level Switch High	Discrete N.O.				
PSL-601	Pressure Switch Low	Discrete N.C.		9-85"WC		
PSL-602	Pressure Switch Low	Discrete N.C.		9-85"WC		
VT-701	Vacuum Transmitter	Analog	Bar	-1.0 - 1.0 Bar	Y	Y
VT-702	Vacuum Transmitter	Analog	Bar	-1.0 - 1.0 Bar	Y	Y
VFD-701	VFD Status	Communcation				
VFD-702	VFD Status	Communcation				
FIT-701	Flow Indicating Transmitter	Analog	GPM	0-300lpm	Y	Y
FQI-701	Flow Totalizer	Discrete N.O.	Pulse/Gal	1liter / Pulse		
FIT-702	Flow Indicating Transmitter	Analog	GPM	0-300lpm	Y	Y
FQI-702	Flow Totalizer	Discrete N.O.	Pulse/Gal	1liter / Pulse		
LSH-801	Level Switch High	Discrete N.C.				
LSL-801	Level Switch Low Low	Discrete N.O.				

### 5.10.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes
VT-701-SP	MBR-1 Vac Mode Permeate Setpoint	-0.1 bar	-0.2 - 0 bar	Open		
VT-701-HFSP	MBR-1 Vac Mode Permeate High Flux Setpoint	-0.15 bar	-0.2 - 0 bar	Open		
VTAH-701-SP	MBR-1 Vacuum Transmitter Alarm High	-0.3 bar	-0.3 - 0 bar	Open	Y	
VT-702-SP	MBR-2 Vac Mode Permeate Setpoint	-0.1 bar	-0.2 - 0 bar	Open		
VT-702-HFSP	MBR-2 Vac Mode Permeate High Flux Setpoint	-0.15 bar	-0.2 - 0 bar	Open		



Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)	Notes
VTAH-702-SP	MBR-2 Vacuum Transmitter Alarm High	-0.3 bar	-0.3 - 0 bar	Open	Y	
FT-701-SP	MBR-1 Flow Mode Permeate Setpoint	60 GPM	0-200	Open		
FT-701-HFSP	MBR-1 Flow Mode Permeate High Flux Setpoint	75%	0-200	Open		
FTAH-701-SP	MBR-1 Flow Transmitter Alarm High Setpoint	100	0-200	Open	Y	
FTAL-701-SP	MBR-1 Flow Transmitter Alarm Low Setpoint	10	0-200	Open	Y	
FT-702-SP	MBR-2 Flow Mode Permeate Setpoint	60 GPM	0-200	Open		
FT-702-HFSP	MBR-2 Flow Mode Permeate High Flux Setpoint	75GPM	0-200	Open		
FTAH-702-SP	MBR-2 Flow Transmitter Alarm High Setpoint	100	0-200	Open	Y	
FTAL-702-SP	MBR-2 Flow Transmitter Alarm Low Setpoint	10	0-200	Open	Y	
BKWSH-TIME-SP	Backwash Time Setpoint	120s	0-999 s	Open		
RELAX-SP	Number of Relaxes Before Backwash	6	0-999	Open		
PERM-PULL-TIME	Permeate Pull Time	9m	0-30m	Open		
RELAX-TIME	Membrane Relax Time	60s	0-999 s	Open		
FLUX-SP	High Flux Setpoint	75%	50-100%	Open		Reading based on LT-301
SLUDGE-WASTE-TOD	Time of Day to Start Sludge Wasting	23hr	0-23 hr	Open		
SLUDGE-WASTE-TIME	Duration of Sludge Wasting	60m	0-1000m	Open		



#### 5.10.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter
B-601	MBR Tank Blower	The membrane tank blower will be ON when the System is in Run. And the MBR 1 is enabled	MBR-1 Disabled	Discrete	Y
B-602	MBR Tank Blower	The membrane tank blower will be ON when the System is in Run. And the MBR 2 is enabled	MBR-2 Disabled	Discrete	Y
P-701	Permeate Transfer Pump	<p>The permeate pump will be ON when MBR-1 is Enabled &amp; level switch LSH-601 = Active &amp; LT-501 &gt; LT501-PERM-SP</p> <p>The Pump will perform a PULL/RELAX Cycle. The pump will be ON for the duration specified by the PERM-PULL-TIME setpoint and then be OFF for the duration of the RELAX-TIME setpoint. This will generate one PULL/RELAX Cycle. The VFD Speed of the pump will operate based on the following:</p> <p>In FLOW MODE: The VFD Speed will operate based on a PID loop to maintain the flowrate setpoint FT-701-SP. IF the vacuum transmitter VT-701 &gt; -0.25 bar then the pump will switch to VAC MODE.</p> <p>IF the level transmitter LT-301 &gt; FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint FT-701-HFSP</p> <p>In VAC MODE: The VFD Speed will operate based on a PID loop to maintain the vacuum setpoint VT-701-SP. IF the level transmitter LT-301 &gt; FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint VT-701-HFSP</p> <p>P-701 will be OFF if P-501 is OFF.</p>	VFDA-701: Pump Will be Off	Communication	Y



Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter
P-702	Permeate Transfer Pump	<p>The permeate pump will be ON when MBR-2 is Enabled &amp; level switch LSH-602 = Active &amp; LT-501 &gt; LT501-PERM-SP</p> <p>The Pump will perform a PULL/RELAX Cycle. The pump will be ON for the duration specified by the PERM-PULL-TIME setpoint and then be OFF for the duration of the RELAX-TIME setpoint. This will generate one PULL/RELAX Cycle.</p> <p>The VFD Speed of the pump will operate based on the following:</p> <p>In FLOW MODE:</p> <p>The VFD Speed will operate based on a PID loop to maintain the flowrate setpoint FT-702-SP.</p> <p>IF the vacuum transmitter VT-702 &gt; -0.25 bar then the pump will switch to VAC MODE.</p> <p>IF the level transmitter LT-301 &gt; FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint FT-702-HFSP</p> <p>In VAC MODE:</p> <p>The VFD Speed will operate based on a PID loop to maintain the vacuum setpoint VT-702-SP.</p> <p>IF the level transmitter LT-301 &gt; FLUX-SP, the pump will run via PID loop to maintain a high flow setpoint VT-702-HFSP</p> <p>P-702 will be OFF if P-502 is OFF.</p>	VFDA-703: Pump Will be Off	Communication	Y
SV-801	Clean In Place Tank Fill Solenoid Valve	<p>The Solenoid Valve SV-801 will be Open (Energized) when level switch LSH-801 is InActive and MBR-1 OR MBR-2 are not in Backwash.</p> <p>The Solenoid Valve SV-801 will be Closed (De-Energized) when LSH-801 is Active or IF MBR-1 OR MBR-2 are in Backwash.</p>		Discrete	
MV-701	Backwash Actuated Valve	<p>A Backwash is enabled once the permeate pumps for MBR-1 reach the number of PULL/RELAX cycles designated by the RELAX-SP on the HMI. The actuated valve will be OPEN when MBR-1 is in Backwash and level switch LSH-801 is Active. If MBR-2 is already in backwash, MBR-1 will complete 1 additional PULL/RELAX Cycle before starting a Backwash Cycle.</p>		Discrete	
MV-702	Backwash Actuated Valve	<p>A Backwash is enabled once the permeate pumps for MBR-2 reach the number of PULL/RELAX cycles designated by the RELAX-SP on the HMI.</p> <p>The actuated valve will be OPEN when MBR-2 is in Backwash and level switch LSH-801 is Active. If MBR-2 is already in backwash, MBR-1 will complete 1 additional PULL/RELAX Cycle before starting a Backwash Cycle.</p>		Discrete	



Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter
P-801	Backwash Transfer Pump	The backwash transfer pump will be ON when MBR-1 OR MBR-2 are in Backwash and level switch LSH-801 is Active The backwash transfer pump will be OFF after the duration of BKWSH-TIME-SP OR level switch LSL-801 becomes InActive.		Discrete	

### 5.10.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Email Notification (Y)	Self Resetting (Y)
LAHH-601	Level Alarm High High	LSHH-601 = Active	5s		Y
LAHH-602	Level Alarm High High	LSHH-602 = Active	5s		Y
PAL-601	Pressure Alarm Low	PSL-601 = InActive	5s		Y
PAL-602	Pressure Alarm Low	PSL-602 = InActive	5s		Y
VTAH-701	Vacuum Transmitter Alarm High	VT-701 < VTAH-701-SP	5s		Y
VTAH-702	Vacuum Transmitter Alarm High	VT-702 < VTAH-702-SP	5s		Y
VFDA-701	VFD Fault				
VFDA-702	VFD Fault				
FTAH-701	Flow Transmitter Alarm High	FIT-701 > FTAH-701-SP	60s		
FTAL-701	Flow Transmitter Alarm Low	FIT-701 < FTAL-701-SP	60s		
FTAH-702	Flow Transmitter Alarm High	FIT-702 > FTAH-702-SP	60s		
FTAL-702	Flow Transmitter Alarm Low	FIT-702 < FTAL-702-SP	60s		



#### 5.10.6 Blower Control



**Blower for scouring air must be on 24/7, as failure of air supply can lead to clogging of the air diffusers and membranes.**

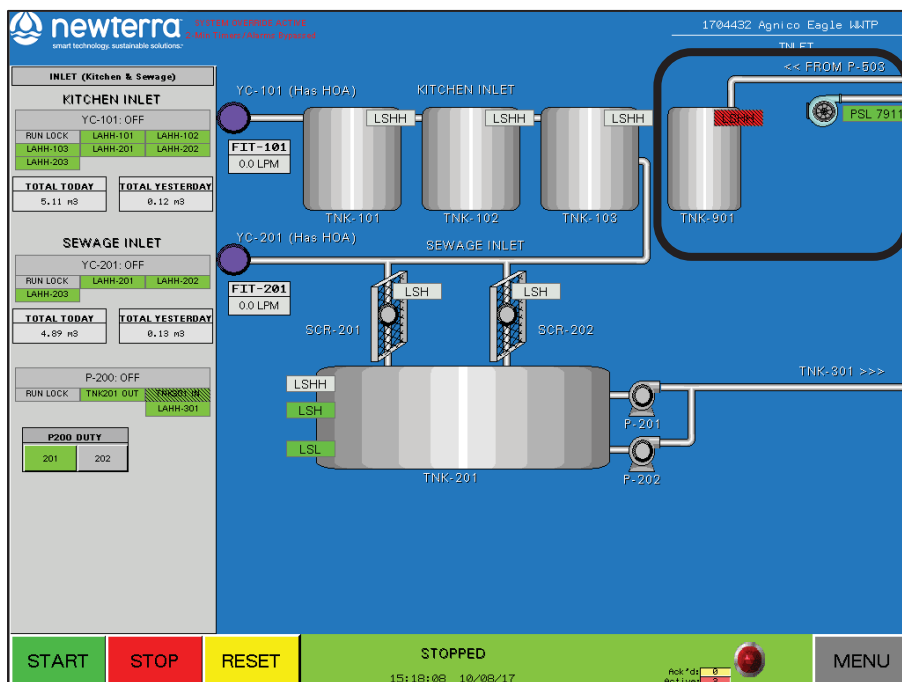
#### 5.10.7 CIP Cleaning

Note: At design flow when the membrane discharge vacuum exceeds 0.2 bar (80" WC), as transmitted by VT-701, VT-702 and indicated locally at PI-701, PI-702, it is necessary to take the membrane tank offline for CIP cleaning. See **Section 7** for instructions on CIP cleaning.



## 5.11 Sludge Holding Tank Module (TNK-901)

A schematic of the Sludge Holding Tanks is located on the INLET HMI screen is shown below.



### 5.11.1 Function

To store and thicken waste activated sludge for later disposal off site.

In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank (TNK-501) to the sludge holding tank (TNK-901). Wasted sludge in the sludge holding tank is thickened by decanting supernatant back to the screen tank. Thickened sludge accumulates in the sludge holding tanks until it is eventually pumped out for disposal.

### 5.11.2 Inputs

Tag	Description	Input Type
LSHH-901	Level Switch High High	Discrete N.C.



### 5.11.3 Setpoints

Tag	Description	Factory Setpoint	Setpoint Range and Units	Setpoint Change Control	Alarm setpoint (Y/N)
P503 WASTE HOUR	When P-503 will waste	12pm	0-23		
P503 WASTE SP	Time that P-503 wastes for	10min	0-99		

### 5.11.4 Logic

Tag	Description	Control Logic	Alarm Interactions	Output Type	Hour Meter	HOA Control
P-503	Waste Activated Sludge Pump	The waste activated sludge pump will be ON at time of day setting SLUDGE-WASTE-TOD IF level switch LT501-SLUDGE-SP	LAHH-901: Pump will be OFF	Discrete		HOA


### 5.11.5 Alarms

Alarm	Alarm Description	Actuation Control	Delay	Self Resetting (Y)
LAHH-901	Level Alarm High High	LSHH-901 = Active	5s	Y



## 5.12 Setpoints

The system Setpoints can be accessed from the SETPOINTS menu option.



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SETPOINTS

INLET		EQ TNK-301		ANOX TNK-401		AERATION			
P200 DUTY		P300 DUTY		B300 DUTY		P400 DUTY		LEVEL HIGH	
201	202	301	302	301	302	401	402	80.0 %	
HIGH FLOW 101 300.0 LPM		LEVEL HIGH 95.0 %		<< STOPS P-200		WASTE LVL 70.0 %		<< STOPS P-300	
HIGH FLOW 201 300.0 LPM		HIGH FLUX LVL 75.0 %		<< PUTS MBR HIGH FLUX		PERM LVL 75.0 %		<< RUNS P-503	
LEVEL LOW 10.0 %		LEVEL LOW 10.0 %		<< START/STOP P-300		LEVEL LOW 70.0 %		<< RUNS PERM PUMPS	
						ON OFF		<< START/STOP P-551/2	
						WASTE NOW			
						WASTE SP		WASTE HOUR	
						10 min		12:00	
						</			

### 5.12.1 PLC Date & Time

The PLC Time and Date can be adjusted from the SETPOINTS HMI screen. Below is an example of the screen that will appear for the operator.

SET PLC DATE/TIME

Day
Month
Year
0
0
0

Hour
Minute
Second
0
0
0

Read PLC
Set & Exit
Exit



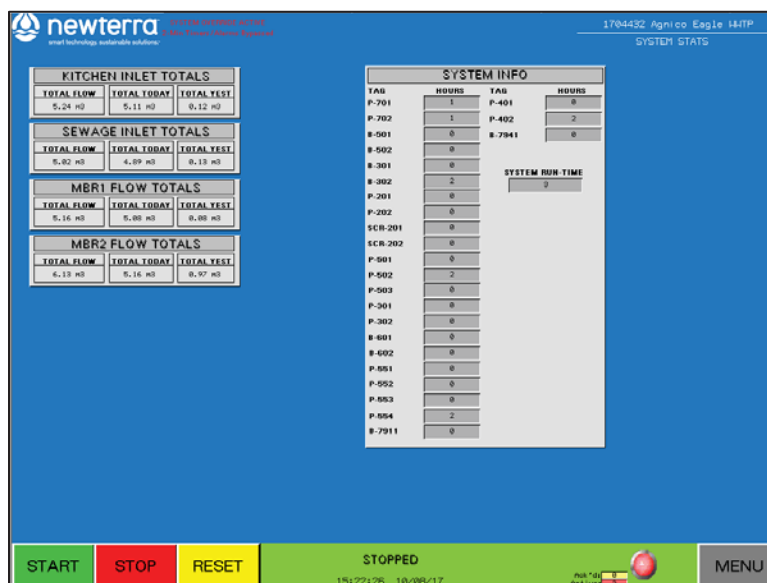
### 5.12.2 Factory Defaults

The Factory Defaults (setpoints) can be restored to the WWTP by pressing the Factory Default button from the SETPOINTS HMI screen. A confirmation screen will appear to the operator. See below. A listing of WWTP Factory Default values (setpoints) are at Appendix K.



### 5.13 Statistics

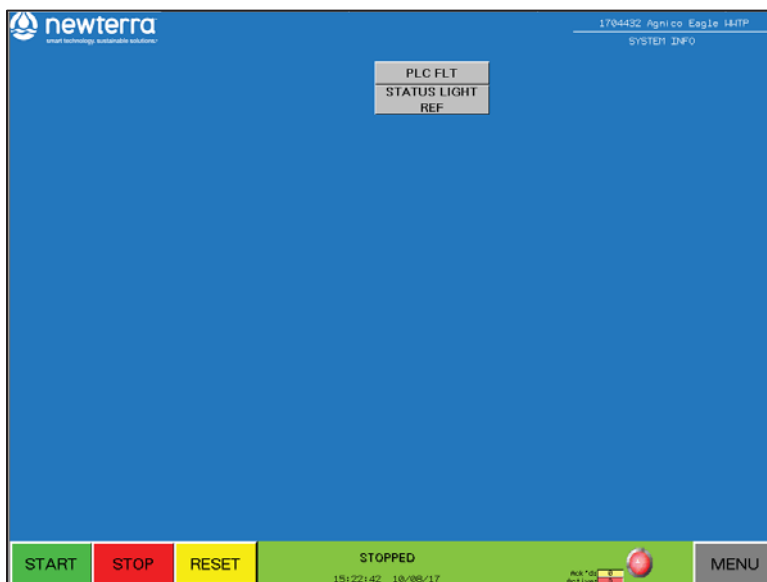
The system statistics can be accessed from the STATS menu option. Influent and Process Flow totals as well as motor run times are provided at this screen.





## 5.14 PLC Status

The system PLC status can be accessed from the SYSTEM INFO menu option.









## 6.0 PLANT START-UP, OPERATING GUIDELINES AND MONITORING

### 6.1 MBR Plant Start-Up

#### 6.1.1 Mechanical & Electrical Start-up Procedure

- If the system is being started for the first time, work your way through the **newterra Commissioning Checklist** presented in **Appendix C** of this O&M Manual.
- If the kill switch on the panel (red mushroom shaped button) is pulled out, then push it in to confirm that the MBR system is off.
- Push the reset button on the operator interface to reset all alarms.
- Make sure there are no obstructions over any moving parts, for example a jacket laying on a belt drive.
- Put all HAND/OFF/AUTO switches to AUTO (**A**) mode.
- Pull the kill Button (red button on panel) out to start the process.
- Push the start button on the Operator Interface.

#### 6.1.2 Process Start-up

NOTE: Sludge from a nearby wastewater treatment plant can be used to start up another system if the treatment process is similar (i.e. nitrification, de-nitrification etc.).

1. Introduce the seed bacteria and fill the aeration tank according to one of the following two methods specific to the type of seed used:

##### Sludge Seed

- a. Calculate the volume of seed sludge required to ensure that there is a minimum of 3,000 mg/L MLSS in the MBR system. The volume of seed sludge required can be calculated with the following formula.

$$V_s = \frac{3000 \times V_t}{MLSS_s}$$

Vs: Total volume of seed sludge for MBR system (m3)

Vt: Total effective volume of process tanks in MBR system (see section 3 of the manual) (m3)

MLSSs: MLSS concentration of seed sludge from a treatment system with similar processes (nitrification, de-nitrification etc.) (mg/L)



Arrange for delivery of fresh seed sludge from an activated sludge system employing a suspended growth type process. If it is possible, obtain seed sludge from a facility treating similar wastewater and operated with similar processes (nitrification etc).

- b. If possible drain the water used for clean water testing from the aeration tank. This will minimize dilution of the seed bacteria.
- c. Pump seed sludge through the screen module to remove any debris that might damage the membranes. This can usually be done by slowly dumping the seed into the closest lift station. Ensure screen process and feed pumps to aeration tank are in "AUTO" mode.
- d. If a primary clarifier is included and there is a screen between the aeration tank and membrane tank: Add seed sludge directly to the aeration tank.
- e. Once aeration tank liquid level has filled above 30% with seed sludge, turn aeration tank blowers to "AUTO" mode.
- f. Continue adding remaining seed sludge.
- g. Once all seed sludge has been pumped into the aeration tank take note of the liquid level. If the aeration tank is full then continue to Step 2. If the aeration tank is not full then continue to fill the aeration tank 15% of its total volume per day using raw wastewater. This is to avoid shocking the bacteria with excess BOD, reducing the risk of forming foam causing bacteria and reducing the impact of un-metabolized BOD on the membranes.

## Dry Seed

- a. If possible drain the water in the aeration tank used for clean water test. This will minimize dilution of the seed bacteria.
- b. Turn screen module and feed pump(s) to aeration tank to "AUTO".
- c. Allow aeration tank to fill to 30% with raw wastewater, and then turn off screen module and feed pump(s).
- d. Remove the access cover from the aeration tank.
- e. Adjust the DO probe and pH probe positioning in the aeration tank until both probes are submerged in the wastewater.
- f. Turn aeration tank blowers to "HAND" to ensure vigorous mixing when adding dry seed bacteria. Note: When set to "HAND" the blowers will only run for 2 minutes. If this time runs out before all the dry bacteria have been added, then the blowers must be set to "OFF" and then back to "HAND".



- g. Slowly add 25% of the supplied heterotrophic dry seed bacteria through the view port). The following quantities in Table 1 are typically shipped with standard camp systems, if the current system is not on this list please consult with a Process Engineer:

Table 1 - Seed bacteria quantities per standard camp model

Standard Camp Model	Dry Bacteria (Bioremove 5190) (lbs)	Nitrifying Bacteria (Bioremove 5895) (lbs)
50 Man	50	10
100 Man	50	10
300 Man	75	20
600 Man	75	20
1000 Man	100	30

- h. Turn aeration tank blowers to “AUTO”.
- i. Continue adding raw wastewater and dry seed bacteria according to the schedule outlined in Table 2 below:

Table 2 - Dry seed and wastewater dosing schedule

Day	Daily Wastewater Flowrate (% of Aeration Tank Volume)	Aeration Tank Fill Level (%)	Dry (heterotrophic) Seed to be Added (% of Total Supplied)
1	30%	30%	25%
2	10%	40%	20%
3	10%	50%	15%
4	15%	65%	10%
5	15%	80%	10%
6	15%	95%	10%
7	5%	100%	10%

- j. As the aeration tank fills, continue to adjust the positioning of the DO and pH probes accordingly.
2. Once the aeration tank is full (liquid level >80%) the remaining equipment in the system can be started. Turn all equipment (except sludge wasting/processing equipment) to “AUTO”. Set the permeate flow rate at a value to achieve a flux of 6.5 lmh initially.

Convert flux (lmh) to flow rate (lpm) as follows:

$$\text{Flow rate (lpm)} = \frac{\text{Flux (lmh)} * \text{membrane surface area (m}^2\text{)}}{60 \left(\frac{\text{min}}{\text{h}}\right)}$$

\*\*\*\* Verify the membrane cassette model – MCXL2 = 8 m<sup>2</sup> of surface area

3. Continue increasing the flux rate everyday according to the schedule in below.



NOTE: Day 1 refers to the day that the aeration tank is full. If dry seed was used this will be day 7. If nitrifying bacteria were provided begin dosing into the aeration tank according to the schedule in below.

Flux and nitrifying bacteria dosing schedule

Day	Flux (lmh)	Nitrifying Bacteria to be Added (% of Total Provided) [If Provided]
1	6.5	20%
2	6.9	20%
3	7.4	20%
4	7.9	20%
5	8.4	20%
6	9.0	-
7	9.6	-
8	10.2	-
9	10.9	-
10	11.6	-
11	12.4	-
12	13.2	-
13	14.1	-
14	15.1	-
15	16.1	-
16	17.1	-
17	18.0	-
18	18.0	-
19	18.0	-
20	18.0	-
21	18.0	-
22	18.0	-
23	18.0	-

4. Foaming may occur during start-up, which is normal. Foaming can be caused by a number of factors. Typically during start-up foaming is a result of a high food (BOD) to microorganism (F/M) ratio. This promotes the growth of long chained filamentous bacteria that increases the surface tension resulting in strong, long lasting foam. As the quantity of biomass builds, and the sludge age increases the normal non-filamentous bacteria will dominate, and the foam should subside. In the meantime foaming can be addressed by spraying water, food based defoamer (silicone based defoamer is strictly prohibited) addition, or aeration minimization in the aeration tank. Check for signs of toxicity and excessive fat, oil and grease.
5. If a defoamer is required, consult with a process engineer for recommendation of an acceptable antifoaming agent and dosing quantities.



6. Monitor the pH throughout the start-up process. An observed decline in pH is an indication that the nitrifying bacteria are beginning to remove ammonia. It is important, however, that the pH does not drop too low, as this can cause biological activity to be inhibited, which can then result in severe membrane fouling. During start-up it is beneficial to operate at a pH between 7.0 and 7.5 to ensure optimal performance and growth of bacteria.

The pH should be maintained between 6.5 and 8.0 during normal operation.

### ATTENTION

**It is advisable to start the MBR system with a minimum MLSS concentration of 3,000 mg/L to minimize foaming. The seed sludge should come from a plant which has a screen of 2 mm. It is critical to screen the seed sludge with 2 mm perforated screen prior to seeding for membrane protection.**

### ATTENTION

**No untreated wastewater should enter the membrane tank. Make sure wastewater is completely biologically treated before it gets to the membrane tank**



## 6.2 MBR System Operating Guidelines and Monitoring

### 6.2.1 Operating Guidelines

This section outlines the operating conditions that are required for proper wastewater treatment, and longevity of the membranes. For instructions on how to control the system using the touch screen HMI, see **Section 5**. The operators are expected to run the MBR system at all times in accordance with the maintenance, operational procedures and details specified in this manual. The following two tables provide operating parameters that can be easily maintained, and define the range of operating values.

**There may be situations where the system needs to operate outside of the conditions covered in this manual. If these conditions develop, please consult newterra ltd. to discuss operation and methods to optimize performance.**

Generally, the following points can be used to operate the MBR system properly:

- The MBR system is designed to treat wastewater with specified influent characteristics.
- Never operate the MBR tank below the minimum membrane submerged level. It is necessary to maintain a minimum of 250 mm liquid level above the membrane modules to ensure they are wet at all times and to allow for proper filtration.
- Always supply the required amount of air for scouring to the membrane module.
- Always filter wastewater at or below design flow rate.
- Periodically, relax the membranes by ending filtration while allowing the membrane aeration scour to operate continuously and initiate backwash operation during membrane relaxation (default relaxation mode preset in PLC - permeation continues for 9 min and stops for 1 min).
- Always operate the MBR in accordance with the parameters listed in the following tables.
- Clean the membranes in-place with a dilute chemical in accordance with **Section 7** of the O&M Manual.



### 6.2.1.1 Membrane Filtration Operational Conditions

Parameter	Recommended Value	Notes
<b>Diffuser Relaxation</b>	10 minutes/day	Effluent filtration must be turned off, blower shuts down for 10 mins/day
<b>Relax Time</b>	1 min/10 min	Filtration must be off and blower are operating continuously
<b>Backwashing</b>	48 cycles	Built-in backwash mode during relaxation mode
<b>In-situ Chemically Enhanced Backwash (CEB)</b>	500 ppm as NaOCl	Requires 3 L to fully backwash one MCXL cassette. Frequency of CEB may vary. Refer to Membrane Cleaning Section 7.3 for cleaning procedure.
<b>TMP</b>	< 0.2 bar (2.9 psi)	Membranes to be cleaned once the TMP exceeds 0.2 bar (2.9 psi)



### 6.2.1.2 MBR – Recommended Biological Operational Conditions

Parameter	Recommended	Range	Notes
<b>MLSS (mg/L)</b>	10,000	8,000 – 15,000	Never operate the membranes if MLSS < 3,000 mg/l. Sludge wasting should be undertaken as required to maintain target MLSS
<b>Temperature (°C)</b>	15 - 35	10 – 35	Avoid sudden changes in temperature. Minimum operating temperature is 15 °C
<b>pH (s.u.)</b>	6.8 - 8.5	6.0 – 9.0	Membrane module can handle a change in pH, however it is recommended to keep pH between 6.8 - 8.5
<b>Aeration Tank, DO (mg/L)</b>	≥ 2.0	1.0 – 8.0	This can be maintained by adjusting the volume of air supplied to the aeration tank
<b>Viscosity (mPa-s)</b>	Not applicable	0 – 300	–
<b>Aeration Tank to Anoxic Tank Recirculation</b>	400%	200 – 500%*	Only applies if an anoxic tank is included. *The recycle ratio is a function of effluent NO <sub>3</sub> -N/TN limit
<b>Membrane Tank to Aeration Tank Recirculation</b>	400%	200 – 600%	–
<b>F:M (kg BOD/kg MLSS/d)</b>	0.1	0.03 – 0.2	$F:M = [\text{Flow (m}^3/\text{d)} \times \text{BOD conc (mg/l)}] / [\text{Process volume (m}^3) \times \text{MLSS conc (mg/l)}]$
<b>F:M (kg COD/kg MLSS/d)</b>	0.15	0.05 – 0.3	$F:M = [\text{Flow (m}^3/\text{d)} \times \text{BOD conc (mg/l)}] / [\text{Process volume (m}^3) \times \text{MLSS conc (mg/l)}]$
<b>SRT</b>	> 15	12 – 50	

Process Troubleshooting Guide is presented in Section 7 of this O&M Manual.



## 6.2.2 Sampling

To ensure accurate system monitoring and the validity of laboratory test data, samples must be collected as outlined below. These are only recommended guidelines. It is imperative that scheduled testing protocols are performed in compliance with local regulatory agency requirements. Composite samples of the MBR systems may need to be sent out to a certified laboratory for testing, based on the local regulatory requirements.

### Monitoring and Testing Requirements

Parameter***	Influent	Aeration Tank	Membrane Tank	MBR Effluent
Flow rate	D (PLC)			D (PLC)
Fat, Oil and Grease (FOG)	AR			AR
Alkalinity	AR			
Biological Oxygen Demand (BOD)	W			W
Total Suspended Solids (TSS)	W			W
Total Kjeldahl Nitrogen / Total Nitrogen (TKN / TN)	M			AR
Ammonia Nitrogen(NH <sub>4</sub> -N)				AR
Nitrate Nitrogen (NO <sub>3</sub> -N)				AR
Total Phosphorus (TP)	W			W
Mixed Liquor Suspended Solids (MLSS)			W	
Mixed Liquor Volatile Suspended Solids (MLVSS)			AR*	
Temperature		D (PLC)		
pH	AR	D (PLC)		W
Dissolved Oxygen (DO)		D (PLC)		
Filterability			TW	
Turbidity				AR**
Fecal Coliform / <i>E-Coli</i>				W

**Legend: D = daily; W = weekly; TW = three times weekly; M = monthly; AR = as required.**

\* If MLVSS /MLSS ratio of a minimum of 0.7 is detected, MLVSS testing can be done periodically, on an “as required” basis.

\*\*The effluent should be routinely checked for any signs of problem. Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, testing should be carried out required.

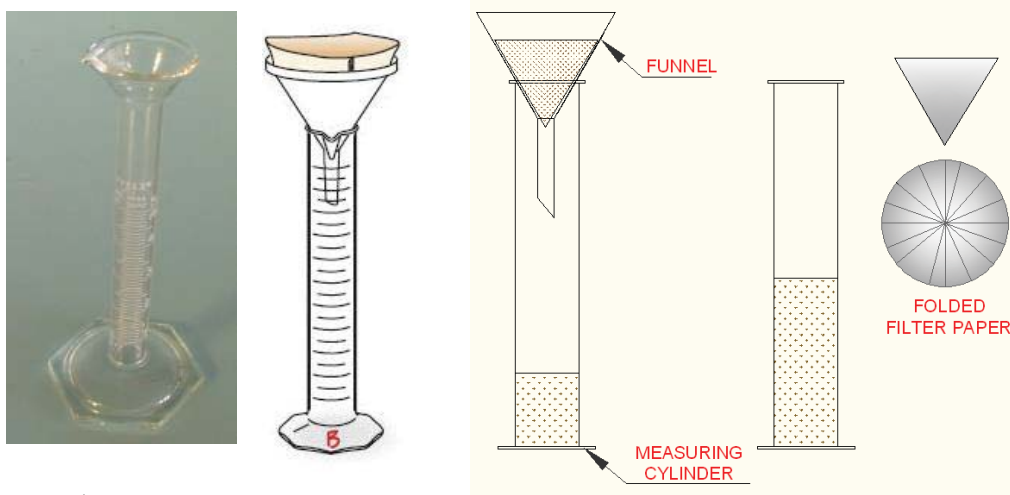


\*\*\* Explanation and definition of abbreviations, acronyms and terms used in the manual are presented in **Appendix G – Glossary & Terms** and **Appendix H – Biological Treatment & Monitoring Parameters**.

### 6.2.2.1 Filterability Test

The objective of the filterability test is to evaluate the condition of the working biomass. This is assessed by measuring the volume of filtrate passing through the filter paper. If filtrate is greater than 10 mL/10 min, then biomass filterability is acceptable; however, if it is less than 10 mL/10 min, modifications to the plant operating condition are required to prevent premature membrane fouling. See the Membrane Fouling Troubleshooting Guidelines table in Section 7.6.1 to determine the cause of the low filterability and how to correct operation to improve the filterability.

#### Laboratory Glassware and Filter Paper



#### Apparatus:

Filterability Kit is distributed by **newterra ltd (Part # 24146)**.

#### Measurement Procedure:

1. Pleat filter paper by folding in half, quarters etc.
2. Line the funnel with pleated filter paper and place the funnel in the graduated cylinder.
3. Collect 50 mL of activated sludge sample in a beaker and stir.
4. Pour the 50 mL sample into the funnel.
5. Start timer when the first drop of water filtered through the filter paper.
6. After 10 minutes of filtration, record the level of filtrate in the graduated cylinder.

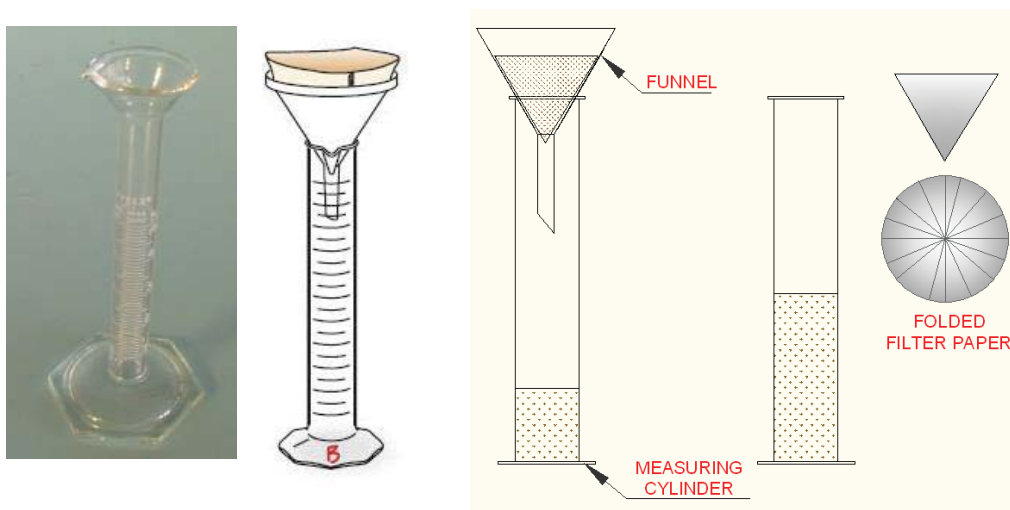


Filterability (FT)	Action	State of urgency
> 10 ml	Excellent, no action req'	
5 - 10 ml	Tweak process operation	
< 5 ml	Process adjustment req	<b>Contact newterra ltd.</b>

### 6.2.3 Suggested Test Equipment for Monitoring

The following test equipment's will assist in the monitoring of the MWWTP but are not provided with the system.

#### 6.2.3.1 Filterability - Laboratory Glassware and Filter Paper



Apparatus:

- Filter paper - AMD Manufacturing, Part Number NO5C 18.5CM or equivalent;
- Funnel (75 mm diameter recommended);
- 50 mL graduated cylinder - Cole-Parmer Graduated Cylinder, Part Number RK-06134-67 or equivalent;
- Beaker (min 100 ml size) and stir rod
- Watch with seconds display or equivalent



### 6.2.3.2 Turbidity, Phosphorus - Hach DR900 (and reagents)



The hand-held DR 900 allows quick and easy access to most-used testing methods. This colorimeter is waterproof, dustproof and field durable. With an intuitive user interface, easy data transfer abilities, and the ability to test up to 90 of the most commonly tested water methods.

### 6.2.3.3 DO and pH - Hach HQ40d with probe or Equivalent



Designed for water applications, the Hach HQ40d portable meter is an advanced meter. HQd<sup>™</sup> meters connect with smart probes that automatically recognize the testing parameter, calibration history, and method settings to minimize errors and setup time.

Portable meter measures critical water quality parameters - without the need for multiple instruments.

Intuitive user interface for simple operation and accurate results.

Meter kit includes field case, 4 AA batteries, protective meter glove, power adapter, USB/DC power adapter for data transfer, quick-start guide, user manual, and documentation CD.

DO and pH probes required.



#### 6.2.3.4 Sludge Settling - Settleometer



The ability to observe and measure the rate and characteristics of solids separation is essential to control biological treatment processes that produce sludge.

#### 6.2.3.5 TSS - Aysix model 3150 hand held TSS meter or Equivalent



Portable Suspended Solids Analyser

#### 6.2.3.6 Hach CEL Advanced Wastewater Laboratory



Includes the DR 900 Colorimeter, HQd multi-meter with pH probe, reagent sets, apparatus, illustrated instrument and procedures manuals, and a rugged carrying case



### 6.2.4 Record Keeping

An essential component of quality control in any facility is sound record keeping. A log book covering the entire treatment system performance should be maintained, updated, and readily accessible to all operators. The log book should be used to record observations, set point alterations, and unusual conditions.

For each wet chemistry parameter analysis, a separate work-sheet has to be prepared. Work-sheet data for at least the previous year should be kept for possible consultation.

The second step in quality control is to train all operators to follow an established procedure for each test. Identical samples should be periodically tested for any parameter by different operators, and the variability among results should be compared. Consistent variability in results may lead to the technique improvement of operators.

Duplicate analysis of a sample should also regularly be done. And, split samples should regularly be sent to an outside accredited laboratory and analysis results should be compared with those done in-house.

In addition to summary sheets, it is highly recommended that data should be entered into prepared Excel spread-sheets. Spread-sheets greatly aid in the data presentation and manipulation, and would be of immeasurable value when report writing is required.

### 6.2.5 Process Trending

Other than pre-planned process changes or major upsets, process modifications should be based on trends shown in the process data. A trend is nothing more than an indication of real change in a process parameter over time. A trend chart is simply a graph of data being trended.

As the graph changes, upward or downward trends are detectable. Smoothing trends by graphing the 3-, 7-, or 30-day average of the data allows the trend to be shown more clearly. Because the individual data point may be questionable, the actual value of data point are less important compared with the trend regarding the process monitoring.

Trend graphs are a part of the Excel data spread-sheet; the operator can trend and analyse many parameters in just a few minutes in order to assess process performance. When a trend is identified, its indication to the process can be evaluated, and corrective action may be carried out, if needed. Statistically, the more data points there are in a trend chart, the more reliable the trend.



## 7.0 SYSTEM MAINTENANCE

 <p><b>ATTENTION</b></p>	<p><b>ATTENTION: MAINTENANCE SHOULD BE PERFORMED ONLY BY TRAINED PERSONNEL!</b></p> <p>When providing maintenance or cleaning the plant, avoid direct contact with wastewater, organic materials, etc.</p> <p>Always wear protective clothing, e.g. waterproof, protective gear, boots, and gloves to keep these materials from body. Wear face and eye protection as required by health &amp; safety protocols and standards, especially when handling chemicals.</p>
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**CAUTION: Shut off all electrical power before working on the mechanical or electrical equipment.**

The system should be routinely checked for any signs of operational problems. Such problems could include, but are not necessarily limited to, abnormally high peak flows, unpleasant odour, and diffuser clogging, and so on.

### 7.1 Plant Visual Checks

<b>Noise</b>	During normal operation, there is a uniform humming sound at the plant. In case of an unusual noise, it could be an indication that the blower needs maintenance or repairs.
<b>Smell</b>	The MicroClear™ MBR is an aerobic system. During normal operation, the system has an earthy smell similar to that of a well-maintained compost pile. If other odours are noticed, the aeration process may not be operating or the system has been overloaded. Check the DO manually and the blower to verify proper operation.
<b>Sight</b>	Normally, the effluent is reasonably clear, colourless, and odourless. If the effluent becomes turbid, there is a pin hole in the membrane or a leakage in the piping. Take the unit out of operation and investigate. <b><u>Check uniformity of membrane air distribution periodically to ensure air scouring is effective across all membrane plates.</u></b>



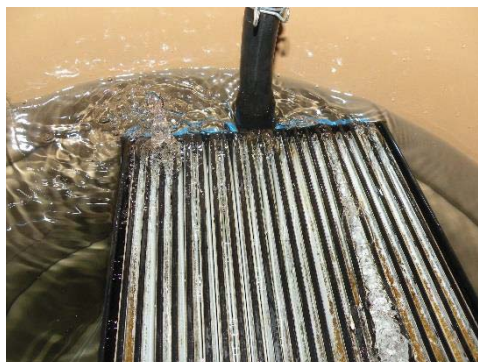
### 7.1.1 Air Scouring Patterns in Membrane Tanks

Membrane air scouring check is an essential routine maintenance procedure for **newterra** MBR WWTP to ensure membranes are receiving effective physical cleaning. Air scouring has to be observed for uniformity of bubbling action all across the membrane module/cassette on regular basis.

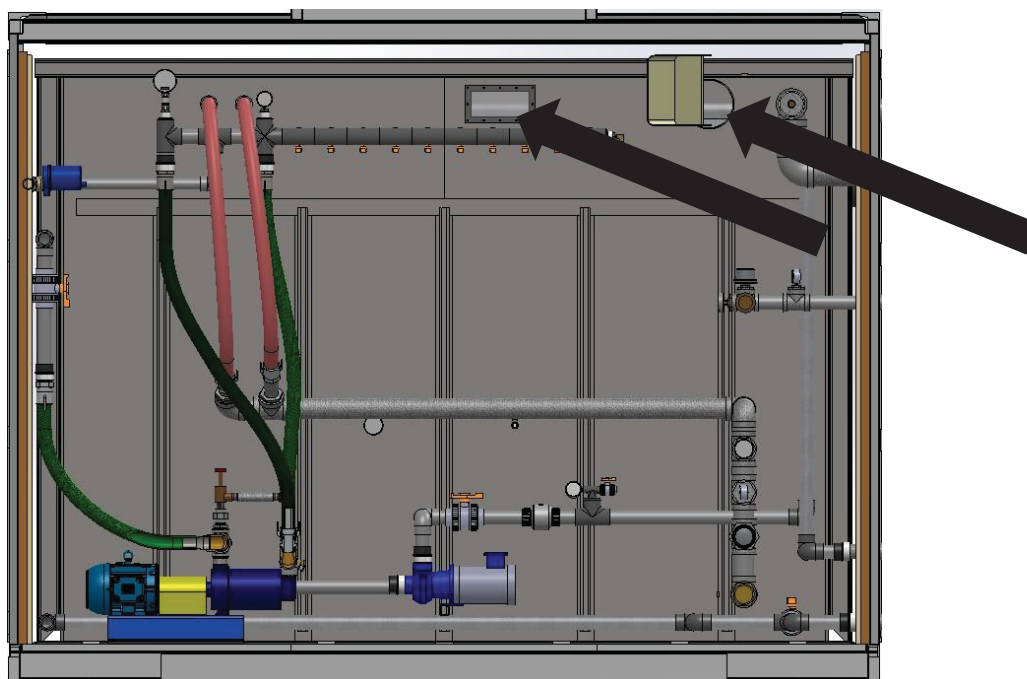
**A visual inspection of the aeration patterns should be performed with the liquid level 2-3" (5 – 7.5 cm) above the top row of membranes and looking thru the tank viewport or inspection opening (see below).**



**Proper air scouring in  
membrane tank**



**Uneven aeration in  
membrane tank**





It is easy to observe aeration patterns through the clear window in the membrane tank(s). Operator should note any unusual patterns of air distribution. The visual inspection should also be performed before any membrane cassettes are removed from the membrane tank(s). Operator has to check for:

- damage of air diffusers - if this occurs, empty the tank and fix the diffuser;
- air leakages - if this occurs, tighten up the fittings.

If there is insufficient air scouring, localized dewatering (**clogging, sludging, caking and plugging**) may occur and may in turn lead to membrane fouling.

## 7.2 Schedule for Routine Operation and Maintenance Checkups

Location	Item	Day	Week	Month	Quarter	Year	Comments
Grease Traps	TNK-101/102/103  Grease traps must be cleaned whenever the grease film is approx. 1 foot thick in any tank. An unmaintained grease trap does not stop any grease waste from entering the WWTP system.						Remove vac out grease film from top of tanks and any food particles from the bottom of tanks.
PROCESS	Perform visual check	X					Refer to Plant Visual Checks
	Record permeate flow rate	X					
	Record DO in the aeration tank	X					
	Record pH in the aeration tank	X					
	Record vacuum pressure at the membranes	X					Normal range: 0.07 – 0.25 bar (28" -100" WC)
<b>Note: When the vacuum at the membranes reaches 0.25 bar/3.5 psig/100" WC, it may be necessary to stop the permeation and perform recovery cleaning (please see Section 7.6.1 for membrane fouling troubleshooting and subsection 7.3 for membrane cleaning procedures )</b>							
MECHANICAL & PROCESS	Inspect membranes and permeate withdrawal system		X				1 hour
	Clean the DO sensor – DO-501 Replace DO probe every second year in accordance with vendor manual.		X				In accordance with vendor manual in Appendix E
	Clean and calibration (as required) PH-501					X	In accordance with vendor manual in Appendix E



Location	Item	Day	Week	Month	Quarter	Year	Comments
MECHANICAL & PROCESS	Inspect and maintain valves & fittings for leaks.		X				
	Membrane in-situ cleaning				X		2-4 hours
	Remove membrane module for mechanical cleaning and inspection					X	Drain membrane tank. Roll out membrane cassette. Remove membranes and inspect. (1 -2 days)
	Remove, inspect and maintain diffusers in aeration and membrane tanks					X	This involves a complete draining of tanks (1-2 days). In accordance with vendor manual in Appendix E
	P-201/202, 301/302, 401/402, 501/502, 553/554, 551/552 – Price Pumps  -General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.) - Pump Performance (Gauges, Speed, Flow) -Clean electrical motor and keep ventilation openings clear				X		See vendor manual at Appendix E.
	P-701/702 – Permeate Pumps  -General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.) - Pump Performance (Gauges, Speed, Flow) -Clean electrical motor and keep ventilation openings clear -Do Not let the pump run dry!				X		See vendor manual at Appendix E.



Location	Item	Day	Week	Month	Quarter	Year	Comments
MECHANICAL & PROCESS	<b>P-801 – Backwash Pump</b>  <b>-General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)</b> <b>- Pump Performance (Gauges, Speed, Flow)</b>						Submersible pumps contain oils which becomes pressurized and hot under operating conditions - allow 2½ hours after disconnecting before attempting service.
	<b>B-301/302 , 601/602 – EQ and Membrane Tank Blowers</b>  <b>-Clean electrical motor and keep ventilation openings clear</b> <b>-Check inlet filter. Clean or replace as necessary.</b>			X X			In accordance with vendor manual in Appendix E
	<b>B-501/502 – Aeration Tank Blowers</b>  <b>-Clean electrical motor and keep ventilation openings clear</b> <b>- Check V-belts for tightness</b> <b>- Check and add fresh oil as required to maintain proper level.</b> <b>- Change blower oil.</b> <b>-Check inlet filter. Clean or replace as necessary.</b>		X X	X  X		X	In accordance with vendor manual in Appendix E  Semi-annual
	<b>SCR-101/102</b>  <b>-Inspect inspecting the unit for blockages and general cleaning. Inspection doors are located on the cover guard and screen body. Washing the screen with high water pressure may be necessary.</b>	X					



Location	Item	Day	Week	Month	Quarter	Year	Comments
	<p>-Check for wear on the brushes and give the unit a thorough cleaning each week will ensure maximum efficiency.</p> <p>-Check the oil level in the motor. Grease the bearings with the appropriate grease. Making adjustments to the brushes to maximize contact with perforated sheet.</p>		X	X			
	<p><b>P-6101/6102/6103 – Dosing Pumps</b></p> <p>-Check the metering diaphragm for damage</p> <p>-Check that the hydraulic lines are fixed firmly to the liquid end.</p> <p>-Check that the suction valve and discharge valve are fitted tightly.</p> <p>-Check the tightness of the entire liquid end - particularly around the leakage hole</p> <p>-Check that the flow is correct: Allow the pump to prime briefly - turn the multifunctional switch briefly to "Test"</p> <p>-Check that the electrical connections are intact.</p> <p>-Check the integrity of the housing.</p> <p>-Check that the dosing head screws are tight.</p>				X		In accordance with vendor manual in Appendix E
	<p><b>Container Fans</b></p> <p>-Dust and dirt on the exterior surface of the motor, fan panel and the entire fan wheel should be removed.</p> <p>-Inspect of all fasteners to ensure they have not loosened due to vibration.</p>					X	In accordance with vendor manual in Appendix E



Location	Item	Day	Week	Month	Quarter	Year	Comments
	<b>Container Heaters</b>  Once a year, remove the dust accumulation inside the heater using a vacuum cleaner or compressed air. Cleaning should be done while the heater is disconnected from the supply circuit.					X	In accordance with vendor manual in Appendix E
ELECTRICAL	Check electrical leads				X		
	Check panel fan filter and replace/clean as necessary.			X			
	Inspect and maintain breakers, fuses, resets and anodes			X			
	Check motor mounting bolts			X			
	Clean dust away from electric motor			X			
	Check PLC and control panel functionality		X				



**All connections (hoses, hose clamps, camlocks) have to be checked periodically (on a monthly basis) to make sure all of them are in good condition with no leaks.**



## 7.3 MBR Membrane Cleaning

### 7.3.1 Membrane In-situ Chemically Enhanced Backflush (CEB)



**Chemical cleaning is only to be carried out by qualified and trained personnel! Chemicals can lead to serious injuries. Always wear personal protective equipment (PPE) when handling chemicals! Obey the chemical safety handling procedure as listed in the Material Safety Data Sheets.**

It is recommended that in-situ CEB be carried out before the TMP exceeds 0.25 bar (or permeability drops rapidly to 50 LMH/bar) This is typically done once every couple weeks/months depending on biomass characteristics and system operating condition.

On certain occasions, membrane module/cassette may need to be physically inspected for membrane integrity if membrane permeability performance is not recovered after the cleaning (i.e., suspect of membrane deterioration); please refer to subsection **7.3.3**.



**The maximum backflush pressure of MicroClear<sup>™</sup> MCXL filter is 0.1 bar or equivalent to a 100 cm water line. Only use gravity force to perform the backflush.**

**Note: Membrane have a maximum active chlorine tolerance of 100,000 ppm.h.**

For better cleaning performance, it is recommended:

- Potable water (permeate is acceptable if potable water is unavailable)
- Water temperature is above 20 °C (better cleaning efficiency if water temperature ranges from 20 to 30 °C)

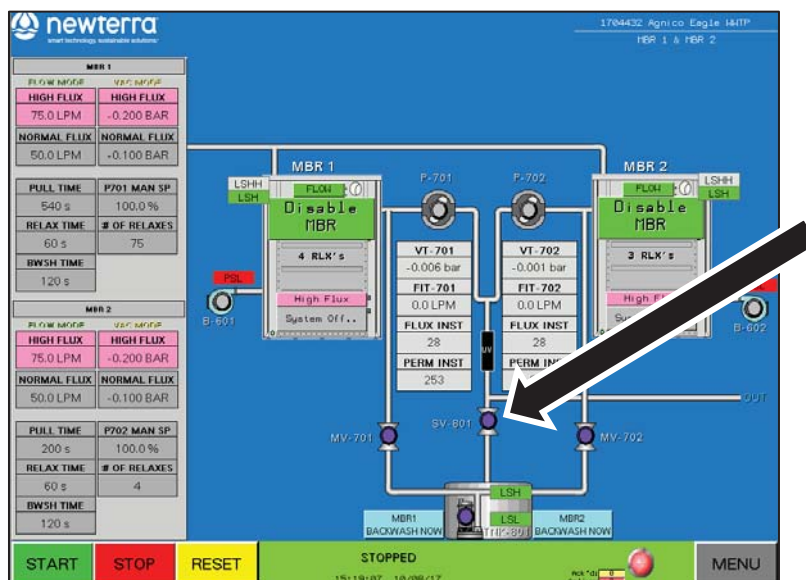


### 7.3.1.1 Procedure – Backwash Solution Preparation

**Note:** It is recommended that only one membrane module at a time be cleaned (backwash).

Prepare the backwash solution as follows:

- 1) If backwash tank TNK-801 is empty:
  - a. Ensure membrane is enabled and pulling, and turn SV-801 solenoid valves on hand (“H”) until backwash tank is filled with required volume for chemical backwash (3L per cassette X 20 cassettes per module = 60 L OR approx. 1/4 capacity of TNK-801). Note TNK-801 capacity is 272L.
  - b. Turn SV-801 series solenoid valves off (“O”)

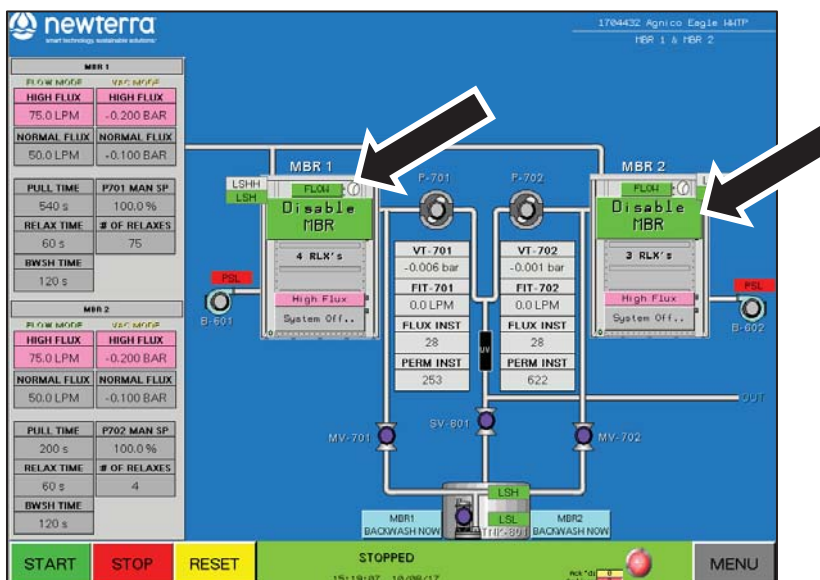


- c. Skip to step 3



2) If backwash tank TNK-801 is full:

- a. Disable membrane by holding down the disable membrane button for about 5 seconds



- b. Turn SV-801 solenoid valves to off ("O")
- c. Turn MV-701/702 (depending on the membranes to be cleaned) motorized valves to hand ("H")
- d. Turn pump P-801 to hand ("H") until the backwash tank has drained to the required volume for chemical backwash (3L per cassette X 20 cassettes per module = 60 L OR approx. 1/4 capacity of TNK-801) – the exact volume can be determined by backwash tank level drop. Note TNK-801 capacity is 272L.
- e. Turn P-801 to off ("O")

### 7.3.1.2 Procedure – Organic Fouling Solution

Organic Fouling - NaOCl: 500 mg/L solution (acceptable range of 200 to 1000 mg/L). Used for removal of organic fouling, which is the most common type of fouling in MBRs.

Volume of concentrated NaOCl required can be calculated with the following formula,

$$V_x = \frac{V_m \times 0.05}{C_s}$$

$V_m$ : Volume of the solution (Gallon, or Litre), equal to 3 L multiplying the number of MCXL cassettes 20 (60L per module);

$C_s$ : Concentrated NaOCl concentration (%)

$V_x$ : Volume of concentrated NaOCl required (Gallon, or Litre)



### 7.3.1.3 Procedure – Organic Fouling Solution

Inorganic Fouling - Citric Acid: 2 g/L solution (up to 20 g/L). Used for removal of inorganic fouling. This is typically only required for systems treating water with a high hardness.



**Rinse membrane filter and backwash tank thoroughly with potable water to completely remove NaOCl solution before treatment with citric acid. Mixing NaOCl with citric acid releases toxic chlorine gas!**

### 7.3.1.4 Procedure

- 1) Ensure MV-701/2 series motorized valves and SV-801 solenoid valve are set to off (“O”). The system is now ready for a chemical backwash. Note: only one membrane module should be backwashed at a time. The modules can be isolated by closing the permeate valves (there are valves per module)



- 2) Turn off all blowers in the membrane tank to be backwashed (B-601)
- 3) Turn the MV-701/702 motorized valve to hand (“H”) then turn pump P-801 to hand (“H”) until the backwash tank has drained.
- 4) Turn pump P-801 to off (“O”) and then turn the MV-701/702 motorized valve to off (“O”).
- 5) Let membranes soak for 45 mins or so.
- 6) After soaking membranes, turn the blowers back on (B-601) and allow blowers to scour for - 15 minutes.
- 7) After the 15 minute scour turn all valves and pump back to auto (“A”)
- 8) Turn SV-801 solenoid valves to off (“O”)



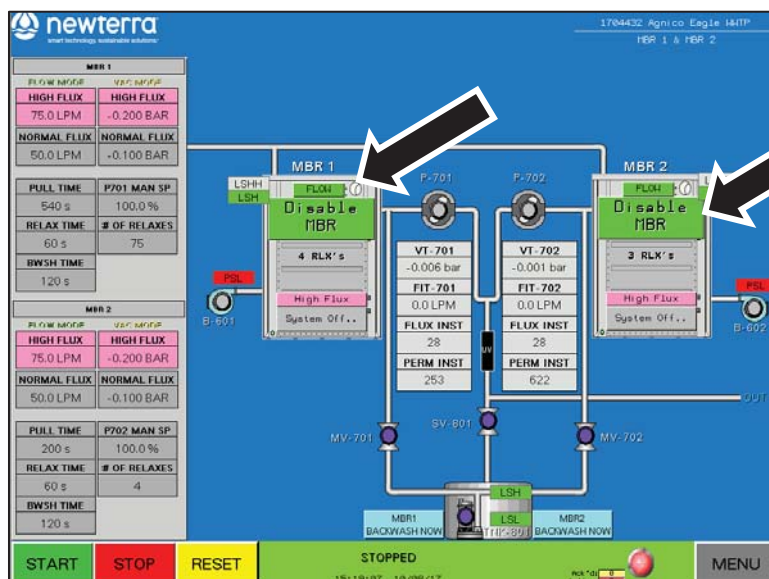
- 9) Enable membranes by holding down the enable membrane button for about 5 seconds
- 10) Allow membranes to permeate for 5 minutes, and then turn SV-801 solenoid valves back to auto ("A")
- 11) Record TMP and flux, and ensure that the permeability has recovered
- 12) Repeat procedure for the second membrane module.

### 7.3.2 Membrane Recovery Cleaning

The membrane recovery cleaning is to be done once a year at a minimum. On certain occasions, membrane cassette may need to be inspected for membrane integrity (suspect of membrane deterioration, membrane permeability performance does not recover after the cleaning, etc.).



**Disable operation of the membrane tank by pressing the disable membrane button on the screen.**



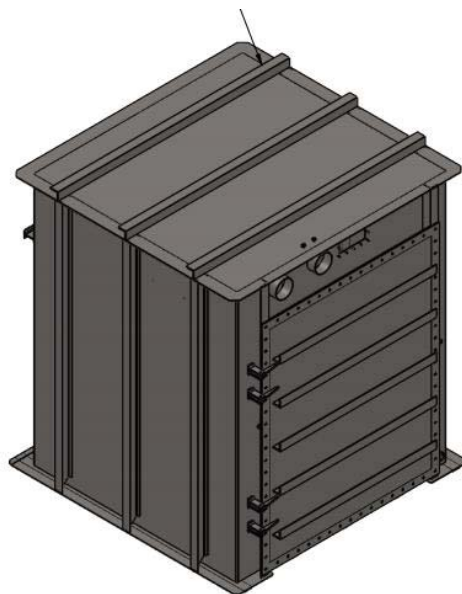
For better cleaning performance, it is recommended:

- Potable water is used
- Water temperature is above 20 °C (better cleaning efficiency if water temperature ranges from 20 to 30 °C)



### 7.3.2.1 Step 1 - Preparation

1. Turn off air scour – B-601/602
2. Drain all mixed liquor from the membrane.
3. Open the MBR tank hatch. Clean (wash down) the membrane tank with water and vacuum out the dirty liquid. Close the MBR tank hatch.



4. Fill the membrane tank with potable water until the membranes are completely covered. The membrane tank (TNK-601/2) holds approx. 8.0 m<sup>3</sup> / 6000L.

### 7.3.2.2 Step 2 – Cleaning with High pH Solution

This step is to be done if membrane fouling is a result of high FOG. Note: FOG in influent wastewater should be maintained below 30 mg/L.

5. Confirm that the membrane tank (TNK-601/2) has been cleaned and refilled with water (Section 7.3.2.1).
6. Add a suitable chemical – normally caustic soda (Sodium hydroxide (NaOH)) - to the membrane tank to raise the pH to 12.
  - a. Volume of NaOH required can be calculated as follows. A starting dose for NaOH would be 400 mg/L. For example: if using a 50% solution of sodium hydroxide, approximately 0.5 L of solution would be required per m<sup>3</sup> of membrane tank. Additional NaOH may be required depending on the alkalinity of the water. The operator should measure pH after addition of 400 mg/L and add more until the pH is 12.



b. TNK-601 holds approx. 8 m<sup>3</sup> or 8000L.

7. Turn on air scour for 2 min to mix the solution and turn it off during membrane soak.
8. Allow membranes to soak for 1 to 2 hours.
9. Drain spent solution.

### 7.3.2.3 Step 3 - Cleaning with Sodium Hypochlorite (NaOCl)

1. Turn off air scour
2. Confirm that the membrane tank (TNK-601) has been cleaned and refilled with water (Section 7.3.2.1).
3. Add NaOCl into the membrane tank to a concentration of 500 mg/L as free chlorine (max. 1,000 mg/L). Turn on air scour for 2 min to mix the solution and turn it off during membrane soak.

Volume of NaOCl required can be calculated with the following formula:

$$V_x = \frac{V_m \times 0.05}{C_s}$$

$V_m$ : Volume of membrane tank - TNK-601 holds approx. 8.0 m<sup>3</sup> / 8000L.

$C_s$ : NaOCl concentration (%)

$V_x$ : Volume of NaOCl required (m<sup>3</sup> or Litre)

4. Keep the membranes soaked for 8 to 12 hours in the NaOCl solution (longer soak time required if severe fouling is evident).
5. Drain spent NaOCl solution.
6. Rinse membrane filter thoroughly with potable water by filling and draining the entire tank. Rinse waters are drained to the sump/recycle back to the headwork.
7. Repeat step 6 to ensure all NaOCl has been thoroughly removed.



#### 7.3.2.4 Step 4 - Cleaning with Citric Acid

This step is only required in case of inorganic fouling caused by the high hardness. The recommended concentration is 2 g/L solution (up to 20 g/L).



**Rinse membrane filter thoroughly with potable water to completely remove NaOCl solution before treatment with citric acid. Mixing NaOCl with citric acid releases toxic chlorine gas!**

1. Turn off air scour
2. Confirm that the membrane tank (TNK-601) has been cleaned and refilled with water (Section 7.3.2.1).
3. Add Citric Acid into the membrane tank to a concentration of 2 g/L solution (up to 20 g/L) – reducing the membrane tank to a pH of 2.0.
  - a. Volume of Citric Acid required can be calculated as follows. A starting dose for Citric Acid would be 2g/L (up to 20g/L). For example: if using a 50% solution of Citric Acid, approximately 3.2 L of solution would be required per m<sup>3</sup> of membrane tank. Additional Citric Acid may be required depending on the alkalinity of the water. The operator should measure pH after addition of 2g/L and add more until the pH is 2.
  - b. TNK-601 holds approx. 8 m<sup>3</sup> or 6000L.
4. Keep the membranes soaked in the citric acid solution for 2 hours (longer soak time required if severe fouling is evident).
5. Drain spent citric acid solution, rinse membranes thoroughly with potable water and drain all the rinse waters. Spent citric acid solution and rinse waters are drained.

#### 7.3.2.5 Step 5 - Resume normal operation

Turn all equipment back to Automatic mode “A”, and enable the membranes.

#### 7.3.2.6 Step 6 - Checking Permeability

Normal permeability after cleaning: 200 to 300 LMH/bar.

Repeat the cleaning procedures If normal permeability is not achieved.



**Note: Membrane maintenance (CEB) and recovery cleaning has to be recorded according to Membrane Cleaning Log Sheet presented in Appendix J of the manual.**

### 7.3.3 Membrane Physical Check



**WARNING: A membrane cassette that has been in operation weighs more than dry membrane cassette before installation. Failure to comply with the instructions provided in this manual can cause equipment & property damage or severe personal injury, and will render the warranty null and void.**

#### To removing membrane module from membrane tank

This procedure is required if the membranes are being inspected as part of routine maintenance for physical check or being replaced.



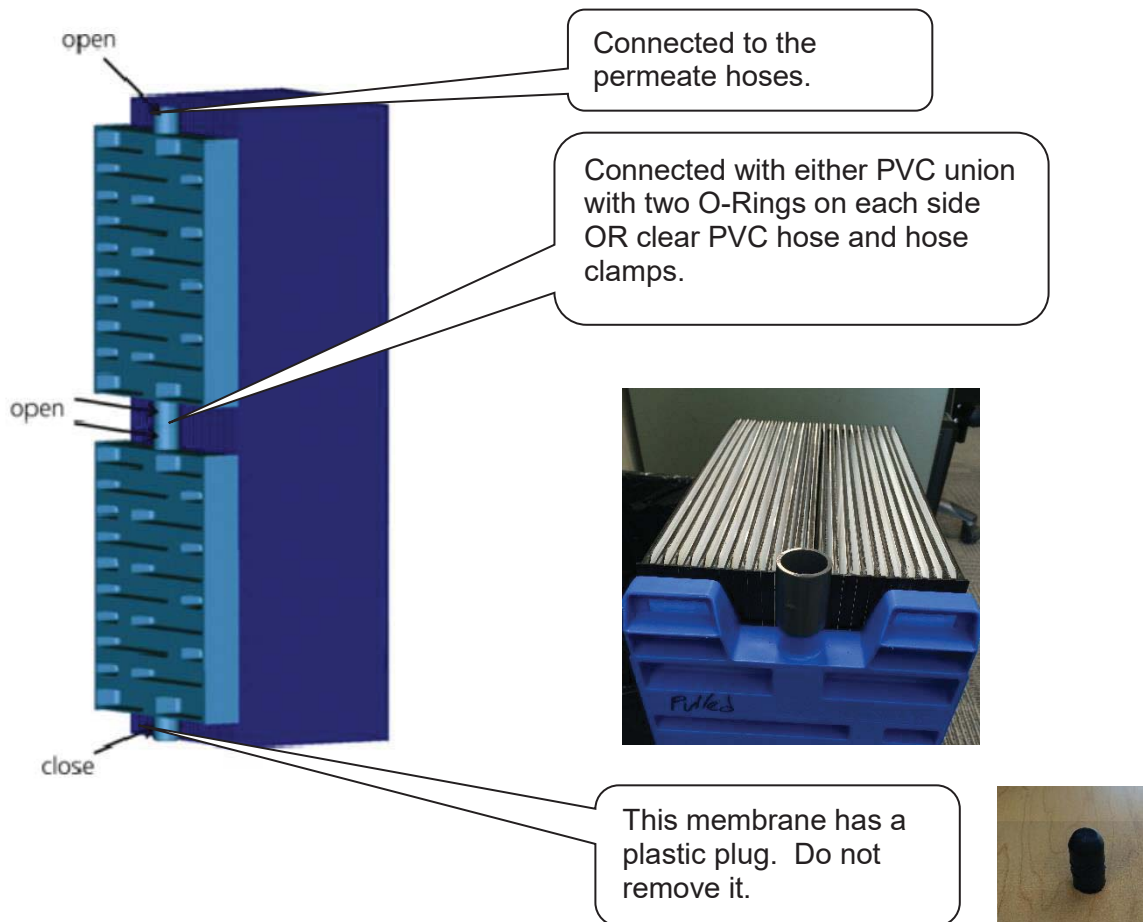
**Once membrane inspection or replacement has begun, it must be completed promptly. It is important that the membranes DO NOT DRY OUT OR FREEZE during this procedure.**

1. Confirm that the eStop switch on the main panel is pushed in. Confirm that the Main Disconnect is ON. Stop the system operations by using the HMI screen button.
2. Empty the MBR tank (TNK-601) via the tank drain valve or recycle back to Aeration Tank using P-601.
3. Open the MBR tank hatch.
4. Wash remainder of waste water in the tank with reuse water and vacuum out.
5. Install the cassette rails and Disconnect the permeate hoses from the top of the membranes.
6. Slide out the cassette and further clean the membranes.

**Membrane module replacement - If membranes require changing** verify membrane modules are secured within the membrane tanks after re-installing the new modules – i.e. verify wheel chocks are in the correct location and that there is no lateral movement (less than an inch) of the membrane modules on the wheel tracks in the tank.

7. Remove the membranes from the cassette. NOTE. The membranes are triple stacked. The bottom membrane has a plug in the bottom opening. Do not remove this plug. Note the membrane orientations for re-installation. The membranes are joined together with either a PVC union with two O-Rings on each side OR clear PVC hose and hose clamps.





8. After membranes are separated, wash with clean water. Remove the blue backing plate and gently separate the membrane plates and clean with water to remove any debris. Replace backing plate.





9. Place bottom membrane cassettes in the MBR tank and then integrate top membranes into the triple stack configuration. Slide in the cassette and reconnect the permeate hoses. Close the MBR tank door and start system operation.



## 7.4 Sludge Decanting (TNK-901)

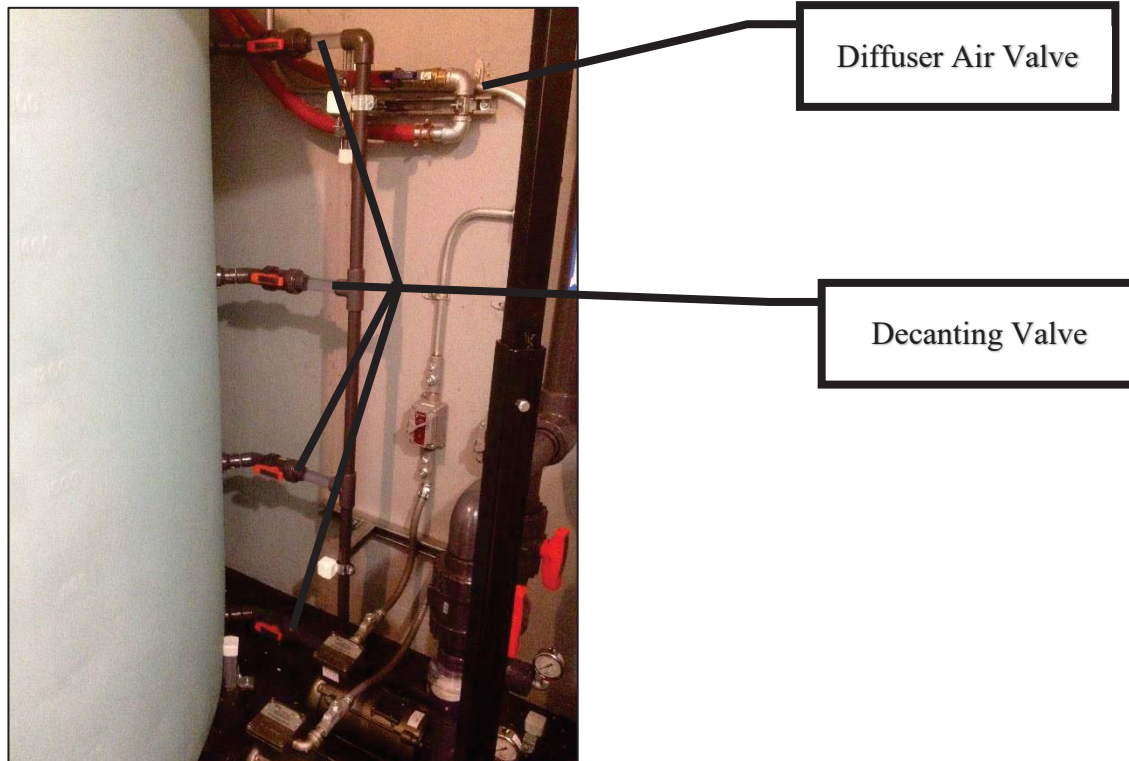
In order to maintain an optimal concentration of mixed liquor suspended solids (MLSS) (typically 10 g/L), a portion of the mixed liquor is periodically wasted by pumping from the Aeration Tank (TNK-501) to the sludge holding tank (TNK-901). Wasted sludge in the sludge holding tank is thickened by decanting supernatant back to the screen tank. Thickened sludge accumulates in the sludge holding tanks until it is eventually pumped out for disposal.

Excess sludge will be wasted by P-503 from the Aeration Tank (TNK-501) every 10 mins at noon. See below.

Tag	Description	Factory Setpoint	Setpoint Range and Units
P503 WASTE HOUR	When P-503 will waste	12pm	0-23
P503 WASTE SP	Time that P-503 wastes for	10min	0-99

In order to decant the water from the sludge, the air to TNK-901 diffuser must be turned off. See valve location below.

After the sludge has settled, that the operator would open the appropriate valve on TNK-901 to decent off the water.





## 7.5 Trouble Shooting

### 7.5.1 MBR Membrane Fouling

#### Introduction

MBR operation relies critically on the ability of the membrane unit to pass all flow incoming to the plant. If membrane permeability is impaired, the MBR plant cannot process all flow with potentially catastrophic results even though effluent quality remains consistently high. This contrasts with typical operation of activated sludge system where the plant hydraulic capacity is rarely exceeded but effluent quality is much more variable. Hence, membrane fouling (and associated reduction of flux or increase of TMP) remains as an operational challenge.

Membrane Fouling in MBR is a result of the interaction between the incoming water quality, mixed liquor filterability, system operation condition, and membrane material. There are four categories of membrane fouling. They are microbial fouling, particle/colloids fouling, inorganic fouling, and organic fouling. A brief description on the nature of fouling and control measures is summarized below.

#### 7.5.1.1 Microbial/Biological Fouling

Microbial fouling is a result of formation of biofilms on membrane surfaces. Living materials, such as bacteria, fungus and algae, or soluble microbial products (SMP) and extracellular polymeric substances (EPS) bound to the activated sludge attach to the membrane; they start to multiply and produce EPS to form a viscous, slimy, hydrated gel. EPS typically consists of heteropolysaccharides and have high negative charge density. This gel structure protects bacterial cells from hydraulic shearing and from chemical attacks of biocides such as chlorine.

#### 7.5.1.2 Particulate/colloid Fouling

This type of fouling may be associated with high concentrations of colloidal solids present in mixed liquor. In most cases, particles and colloids do not really foul the membrane because the flux decline caused by their accumulation on the membrane surface is largely reversible by hydraulic cleaning measures such as backwash and air scouring. However, the accumulation of solids between the membranes can create increased membrane resistance to permeation and permanent physical membrane damage.

To distinguish the different fouling phenomena, particles and colloids here are referred to biologically inert particles and colloids that are inorganic in nature.



### 7.5.1.3 Inorganic Fouling

Inorganic fouling or precipitative fouling is caused by the accumulation of inorganic precipitates such as metal hydroxides, and “scales” on membrane surface or within pore structure. Precipitates are formed when the concentration of chemical species exceeding their saturation concentrations. Scale can be caused by high pH and extremely hard feed water. For the ultrafiltration (UF) membranes in our MBR system, inorganic fouling can exist most likely due to interactions between ions and other fouling materials (i.e., organic polymers) via chemical bonding.

### 7.5.1.4 Organic Fouling

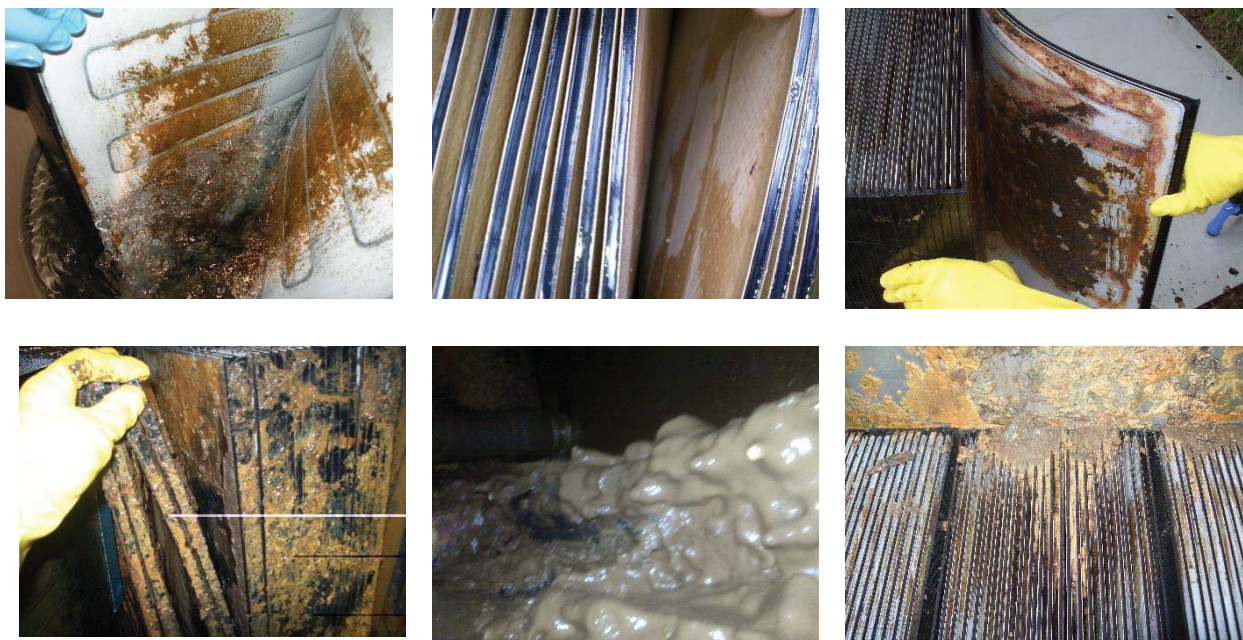
Organic fouling is the attachment of materials such as oil or grease to the membrane surface. It is common in MBR systems used for treating industrial effluent. Organic fouling often leads to surface and internal pore fouling. More importantly, organic fouling progressively leads to biological fouling (i.e., biofilm growth/build up on membrane surface). Sometimes the adsorption process is irreversible when the organic substances are hydrophobic or positively charged polymers with high molecular weight. Such organic substances including organics present as an emulsion must be removed in the pretreatment.

**The following pictures are examples of clean membranes**



**The following pictures are examples of fouled membranes**





#### 7.5.1.5 Fouling Prevention

Control of fouling and clogging in practice is generally limited to six main strategies:

1. Applying appropriate pretreatment to the feed water. Fine screen helps to eliminate the build-up of trash, hair, lint and other fibrous materials, and decrease the risk of solids accumulation.
2. Maintaining operation within the design conditions, such as HRT, SRT, MLSS, temp, BOD/COD loading, pH, DO, F/ M ratio. Sludge wasting is a key in controlling the target operating SRT (typically  $\geq 15$  day) in the system. Table F.1 shows some examples.

#### Relationship between various operating parameters and their effect on membrane fouling

Parameter	Effect on membrane fouling
MLSS concentration $\uparrow$ or $\downarrow$	Fouling potential $\uparrow$
SRT $\uparrow$ or $\downarrow$	Fouling potential $\uparrow$
HRT $\downarrow$	Fouling potential $\uparrow$
Temperature $\downarrow$	Viscosity $\uparrow \Rightarrow$ membrane permeability $\downarrow$
Filamentous bacteria $\uparrow$	Viscosity $\uparrow \Rightarrow$ membrane permeability $\downarrow$
Air scour intensity $\uparrow$	membrane permeability $\uparrow$
EPS $\uparrow$	Fouling rate $\uparrow$
SMP $\uparrow$	Fouling potential $\uparrow$



3. Employing appropriate physical or chemical cleaning protocols. For example, sodium hypochlorite and citric acid solutions are used to remove organic and inorganic foulants respectively.
4. Chemically or biochemically modifying the mixed liquor, such as addition of coagulants and powdered activated carbon (mostly in industrial effluent).
5. Reducing the flux. Particulate/colloid fouling is "reversible" in the sense that a reduction of the forward flux (through lowering of the membrane flux or solids concentration) or an increase of backwash intensity restores membrane permeability.
6. Ensure sufficient air scouring is being maintained to slough off excessive biofilm layer on the membrane surface.

### 7.5.1.5 MBR WWTP Fouling Control & Troubleshooting Chart

Combination of membrane physical cleaning operations as air **scouring**, **backwashing** and **relaxation** are efficient in membrane fouling control.

#### 7.5.1.5.1 Air Scouring

Aeration generates a shear stress at the membrane surface, which provides a scouring action and reduces membrane cake fouling.

Membrane air scouring check is essential procedure for newterra MBR WWTP. Air scour has to be observed for uniformity of bubbling action all across the membrane module/cassette on regular basis. It is easy to observe through clear window in membrane tank. Operator should note any unusual patterns of air distribution. Operator has to check for:

- damage of air diffusers and if this occurs, empty the tank and fix the diffuser;
- air leakages: if this occurs, tighten up the fittings.

If there is insufficient air scouring, localized dewatering (**clogging**, **sludging**, **caking** and **plugging**) may occur and as a result, membrane fouling occurs.

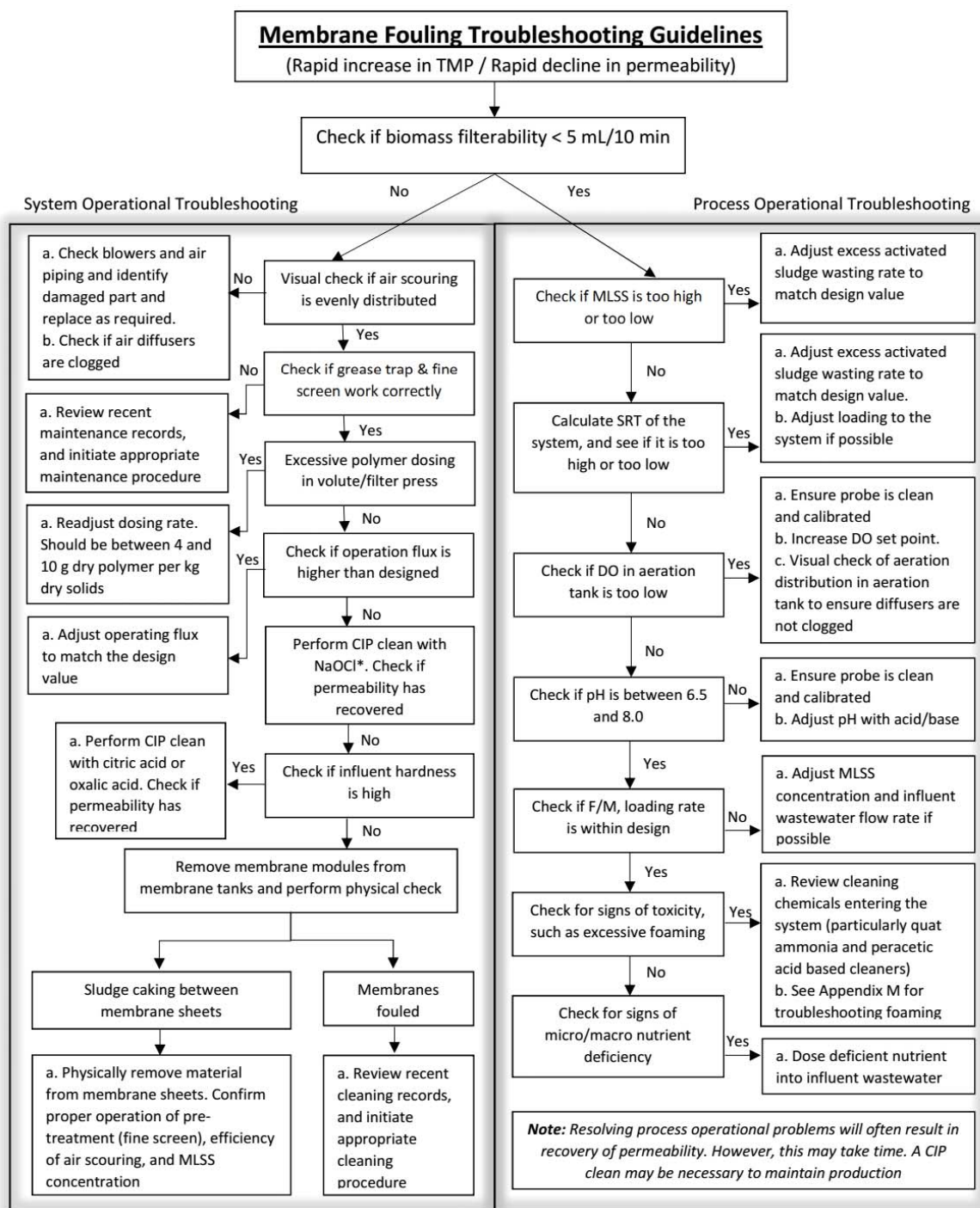


**Proper air scouring  
in membrane tank**



**Uneven aeration in  
membrane tank**







## 7.5.2 MBR Alarm Trouble Shooting

Alarm Name	Alarm Location	Alarm Description	Beacon Status	Troubleshooting Recommendation	Remedy Action
PLC ALM	CP	SHUTDOWN PLC Fault	FLASH	Turn off entire system. Wait 10 seconds before restoring power.	Please contact newterra -PLC problem
PWR FAIL ALM	CP	WARNING , Power Fail	SOLID	Power has failed to the unit	Press Reset
ESTOP ALM	Panel	E-Stop	FLASH	Check all locations of E-Stop Buttons to ensure they are not pushed in.	Pull out E-Stop
TALL-201	Clarifier	Temperature alarm low low	FLASH	Check for building heater malfunction. Assess influent water temperature	Replace heater. Take action to increase influent water temperature.
B-201/ B-202 Fail	Clarifier	Blower B-201/B-202 has potentially failed	FLASH	Check blower for failure. Check breaker	Replace blower B-201/B-202.
LAHH-401	SCREEN DISCHARGE	High high level alarm in Screen Module discharge tank	FLASH	Potential discharge tank pump P-401/P-402 failure Check Breaker	Replace pump
P-401 or P-402 FAIL	SCREEN PUMP	P-401/P-402 has potentially failed	FLASH	P-401/P-402 for failure. Check Breaker	Replace pump P-401/P-402



Alarm Name	Alarm Location	Alarm Description	Beacon Status	Troubleshooting Recommendation	Remedy Action
SCN-401 Or SCN-402 FAIL	SCREEN	Potential screen paddle wheel motor failure.	FLASH	Check screen motor for failure. Check Breaker	Replace motor
LAHH-301	EQ Tank	Level Alarm High High, EQ Tank	FLASH	Investigate if pump P-301, P-302 has failed, or system is receiving higher than design flow, or membrane is fouling.	Replace pump, divert flow, perform membrane chemical cleaning.
LALL-301	EQ TANK	Low Low Level Alarm	WARN	Check for level transmitter operation or upstream pipe obstruction or pump failure.	Clear obstruction or repair/replace faulty equipment.
P-301 or P-302 FAIL	EQ PUMP	Pump P-301 has potentially failed	FLASH	Check pump P-301 or P-302 for failure or if it is unplugged. Check Breaker	Plug in or replace pump P-301 or P-302.
PAL-301	EQ TANK	Pressure Alarm low on air inlet to EQ Tanks	FLASH	Check if blower B-301 or B-302 have failed. Check Breaker	Replace blowers if required.
LAHH-501 or LAHH-502	AERATION TANK	High High level alarm in Aeration Tank	FLASH	Check pump P-501/P-502 for failure	Replace faulty pump
LALL-501	AERATION TANK	Low Low Level Alarm	WARN	Check level in the tank and ensure Level switch or transmitter is functioning correctly.	Clear obstruction or repair/replace faulty equipment



Alarm Name	Alarm Location	Alarm Description	Beacon Status	Troubleshooting Recommendation	Remedy Action
PHAL-501	AERATION TANKAERATION TANK	Low pH AlarmLow low in Aeration Tank	WARN WARN	Check if caustic injection system is working and or needs refill Check if the pH probe is fouled or if the probe requires calibration. Check setpoint temperature.	Replace caustic injection system or refill. Clean pH probe. Calibrate pH probe. Adjust set point temperature.
PHAH-501	AERATION TANKAERATION TANK	High pH alarm	WARN WARN	Check if caustic injection system is malfunctioning or if PH probe is calibrated or fouled.	Replace caustic soda injection. Calibrate pH probe or clean sensor
DOAL-501	AERATION TANKAERATION TANK	Dissolved Oxygen Alarm low	WARN WARN	Investigate if there is septic smell & check the mixing pattern. If system smells septic with no uniform mixing, air diffuser might be clogged, blowers may not work or plant is overloaded. Ensure DO probe is calibrated and clean.	Increase aeration rate to maintain DO above 1.5 mg/L, or replace clogged diffuser, or change blower, or calibrate or clean DO probe. Replace caustic soda injection. Calibrate pH probe or clean sensor
P-501 or P-502 FAIL	AERATION TANK	Pump P-501 or P-502 has potentially failed	FLASH WARN	Check pump P-501 or P-502 for failure. Check Breaker	Replace pump P-501 or P-502.



Alarm Name	Alarm Location	Alarm Description	Beacon Status	Troubleshooting Recommendation	Remedy Action
P-503 FAIL	AERATION TANK	Pump P-503 has potentially failed	FLASH FLASH	Check pump P-503 for failure. Check Breaker	Replace pump P-503
PAL-501	AERATION	Blower motor tripped off on overload Pressure	WARN FLASH FLASH	Check blower air line equipment and blower motor Check if 500 series blowers have failed	Replace faulty equipment Replace blowers if required
PAL-601 or PAL-602	MEMBRANE TANK	Pressure Alarm low on air inlet to corresponding Membrane Tank. Blower motor tripped off on overload	FLASH WARN	Check if blower B-601 or B-602 has failed. Check blower air line equipment and blower motor	Replace blower if required. Replace faulty equipment.
LAHH-601 or LAHH-602	MEMBRANE TANK	High High level alarm in Membrane	FLASH WARN	Check pump P-601 for failure	Replace pump P-601 Replace faulty equipment
FLT-701 or 702	PERM VFD 1 or 2	VFD Fault	FLASH WARN	Check VFD fault	Replace pump and VFD Replace faulty equipment
VTAL-701 or 702	MEMBRANE 1 or TANK 2	Low vacuum alarm on permeate line from MBR1 or MBR2	FLASH WARN	Check for vacuum leak and membrane or pump fail	Repair and replace as required



Alarm Name	Alarm Location	Alarm Description	Beacon Status	Troubleshooting Recommendation	Remedy Action
VTAH-701 or 702	MEMBRANE 1 or TANK 2	High vacuum alarm on permeate line from MBR1 or MBR2	FLASH WARN	Check for closed valve on permeate side or check membranes for severe fouling	Open valve or clean membranes Repair and replace as required
FTAL-701 or 702	MEMBRANE 1 or TANK 2	Low permeate flow alarm on permeate line from MBR1 or MBR2	FLASH WARN	Check for closed valve or permeate pump failure Check for closed valve on permeate side or check membranes for severe fouling	Open valve or repair/replace permeate pump Open valve or clean membranes Repair and replace as required
FTAH-701 or 702	MEMBRANE 1 or TANK 2	High permeate flow alarm on permeate line from MBR1 or MBR2	FLASH WARN	Check for vacuum leak or membrane failure and operation of permeate pump	Repair and replace as required Open valve or repair/replace permeate pump Open valve or clean membranes
UVA-811 or 812	PERM	UV-811 or UV-812 has failed.	FLASH WARN	Check if UV lamp has failed	Change UV lamp
UVA-BOTH	PERMEATE	UV-light 811 and UV-812 have failed	FLASH WARN	Check if UV lamp has failed Check if UV lamp has failed Check if UV lamp has failed	Change UV lamp Change UV lamp Change UV lamp Repair and replace as required
BACKWASH1 or BACKWASH2 FAILED	BACKWASH PERM1 or PERM2	Backwash to TNK-601 or TNK-602 failed	FLASH WARN	Backwash did not complete – system skipped backwash	Check function of back-wash pump and valve



Alarm Name	Alarm Location	Alarm Description	Beacon Status	Troubleshooting Recommendation	Remedy Action
P-901 FAIL	MEMBRANE PERM 1	Pump P-901 has potentially failed	FLASH WARN	Check pump P-901 for failure Check for vacuum leak or membrane failure and operation of permeate pump	Replace pump P-901 Repair and replace as required
TALL-7901	BLDG-7901	Low low Temperature alarm for building	FLASH WARN	Check if electric heaters have failed or if BLDG door is open	Repair or replace heater(s) if required. Repair and replace as required
B-7901 FAIL	AIR EXCHANGE BLDG-7901	Potential blower failure	FLASH WARN	Check motor breaker	Turn breaker on

### 7.5.3 MBR Process Trouble Shooting

The following **newterra MicroClear™ MBR WWTP troubleshooting guide** can be used as a quick reference. If any of the problems discussed in this section or other difficulties persist, consult **newterra** Ltd.

#### 7.5.3.1 Biological System

Condition	Possible Cause	Potential Remedies
<b>Mixed liquor is black or dark brown</b>	Insufficient aeration is supplied for mixed liquor and/or plant is under-loading	Increase aeration rate and keep it above 1 mg/L Waste more sludge Increase influent feed rate if required
<b>Mixed liquor concentration is too high or too low</b>	Sludge wasting rates are incorrect	Review operation of the activated sludge process and revise the sludge wasting rates as necessary
<b>No mixing in tanks</b>	Blowers failure	Check for electrical/blower failure, and replace blowers as necessary



Condition	Possible Cause	Potential Remedies
<b>Unpleasant odour from tanks</b>	<p>Mechanical/electrical failure, e.g. blower and air piping are not operating correctly</p> <p>System is overloading</p>	<p>Ensure good order of mechanical/electrical components</p> <p>Check the maximum flow and BOD loading rate to the MBR unit to see whether it is within the limits as per design specification</p> <p>Check the quality and contents of the flow into the MBR unit for any abnormal or prohibited substances</p>
<b>Effluent quality does not meet discharge criteria</b>	Mixed liquor characteristics are not within proper operating standards	Improve the process operating conditions of the activated sludge system (confirm operating SRT and loading is within design and no present of toxic compounds)



### 7.5.3.2 Foaming

Condition	Possible Cause	Potential Remedies
<b>Excessive foaming (white foam accumulating over the liquid surface) in aeration and/or membrane tanks</b>	Influent inhibition/biomass toxicity occurs	Check the quality and contents of the flow into the MBR system for any abnormal or prohibited substances
	MBR system is overloading	Check the flow rates, BOD/COD loading and F:M ratio and then reduce flow/loading and/or increases MLSS concentration accordingly
	Mixed liquor characteristics are not within proper operating standards	Improve the operating conditions of the activated sludge system
	Membrane air scour system is over aerating	Review operation of the membrane scour system
	Foam control strategies are not operating correctly	Review foam removal equipment, anti-foam chemical dosing system (if applicable)
	MBR system are undergoing start-up	Remove foam and use approved defoamer as necessary (consult <b>newterra</b> Ltd); Control foam and ensure sprayer pump is running at all time during start-up, Ensure that MLSS concentration is increased, after start-up is completed



### 7.5.3.3 Permeate

Condition	Possible Cause	Potential Remedies
<b>Cloudy permeate</b> (The permeate turbidity or TSS is above the specific setpoint)	Faulty operation of instrumentation	Confirm proper operation of control systems and instrumentation, clean, replace, recalibrate as required
	Membrane cassette sheets are damaged	Take out membranes and visually inspect the individual membrane sheets, and repair or replace the membrane sheets as necessary
	Membrane module assembly are damaged	Identify damaged part, e.g. leaking tube, pipe, O-ring, gasket, and replace as required
	Permeate piping leak	Identify the leak and repair as required, e.g. tighten connections
<b>Lower permeate flow than expected</b>	Mechanical equipment failure	Ensure proper operation of permeate pumps
	Incorrect operation of permeate piping and valves	Check permeate piping for leaks
<b>High TMP and lower permeability than expected</b>	Membrane sludging	Confirm proper operation of pretreatment Take out membranes and visually inspect the individual membrane sheet. Remove sludge material from membrane sheets**
	Mixed liquor characteristics are contributing to poor filterability	Test the filterability of the mixed liquor; review and improve operating conditions of the activated sludge system as necessary
	Desired operating flux or flowrate is higher than design	Adjust operational flux or flowrate to match the design flux or flowrate



Condition	Possible Cause	Potential Remedies
	<p>Membrane surface is fouled</p> <p>MLSS is too high, SRT is too low or insufficient dissolved oxygen in aerobic zone</p>	<p>Review recent cleaning records, and initiate appropriate cleaning procedure</p> <p>Improve the characteristics of sludge by adjusting the activated sludge process operation</p>
<b>Uneven permeate and/or MLSS flow between membrane tanks</b>	<p>More recent completion of maintenance or recovery cleanings for one of the membrane tank</p> <p>Uneven flow distribution to each membrane tank</p>	<p>Review membrane cleaning records</p> <p>Confirm proper operation of flow distribution system (pumps/control valves, etc)</p>



#### 7.5.3.4 Membrane air system

Condition	Possible Cause	Potential Remedies
<b>Uneven aeration of membrane module</b>	Membrane diffuser clogging;	Wash or clean the diffusers
	Loose air piping connections	Tighten pipe connections
<b>Uneven aeration in membrane tank</b>	Membrane diffusers or membrane modules are not level	Level the equipment
<b>Air scour rate fails to reach the specified values</b>	Improper operation of membrane blowers and/or air scour system, malfunctioning diffusers	Repair or replace the blowers Review and repair air piping as necessary Repair the diffusers

#### 7.5.3.5 Membrane Cleaning

Condition	Possible Cause	Potential Remedies
<b>Increased frequency of cleaning</b>	Mixed liquor characteristics are contributing to poor filterability	Test the filterability of the mixed liquor Review and improve operating conditions of the activated sludge system as necessary
	Improper operation of membrane cleaning	Confirm cleaning is done correctly, such as controls, cleaning cycles or durations, chemical concentration, and dosing system
	Membrane operate at higher flux than designed	Review MBR flow records
<b>Cleaning fails to recover flux, permeability of membranes</b>	Improper operation of membrane cleaning	Confirm cleaning is operated correctly, such as controls, cleaning cycles or durations, and chemical concentration etc.
	Improper operation of permeate pumps, piping, and control valves	Repair equipment as necessary
	Irrecoverable fouling of membranes	Review operating history with the goal of identifying contributing factors to fouling;



Condition	Possible Cause	Potential Remedies
		Perform membrane autopsy on membrane cassettes

#### 7.5.3.6 Mechanical / Electrical Issues

Condition	Possible Cause	Potential Remedies
<b>Indicator light at the control panel is on.</b>	<p>Air intake is blocked</p> <p>Air discharge or vent line is blocked</p> <p>MBR is flooded</p> <p>Blower failed</p>	<p>Clean intake screens on blower housing</p> <p>Check air filter on blower for blockage</p> <p>Check discharge line and vent line visually or with drain cleaning equipment for obstructions</p> <p>Determine the cause of flooding, e.g., line obstruction, high flows, etc., and fix it</p> <p>Determine if blower failure was caused by an obstructed intake or discharge line</p> <p>Investigate overheating (i.e. internal thermal overload protection), short-circuiting, or other electrical failure, and mechanical failure (i.e. bearing failure) and correct it</p>
<b>Wastewater is backing up</b>	<p>Obstruction in the incoming sewer</p> <p>Obstruction in the discharge piping</p> <p>Pumps failed</p> <p>Flow rate to the MBR is too high</p>	<p>Check the inlet pipe leading to the MBR visually or with drain-cleaning equipment</p> <p>Check the permeate piping and later field piping visually or with drain-cleaning equipment</p> <p>Check the operation of pumps as per pump manufacturer's specifications</p> <p>Check if the maximum flow rate to the MBR is within the limits as per design specification</p>
<b>Blower/pump not working</b>	<p>Fuse blown</p> <p>Motor is overloading</p> <p>Power failed</p>	<p>Electrician to check</p> <p>Electrician to check</p> <p>Electrician to check</p>
<b>System not in run mode</b>	<p>Kill switches are mistakenly pushed in</p> <p>Power failure/outage</p>	<p>Ensure kill switches (on control panel/wall) are not pressed;</p> <p>Electrician to check</p>



## 7.5.4 P-201/2, 301/2, 401/2, 501/2, 553/4, 551/2 - Trouble Shooting

TROUBLESHOOTING		
<p><b>1. Pump fails to build head pressure:</b></p> <p>Check for:</p> <ul style="list-style-type: none"> <li>a. Pump not primed.</li> <li>b. In correct pump rotation.</li> <li>c. Driver speed too low.</li> <li>d. Suction line restricted.</li> <li>e. Driver failure.</li> <li>f. Plugged or damaged impeller.</li> <li>g. Pump or impeller undersized.</li> <li>h. Pump cavitation.</li> <li>i. Improper impeller clearance.</li> </ul>	<p><b>3. Excessive noise or vibration during operation.</b></p> <p>Check for:</p> <ul style="list-style-type: none"> <li>a. Motor bearing failing.</li> <li>b. Pump cavitation.</li> <li>c. Improper impeller clearance.</li> </ul> <p><b>4. Leaking mechanical seal.</b></p> <p>Check for:</p> <ul style="list-style-type: none"> <li>a. Improper assembly.</li> <li>b. Worn or cracked seal faces.</li> <li>c. Abrasive material in fluid.</li> <li>d. Liquid flashing at seal faces (Fluid temperature too high).</li> <li>e. Seal pressure rating too low for the service.</li> <li>f. Chemical attack of seal components.</li> <li>g. Seal operated dry or with a liquid having poor lubricating properties.</li> </ul>	<p><b>5. Pump gradually loses pressure and head.</b></p> <p>Check for:</p> <ul style="list-style-type: none"> <li>a. Increasing temperature causing cavitation or liquid vaporization.</li> <li>b. Driver failure.</li> <li>c. Suction lift too high.</li> <li>d. Air entering suction line.</li> </ul> <p><b>6. Motor overheating.</b></p> <p>Check for:</p> <ul style="list-style-type: none"> <li>a. Excessive flow and amp draw (Throttle discharge).</li> <li>b. Low voltage or frequency.</li> <li>c. Flow rate too low with resulting heat rise.</li> <li>d. Bearing failure.</li> <li>e. System temperature too high.</li> </ul>
<p><b>2. Pump fails to provide enough flow rate.</b></p> <p>Check for:</p> <ul style="list-style-type: none"> <li>a. System resistance too high.</li> <li>b. Pump undersized.</li> <li>c. Pump not primed.</li> <li>d. Driver speed too low.</li> <li>e. Poor suction conditions.</li> <li>f. Improper impeller clearance.</li> </ul>		



## 7.5.5 P-701/702 Trouble Shooting

### TROUBLESHOOTING

**WARNING:** Before making adjustments, disconnect power source and thoroughly bleed pressure from system prior to disassembly. Failure to do so could lead to electric shock or serious bodily harm.

#### Failure To Pump.

1. Motor will not start: Check power supply. Voltage must be  $\pm 10\%$  of nameplate rating when motor is in locked rotor condition. Check for faulty capacitor on 1 phase Models.
2. Motor runs and thermally kicks out: Check for excessive discharge pressure. Check for defective centrifugal switch on 1 phase Models. Increase ventilation to motor. Do not use less than #14 wire size.
3. Stator torn; possible excessive pressure: Replace stator, check pressure at discharge port.
4. Flexible joint broken; possible excessive pressure: Replace joint, check pressure at discharge port.
5. Wrong rotation (3 phase only): Rotation must be clockwise when facing pump from motor end. Reverse the connections of any two line leads to the motor.
6. Excessive suction lift or vacuum.

#### Pump Overloads.

1. Excessive discharge pressure: Check pressure at discharge port for maximum ratings given in Table 1.
2. Fluid viscosity too high: Limit fluid viscosity to 100 CP or 500 SSU.

#### Noisy Operation.

1. Excessive suction lift or vacuum: Maximum suction lift is 25 feet for water.
2. Suction line too small: Check pipe size. Be sure lines are free from obstructions.
3. Pump Cavitates: Pump speed is 1725 rpm. Viscosity of fluid should not exceed 100 CP or 500 SSU.
4. Flexible joint worn: Replace joint. Check pressure at discharge port.
5. Insufficient mounting: Mount to be secure to a firm base. Vibration induced noise can be reduced by using mount pads and short sections of hose on suction and discharge ports.

#### Seal Leakage.

1. Leakage at startup: If leakage is slight, allow pump to run several hours to let faces run in.
2. Persistent seal leakage: Faces may be cracked from freezing or thermal shock. Replace seal.

#### Pump Will Not Prime.

1. Air leak on suction side: Check pipe connections.



## 7.5.6 P-801 Trouble Shooting

CONDITION	COMMON CAUSES
<b>A. Pump will not start or run.</b>	Check fuse, low voltage, overload open, open or incorrect wiring, open switch, impeller or seal bound mechanically, defective capacitor or relay when used, motor or wiring shorted. Float assembly held down. Switch defective, damaged, or out of adjustment.
<b>B. Motor overheats and trips overload or blows fuse.</b>	Incorrect voltage, negative head (discharge open lower than normal) impeller or seal bound mechanically, defective capacitor or relay, motor shorted.
<b>C. Pump starts and stops too often.</b>	Float tight on rod, check valve stuck or none installed in long distance line, overload open, level switch(s) defective, sump pit too small.
<b>D. Pump will not shut off.</b>	Debris under float assembly, float or float rod bound by pit sides or other, switch defective, damaged or out of adjustment.
<b>E. Pump operates but delivers little or no water.</b>	Check strainer housing, discharge pipe, or if check valve is used vent hole must be clear. Discharge head exceeds pump capacity. Low or incorrect voltage. Incorrect motor rotation. Capacitor defective. Incoming water containing air or causing air to enter pumping chamber.
<b>F. Drop in head and/or capacity after a period of use.</b>	Increased pipe friction, clogged line or check valve. Abrasive material and adverse chemicals could possibly deteriorate impeller and pump housing. Check line. Remove base and inspect.

## 7.5.7 B-501/502 - Trouble Shooting

PROBLEM	POSSIBLE CAUSES	SOLUTION
Knocking	<ol style="list-style-type: none"> <li>Unit out of time.</li> <li>Distortion due to improper mounting or pipe strains.</li> <li>Excessive pressure differential.</li> <li>Worn gears.</li> <li>Worn bearings.</li> </ol>	<ol style="list-style-type: none"> <li>Re-time impellers</li> <li>Check mounting alignment and relieve pipe strains.</li> <li>Reduce to manufacturer's recommended pressure. Examine relief valve, re-set if necessary.</li> <li>Replace timing gears.</li> <li>Replace bearings..</li> </ol>
Excessive blower temperature.	<ol style="list-style-type: none"> <li>Too much oil in gear case.</li> <li>Too low operating speed.</li> <li>Dirty air Filter.</li> <li>Clogged filter or muffler.</li> <li>Excessive pressure differential.</li> <li>Worn impeller clearances.</li> <li>Internal contact.</li> </ol>	<ol style="list-style-type: none"> <li>Reduce oil level.</li> <li>Increase blower speed.</li> <li>Clean or replace air filter</li> <li>Remove cause of obstruction.</li> <li>Reduce pressure differential across the blower.</li> <li>Replace impeller.</li> <li>Correct clearances.</li> </ol>
Impeller end or tip drag.	<ol style="list-style-type: none"> <li>Insufficient assembled clearances.</li> <li>Case or frame distortion.</li> <li>Excessive operating pressure.</li> <li>Excessive operating temperature.</li> </ol>	<ol style="list-style-type: none"> <li>Correct clearances.</li> <li>Check mounting and pipe strain.</li> <li>Remove cause.</li> <li>Remove cause</li> </ol>
Lack of volume.	<ol style="list-style-type: none"> <li>Slipping belts.</li> <li>Worn clearances.</li> <li>Dirty air filter</li> </ol>	<ol style="list-style-type: none"> <li>Tighten belts.</li> <li>Re-establish proper clearances.</li> <li>Clean or replace air filter.</li> </ol>
Excessive bearing or gear wear.	<ol style="list-style-type: none"> <li>Improper lubrication.</li> </ol>	<ol style="list-style-type: none"> <li>Correct lubrication level. Replace dirty oil.</li> </ol>
Loss of oil.	<ol style="list-style-type: none"> <li>Headplate, gear case or drive cover vents plugged.</li> <li>Worn Seal.</li> </ol>	<ol style="list-style-type: none"> <li>Clean vents.</li> <li>Replace seals.</li> </ol>



## 7.5.8 B-301/302, B-601/602 - Trouble Shooting

Fault	Cause	Remedy	Carried out by
Motor does not start; no motor noise.	At least two power supply leads interrupted.	Eliminate interruption by fuses, terminals or power supply cables.	Electrician
Motor does not start; humming noise..	One power supply lead interrupted.	Eliminate interruption by fuses, terminals or power supply cables.	Electrician
	Impeller is jammed.	Open vacuum pump/compressor cover, remove foreign body, clean.	Service <sup>*)</sup>
		Check or correct impeller gap setting if necessary.	Service
	Impeller defective.	Replace impeller.	Service <sup>*)</sup>
	Rolling bearing on drive motor side or vacuum pump/compressor side defective.	Replace motor bearing or vacuum pump/compressor bearing.	Service <sup>*)</sup>
Protective motor switch trips when motor is switched on. Power consumption too high.	Winding short-circuit.	Have winding checked.	Electrician
	Motor overloaded. Throttling does not match specification on rating plate.	Reduce throttling.	Service <sup>*)</sup>
		Clean filters, mufflers and connection pipes if necessary.	Service <sup>*)</sup>
	Compressor is jammed.	See fault: "Motor does not start; humming noise." with cause: "Impeller is jammed.".	Service <sup>*)</sup>
Pump-motor unit does not generate any or generates insufficient pressure difference.	Leak in system.	Seal leak in the system.	Operator
	Wrong direction of rotation.	Reverse direction of rotation by interchanging two connecting leads.	Electrician
	Incorrect frequency (on pump-motor units with frequency converter).	Correct frequency.	Electrician
	Shaft seal defective.	Replace shaft seal.	Service <sup>*)</sup>
	Different density of pumped gas.	Take conversion of pressure values into account. Inquire with Service Department.	Service
	Change in blade profile due to soiling.	Clean impeller, check for wear and replace if necessary.	Service <sup>*)</sup>
Abnormal flow noises.	Flow speed too high.	Clean pipes. Use pipe with larger cross-section if necessary.	Operator
	Muffler soiled.	Clean muffler inserts, check condition and replace if necessary.	Service <sup>*)</sup>
Abnormal running noise.	Ball bearing lacking grease or defective.	Regrease or replace ball bearing.	Service <sup>*)</sup>
Compressor leaky.	Seals on muffler defective.	Check muffler seals and replace if necessary.	Service <sup>*)</sup>
	Seals in motor area defective.	Check motor seals and replace if necessary.	Service

<sup>\*)</sup> Only when the maintenance manual is at hand: rectification by the operator.



## 7.5.9 LT-301/501 - Trouble Shooting

### 1. **Symptom:** *Transducer fails to give output of any kind.*

**Procedure:** Isolate the problem to either the transducer or the power supply/readout. See the Quick Check Procedures (above) for this check. If it can be determined that the transducer is no longer operable, remove it from service for further analysis. If the transducer output falls within the limits described above, the fault lies somewhere else in your system.

### 2. **Symptom:** *Transducer has failed and has been removed for analysis.*

**Procedure:** Inspect the cable for physical damage. Cuts in the cable jacket can result in liquid incursion into the transducer housing, which can cause permanent damage. If operational, the cable can be repaired by using a splice kit (P/N 830) supplied by Pressure Systems.

Inspect the transducer housing. It should be intact and free of corrosion. If the outer surface of the transducer is pitted, this could be an indication of galvanic corrosion caused by stray ground currents. If this is the case, the transducer will probably require replacement. If the external case exhibits none of these characteristics, carefully unscrew the nosepiece and look into the pressure sensing end of the transducer. The concentric rings of the sensing diaphragm should be visible. If they are not, it could be that residue has accumulated on the diaphragm, preventing it from responding properly to pressure changes. The transducer can be cleaned by gently swishing the transducer back and forth in a bucket of warm, soapy water until the residue softens and washes off. (See **Cleaning Your Transducer**, page 8.) ***Under no circumstances should any object or tool be used to remove residue from the sensing diaphragm or else permanent damage will be done.*** If cleaning the diaphragm does not solve the problem, the transducer should be returned to the factory for repair or replacement.

### 3. **Symptom:** *Transducer develops a negative offset and gets worse over time (actual level exceeds specified level).*

**Procedure:** This may be a sign that moisture has entered the reference (vent) tube in the cable and is inside the transducer housing. This is usually the result of not maintaining the desiccant vent filter or of operating the transducer without a desiccant filter or aneroid bellows. If caught early enough, the transducer can be saved by coiling the cable and transducer in a pan and baking it in an oven at 50°C (122°F) for a minimum of 2 hours. ***Be careful that the oven temperature does not exceed 50°C (122°F) or both the transducer and the cable can be damaged.*** Alternatively, suspend both the cable and transducer in a vertical position (with vent tube down), overnight to allow water to drain from the transducer and vent tube.



**4. Symptom:** *Transducer suddenly fails during or just after a nearby lightning event.*

**Procedure:** This failure is usually caused by overvoltage due to ground transients resulting from a direct or indirect lightning event. These transients can travel

distances of a mile or more. The transducer may be returned to the factory for repair and optional retrofit of our **lightning protection system**. This system carries a lifetime warranty against transducer damage due to lightning.

**5. Symptom:** *Transducer response to pressure/level input changes becomes sluggish.*

**Procedure:** This is usually a sign that the sensing end of the transducer has become fouled with residue. The transducer must be removed from service and the sensing diaphragm cleaned as described in Item 2, (warm, soapy water). If fouling persists, the transducer may be replaced with a Series 705 or Series 750 (non-fouling) transducer, which is specifically designed for trouble-free operation in a high residue environment.

**6. Symptom:** *Output reading is within limits but "freezes" at one point.*

**Procedure:** In certain environments "crust" may form over the sensing diaphragm, preventing the sensor from identifying change in level. Removing the transducer from service and cleaning it (as described in Item 2) will generally solve the problem. To combat marine growth, you might try wrapping the transducer with copper wire similar to that found in wire scouring pads for cleaning dishes. Marine growth occurs on the copper and eventually erodes the copper and drops off or the copper is manually removed during routine maintenance. Alternatively, there are various companies that will impregnate/coat the 316 stainless steel with anti-fouling chemicals of coatings. Level transducers temporarily removed from the well or sump should not be stored dry, but should be stored in a bucket of fresh water in order to prevent "crust" formation.

**7. Symptom:** *Readings increase very slowly over time.*

**Procedure:** Our cable is shipped coiled and consequently takes time to straighten when installed. Attaching a weight to the transducer (e.g., one of our sacrificial anodes) will help. To prevent cable stretch with lengths greater than 200 feet (60 m), secure the Kevlar fibers (just under the cable jacket) to your junction box or other secure object.

**8. Symptom:** *No electrical output from your transducer.*

**Procedure:** Check all electrical connections to ensure they are correct and secure. Double check your power supply or use a battery (as described previously) to ensure the transducer is getting power. If all checks OK, the problem could be a circuit board or the sensor in your transducer. The unit must be returned to the factory for evaluation. The most probable cause of this type of failure is damage to the submersible cable jacket allowing water to leak down the cable and into the transducer housing or lightning damage.



**9. Symptom:** *Formation of marine growth on a submersible transducer.*

**Procedure:** Certain transducer construction materials, for example, 316 stainless steel, attract marine life (snails) and algae. Clean the transducer diaphragm by

soaking it in a bucket of warm water with a non-aggressive cleaning solution. You can also coat the transducer with marine grease. This may be the most effective and inexpensive way to protect your transducer.

**10. Symptom:** *Submersible transducer exhibits corrosion or pitting on body or diaphragm*

**Procedure:** Dissimilar metals (for example, your transducer housing and your pump housing) in an electrolytic environment (fluid in your well) can lead to *galvanic corrosion* of the metal that is nearer the anodic end of the galvanic series. Likewise, a voltage potential between the ground wire of the transducer and the ground of other equipment in the well can lead to *galvanic corrosion*. Installation of a P/N 820 or 825 sacrificial anode will help protect your transducer from *galvanic corrosion*. Our sacrificial anodes are made of a zinc alloy that, being nearer the anodic end of the galvanic series than the 316 stainless steel or titanium housing of the transducer, will corrode before the transducer.

**11. Symptom:** *The transducer is buried in dirt or silt and the readings seem to be erroneous.*

**Procedure:** Use of a piezometer nosepiece in this application would help. This nosepiece can be easily installed in the field and features a very fine screen to keep dirt from fouling the diaphragm, but allows the diaphragm to sense moisture levels.

**12. Symptom:** *Transducer has an offset error.*

**Procedure:** Our submersible transducers perform best when the sensing end is pointing in a downward manner. Keep in mind that you can experience offset error due to the position sensitivity or orientation change of the sensor. Offset errors are more prominent in low pressure applications with the sensing end of the transducer lying flat or pointing upward.



- 13. Symptom:** *I am testing a Series 700 4-20mA sensor for use with our data logger. On page A-2 of the KPSI Level and Pressure Transducers User's Manual, I see the standard 4-20mA configuration. Does the recording channel of my data logger become the mA meter?*

**Procedure:** Most data loggers cannot measure current (mA) directly. When this is the case a load resistor must be used to convert the current (mA) output into an appropriate voltage. If the User's Manual for your particular instrument does not illustrate a preferred method for recording current (mA) data then you should attach your transducer signal wires to your data logger in the following manner.

Transducer red wire - Data Logger Excitation Terminal  
(The minimum excitation for a Series 700 Transducer is 9VDC)  
Transducer black wire – Data Logger signal input (+) terminal

Attach a Load resistor between the Data Logger signal input (+) terminal and the Data Logger signal input (-) terminal.

Attach a separate piece of wire between the Data Logger signal input (-) and analog ground.

In this configuration you will turn your data logger into a milliammeter. The size of your load resistor can be calculated in the following manner.

$$D/0.02=R$$

Where:

Data logger input range = D  
Full scale output of transducer = 0.02 A (20 mA)  
Load Resistor Value = R

Pick an appropriate standard value

250 Ohms results in 1 to 5 VDC at 4 and 20 mADC  
125 Ohms results in 0.5 to 2.5 VDC (500 to 2500 mVDC) at 4 and 20 mADC

At this point the discussion needs to address IR loss (voltage drop) in series circuits. Note that Series 700 transducers need a minimum of 9 VDC to operate correctly. When the transducer is operating correctly it will output a current which, when driven through a resistor, will generate some amount of voltage drop. If the resistor value is 250 Ohms then the voltage measured across that resistor will be  $0.004 \text{ A} \times 250 \text{ Ohms} = 1.000 \text{ VDC}$  and  $0.020 \text{ A} \times 250 \text{ Ohms} = 5 \text{ VDC}$ . Notice that, if the available voltage from the data logger is 12 VDC then  $12 \text{ VDC} - 5 \text{ VDC} = 7 \text{ VDC}$  which is less than the voltage required by the transducer to operate. If this scenario were to occur the transducer would actually stop functioning correctly when its output reached 12 mADC (50% of transducer full scale range). In this case the appropriate choice for a load resistor value is 125 Ohms.





- 14. Symptom:** *I have a Series 700 4-20mA transducer rated for 7.5 PSIG attached to a pressure source that is outputting 7.5 PSIG. With 20VDC being supplied I am getting 19.94 mA. I can't find the upper range allowance for the sensor, but this seems low to me. Does this mA reading fall into the acceptable range for the transducer with the settings I've specified?*

**Procedure:** When evaluating a transducer it is sometimes convenient to make some broad generalizations in order to rapidly determine the condition of the unit. In general, transducers that output a 4-20 mADC signal have a 16 mADC span ( $4 - 20 = 16$ ). If the transducers accuracy is reported as being some percentage of its full-scale range then the following table could be used in conjunction with the instructional notations to determine whether a more detailed analysis of data quality is required.

Model	Accuracy	Accuracy in mADC
700	1.00%FS	±0.16 ma
710	0.50%FS	±0.08 ma
720	0.25%FS	±0.05 ma
730	0.10%FS	±0.016 ma
735	0.05%FS	±0.008 ma

In order to approximately determine how many milliamps a transducer should output at a given depth.

1. Determine the depth (in feet) at which the transducer is sited.
2. Divide the depth value (from step 1) by the transducer full-scale range (in feet). - Record the value.
3. Multiply the value calculated in step 2 by 16 (the transducer span in milliamps).
4. Add 4 to the product of step 3. This is the approximate value in milliamps that should be output by the transducer at its current depth.

In order to approximately determine the depth of a transducer (in feet) using a given value of milliamps.

1. Divide the full-scale range of the transducer (in feet) by 16.  
Record this value.
2. Subtract 4 from the milliamp output of the transducer.  
Record this value
3. Multiply the result of step one by the result of step 2.  
This is the approximate depth at which the transducer is sited.

If the resulting numbers are reasonably close to some verified value for current water depth, then the unit is functioning. In order to determine the quality of measurement, additional steps need to be performed.



### 7.5.10 PH-501 - Trouble Shooting

Fault reporting and troubleshooting					
Display	Description / cause	Status <sup>1</sup>	Mode <sup>2</sup>	Measured variable output <sup>3</sup>	Correction variable output <sup>4</sup>
pH/mV RANGE ↓	Input voltage too low	Error	Basic load	Fault current	-
pH/mV RANGE ↑	Input voltage too high	Error	Basic load	Fault current	-
T RANGE ↓	Measured temperature beneath measuring range	Error	Basic load	Fault current	Fault current
T RANGE ↑	Measured temperature above measuring range	Error	Basic load	Fault current	Fault current
CAL ERROR	No valid user calibration exists	Error	-	-	-
NO PROBE	If activated: pH sensor monitoring outputs: no sensor	Error	Basic load	Fault current	-
PROBE ERR	If activated: pH sensor monitoring outputs: sensor break	Error	Basic load	Fault current	-
CHECK-TIME	Control checkout time elapsed	Error	Basic load	Fault current	-
mA RANGE ↑	mA output current has an upper limit	Error	-	-	-



Display	Description / cause	Status <sup>1</sup>	Mode <sup>2</sup>	Measured variable output <sup>3</sup>	Correction variable output <sup>4</sup>
mA RANGE ↓	mA output current has a lower limit	Error	-	-	-
LIMIT ↑	Measured variable exceeds upper set limit	Warning	-	-	-
LIMIT ↓	Measured variable falls below lower set limit	Warning	-	-	-
T LIMIT ↑	Correction variable exceeds upper set limit	Warning	-	-	-
T LIMIT ↓	Correction variable falls below lower set limit	Warning	-	-	-
LIMIT ERR	Set checkout time for monitoring the measurement variable limits has elapsed	Error	Stop	Fault current	-
TLIMITERR	Set checkout time for monitoring the correction variable limits has elapsed	Error	Stop	Fault current	Fault current
NO CAL	No valid user calibration exists	Warning	-	-	-
CONTACTIN	If activated: Power relay is activated in 'PAUSE/HOLD'	Error	-	-	-

1 = [Status] Error status after occurrence of the fault (error means: alarm relay deactivates, "E" is displayed before the error message, can be acknowledged with OK)



2 = *[Mode]* Resulting controller mode (relates to control variable and thus, as necessary, mA output)

3 = *[Measured variable output]* Consequence for the current output, if this is set as 'a measured variable output'

4 = *[Correction variable output]* Consequence for the current output, if this is set as 'a correction variable output'

### 7.5.11 MV-701/702 - Trouble Shooting

Conditions	Possibilities	Solutions
Motor does not operate	<ol style="list-style-type: none"> <li>1. Is the supplied power and voltage correct?</li> <li>2. Any blisters on the capacitor?</li> <li>3. Are the gear trains free?</li> </ol>	<ol style="list-style-type: none"> <li>1. Checking by meter.</li> <li>2. If so replace.</li> <li>3. Remove motor to check.</li> </ol>
Motor stops running	<ol style="list-style-type: none"> <li>1. Is power supply short circuited?</li> <li>2. Any foreign objects in flow stream?</li> </ol>	<ol style="list-style-type: none"> <li>1. Check wiring.</li> <li>2. Check for obstructions.</li> </ol>
Unable to fully open/close	<ol style="list-style-type: none"> <li>1. Loose/Misaligned cam?</li> <li>2. Bent valve stem?</li> <li>3. Mechanical stop adjustment incorrect?</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust/Tighten using spanner.</li> <li>2. Replace valve stem.</li> <li>3. Check position of stops.</li> </ol>
Valve stops operating when motor is running.	<ol style="list-style-type: none"> <li>1. Gear worn out?</li> <li>2. Sleeve adapter worn out or broken?</li> <li>3. Broken valve stem or actuator transmission shaft?</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace gear.</li> <li>2. Replace sleeve adapter.</li> <li>3. Replace valve stem or actuator transmission shaft.</li> </ol>
Abnormal control for operating two or more actuators simultaneously.	<ol style="list-style-type: none"> <li>1. Controlling circuit connects in tandem or parallel?</li> </ol>	<ol style="list-style-type: none"> <li>1. Please refer to the wiring diagram.</li> </ol>
Motor overheats.	<ol style="list-style-type: none"> <li>1. Is the voltage correct?</li> <li>2. Is valve too tight to operate?</li> <li>3. High working frequency?</li> <li>4. Is motor stem or bearing binding?</li> </ol>	<ol style="list-style-type: none"> <li>1. Checking by meter.</li> <li>2. Replace valve.</li> <li>3. Check duty cycle.</li> <li>4. Replace the binding parts.</li> </ol>
Abnormal on/off angle on 3-phase voltage.	<ol style="list-style-type: none"> <li>1. Wrong phase wiring?</li> </ol>	<ol style="list-style-type: none"> <li>1. Change phase wiring.</li> </ol>
Occasional on/off actuator failure.	<ol style="list-style-type: none"> <li>1. Simultaneous input power on/off.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check if the selection switch is normal.</li> </ol>
Vibration when valve is closed.	<ol style="list-style-type: none"> <li>1. Motor brake spring fatigued or Teflon worn?</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace spring or Teflon.</li> </ol>







## 8.0 SHUT DOWN

### 8.1 MBR Temporary Shut Down

A temporary shutdown for a few days requires continuous aeration of the biomass to keep the DO level at least 2 mg/L and continuous biomass recycle between the bioreactors.

### 8.2 MBR Permanent Shut Down / Winterizing

Permanent shut down is required if system operation stops for at least 2 weeks without inflow. Permanent shut down includes the following procedure:

#### 8.2.1 Process Shut Down Procedure

- Conduct a “Backwash Now” operation on the system
- Stop influent flow into the System
- Ensure all pumps are in the “OFF” position using the HOA HMI screen
- Ensure all Blowers are in the “AUTO” position using the HOA HMI screen. This is to be done until a vacuum truck can be provided or contracted locally to clean out the tanks.
- Ensure all automated valves are in the “OFF” position using the HOA HMI screen.
- Ensure that the MBR is disabled using the HMI screen button
- Conduct all maintenance procedures on Section 7 Table – regardless of schedule time

#### 8.2.2 Cleaning - General

- Conduct general system interior cleaning
- Open all tanks, wash out with a garden hose and Vacuum out.
- Clean all sensors and level switches

#### 8.2.3 Membranes

- Ensure that the membrane tanks (TNK-601/602) are drained before opening the membrane tanks.
- Open TNK-601/602 doors with hand/power tools.

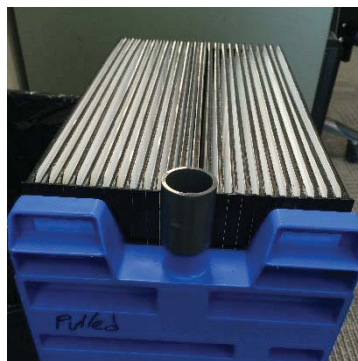
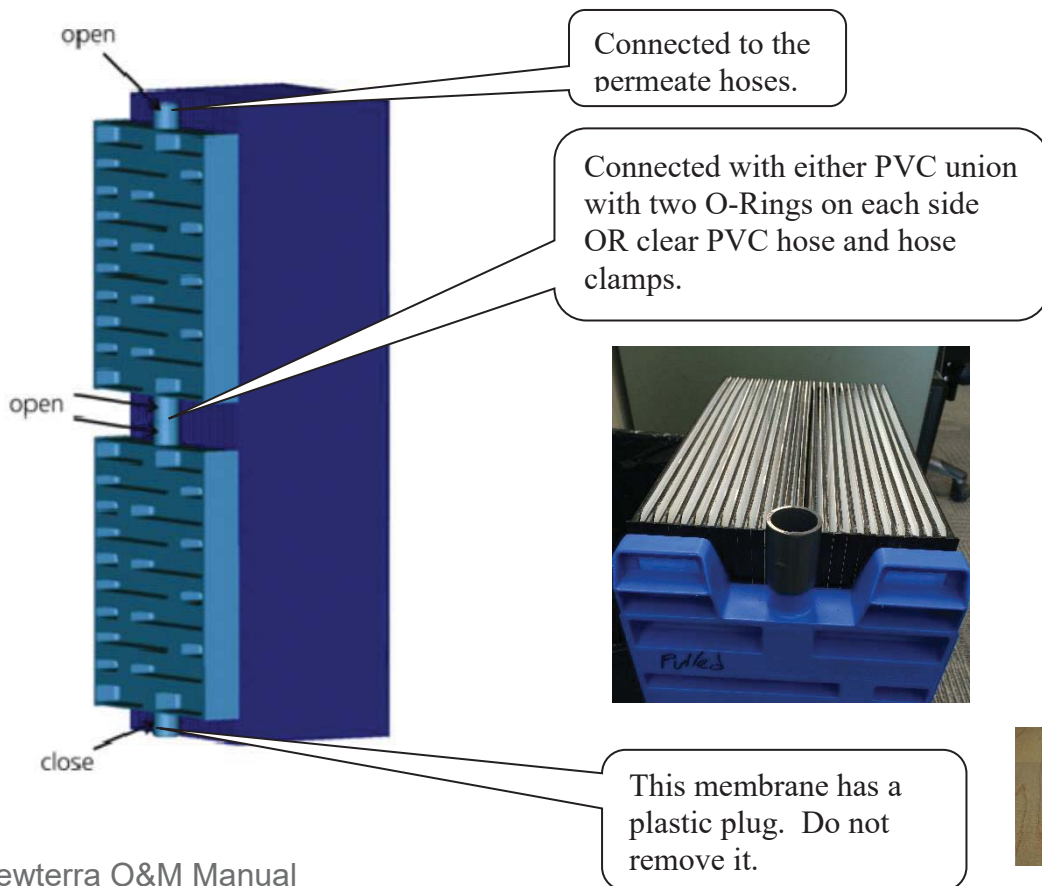




- Using a garden hose, wash the inside of the tanks and vac out any remaining waste water. **DO NOT USE A PRESSURE WASHER!**
- Disconnect the permeate hoses from the top of membrane the membrane stack.
- Remove the membranes from the membrane frame using hand tools.

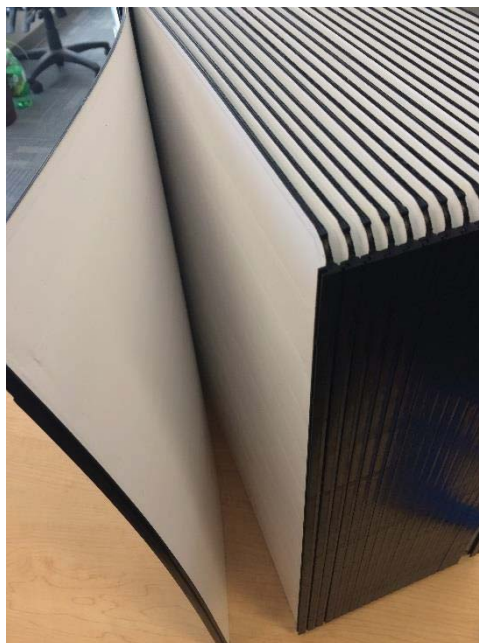


- **CAUTION** – the membranes are contaminated with waste water. PPE required.
- **NOTE.** The membranes are double stacked. The bottom membrane has a plug in the bottom opening. Do not remove this plug. Note the membrane orientations for re-installation. The membranes are joined together with either a PVC union with two O-Rings on each side OR clear PVC hose and hose clamps.





- After membranes are separated, wash with clean water. Remove the blue backing plate and gently separate the membrane plates and clean with water to remove any debris.



- Replace backing plate and let the membranes dry out.
- Shrink wrap the membrane cassettes in multiple film layers and seal the membranes cassettes with tape. Note and mark which membranes have the bottom plug in them.
- Store the preserved membrane cassettes at room temperature (never expose the membrane cassettes to frost, dust, or direct sunlight).

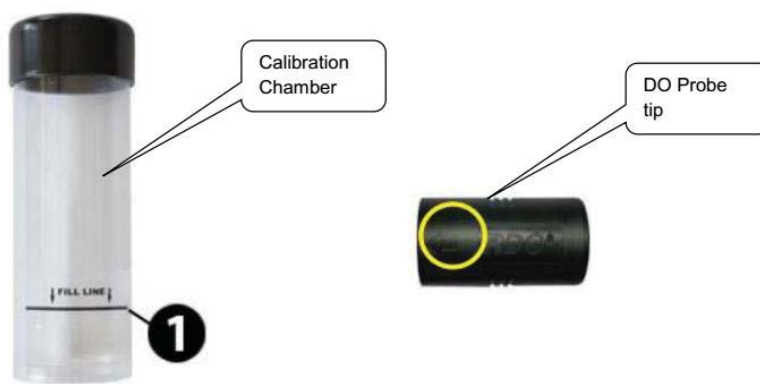
### 8.3 General Components

- Conduct all preventative maintenance as listed in Section 7.
- Drain/Vacuum Out and wash out all tanks.
- Clean and Wash out SCR-201/202
- Disassemble all PVC ball valves and drain any water inside (open and close to ensure trapped water escapes).
- Leave all valves ½ open during reinstallation
- Open all drain valves and leave open.
- Find all check valves and make sure water is not being held by valve (Wet/Dry Vac works well here).
- Drain / remove all pumps from tanks, ensure no water is left inside the pump.
- Use RV Antifreeze that is suitable for potable water systems
  - Refill any check valve



- Dump in 2 (qty) 4-L bottles in each tank
- Remove power from system.
- Double check and ensure that there is no water left in any pipes, fittings etc. If it is not possible to remove the water fill with antifreeze.
- Drain the chemical tanks and dispose of chemicals in accordance with manufacturer's recommendations and local regulations.
- Remove pH (PH-501) and DO (DO-501) probes from TNK-501 and store with membranes in a heated area ensure probes are kept wet.

- **NOTE: Remove DO probe tip from the DO sensor (DO-501) in accordance with vendor directions in Appendix E and store in the calibration chamber with the storage cap attached with a few drops of clean water. Store with the membranes in a heated area and ensure probe tip is kept wet.**





## 8.4 Blowers – B-501/502

### STORAGE

Your Gardner Denver Blower was packaged at the factory with adequate protection to permit normal storage for up to six (6) months.

If the unit is to be stored under adverse conditions or for extended periods of time, the following additional measures should be taken to prevent damage.

1. Store the blower in a clean, dry, heated (if possible) area.
2. Make certain inlet and discharge air ports are tightly covered to prevent foreign material from entering the air box.
3. All exposed, non-painted surfaces should be protected against rust and corrosion.
4. Provide adequate protection to avoid accidental mechanical damage.
5. In high humidity or corrosive environments, additional measures may be required to prevent rusting of the blower internal surfaces.
6. To prevent rusting of gears, bearings, etc., the oil reservoirs may be filled with normal operating oil.



**Before running the blower, drain the oil and replace to the proper operating level with clean, fresh lubricant.**

7. Rotate the blower shaft (10 to 25 turns) weekly during storage. Inspect the blower shaft (near the shaft seal area) monthly and spray with rust inhibitor if needed.
8. For long term storage (over six (6) months), contact Gardner Denver Compressor Division Customer Service for recommendations.

### REMOVING PROTECTIVE MATERIALS

The shaft extension is protected with rust inhibitor which can be removed with any standard solvent.



**Follow the safety directions of the solvent manufacturer.**

Blower inlet and outlet are temporarily capped to keep out dirt and other contaminants during shipment. These covers must be removed before start-up.

The internal surfaces of all Sutorbilt units are mist sprayed with a rust preventative to protect the machine during shipment. Remove this film upon initial startup, using any commercial safety solvent. Position the blower so that the inlet and discharge connections are in the vertical position (vertical airflow). On vertically mounted units, it will be necessary to lay the unit on its side supporting the ends of the unit so as not to restrict the port on the bottom side. Place a shallow pan on the under side of the unit. With the blower disconnected from power, spray the solvent in the top port, rotating the impellers by spinning the shaft manually. Continue this procedure until the unit is visibly clean.



**Rotating components will cause severe injury in case of personal contact. Keep hands and loose clothing away from blower inlet and discharge ports.**



#### 8.4 Chemical Dosing Pumps – P-6101/6102/6103

1. ➡ Disconnect the pump from the mains power supply.
2. ➡ Empty the liquid end by turning the pump upside down and allowing the feed chemical to run out.
3. ➡ Flush the liquid end with a suitable medium; flush the dosing head thoroughly when using hazardous feed chemicals!







## 9.0 SERVICE & SUPPORT

### 9.1 Commissioning and Start-up

**newterra** MicroClear™ MBR System's **commissioning & start-up** is the last step of the **newterra** project execution process.

As part of your order, the following on site services will be provided by experienced factory trained newterra representative:

- Includes five (5) 8-hour days of onsite startup/commissioning by one (1) factory trained newterra representative
- Includes five (5) 8-hour days of onsite training by one (1) factory trained newterra representative

#### 9.1.1 Startup/Commissioning

Typical System Startup/Commissioning includes the following:

- Equipment checks - Electrical, mechanical, and controls
- Functional test - Equipment and control system
- Hydraulic test
- Operation during plant seeding

#### 9.1.2 Training

On-site operator training including the following topics:

- General MBR theory & process
- Specific system instruction
  - Components
  - Controls and operating philosophy
  - Alarms and alarm troubleshooting
  - Maintenance
  - Troubleshooting
  - MBR fouling control (Biology, physical, and chemical)



## 9.2 Post commissioning Services

A comprehensive range of post commissioning services are available from **newterra** beyond system design and installation. Specific services include:

- Technical support (including after-hours emergency telephone support).
- Spare parts order and delivery.
- Training program.
- Plant optimization and upgrades.
- Telemetry control and monitoring.
- Assistance in preparing system performance reports (process data monitoring & analysis).
- Preventive maintenance cleaning (including membrane cleaning).
- System audits for reviewing the performance and efficiency of all MBR subsystems..

### 9.2.1 Technical Support

**Technical support** is available to assist in troubleshooting of **newterra** MBR systems during normal working hours 8:30 am to 5:00 pm (Eastern Time Zone for **newterra** Ltd.). Telephone service is available via **1.800.420.4056**.

**Emergency 24/7 telephone technical support** – This will be activated upon subscribing to **newterra's** 24/7 technical support service. If a problem cannot be resolved through telephone or e-mail support, **newterra** technicians and engineers are available for site visits.

### 9.2.2 Spare Parts

**newterra** has spare parts to provide quick response to any critical system breakdown. Contact **newterra** parts department at **1.800.420.4056**.

All parts and components associated with **newterra** MBR Systems are available from within service departments and manufacturing facilities of **newterra** Ltd across Canada and abroad.

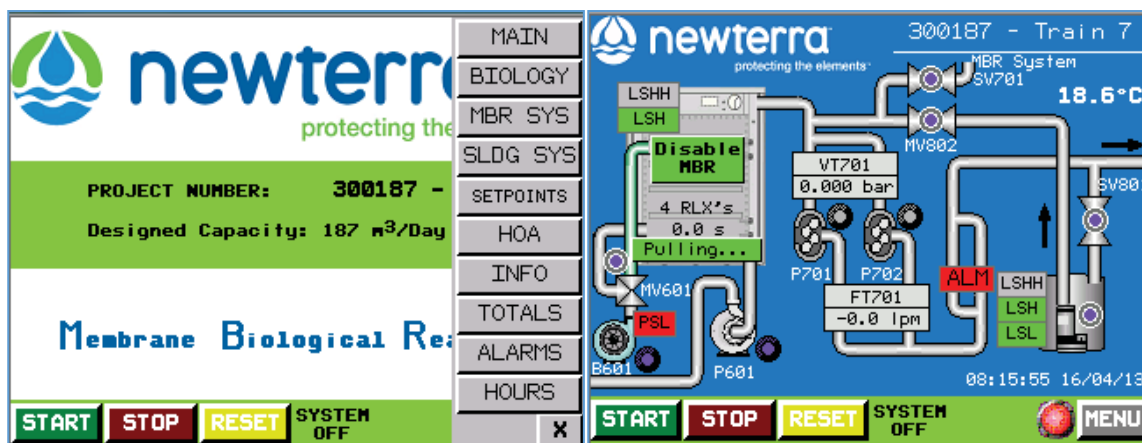
**Potentially required spare parts are:**

- membrane modules/membrane cassettes;
- parts for repair/replacement (valves, transmitters, switches, gauges, pH & DO probes, pump motors, analyzers, PLC components, fuses, etc.);
- maintenance spare parts (air blowers, air filters, pumps, immersion heaters, chemical metering pumps, etc.).



### 9.2.3 Assistance in telemetry control and monitoring

**newterra** SITE-LINK is a customized software program and hardware configuration which provides a real-time link to a treatment system via cellular modem or customer supplied internet connection using our secure Site-Link Server.



**newterra** Site-Link comes with the following customizable features:

- Customized P&ID layout with system status
- Start/Stop/Reset of system
- Manual control of all system components
- Data logging downloads in .csv format<sup>†</sup>
- Daily system status reports (E-Monitor)
- Alarm history including current alarm status
- Hour meters for applicable equipment
- Customization of all system set points<sup>†</sup>
- Live and historical trending
- Immediate text & email on alarm (E-Alarm)

<sup>†</sup>certain restrictions apply

The basic system requires that the customer provide a standard computer network cable to the control panel. If the customer's computer network is accessible to the internet, this system can also be monitored from any internet enabled computer. Static IP is not required but is recommended and must be provided by customer.

This system is not available if customer supplied internet connection or cellular service is not available at the site. During internet outages, reports cannot be sent and system status cannot be monitored remotely.



#### 9.2.4 Site visits and system audits

Site visits and system audits can be arranged at an additional cost. Contact **newterra** for all financial aspects of **newterra** initial and post-commissioning services.

During a system audit, technical reviews of the performance of all **newterra** MBR subsystems and the efficiency of the biological process can be performed. Based on the site visit and agenda discussed with the client, we can assist in:

- Maintenance coordination and scheduling, including membrane maintenance and cleaning.
- Validation of chemical dosing settings.
- MBR System inspection for the proper operation of the membrane system in accordance with the O&M manual; equipment calibration, process optimization and upgrades.
- Continued on-site operator training and coaching.



## 10.0 WARRANTY

### General Warranty Statement

1. **newterra** warrants and guarantees products of its manufacture against defective workmanship or material for a period of one year from the date of notice of readiness to ship.
2. This warranty is expressly and strictly limited to replacing, without charge, any part or parts which prove to **newterra's** satisfaction upon examination, to have been defective in design, material or workmanship, and which have not been neglected, abused or misapplied, provided the buyer gives **newterra** immediate written notice upon discovery of any claimed defect.
3. During the warranty period, parts will be shipped as necessary with instructions to replace, which can be further elaborated over phone or email; visit(s) of our technician to site can be covered if there is a service agreement in place; otherwise, actual charges will be quoted to the owner at that time, if required.
4. **newterra** will also guarantee component parts manufactured by others to the extent of the guarantee made by the manufacturer of such equipment. In any case, guarantees on specific components will be extended a minimum of one year from date of notice of readiness to ship.

### Warranty Exclusions

1. Warranty coverage does not include:
  - Freight, labor, travel, and living expenses associated with parts replacement
  - Normal maintenance items such as lubrication, fan belts, and cleaning of the equipment
  - System parts damaged as a result of customer changes to the system and/or PLC program without the written consent of **newterra**.
2. In the event that the customer, or any contractor employed by the customer, contracts an outside company, other than **newterra** for modification of system equipment, without knowledge of **newterra**, the warranty in that case may become null & void.
3. In the event that the customer, or any installation contractor employed by the customer, contracts outside **newterra** for installation work or erection of quoted equipment, the customer shall assume full responsibility for said contract.

### Warranty Validation and Conditions

1. **newterra** highly recommends that the system be started up by a **newterra** factory trained technician to ensure the correct installation and trouble-free startup. The startup checklist provided in the O&M manual must be completed and returned to **newterra** to validate your equipment warranty which begins on the date of shipment from the factory.
2. In the event that the system is commissioned by a certified technician that is not an employee of **newterra**, the Startup Checklist must be returned to **newterra** within 15 days of the completion of startup



# APPENDIX A

## Drawings







