YORK®	*MILLENNIUM* ® VSD VARIABLE SPEED DRIVE	
INSTALLATION	Supersedes: Nothing	Form 160.05-N4 (998)

RETROFIT
INSTALLATION GUIDE
FOR
CENTRIFUGAL CHILLERS

NOTE

IT IS STRONGLY RECOMMENDED THAT THIS GUIDE BE REVIEWED IN ITS ENTIRETY BEFORE QUOTING, SELLING OR INSTALLING A RETROFIT VSD.

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SAFETY WARNING & CAUTION

GENERAL SAFETY GUIDELINES

1. This equipment is a relatively complicated apparatus. During installation, operation, maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to, refrigerants, oils, materials under pressure, rotating components and electrical voltage. Each of these items has the potential, if misused or handled improperly, to injure. It is essential that the technician/operator identify and recognize these inherent hazards and proceed safely in completing their tasks.

2. Bodily injury or death may result from high voltage electrical components and controls as well as from rotating equipment. During installation or any service/ maintenance, the electrical supply should be disconnected, locked out and tagged. If any testing, service or maintenance must be done while the equipment is still energized, it is the responsibility of the person performing these tasks to identify all possible risks to personal safety that they may be exposed to during the course of performing the task. The task should only be performed when the individual feels that the task can be completed safely and with minimal risk.

USE OF DOCUMENT

This document is intended for use by factory-authorized service personnel. It is expected that this individual will possess independent training that will enable them to perform their assigned tasks properly and safely. It is essential that prior to performing any task on this equipment, that the individual read and understand this document and any referenced materials. He should be familiar with and comply with all applicable federal, state and local standards and regulations pertaining to the task in questions.

It is the obligation and responsibility of the authorized individual to work safely. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to people at the site.

CHANGEABILITY

In complying with YORK's policy for continuous product improvement, the information in this document is subject to change without notice. While YORK makes no commitment to update or provide current information automatically to the manual owner, that information, if applicable, can be obtained by contacting your local YORK Service Office. It is the responsibility of the reader (operator/service person) to verify the applicability of these documents to the equipment in question. If there is any question in the mind of the reader (operator/ service person) as to the applicability of these documents, then prior to working on the equipment, they should verify with the owner whether the equipment has been modified and if the current literature is available.

INTRODUCTION / OVERVIEW

This Installation Guide is intended to provide a general guideline for the field retrofit of the YORK Millennium Variable Speed Drive (VSD). It can be applied to YORK YK and YT chillers and other centrifugal chillers which use a YK, or YTH and later compressor. The Millennium VSD retrofit is intended for application with open motors which have a supply voltage of nominal 440-480V/60 Hz and 380-400V/50 Hz. Refer to the complete Application Data (Form 160.05-AD1) and the Retrofit Marketing Guide (Form 160.05-MG1) to ensure proper application and selection of a VSD retrofit kit.

The following are the major installation tasks required to complete a VSD retrofit:

- Determine Optimum Drive Location and Mount Drive Enclosure
- Cooling (condenser) Water Piping
- Main power wiring
- Control wiring

This guide is intended to provide general direction and recommendations for each of these tasks as commonly found in an indoor commercial application. It is not intended to be a definitive guide governing every conceivable combination of drive, chiller type, and location. In all cases, local and national codes must govern and take precedence over any information contained in this or any other product literature.

This guide covers the installation of the retrofit VSD. Additional information related to start-up, operation, and maintenance can be found in the following two publications available through the literature distribution system: Service Instructions (160.00-M1) & Operating Instructions (160.00-O1).

LOCATION & MOUNTING CONSIDERATIONS

The first step in a proper installation is to determine the optimum location for the VSD enclosure. This is often determined by the location of the existing power conduits. It is a definite advantage to be able to use the existing wiring, without having to add a junction box and additional power cables. The majority of installations will have the conduits located overhead. Determine if it is possible to remove a section, or sections, of existing conduit, and reinstall the existing 90° downward elbow. This often provides more than enough power cable to reach the terminal lugs inside the VSD. Often the VSD can be located adjacent to the chiller shell to meet this objective.

The physical dimensions of the VSD enclosure must be taken into consideration when selecting the mounting location and evaluating site access. Doorways, elevators, and traffic patterns should be checked to ensure ease of passage of the VSD to its mounting location. Some components on the VSD enclosure can be temporarily removed if required for site access and replaced when the drive is in its final mounting location.

The retrofit VSD comes in three enclosure sizes. The enclosure dimensions can be determined by the motor code to which the VSD is applied. The three sizes are identified in table 1. Complete dimensional data can be obtained from the dimensional and physical data (Form 160.05-PA1.1)

The National Electric Code (NEC) requires a minimum of 3 feet (0.9 m) of free space in front of the enclosure. It also requires that the hinged doors be able to open a minimum of ninety degrees. Service access to the electrical and cooling water piping in the rear of the VSD must also be taken into consideration. Care should be taken to ensure that the VSD enclosure, and its associated wiring and piping do not obstruct the tube pull or other chiller service areas.

NOTE: *The NEC is primarily a U.S. Code and adherence to it may only be mandatory in the U.S. However, the NEC is based on sound scientific principals and safety practices and we recommend that its guidelines be followed even if it exceeds local requirements.*

TABLE 1 – VSD ENCLOSURE OVERALL DIMENSIONS

MOTOR CODE		ENCLOSURE SIZE – WIDTH X HEIGHT X DEPTH	
60 HZ	**50 HZ**	**INCHES**	**MM**
CF – CN	5CC – 5CI	54 x 57 x 32	1372 x 1448 x 813
CP – CT	5CJ – 5CM	59 x 57 x 32	1499 x 1448 x 813
CU – CZ	5CN – 5CS	59 x 59 x 47	1499 x 1499 x 1194

SHELL MOUNTING

In some cases it may be desirable to mount the VSD on the chiller shell. This is a very difficult task requiring two to three days additional labor for installation. Another drawback is the need to re-certify ASME coded vessels when working on high-pressure systems.

If shell mounting is absolutely required, you should have three feet (0.9 m) of clearance above the top of the motor to erect a gantry. This height is necessary because the cabinet sits higher than the motor and additional height is needed for a chain fall. A small spreader bar may also be used, and may require less height than the chain fall. The VSD can be elevated over the chiller shell with a fork-lift; however, if there is ample space to get a fork-lift up to the chiller, there is likely enough space to locate the VSD on the floor.

When shell mounting the VSD, some installers have successfully modified the end base mounting channels to fit the curvature of the shell. This has the added advantage of reducing the mounting height.

SPRING ISOLATION

If the chiller is mounted on spring isolation, the additional weight of the VSD may necessitate replacing the existing springs. Any piping and conduit connected to the VSD will also be required to accommodate the spring isolation.

COOLING WATER PIPING

The VSD requires a 10 gpm (0.63 l/s) supply of cooling water conforming to the temperature criteria in the Application Data Form 160.05-AD1. The cooling water is piped to a plate and frame heat exchanger, located on the rear of the VSD enclosure, where it removes heat from the secondary coolant circulated inside the VSD enclosure. The cooling tower water can be obtained from the condenser water boxes or directly from the condenser water piping system.

Differential pressure is the normal means of inducing the required flow, but in some cases a booster pump may be required. (See pages 11 and 12 to determine if a booster pump is required for the application.) The following paragraphs and flow chart will help you choose between piping the system with hose or hard pipe, and determine whether a booster pump will be required. Either a “local” hose piped or “remote” hard piped piping kit is provided with the retrofit VSD. Both kits are available for installation in condenser piping systems with design working pressures of either 150 PSIG (1034 kPa), or 300 PSIG (2068 kPa). The appropriate kit is obtained by designating, on the retrofit VSD order form (160.05-F1), local or remote and the design working pressure (DWP).

“Local” Hose Piped Installation Kit – The hose piping kit contains 30 feet (9.2 m) of hose, valves, strainer, and hose fittings required for an all hose installation. (Refer to the sample local piping illustration, Fig. 2, for more details.)

Application – Hose can be used when the following criteria are met:

- The VSD enclosure is located within one foot (0.3 m) of the evaporator shell and does not extend past either tube end sheet
- Less than 30 feet (9.2 m) of total hose length is required
- Hose will be connected at or near the condenser water boxes

“Remote” Hard Piped Installation Kit – The hard piping kit contains 6 feet (1.8 m) of hose, valves, strainer, and hose fittings required to form the basis of a hard piped system with hose terminations. All additional pipe and fittings must be field supplied! Refer to the sample remote piping illustration, Fig. 3, for more details.

Application – A hard piped system is recommended for any VSD location which falls outside of the “local” criteria above. These are applications which fall into the following three classes:

- The VSD enclosure is located more than one foot (0.3 m) away from the evaporator shell or extends past either tube end sheet
- The location of the VSD requires a total piping length greater than 30 feet (9.2 m) between the VSD and the source of cooling water
- The piping will be connected directly to the main condenser piping system instead of at or near the condenser water boxes

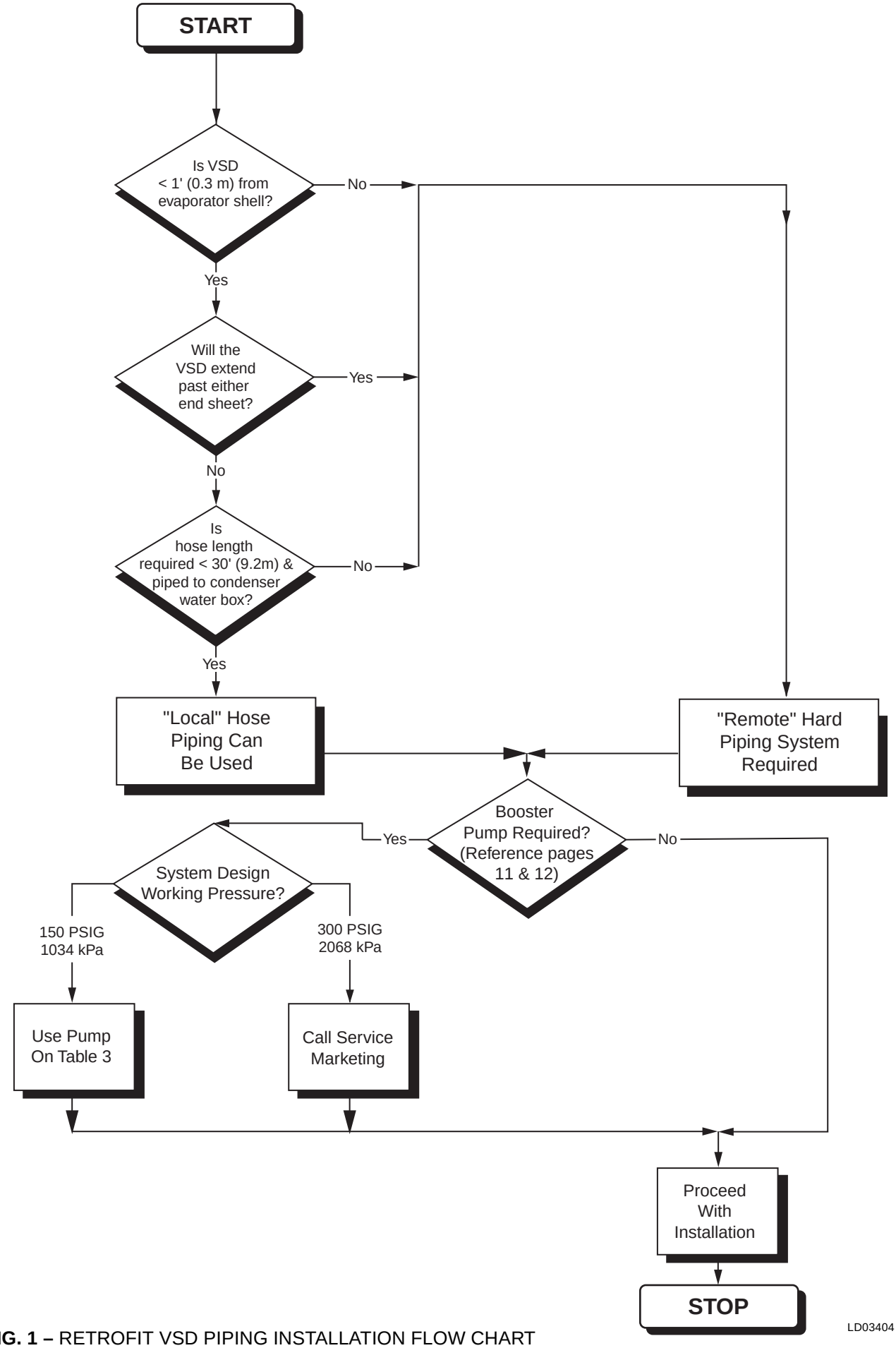
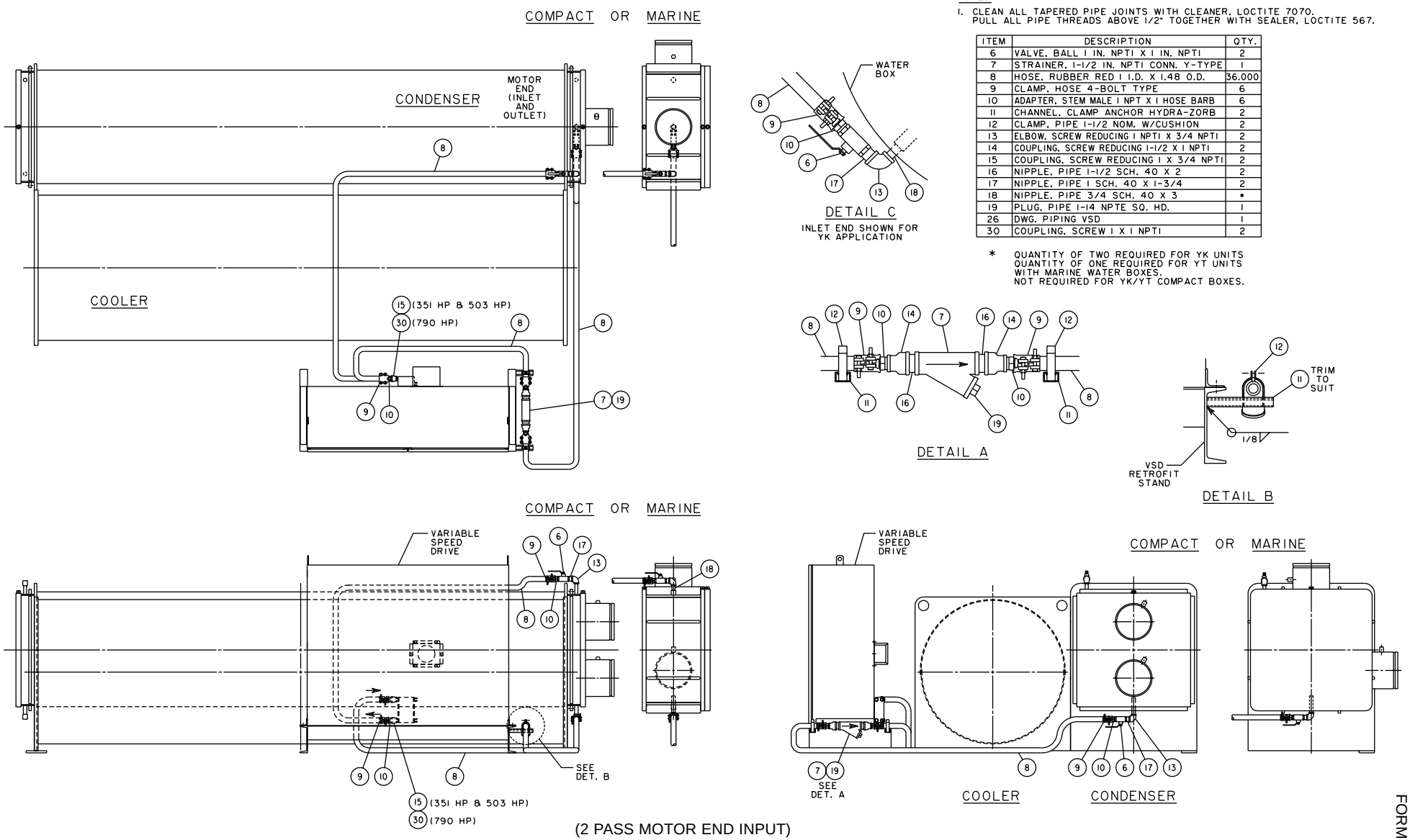


FIG. 1 – RETROFIT VSD PIPING INSTALLATION FLOW CHART



NOTES:

1. CLEAN ALL TAPERED PIPE JOINTS WITH CLEANER, LOCTITE 7070. PULL ALL PIPE THREADS ABOVE 1/2" TOGETHER WITH SEALER, LOCTITE 567.

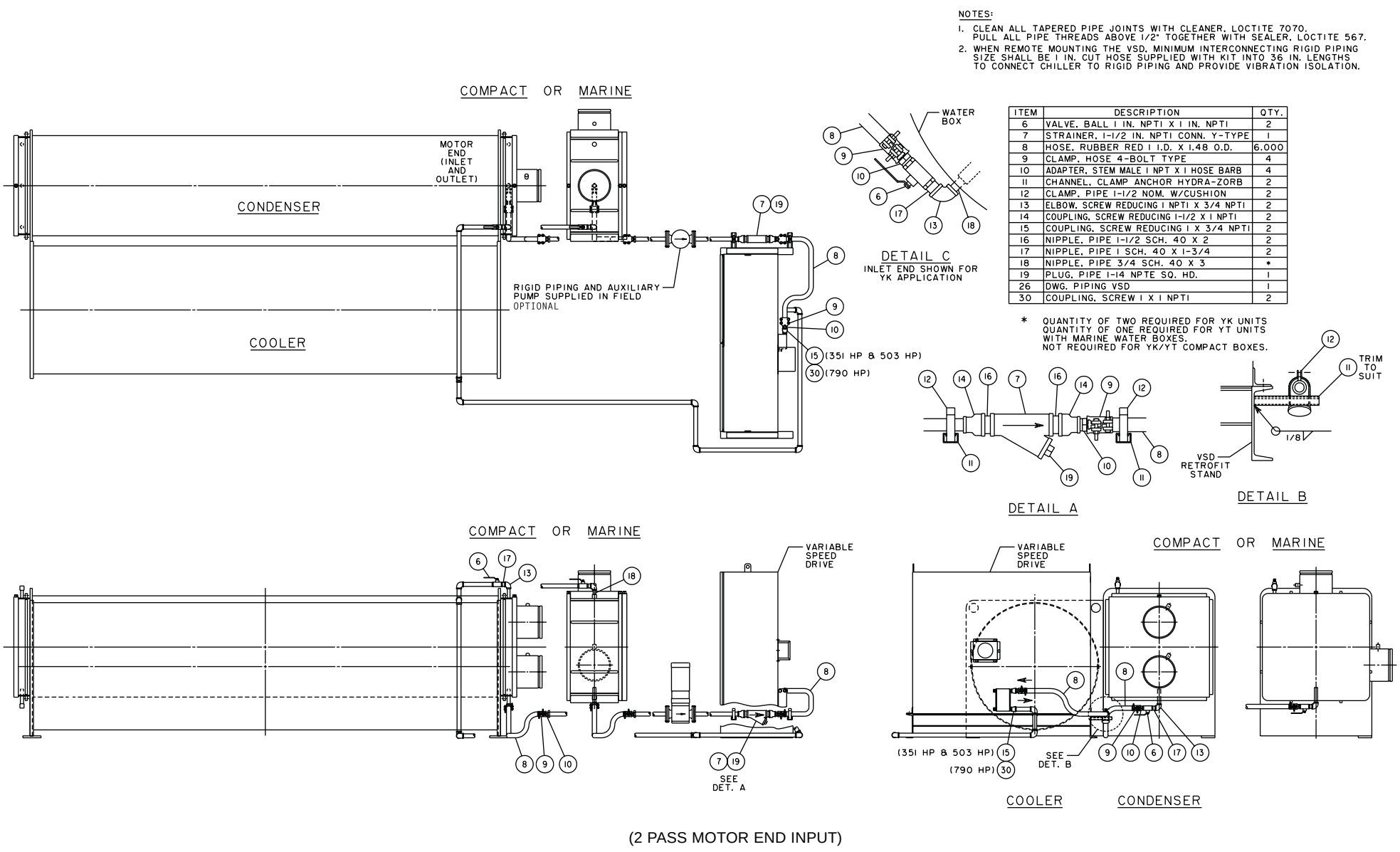
ITEM	DESCRIPTION	QTY.
6	VALVE, BALL 1 IN. NPTI X 1 IN. NPTI	2
7	STRAINER, 1-1/2 IN. NPTI CONN. Y-TYPE	1
8	HOSE, RUBBER RED 1 I.D. X 1.48 O.D.	36.000
9	CLAMP, HOSE 4-BOLT TYPE	6
10	ADAPTER, STEM MALE 1 NPT X 1 HOSE BARB	6
11	CHANNEL, CLAMP ANCHOR HYDRA-ZORB	2
12	CLAMP, PIPE 1-1/2 NOM. W/CUSHION	2
13	ELBOW, SCREW REDUCING 1 NPTI X 3/4 NPTI	2
14	COUPLING, SCREW REDUCING 1-1/2 X 1 NPTI	2
15	COUPLING, SCREW REDUCING 1 X 3/4 NPTI	2
16	NIPPLE, PIPE 1-1/2 SCH. 40 X 2	2
17	NIPPLE, PIPE 1 SCH. 40 X 1-3/4	2
18	NIPPLE, PIPE 3/4 SCH. 40 X 3	*
19	PLUG, PIPE 1-14 NPTE SQ. HD.	1
26	DWG. PIPING VSD	1
30	COUPLING, SCREW 1 X 1 NPTI	2

* QUANTITY OF TWO REQUIRED FOR YK UNITS
QUANTITY OF ONE REQUIRED FOR YT UNITS WITH MARINE WATER BOXES.
NOT REQUIRED FOR YK/YT COMPACT BOXES.

(2 PASS MOTOR END INPUT)

FIG. 2 – SAMPLE LOCAL PIPING

LD03425

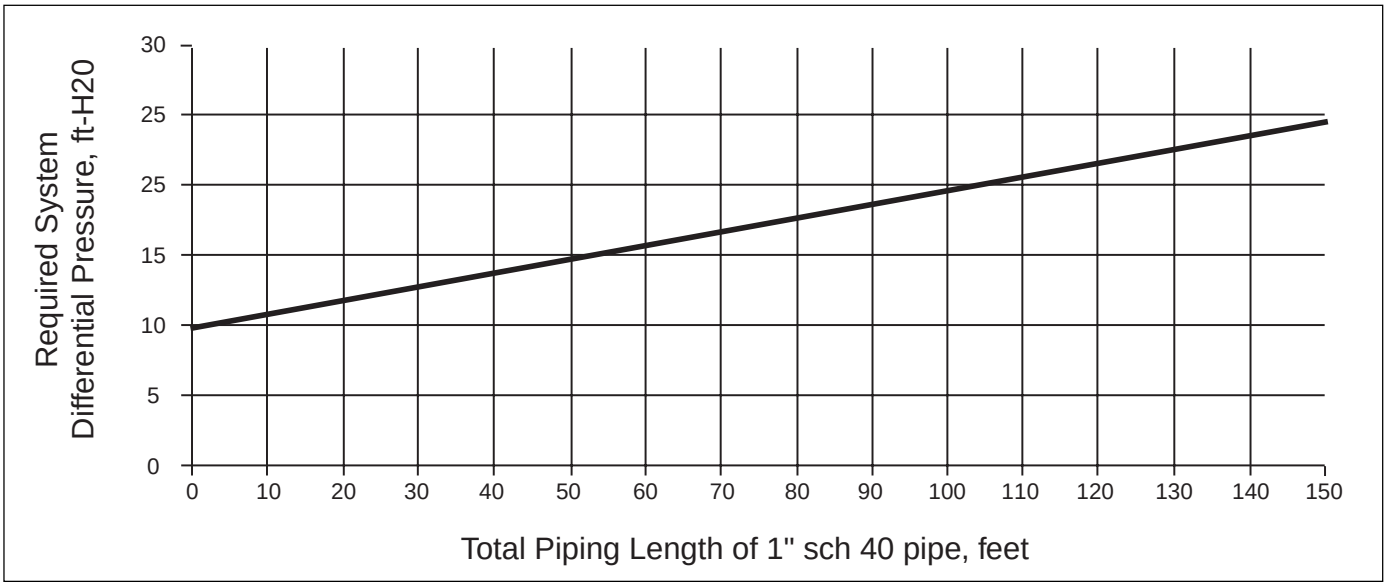


(2 PASS MOTOR END INPUT)

FIG. 3 – SAMPLE REMOTE PIPING

LD03425

GRAPH 1 – REMOTE HARD PIPED SYSTEM MINIMUM REQUIRED SYSTEM DIFFERENTIAL PRESSURE



The graph above is based on the following: 10 GPM (0.63 l/s) water flow rate, 1" schedule 40 threaded steel pipe, and the following fittings (14 elbows, 2 ball valves, 1 strainer, VSD heat exchanger, and misc. fittings).

HELPFUL CONVERSION FACTORS:

FEET x 0.305 = METERS

FEET of H_2O x 0.43 = Pounds Per Square Inch Differential (PSID)

FEET of H_2O x 2.99 = kPa

"REMOTE" HARD PIPED SYSTEM DETAILS

(Reference Fig. 4)

When connecting the retrofit VSD cooling piping system, it is desirable to minimize the piping length and maximize the available differential pressure at the connection points. Piping length must take into consideration the total length of the piping run that will be required to complete the circuit from inlet to outlet. If the piping must be run overhead, the total length should include all vertical and horizontal pipe runs.

The connection points should provide at least the minimum differential pressure as determined by Graph 1. The most convenient connection points will generally be at or near the chiller's condenser water box (points 3 and 4). The chiller design data can be reviewed to determine the pressure drop across the condenser but it would be better to measure it directly. When measuring pressure drop with a gauge, it is recommended that a single gauge be connected at the two different piping connection locations and the difference be determined mathematically.

If the available pressure differential at or near the condenser water box is less than specified by Graph 1, alternate connection points should be considered. Greater pressure differential is available when the water inlet is connected to the discharge side of the pump (Point 2) and the outlet is piped downstream of the condenser (Point 4).

The greatest available differential pressure in the condenser piping system can be found directly across the main condenser water pump (Points 1 and 2). The cooling piping can be connected in this location if the minimum required differential pressure is not available anywhere else in the condenser piping circuit. Piping to this location will slightly elevate the chiller's entering condenser water temperature.

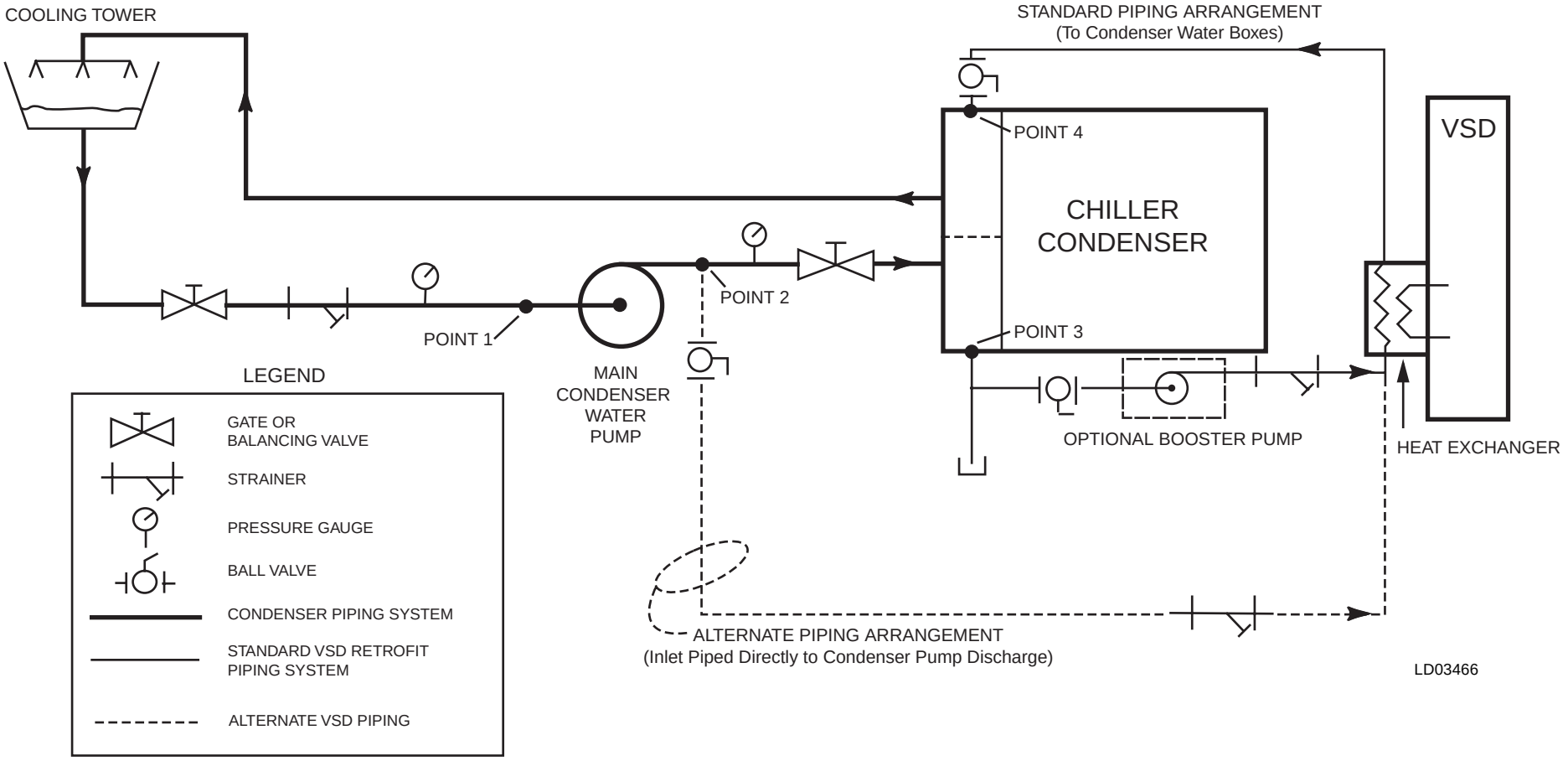


FIG. 4 – CONDENSER LOOP AND VSD PIPING

TABLE 2 – CONNECTION POINT SUMMARY

INLET	OUTLET	DIFFERENTIAL PRESSURE	COMMENTS
3	4	MINIMUM	MOST COMMON
2	4	GREATER	
2	1	MAXIMUM	WILL SLIGHTLY INCREASE CONDENSER WATER TEMP.

WHEN TO USE A BOOSTER PUMP

If it is not practical to connect the cooling piping to a location that provides adequate pressure drop, application of a booster pump should be considered (see Fig. 4). The sum of the available pressure drop at the connecting points and the head produced by the booster pump should meet or exceed the minimum head requirements in table 4 for "local" hose piped systems or graph 1 for "remote" hard piped systems.

The recommended pumps are in-line mounted and the piping connected to them should be rigidly supported and free of bending or twisting forces, which could stress the pump flanges and body. If the booster pump is applied in a "local" hose piped system, it should be connected to rigidly supported hard pipe. Depending on available space, it will probably be easiest to directly couple the pump to the strainer.

Note: The pumps called for in the piping drawings currently shipped with the retrofit VSD kits are no longer recommended. Only the pumps in the following table are recommended! The next revision of the retrofit piping drawings will reflect this change.

For systems with a design working pressure of up to 145 PSIG (1000 kPa), the following Grundfos pumps are recommended:

TABLE 3 – BOOSTER PUMP SELECTION

MFG. MODEL	MFG. PART NUMBER	YORK P/N	FLOW RATE	HEAD @ RATED FLOW	POWER	VOLTS/HZ/PH
UP26-96BF	52.7223 36	026-34469-000	10 GPM	15 ft-H_2O	1/12 HP	115/60/1
1" flange kit for UP26-96BF	51.9652	026-34471-000				
UPS 32-60FB	Not Available	Not Available	0.63 l/s	33 kPa	90 W	230/50/1

Note: *The 50 Hz booster pump is not stocked in the Parts Distribution Center due to uncertainty of demand and variability related to pipe connection sizes and type. It should be available locally in most countries with 50 Hz power.*

For systems with a design working pressure of greater than 145 PSIG (1000 kPa) call the service marketing department for pump recommendations.

TABLE 4 – HOSE PIPED MINIMUM DIFFERENTIAL PRESSURE

SYSTEM TYPE	MINIMUM REQUIRED DIFFERENTIAL PRESSURE
"Local" Hose Piping up to 30 feet (9.2 m)	9 ft-H_2O/3.9 PSID/26.9 kPa

Piping Example 1

Description – The pressure readings taken on the job site indicate the following pressures (Reference Fig. 4). Piping from the VSD enclosure to the condenser water box connections will require 100 feet (30.5 m) of pipe.

POINT 1	POINT 2	POINT 3	POINT 4
50 Ft.– H_2O	100 Ft.– H_2O	80 Ft.– H_2O	70 Ft.– H_2O
150 kPa	299 kPa	239 kPa	209 kPa

Solution – Since the total piping length required is greater than 30 feet (9.2 m), the system must be hard piped using the "remote" piping kit and field supplied piping. From Graph 1, we find that the differential pressure required for 100 feet (30.5 m) of pipe is 19 ft-H_2O (56.8 kPa). The differential pressure available across the condenser water box (points 3 and 4) is only 10 ft-H_2O (29.9 kPa). Therefore, it cannot be piped directly across the water boxes.

At this point, two options are available:

1. Alternate piping connections – Site measurements indicate that it will require an additional 40 feet (12.2 m) of pipe, to connect the inlet water to the discharge of the main condenser water pump (point 2) for a total piping length of 140 feet (42.7 m). Graph 1 indicates that 23 ft-H_20 (68.8 kPa) differential pressure is required for a total pipe length of 140 feet (42.7 m). Since a differential pressure of 30 ft-H_20 (90 kPa) is available by piping between the pump discharge (point 2) and the downstream water box (point 4), the installation of a booster pump is unnecessary.

2. Use of the booster pump – The sum of the standard booster pump head 15 Ft-H_2O (44.9 kPa) and the available pressure differential across the water boxes 10 ft-H_2O (29.9 kPa) is 25 ft-H_20 (74.8 kPa). Since this is greater than the required pressure differential of 19 ft-H_20 (56.8 kPa), the booster pump can be applied. In addition to the cost of the pump, application of the booster pump complicates the piping, wiring, and maintenance of the installation.

OTHER PIPING CONSIDERATIONS / RECOMMENDATIONS:

PIPING CONNECTIONS

For most installations, it will be most convenient to connect the cooling water piping to the condenser water box, nozzle, or adjacent piping. The cooling water inlet connection should **not be taken off the bottom** of the water box, unless a dip tube extends up into the water box (as in factory mounted installations). Otherwise, dirt and debris will collect at the bottom of the water box and may eventually clog the supply line. If a bottom connection is used without a dip tube, the addition of a dirt leg will reduce the pickup of debris and sediment, but it may still be prone to clogging.

The factory supplied vent and drain line connections could be as small as ½" (12.7 mm) NPT. This small size contributes significant pressure drop. This may be an issue for any system with marginal pressure drop. The use of vents and drains for piping connections also prohibits them from being used as originally intended unless an additional valve is added for that purpose. For units requiring a micropanel retrofit, it may also be desirable to use the vent connections for the installation of entering and leaving condenser water sensors.

An existing thermometer or pressure gauge tap in nearby piping may be a more suitable connection point. In order to obtain an acceptable connection point for the inlet piping, it may be necessary to isolate and drain the condenser water piping. Mounting a 1" (25.4 mm) weld-o-let on the **side** of the water box, nozzle, or piping is preferable to either the top (because of potential for becoming air bound) or the bottom (because of the potential for clogging). If the water boxes are ASME coded vessels; code welding procedures and re-stamping of the water box will be necessary.

AIR VENTING

Many piping arrangements have the potential to become air bound. Remote installations with overhead risers are particularly susceptible. For this reason, it is recommended that an automatic float/vent be added to a "T" connector at the highest point in the system. For

systems with a design working pressure of 145 PSIG (1000 kPa) or less, a float/vent similar to the ITT Bell & Gosset model number 67 is recommended. Since a float/vent for higher working pressure systems could not be readily identified, it is recommended that a small ball valve be used in the same location for start-up and periodic venting. Care should be taken that neither type of vent is located near electrical panels or other equipment that could be damaged by water.

PRESSURE GAUGES AND TAPS

Although the piping illustrations included in this guide and in the kits do not illustrate them, pressure gauges or taps are recommended at both the inlet and outlet of the cooling piping network for non-booster pump systems, or across the pump in booster pump systems. This will facilitate balancing the system and ensure the minimum design flow of 10 gpm is maintained.

STRAINER

A 1-½" (38 mm) "Y" type strainer housing with a 20 wire per inch wire-mesh strainer is supplied in the piping kits to prevent clogging of the flat plate heat exchanger. It is to be mounted upstream of the VSD heat exchanger and downstream of the booster pump (if used) as illustrated in figures 2 and 3. The strainer should be rigidly supported by the channel support and clamp supplied in the piping kit. The channel support can be welded to the VSD base, adjacent piping, or the chiller itself. If the booster pump is used, it can be close coupled to the strainer and mounted as a single rigid assembly. Additional channel and clamps should be field supplied if required for secure mounting.

If the strainer requires excessive cleaning, a second parallel strainer and valve network should be added, which permits one strainer to be valved-off, drained, and cleaned while the VSD remains on-line.

300 PSIG (2068 kPa) HOSE FITTINGS

The hose fittings included in the high pressure hose kits contain barb fittings and four bolt hose clamps. These hose clamps have retaining fingers intended to prevent the barb fitting (on the inside of the hose) from separating from the hose and clamps (on the outside of the hose). This style hose clamp is highly recommended based on safety considerations.

WARNING: *A detached hose under pressure or a barb fitting which becomes a projectile could cause serious injury to personnel and/or equipment.*

Some installers have reported difficulty in getting the four bolt hose clamps to seal. It is suspected that the fitting leaks are related to over tightening the hose clamps. Care should be taken to not "buckle" the hose when tightening the bolts. The manufacturer recommends a bolt torque of 21 ft-lbs (29 N-m). Tightening the bolts in a diagonal pattern across the hose will promote even torque on all bolts. After initial tightening, the bolts should be re-torqued after a resting period of 4 to 24 hours. When properly assembled, the hose and fittings have been tested in the factory up to 400 PSIG (2758 kPa) without leaks.

To minimize stress on the fittings and minimize pressure drop in the hose, route the hose so that it contains only gradual bends and turns. Refer to pages 22- 27 for more information related to the proper installation of hose and clamps.

HARD PIPING MATERIAL RECOMMENDATIONS

Steel Pipe: The standard hard piping material is 1" (25.4 mm) threaded steel pipe of the type STD, XSTG, or Sch 40.

- For 150 PSIG (1034 kPa) systems: Use fittings conforming to ANSI/ASME B16.3 class 150
- For 300 PSIG (2068 kPa) systems: Use fittings conforming to ANSI/ASME B16.3 class 300

Copper Pipe: 1" Copper is also an acceptable piping material.

- For 150 PSIG (1034 kPa) systems: Type M, L&ACR, or K pipe with wrought copper or cast bronze fittings.
- For 300 PSIG (2068 kPa) systems: Type L&ACR, or K pipe with cast bronze fittings only.

NON-NORTH AMERICAN PIPING

No attempt has been made, in this guide, to discuss the various piping standards used around the world. The connectors and fittings in both the "local" and "remote" piping kits are all based on the National Pipe Thread (NPT) convention. It will be necessary to locally supply mating NPT fittings if required. If desired, the entire system can be piped using locally available materials which have approximately a one inch (25.4 mm) inside diameter. Note that the 50 Hz booster pump is not stocked in the Parts Distribution Center due to uncertainty of demand and variability related to pipe connection sizes and type. It should be available locally in most countries.

POWER WIRING

MAJOR TASKS

All wiring, conduit, licenses, permits, inspections, etc. are to be field supplied according to local requirements. A licensed electrician will be required to complete most or all of the tasks in this section. The following major tasks related to power wiring must be accomplished in order to install the retrofit VSD.

- Wiring between the power source and VSD
- Wiring between the VSD and the main drive motor
- Wiring between the VSD and the oil pump starter
- Installation of the Voltage Snubber Network (DV/DT)
- Installation of the motor terminal box (if applicable)

WIRE SIZING

Power Source to VSD – Power wires are sized at 1.25 times the sum of the full-load current of the compressor drive motor, the oil pump motor, and the control power transformer current. Note that this formula differs from the 1.38 multiplier recommended on the earlier turbomodulator drives.

VSD to Motor – Power wires between the VSD and the motor need only be 1.25 times the motor FLA, since the oil pump and control power are not part of the equation at this point.

Specific Data – Detailed electrical data and considerations are contained in the field connection drawings for the current YT (160.48-PA15) and YK (160.49-PW12) Chillers, which should be used for reference.

Run Power Conduits into VSD Cabinet – A power conduit entrance plate is located on the left top corner of the VSD cabinet. Power conduits must enter the VSD through this entrance plate on the top of the cabinet. There are 7/8" knockouts supplied to act as pilot holes for a conduit punch. The plate is designed to be removed from the VSD while the conduit holes are being punched or cut, to ensure that metal shavings do not drop inside the VSD cabinet.

We have received many requests to route the power wires through the side of the VSD cabinet. This should not be done for two reasons: first, the ground fault CT would need to be moved and the effects of electrical noise from this change cannot be accurately predicted; second, damage to the cabinet and internal components could result from cutting into the side of the VSD cabinet.

Connect Motor Wiring to VSD – A special junction box is supplied on the back of all retrofit VSDs, to facilitate connection of the motor wiring. The removable cover plate on this box is pre-punched for conduit knockouts. The size of the wires to the motor are typically the same as the input wires, and must be based on 1.25 times the motor FLA.

Motor Terminal Box – If the retrofit VSD is replacing a factory mounted liquid cooled starter and if the VSD is not shell mounted, it will be necessary to add a motor terminal box to the motor. The motor terminal box can be ordered on the same sales order form as the retrofit VSD kit. The motor manufacturer must be specified in order to obtain the correct terminal box.

IEEE Filter – The retrofit VSD may contain the IEEE filter accessory that minimizes the electrical “noise” or harmonic distortion that is transmitted back onto the building and/or utility power grid. If the filter is included, it is integrally mounted within the VSD enclosure and requires no additional power or control wiring. It is possible to field install the filter even if it was not originally supplied with the VSD. The procedure will take approximately 2 days. Specific instructions for this procedure are not provided in this guide, but can be obtained from service engineering when needed.

Voltage Snubber Network (DV/DT) – When the VSD is remotely mounted from the motor (i.e.. not shell mounted and directly connected through the factory junction box), it is essential that a voltage snubber (DV/DT) Network be located at the motor terminal box. This delta connected filter network suppresses excessively large and fast rising voltages that would otherwise be applied to the motor due to the combination of long wiring and the use of a PWM inverter. This DV/DT network must be connected directly across the motor windings.

A special delta-wired circuit in a perforated metal enclosure (approximately 7 X 7" / 178 X 178 mm) has been created for this purpose and supplied in all VSD retrofit kits. Mount this accessory at the motor terminal box, and tie the three leads to the three output phases. On some large motor terminal boxes there will be no location which permits the wires supplied to reach all three motor conductors. The instructions with the snubber network (DV/DT) cautions not to lengthen these leads. If necessary, it is acceptable to add 10" of wire, butt-spliced to each of these wires from the Snubber Network.

On all VSD units, this same circuit is located inside the VSD drive enclosure on the red fiberglass vertical support located just to the left of the pole assemblies. When this external device is used, it is not necessary to disconnect the VSD's internal output snubber.

12 Lead Motor Wiring – Many inquiries have been received related to the correct connection of a twelve lead motor. Most of these motors actually have two sets of parallel windings, and therefore have two one's, two two's, etc. VSDs and Solid-State Starters are connected to the motor in the delta configuration, that is 1&6, 2&4, 3&5. The T1 lug will then have two one's and two six's tied to it.

There were a few motors, made several years ago, which were numbered 1 through 12. These motors had the first set of wires marked 1 to 6. Numbering then continued, with the second 1 numbered 7, the second 2 numbered 8, and so on, up to 12. In other words, take the numbers above six, subtract 6 from the number, and re-label as the result.

CONTROL WIRING AND MICROPANEL MODIFICATIONS

MAJOR TASKS

The following major tasks related to controls and control wiring must be accomplished in order to install the retrofit VSD. Control wiring for the purpose of this guide is loosely defined as wiring of less than or equal to 120V.

- Micropanel retrofit or Micropanel upgrade (depending on chiller model and modification level)
- Install the PRV potentiometer and wire it to the control panel
- Connect the control wiring between the micropanel and the VSD

WIRING KITS

Each VSD retrofit kit includes either a "local" or a "remote" wiring kit. Both kits contain the major hardware and software necessary to retrofit or upgrade the micropanel. The only difference between the two kits is in the length of control wiring and conduit supplied. The kit includes all control wiring illustrated in Fig. 5. The wiring length of either kit may be reduced for appearance.

Local wiring kit includes 10 ft (3 m) of all control wire **and flexible conduit** for wiring between the VSD and the chiller micropanel.

Remote wiring kit includes 50 ft (15.3 m) of all control wire, but no conduit is supplied, for wiring between the VSD and the chiller micropanel.

NOTE: *Neither wiring kit includes any power wiring or conduit!*

MICROPANEL RETROFIT & UPGRADE OVERVIEW

Depending on the chiller model and modification level, varying amounts of retrofit and upgrade will be required to enable the chiller controls to interface correctly with the VSD. See Table 5 which details the equipment supplied for each chiller model and modification level. The following paragraphs apply as called for in Table 5.

COMPLETE MICROPANEL CONTROL RETROFIT

YT modification levels A-D require the existing control panel to be removed and replaced with the current micropanel, sensors, and transducers included in the retrofit kit. No one single reference comprehensively includes all information necessary to properly install the retrofit micropanel and retrofit VSD. It will be necessary to refer to the micropanel retrofit installation instructions (form 50.40-N1), the current YT field wiring diagrams (form 160.48-PA15), the YT control panel wiring diagram (form 160.48-PA21 or drawing 035-12636-000), and the VSD schematic in the service instructions form 160.00-M1.

UPGRADE EXISTING CONTROL PANEL

YT modification levels E-H and all YKs will require varying degrees of micropanel upgrades. The first step in upgrading the panel is to remove and discard the existing hinged panel inside the enclosure since it is not used. If the micro-board is part number 031-00940-00X, it must be changed to the newer part number 031-01065-00X. Install the new centrifugal EPROM in the micro-board, and clip the TM/Non-TM jumper.

Next, mount four long hex-steel standoffs, two above, and two below the micro-board. Some panels will already have holes provided. Older panels will require drilling. Be careful not to allow metal shavings to drop inside the enclosure. With the standoffs in place, mount the two rails that hold the Adaptive Capacity Control (ACC) board in a piggy-back orientation with the micro-board. Mount the ACC using hardware provided, and connect the ACC to the micro-board, using the two large ribbon wire jumpers. Also make connections between

J3 on the ACC, and J22 & J24 on the micro-board. When the **condenser water sensor kit** is used, it will be necessary to remove the wire from pin 1 of J22 and reinsert it in pin 1 of the new J22 connector containing the condenser water sensor wires. Install the two-conductor harness between J6 on the ACC and J5 on the power supply board in the control panel.

The final step required for panel upgrade is to replace the front panel keypad with the one including the new VSD keys. On some older micro-panels, the ribbon wire connector that plugs into the keypad, will have a polarity locator molded into the plastic of the connector, and this will prevent plugging together without twisting the cable. In some cases, the polarity locator is on the wrong side of the cable. The cable normally does not require twisting. We suggest you match up the pin #1 (designated on board near connector) with the stripe on the wires, not the connectors.

PRV FEEDBACK POTENTIOMETER

Refer to the drawing supplied with the vane pot kit. Operation is similar to vane pots utilized on older models of variable speed drives, except that the voltage range is less, and exact voltages at the ends of travel are not necessary. This system requires installation of a new vane arm bolt, as with other vane pot designs. When the 90° angled bracket is installed to the compressor housing, you may find that the vane arm interferes with the heads on the bolts holding the bracket. This is especially true on older compressor models. We suggest you use a portable grinder to notch the edges of the arm where it hits the bolts.

Once all hardware is in place, adjust the position of the pot so it is not against either end-stop at either end of the vane arm's travel. The exact position is not important, since the panel will automatically scale the pot's output from 0% to 100%. Route the cable around or under the suction elbow, and then into the control panel where it connects to J4 on the ACC board.

CONNECT CONTROL WIRING CONDUITS BETWEEN MICROPANEL AND VSD

When using the "local" wiring kit, the interface wiring between the panel and VSD is accomplished using the single one inch flexible conduit and wires supplied in the kit. When using the "remote" wiring kit, the interface wiring between the panel and VSD is accomplished using the wire supplied with the kit and 1" (25.4 mm) field supplied conduit. Connect wires "L" and "2" to available terminals at TB6 in the control panel. Wires 16, 53, and 24 connect to the J10 six-pin AMP plug which previously went to the circuits on the hinged panel. The remaining two shielded cables plug into J8 (three conductor + drain) and J9 (four conductor + drain) on the ACC board.

The shield conductors (bare wires) on these two cables should be tied in the panel cabinet to a secure ground. Make sure the paint has been scraped away from this ground screw. Early drawings showed these shield wires going into the J8 and J9 connectors, but this has been found to introduce undesirable electrical noise into the ACC board.

The opposite end of the 1" (25.4 mm) conduit connects to the lower left front corner of the VSD. Terminals are provided for all the above wires and cables. Be certain the VSD Logic cable and Filter Logic cable do not get swapped. The VSD Logic cable is three conductors plus a shield, and the Filter Logic cable, if used, is four conductors (two twisted pair), plus a shield.

PRESSURE TRANSDUCERS

The YT Condenser Pressure Transducer for use with the VSD is now a part number 025-29148-009, which has a lower range of operation to address applications with low entering condenser water. Its range is 4 to 34 PSIA, with a proportional output of 0.5 to 4.5 VDC. The VSD software for YT chillers requires the use of this transducer.

YT and YK chillers with a manufacturing date before 8/1/95 will require the replacement of all existing pressure transducers: Condenser, Evaporator, High Oil Pressure, Low Oil Pressure, and Purge Pressure (YT only). The existing sensors, which may actually have the same part number, may be adversely affected by the RFI generated by the VSD.

AMOT VALVE (THERMOSTATIC VALVE)

YT chillers with modification levels A-G require installation of a thermostatic valve (commonly referred to as the AMOT valve) in the oil circuit. This will require approximately 15' (4.6 m) of ¾" (19 mm) outside diameter 0.049" (1.25 mm) wall thickness steel tubing. Reference the drawing included with the kit for specific connection details.

WIRING ACC TO POWER SUPPLY BOARD IN CONTROL PANEL

The ACC is powered by a +30 VDC unregulated power supply from the control panel's power supply board plug J1. If the J1 plug is already being used by the liquid level control, it is permissible to wire in parallel at this location.

Wires #34 & #61 in the Control Panel on YK chillers are wired differently when a VSD is applied. The vent line solenoid and the oil return solenoid are both tied together and energized by wire #61. Wire #34 now only energizes the liquid line solenoid (gear cooling). The liquid line solenoid energizes when the sump temperature rises above 140°F, and de-energizes when the sump drops below 135°F. Note that newer YKs no longer utilize a vent line solenoid. If the refrigerant side of the chiller is to be opened during the retrofit, it may be advisable to remove the vent line solenoid. Consult with service engineering regarding this modification.

BOOSTER PUMP WIRING

If either of the standard Grundfos booster pumps recommended in the piping section of this guide is used, it can be wired directly to the micropanel. The conduit should enter through a separate knockout and connect to terminal board TB6 terminals L, 2, and ground. The wire going to terminal L should pass through an open set of contacts of a field supplied relay. One of the following two relays are recommended: YORK P/N: 024-23962-000 or Potter & Brumfield P/N: KUP-5A55-120 (Grainger P/N: 2XC49). Be certain to place a YORK suppressor (P/N: 031-00808-000) across the pilot relay coil. The relay can be mounted directly in the micropanel. The coil of the relay should be energized in parallel with the oil pump contactor (factory wiring terminals 2 & 29 in the micropanel).

SPECIAL WIRING TOOLS

The control connectors on the microboards and panels utilize several different types of AMP® connectors that may require specialized tools. These tools facilitate adding or extracting conductors and pins. The tools in the following table should be available to anyone performing a retrofit VSD installation. These tools are distributed under the AMP brand name and can be obtained locally at an electronic supply house.

DESCRIPTION	MANUFACTURER	PART NO.
Extraction Tool for Mini-Universal MATE-N-LOK Pins	AMP	189727-1
Extraction tool for MATE-N-LOK Pins	AMP	1-305183-2
Insertion Tool for Mass Termination Assembly Connectors	AMP	59803-1
Crimping Tool	Various	Not Applicable

EXTRA CONNECTION PINS

Although they may not always be required, it is recommended that a few (approximately 6 of each size) connector pins, of the type used on the VSD and Micropanel, be on hand during installation in case they are required. The pins in the following table are available from the Parts Distribution Center.

DESCRIPTION	YORK PART NUMBER
Small Size Pins (Mini-Universal MATE-N-LOK)	025-28386-000
Large Size Pins (MATE-N-LOK)	025-19674-000

Refer to the section titled Start-Up Preparations in the Service Instructions (Form 160.00-M1) for further information and tasks.

TABLE 5 – VSD KIT

DESCRIPTION	YT REV A-D	YT REV E	YT REV F-H	YK REV A-D
CONTROL PANEL	✓			
SYSTEM WIRING KIT	✓			
ACC		✓	✓	✓
ACC INSTALLATION KIT		✓	✓	✓
MICRO BOARD		✓		
KEYPAD		✓	✓	✓
ACC EPROM		✓	✓	✓
PANEL EPROM		✓	✓	✓
PRV POT	✓	✓	✓	✓
VSD WIRING KIT (LOCAL OR REMOTE)[1]	✓	✓	✓	✓
VSD PIPING KIT (LOCAL OR REMOTE)[2]	✓	✓	✓	✓
SNUBBER KIT	✓	✓	✓	✓
EVAP TRANSDUCER	✓	✓	✓	✓
COND TRANSDUCER	✓	✓	✓	✓
HIGH OIL PRESS TRANSDUCER	✓	✓	✓	✓
LOW OIL PRESS TRANSDUCER	✓	✓	✓	
PURGE PRESS TRANSDUCER	✓	✓	✓	
CHILLED WATER TEMP SENSOR	✓			
HOT/HDT TEMP SENSOR	✓			
TEMP WELL	✓			
OIL RESERVOIR TRANSDUCER				✓
INHIBITOR	✓	✓	✓	✓

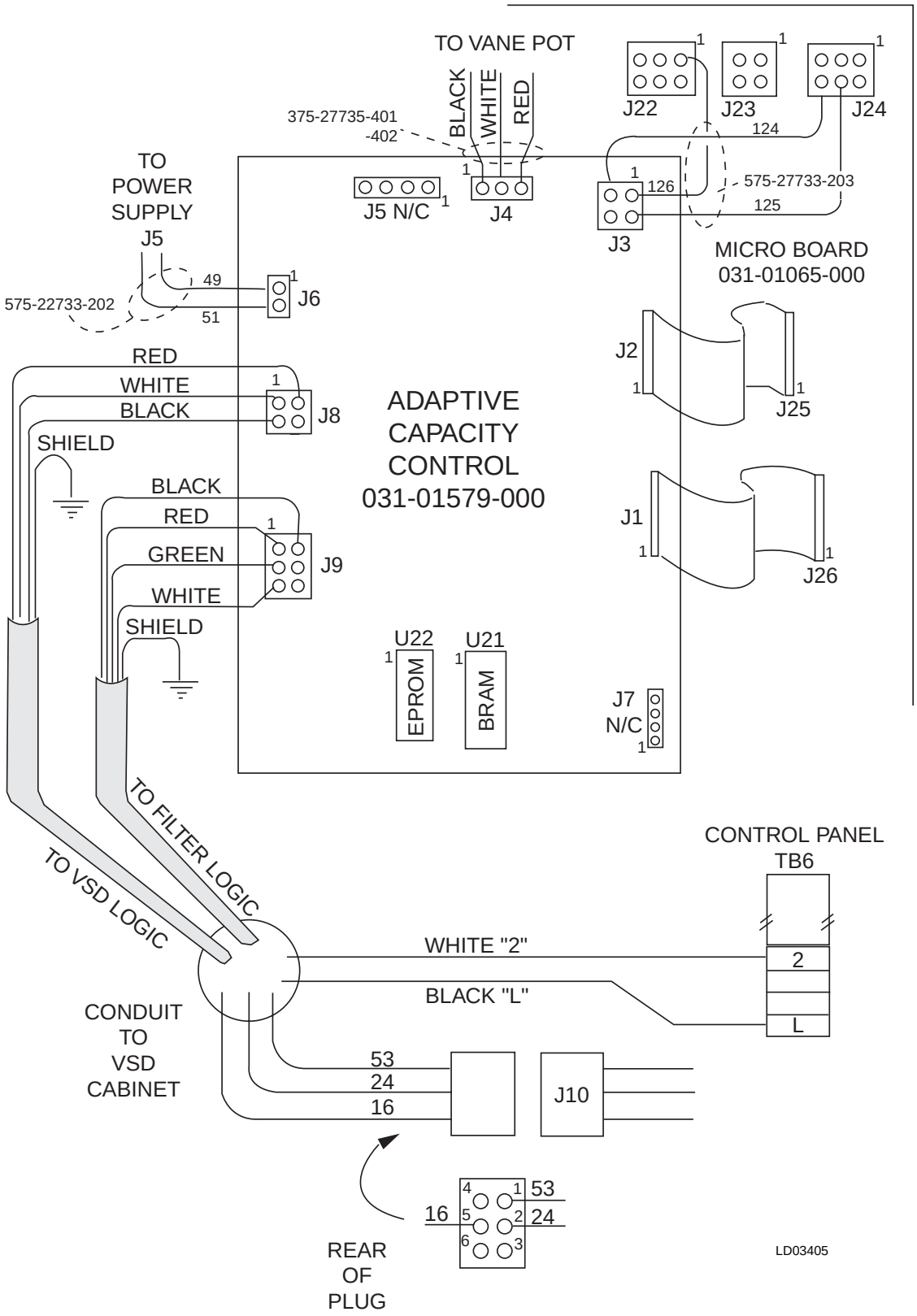


FIG. 5 – ADAPTIVE CAPACITY CONTROL BOARD

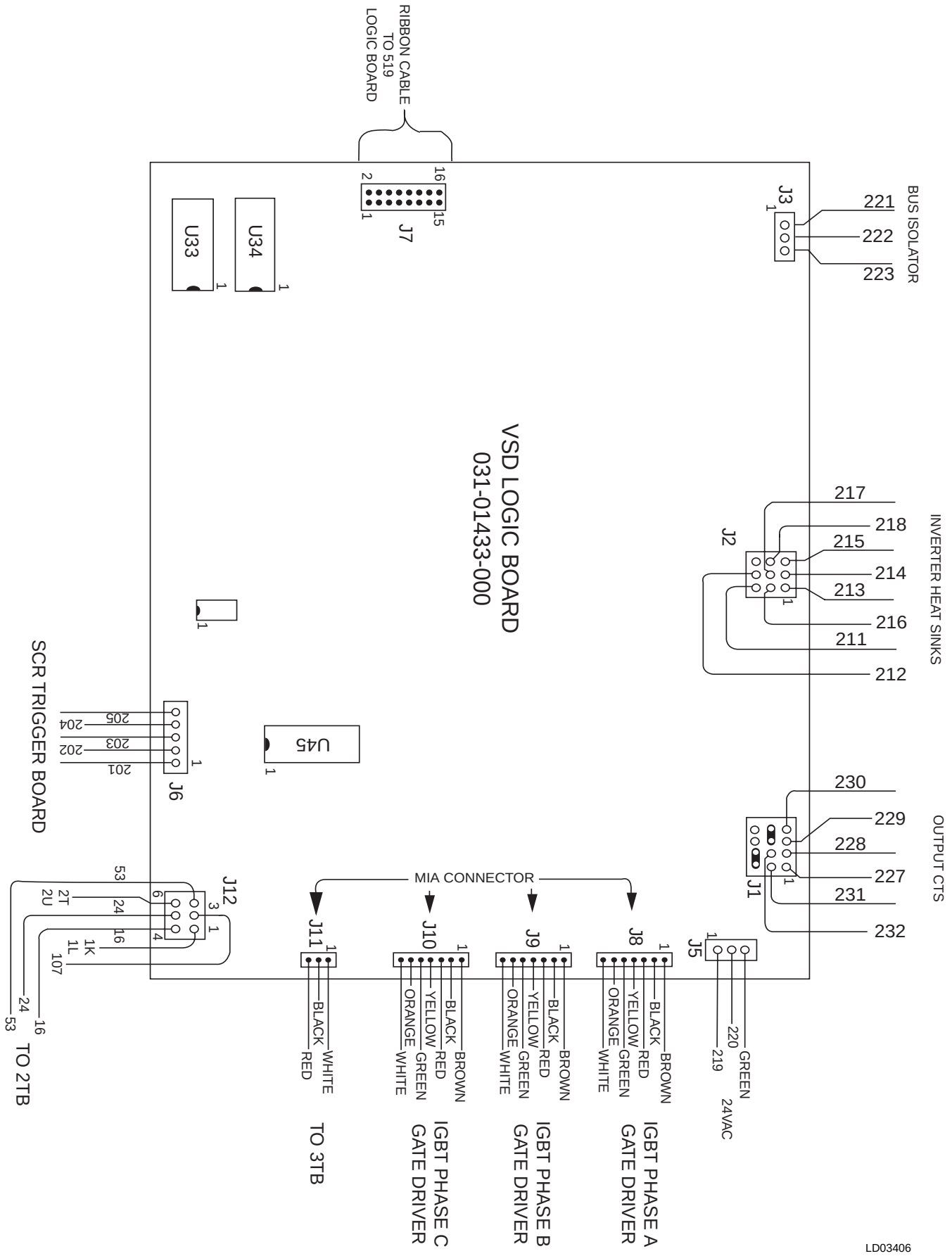


FIG. 6 – VSD LOGIC BOARD

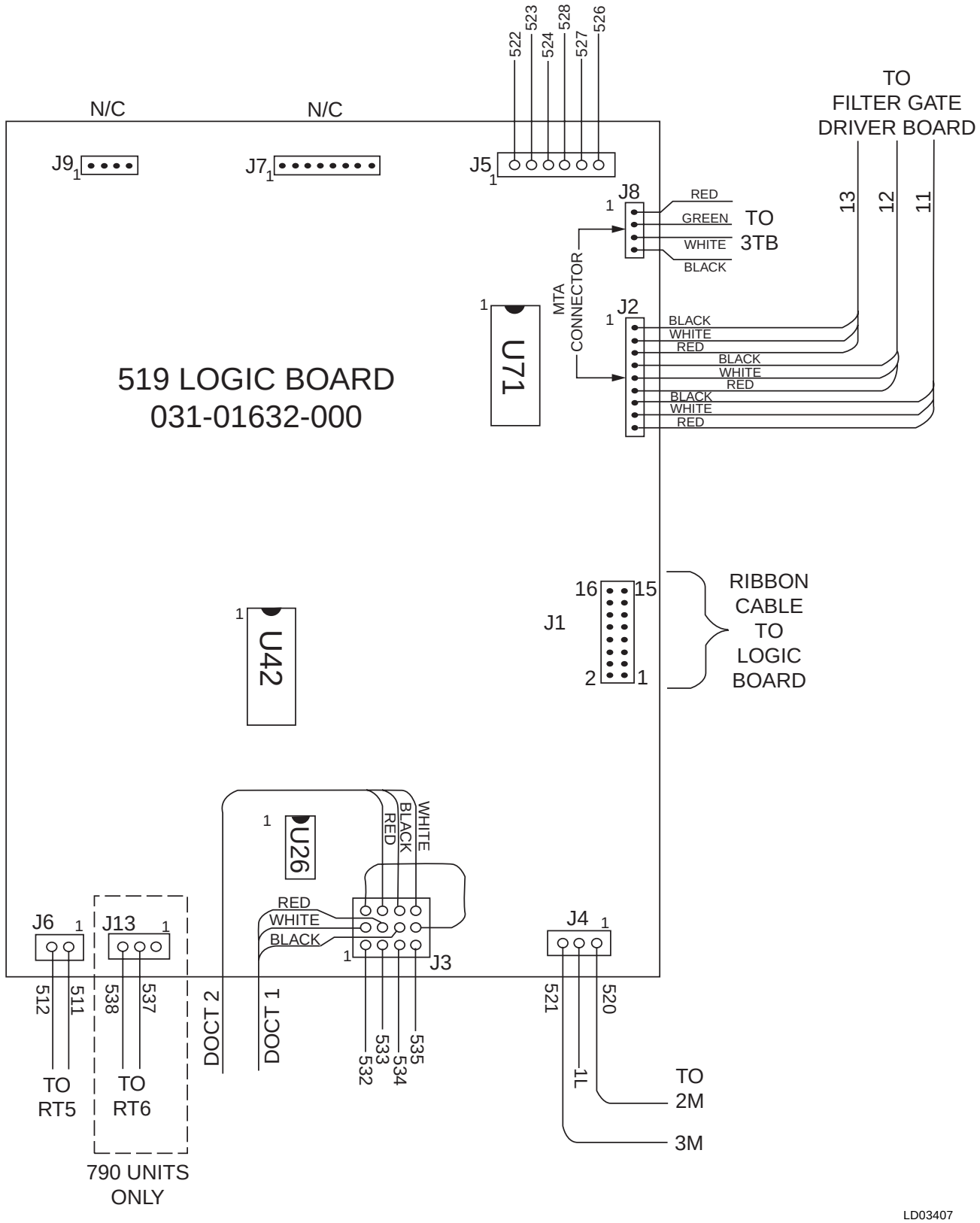


FIG. 7 – IEEE-519 FILTER LOGIC BOARD

PROTECTION OF THE TUBE

Any injury to the tube resulting from improper fittings or improper application allows the material in the hose to reach the reinforcing yarn or fabric. In such instances, the water, air or other material being carried by the hose may travel many feet through the wall of the hose until it finds an opportunity to escape through the cover. In this way, a hose failure that appears at some distance from the coupling may be traced directly to the coupling. To avoid such failures, the user should observe the following:

1. Use fitting shanks with radius at end to prevent cutting the tube. Remove all sharp edges from fittings before application.
2. Do NOT use fittings that require puncturing the tube with screws through the wall of the hose.
3. Do NOT remove portion of the tube to insert coupling. If this is necessary, then coupling and hose are improperly combined.
4. Do NOT use oversize shank. In general, observe the following limitations:

PROTECTION OF THE COVER

Avoid removing any part of the cover to apply couplings. This exposes the carcass to deterioration and develops a localized flexing point at the shoulder of the reduced diameter section.

FLEXING

Where extreme flexing occurs at the fitting, or the hose is required to withstand considerable amount of jerking, clamps should extend back on the hose at least as far as the end of the shank. This gives the hose better support and helps eliminate the extreme stresses that might otherwise occur when hose is bent around long shanks.

LUBRICATION

When inserting a coupling shank in a hose, the use of a temporary lubricant is advisable. Rubber cement is recommended, although a thick soap solution is an acceptable substitute. Do NOT use oil, grease or paint as a lubricant when applying couplings.

HIGH-PRESSURE APPLICATIONS

When coupling hose for high-pressure service, such as Jetting Hose, it is suggested that the clamps be drawn up a second time after a rest period of from 4 to 24 hours. This will overcome the tendency of the clamping pressure to relieve itself.

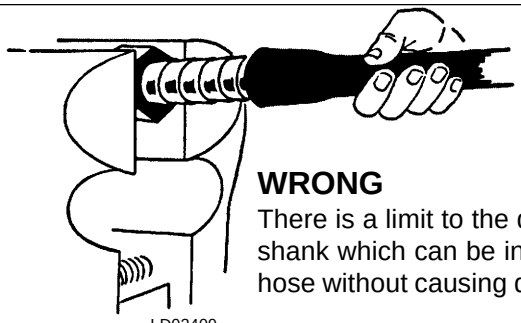
MACHINE COUPLINGS

Special machines are required to apply one-time couplings. Such couplings are usually lower in cost due to simplicity of design and volume production. Such couplings also have greater holding power because they are specifically designed for the hose, and because the machines assure firm attachment to the hose.

FITTING INSTALLATION PROCEDURES

It is important to remove from fittings all sharp edges that might injure the tube in any way.

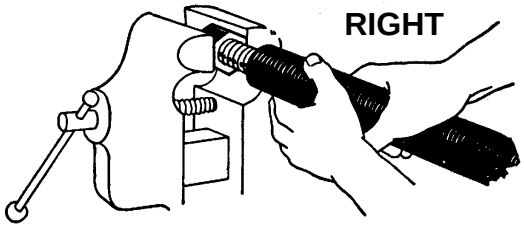
LD03408



WRONG

There is a limit to the diameter of shank which can be inserted in a hose without causing damage.

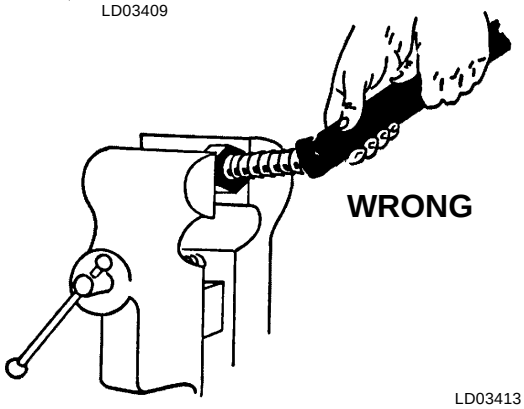
LD03409



RIGHT

LD03412

After lubricating the fitting shank and the hose I.D., push hose on to shank firmly and on an exact horizontal plane so the end of the fitting has no chance to fracture tube.

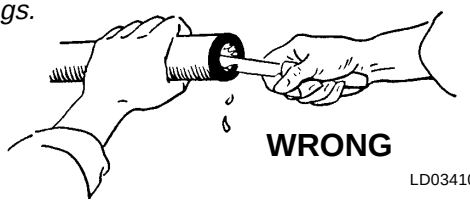


WRONG

LD03413

A temporary lubricant to facilitate the insertion of the coupling shank is advised. Rubber cement is recommended, but a thick soap solution is an acceptable substitute. Neither has any harmful effects on the tube.

Never use oil, grease or paint as a lubricant when applying couplings.



WRONG

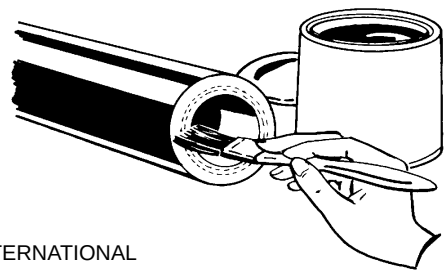
LD03410

It should never be necessary to remove any portion of the tube to insert the coupling shank.

Such a requirement indicates an improper combination of hose and coupling and, as explained previously, any damage to the tube will result in premature failure.

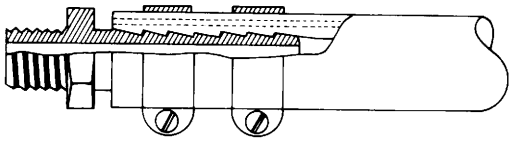
FITTING COUPLINGS

A good practice, after the end of the hose is trimmed square preparatory to fitting a coupling, is to seal off the cut end with rubber cement. This will prevent water, oil, etc. from entering the hose reinforcement.



LD03411

When securing couplings to the hose by clips or clamps, make sure that they are located fully over the coupling shank and in a position where they will provide maximum support for the hose. This is especially important in cases where the hose is likely to be subjected to flexing near the coupling.



LD03414

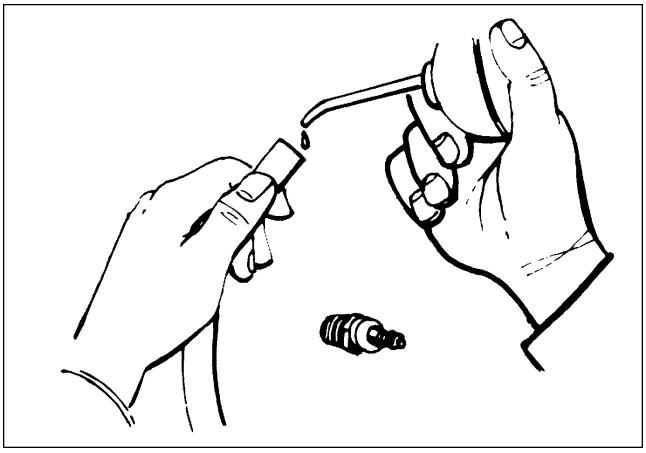
In all cases where a hose is to be coupled to a fixed delivery point, it should be allowed to assume its natural lay or position, to avoid undue stress which can lead to premature failure.

This procedure is even more important where abrasive substances are being conveyed, and it is particularly advisable for shot blast hose to be fitted with a semi-flexible support (such as a coil-spring protector) at the intake point.

“PUSH-ON” COUPLING INSTALLATION

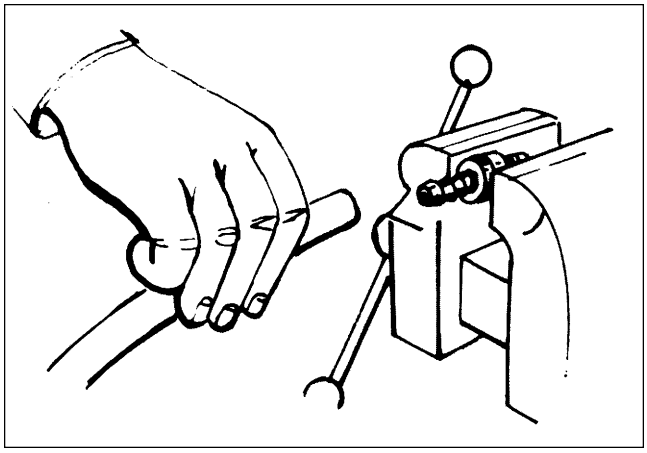
ASSEMBLY

Cut the hose to the length required. Be sure the hose end is cut square. For maximum assembly ease, lubricate the inside of the hose and the outside of the nipple with rubber cement or with a thick, liquid soap solution. Never use oil, grease or paint.



LD03427

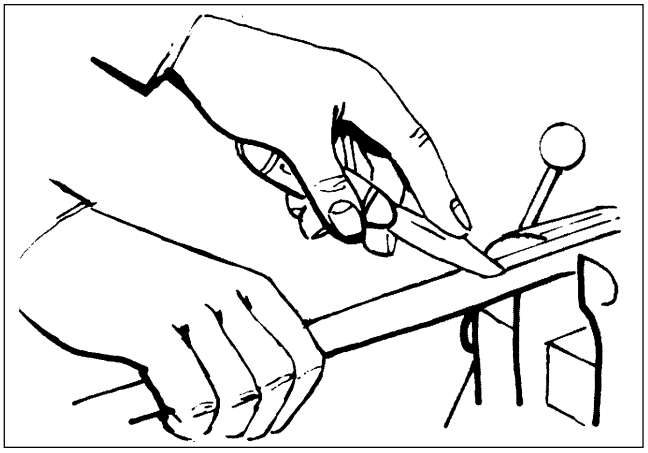
Push the hose over the stem until it seats against the bottom of the protective cap. Be sure the cap is the correct size for hose O.D.



LD03428

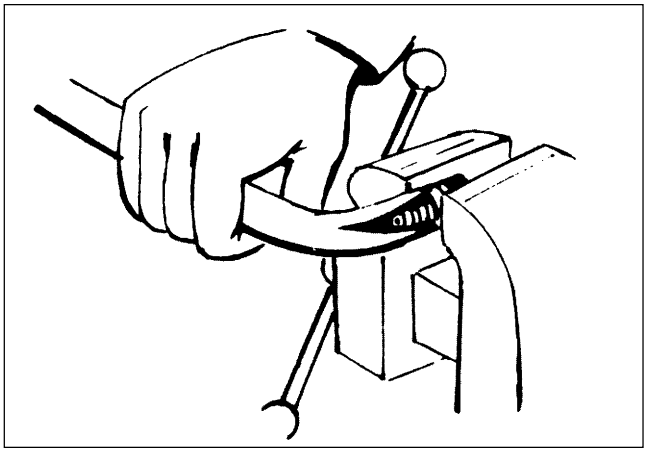
DISASSEMBLY

Slit hose lengthwise from the protective cap to the end of the stem with a sharp knife.



LD03429

Bend the hose to the side. A sharp jerk will then snap the hose from the coupling.

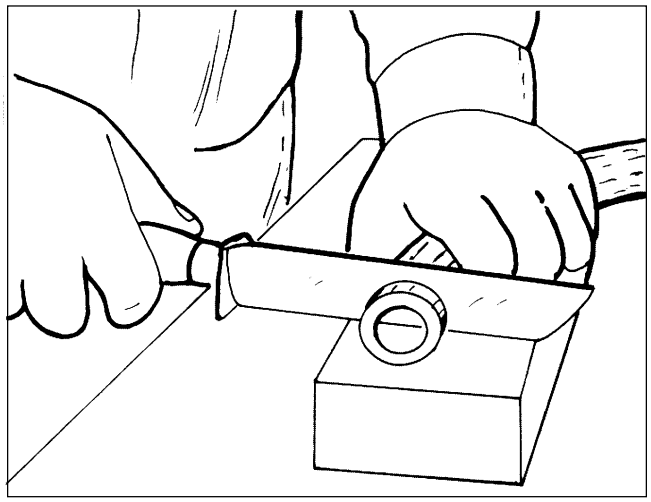


LD03430

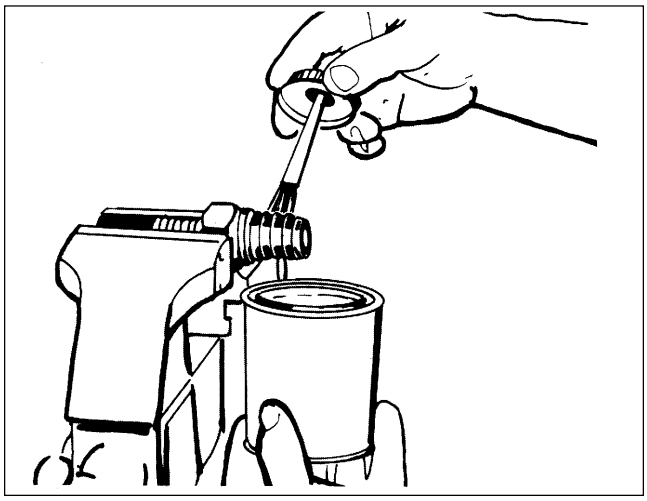
CLAMP AND BAND-TYPE FITTING INSTALLATION

1. Cut hose end square so it will seat snugly against the coupling body. For fabric-reinforced hose, use a sharp knife and support hose on a piece of two-by-four or other cutting block. Lubricate the knife with water for easier cutting. To seal exposed fabric (after drying) against the entrance of water, chemicals, etc. apply one or two coats of rubber cement or shellac to the hose end, and let dry.

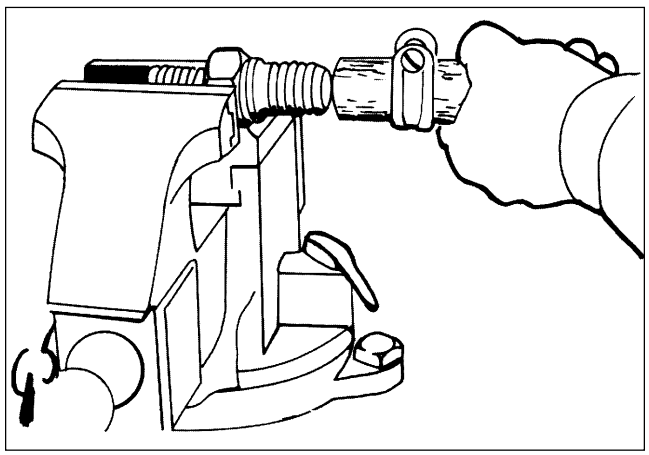
2. Clamp the coupling in a vise with the shank projecting. Mark the length of coupling shank on the outside of hose to provide a reference point for the correct positioning of clamps. To reduce friction when pushing hose over shank, apply a lubricant to the shank or to the hose tube. Suitable lubricants include: Pre-gum cement (for hose lined with non-oil-resistant rubber); Neoprene cement (for oil and gasoline hose); soapy water; shellac solution; or glycerine. Do NOT use oil. Assemble the hose on the coupling immediately after applying the lubricant.



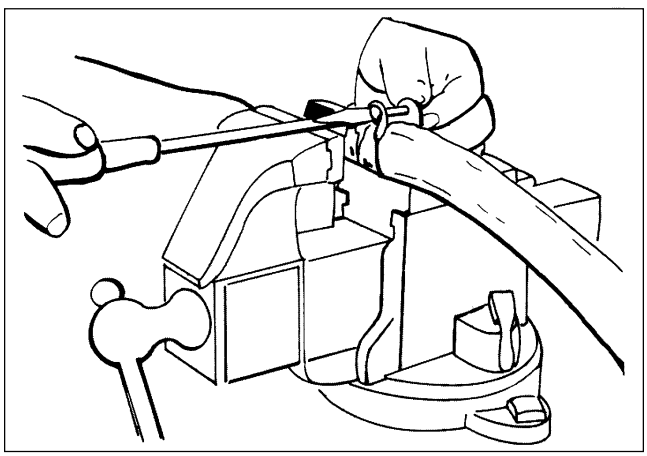
LD03431



LD03432



LD03433



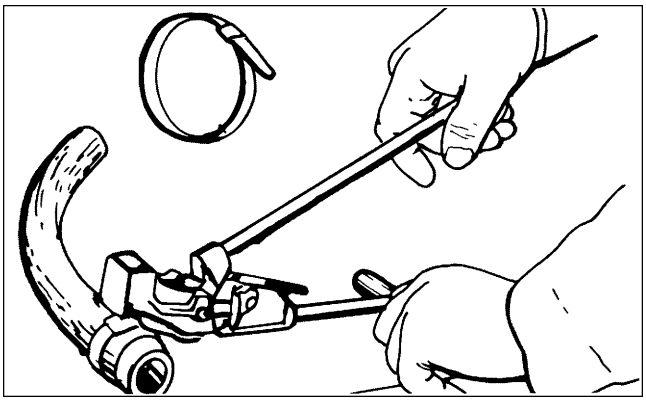
LD03434

3. Slip the clamp, such as single-band type shown, over hose end (unless it is a “come-apart” type that can be installed later). For short-shank couplings, use a single clamp; for a long-shank, two clamps. Push the hose over the coupling shank as far as it will go. If the hose is too small to be forced into position with a straight push, never ream out the inside to enlarge the tube or use a wrench or other tool to force the hose on coupling. Instead, select another coupling with a smaller shank, or reduce the oversize shank with a file or by turning it down on a lathe. Avoid excessive thinning that can weaken the shank. Never trim rubber from the hose cover so an undersize clamp can be used.

4. Slip the clamp(s) toward the coupling until they are positioned over the shank. When one clamp is used, it should be located 1/2" from the end of the shank. When two clamps are used the second should be located 1/2" from the end of the hose. Tighten each clamp screw enough to compress hose snugly around the shank, but leave enough screw capacity for later tightening. If clamp ends come together with only moderate tightening of the screw, the clamp is too large.

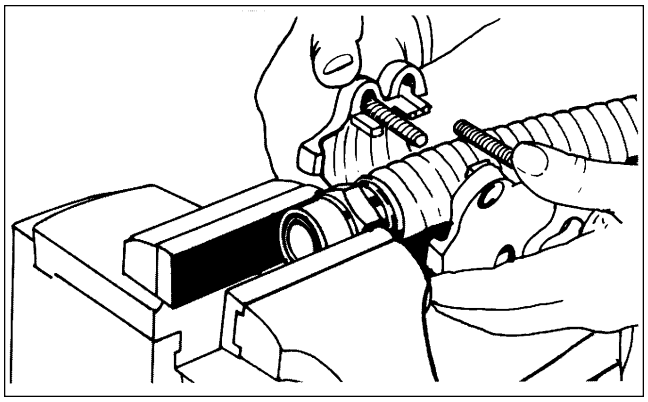
CLAMP AND BAND-TYPE FITTING INSTALLATION

(con't)



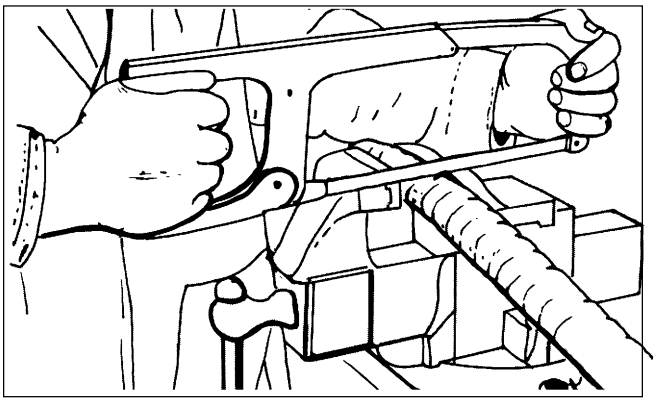
LD03435

5. Installing Punch-Lok clamp. Use one large clamp on a short-shank coupling; two on a long shank. If a preformed clamp is employed, slip it over hose before assembling the hose to the coupling (an open-end Punch-Lok clamp can be placed around hose at any time). Select a clamp the next size larger than the hose outside diameter. Generally, it is more convenient to remove the coupling from the vise and lay the hose on bench for tensioning with the locking tool, as illustrated.



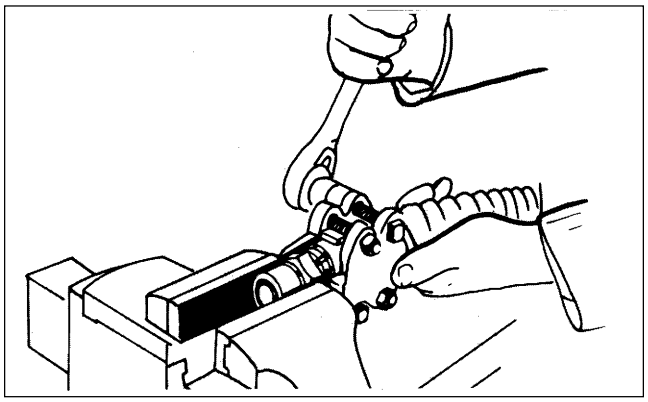
LD03437

7. Clamp the coupling in vise, lubricate the shank (see step 2), and push the hose over shank before installing the clamp. Assemble a high-pressure clamp around the portion of the hose over the coupling shank. Be sure that the fingers engage the collar properly. A four-bolt clamp is shown, installation of a two-bolt clamp is the same. After assembling the clamp halves so their fingers engage groove in stem, place the clamp sections in the vise for preliminary tightening of the bolts. Threads of the coupling should be protected by a cardboard or plastic sleeve to prevent damage during installation.



LD03436

6. Wire-reinforced high-pressure hose can be clamped in a vise and cut with a hack saw. If the hose has a spiral wire reinforcement, the wire can be cut with pliers and the rubber cut with a knife. When hacksawing, use a blade having fairly fine teeth and take care to cut the hose end square. It is not necessary to lubricate the saw, though water can be used. Be sure the fabric is dry before sealing the cut with rubber cement or shellac.



LD03438

8. Remove the clamped assembly from the vise and place the stem hex-nut section in the vise. Finish tightening the clamp with a wrench. Turn the nuts until the clamp halves are pulled tight around hose, but leave a little space between clamp ears for later take-up.

9. (Not Illustrated). Attaching static wire in butane-propane hose and gasoline hose, when coupled with shank type couplings and clamps.

Good electrical contact must be made between the static wire and the coupling shank – not between the wire and the clamp.

A. For braided copper static wire: Cut the hose end square. Seal with shellac. Push one leg of a brass or copper staple into the center of each static braid for a distance of 1/4" to 3/8". The other leg should be placed in the bore of the hose so it will contact the coupling shank.

B. For solid or stranded steel static wire: Trim 1/2" from the end of the hose, but do not cut the wire. Bend the projecting wire into the hose tube, where it will contact the coupling shank. Seal the hose end with shellac, but don't shellac the wire.

C. When using Type 66, Type 68 or Permalock "D" or "F" couplings, turn the static wire to the outside of the hose to contact the shell or ferrule.

To be effective, a static wire must be connected to the couplings at both ends of the hose section. When there is more than one static conductor in a hose, each should be connected to couplings.

Well-made hose couplings generally are ready to install when unpacked. However, it is good practice to examine each one for sharp edges, points, and other irregularities that might damage the hose. Remove any roughness by filling or grinding.

To maintain couplings in good condition, do not subject them to damaging bumps or other abuse in handling. Keep in mind that a coupled hose should be positioned so it is not flexed severely at couplings.

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