CONSTRUCTION REPORT FREE PRODUCT RECOVERY SYSTEM ENHANCEMENTS

HONEYWELL INDUSTRIAL COMPLEX SOUTH BEND, INDIANA

PREPARED BY:

HARDING ESE, A MACTEC COMPANY
46850 MAGELLAN DRIVE, SUITE 190
NOVI, MICHIGAN 48377

PROJECT NUMBER: 52040

JUNE 2001

CONSTRUCTION REPORT
NAPHTHA RECOVERY SYSTEM ENHANCEMENT

HONEYWELL INDUSTRIAL COMPLEX
SOUTH BEND, INDIANA

IDEM SITE NO. 6980601

PREPARED FOR:

HONEYWELL INTERNATIONAL INC.
3520 WESTMOOR STREET
SOUTH BEND, INDIANA 46628

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PROJECT NUMBER 52040

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1. INTRODUCTION

This report documents enhancements to the free product recovery well systems at the Honeywell Industrial Complex, South Bend, Indiana. The report describes the history of the existing free product recovery systems, project goals and objectives, construction details, and an evaluation of the system's effectiveness after completing the enhancements.

1.1 REGULATORY FRAMEWORK

Honeywell International, Inc. (Honeywell) has entered into a Voluntary Remediation Agreement with the Indiana Department of Environmental Management (IDEM) under the Voluntary Remediation Program (VRP). In April 2001, Honeywell received approval of the facility-wide Remediation Work Plan from IDEM. The Remediation Work Plan established and prioritized remedies that will be implemented to address soils and groundwater impacts at areas identified during previous investigations at the facility.

One of the objectives stated in the plan is to "recover the remaining areas of free product where technically practicable". To achieve this objective, one of the first work tasks stated in the plan is the enhancement of the existing free product recovery systems.

1.2 BACKGROUND INFORMATION

The first environmental impact at the Complex was documented in 1978 when naphtha was found seeping through the floor of the Plant 2 basement. An investigation revealed that the naphtha was present as free product floating on the groundwater table. Recovery well system E3, consisting of a pumping well and a product collection well, was installed adjacent to the Plant 2 basement to remove the naphtha from the water table. Based upon the results of further investigation, four additional naphtha recovery well systems were installed (RWB6, RWB16, RWB21, and RWB22). Each of these systems consists of a pumping well and a product collection well. In addition to providing a cone of depression for the collection of free product, the pumping wells also served to contain impacted groundwater on-site. The locations of the recovery systems, designated E3, RWB6, RWB16, RWB21, and RWB22, are shown on Figure 1.

Initially, free product recovery from all of the wells was substantial. In the early 1990's, product recovery became negligible. Water level data obtained as part of on-going groundwater monitoring efforts indicated that three naphtha wells (wells E3, RWB16, and RWB22) provided sufficient groundwater containment. As a result, wells E3, RWB16, and RWB22 continued to operate as groundwater recovery wells and wells RWB6 and RWB-21 were taken off-line.

In 1996 and 1997, twelve additional monitoring wells (designated MW-1 through MW-12) were installed to refine the groundwater monitoring network (see Figure 1). Data obtained from these wells confirmed that the free product recovery well systems had removed the majority of the free product present on the water table. At the time of installation, monitoring well MW-6, located northeast of Plant 6/16 and near Dock 10 (see Figure 1), was the only well to contain a significant quantity of free product. A 1- to 1.5-foot-thick layer of free product was measured in monitoring well MW-6. Due to the presence of free product in well MW-6, a dual-well recovery system was installed adjacent to MW-6 to recover the product[1]. This system was installed and brought on-line in January 1999.

During quarterly groundwater monitoring activities, free product was observed in two other locations, at monitoring well MW-8 (located in the former Plant 1 Metal Stamping Area) and at recovery well E3. In Spring 2000, the extent of free product in the Former Metal Stamping Area was delineated[2]. Honeywell then contracted Harding ESE, a MACTEC Company (Harding ESE) to design and implement appropriate measures to actively recovery free product from these two areas.

2. PROJECT GOALS

The goal of the project was to recover free product in the areas near monitoring well MW-8 and well E3. These goals were achieved by the:

- Installation of a groundwater extraction well and product recovery well adjacent to MW-8; and

- Installation of a product recovery system in the E3 product recovery well.

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[1] Construction Report, Naphtha Recovery System Enhancement, AlliedSignal Industrial Complex, South Bend, Indiana, Harding Lawson Associates, Inc., June 1999.

[2] Supplemental Investigation Report – Voluntary Site Investigation, Honeywell Industrial Complex, South Bend, Indiana, Harding Lawson Associates, April 2000

The wells installed near MW-8 were designated EW-4 (groundwater extraction well) and EW-4P (product recovery well). The well locations are shown on Figure 1 as EW-4. Construction details and an evaluation of the recovery system's effectiveness after completing the enhancements are discussed below.

3. DUAL-WELL RECOVERY SYSTEM ADJACENT TO MW-8

Figure 2 details extraction well locations and newly installed power supply to the recovery well system adjacent to MW-8. Figure 3 presents a layout of the newly installed dual-well recovery system. System construction details are described below.

3.1 PERMIT MODIFICATION

Prior to mobilizing to the site, a requested was submitted to the City of South Bend to add proposed well EW-4 to the Industrial Waste Water Permit No. SB004 : 4. The City of South Bend approved the addition provided the total system flow remained in compliance with the established water budget of 0.154 million gallons per day. Harding ESE evaluated historical pumping rates of existing wells and concluded that with additional well operation, the total system discharge will remain in compliance with the permit.

3.2 EXTRACTION WELL INSTALLATION

Stearns Drilling Company of Dutton, Michigan performed well construction and development activities. This work was performed during period from February 18, through March 2, 2001. Initially, a pilot boring was performed with 4.25-inch hollow-stemmed augers at the groundwater extraction well location (EW-4) to assess geology below the water table. Soil samples were collected with a split-spoon sampler every 5 feet starting 14 feet below grade (fbg). Soil cuttings and split-spoon samples were visually classified by a Harding ESE geologist. After subsurface geology had been characterized, 12.25-inch hollow stem augers were advanced for recovery well construction. The borehole for the groundwater extraction well was advanced to the top of a silt layer, which was encountered at a depth of 52 fbg. The borehole for the product recovery well was advanced approximately 7 feet below the groundwater table (a depth of 23 fbg). Boring logs are presented in Appendix A.

Upon reaching the targeted depth, the wells were installed inside the augers. The well risers and screens are 6-inches in diameter. The well screens were constructed of continuous-wound, 0.010-inch slot, stainless steel. The riser pipes were constructed of welded carbon steel. Sand filter pack, bentonite seal and grout were placed as the augers were retracted. The filter pack was placed to a minimum depth 2 feet above the top of the screen, then an additional 1-foot thick finer sand was placed, and the remainder of the borehole was filled with bentonite. Well construction, pump and control details are provided in Appendix B.

After allowing the grout to cure for a minimum of 12 hours, the well was developed by air jetting and surging. The jetting tool was placed in the bottom of the well screen and pulled slowly upward. After completing a jetting pass through the entire screen section, the material loosened from the formation by the jetting process was removed by air-lift. This process will be repeated until the well water appeared visually free of fine sediments and no increase in yield occurred over the last hour of well development.

All downhole drilling equipment was decontaminated using a steam cleaner. The well casing and screen were decontaminated using a steam cleaner prior to well construction. Soil cuttings were contained in DOT-approved 55-gallon steel drums. A composite sample was collected from drummed soils and submitted to TriMatrix Laboratories for waste characterization. Upon receipt of the laboratory data, Honeywell will arrange subsequent disposal of drummed soils.

3.3 PUMP AND CONTROLS INSTALLATION

Equipment, instrumentation, and controls for the groundwater extraction well and product recovery well are described below. Construction activities associated with power supply and system setup activities were performed during the period from March 19, through March 30, 2001. Equipment cut sheets and specifications are provided in Appendix C (Groundwater Extraction) and Appendix D (Product Recovery).

3.3.1 Groundwater Extraction Well Pump and Controls

Harding ESE electrical contractor, Trans Tech of South Bend, Indiana, provided power to the EW-4 area by connecting to the existing electrical power source located at the south side of Building 501. A 200-amp service of 460 volt, 3-phase power was provided via overhead power lines. Also, a new power line was established to existing groundwater extraction wells EW-1 and EW-2 along Bendix Drive. Line

disconnects and pump starters for the Plant 1 extraction wells are located on an aboveground panel adjacent to EW-4/4P. The new power feeds to EW-1 and EW-2 were constructed below grade. Lines were run in separate ½" electrical supply conduits to each of the wells. Figure 2 presents the electrical supply layout for the Plant 1 extraction wells.

A Grundfos Model 40S submersible pump was installed in EW-4. The submersible pump was equipped with a 1.5 horsepower (h.p.), 460-volt, 3-phase Franklin motor. Anticipated flow rates were between 20 to 40 gallons per minute. Similar submersible pumps are used at EW-1 and EW-2. A pump saver (Integra Model 101A – Motor Minder) was installed in the above ground control panel to protect the pump from dry run, power surges, and overloads.

The submersible pump was installed with the intake of the pump just above the top of the screen. The submersible pump was connected to 2-inch diameter drop pipe. The drop pipe was connected to a pitless adapter (Merril Model MHB 300). A pressure gauge, sample port, throttling butterfly valve, and flow totalizer (Sensus Type S, 1" diameter) were installed on the galvanized steel above-grade discharge line. The flow of water to the sample port is controlled by a ball valve located on the discharge line. The remainder of the discharge line was placed below grade. The 2-inch ID, galvanized steel pipe was transitioned to 2-inch ID high-density polyethylene below grade. The discharge line connects to former process/sanitary sewer system and is discharged under amended Industrial Waste Water Permit.

Groundwater extraction well EW-4 was brought on-line on April 4, 2001. The pumping rate is currently set at 45 gallons per minute. The resulting draw down in the shallow aquifer adjacent to EW-4 is between 1.5 to 2 feet. This is the target drawdown to induce free product pooling at EW-4P location.

3.3.2 Product Recovery Well Pump and Controls

A pneumatic selective oil skimmer pump (Clean Environment GNE/SOS-4 Genie Controllerless System) was installed in EW-4P. A similar system is operating at the RWB23 location. This is a pneumatic pumping system that uses a pump with a hydrophobic screen to repel water but allow product to enter the pump. The system consists of a compressor trailer, a pneumatically-operated skimming pump, air supply lines, a 560-gallon steel aboveground product storage tank (AST), product lines, a pneumatically-operated tank-full shutoff switch (TFSO), and an air supply/control panel. System layout is presented on Figure 3.

Due to remote location of this system, supplied air was not available from the facility. A utility trailer was set up to house a compressor and pneumatic control box. The compressor trailer was fabricated off-site by Trans Tech. The trailer was equipped to house control box (GNE-HW Control Box) and an Ingersoll Rand 5 h.p. air compressor. This control box regulates supplied air to the pneumatic skimming pump, and the pneumatic TFSO. The use of pneumatic equipment and controls eliminates the need for NEC Classified electrical controls and power for the product recovery system. The control box contains single-stage air filters and regulators for two air lines that extend to the pump and the TFSO. The control box has an indicator light that signals when the tank is full, and a reset button. The "tank full" condition must be reset manually at the control box. The trailer also houses a 'dry' transformer to drop the phase of power for operation of the compressor, heater unit, and lights (see Figure 3 for layout).

The skimming pump has been suspended in the well at the approximate depth of the free product layer. The skimmer portion "floats" with a vertical float range of 23 inches, meaning that as the water table and product surface fluctuates, the skimmer moves with the surface of the product. The skimming pump requires compressed air supplied at a minimum of 40 psi, and cycles at a rate that is adjustable, based on site conditions. Product is discharged from the pump into the AST. When the tank is full, the TFSO will shut off the compressed air supply to the pump, and must be reset manually at the control box. Should the TFSO malfunction, and product continues to be pumped to a full tank, a product return hose sends the product back to the well. Product will be removed from the AST when necessary and disposed in accordance with State and Federal regulations.

The AST is located immediately south of the compressor trailer. The AST has secondary containment, as required by the Indiana Fire Marshall. The compressor trailer and AST are grounded with rods. An explosion proof, battery-operated alarm is located on the tank to detect any fluids released into the interstitial space between the storage tank, and the secondary containment. If fluids are introduced into the secondary containment, a float located in the tank will set off a visual and audible alarm, indicating a release into the secondary containment. In compliance with facilities requirements, operation and maintenance contractor will inspect this system weekly.

4. E3 FREE PRODUCT RECOVERY UPGRADE

At the well E3 location, the 24-inch crock well, which was installed in 1978, had been previously converted to a groundwater extraction well. Harding ESE retrofitted this crock well with a product recovery skimming system. The system upgrade was performed during the week of October 13, 2000.

The system consisted of the same components as detailed in Section 3.2.2. Figure 4 illustrates the layout of the product recovery system relative to Plant 2. A cross sectional detail of system configuration and system control layout are presented on Figure 5 and Figure 6, respectively. This compressed air for this system was supplied by the facility. Manufacturer information on system components is presented in Appendix D.

5. SYSTEM EFFECTIVENESS

The effectiveness of the system in containing groundwater and recovering free product is discussed below.

5.1 CONTAINMENT OF IMPACTED GROUNDWATER

Figure 7 is a potentiometric map of the water table after system enhancement where the existing and newly installed naphtha wells and existing VOC recovery system wells. During site visit for groundwater level measurements, EW-3 was off-line for repair. The flow map indicates that the groundwater extraction wells are effectively containing on-site groundwater. As a result, influence from extraction well EW-3 is not represented on this figure.

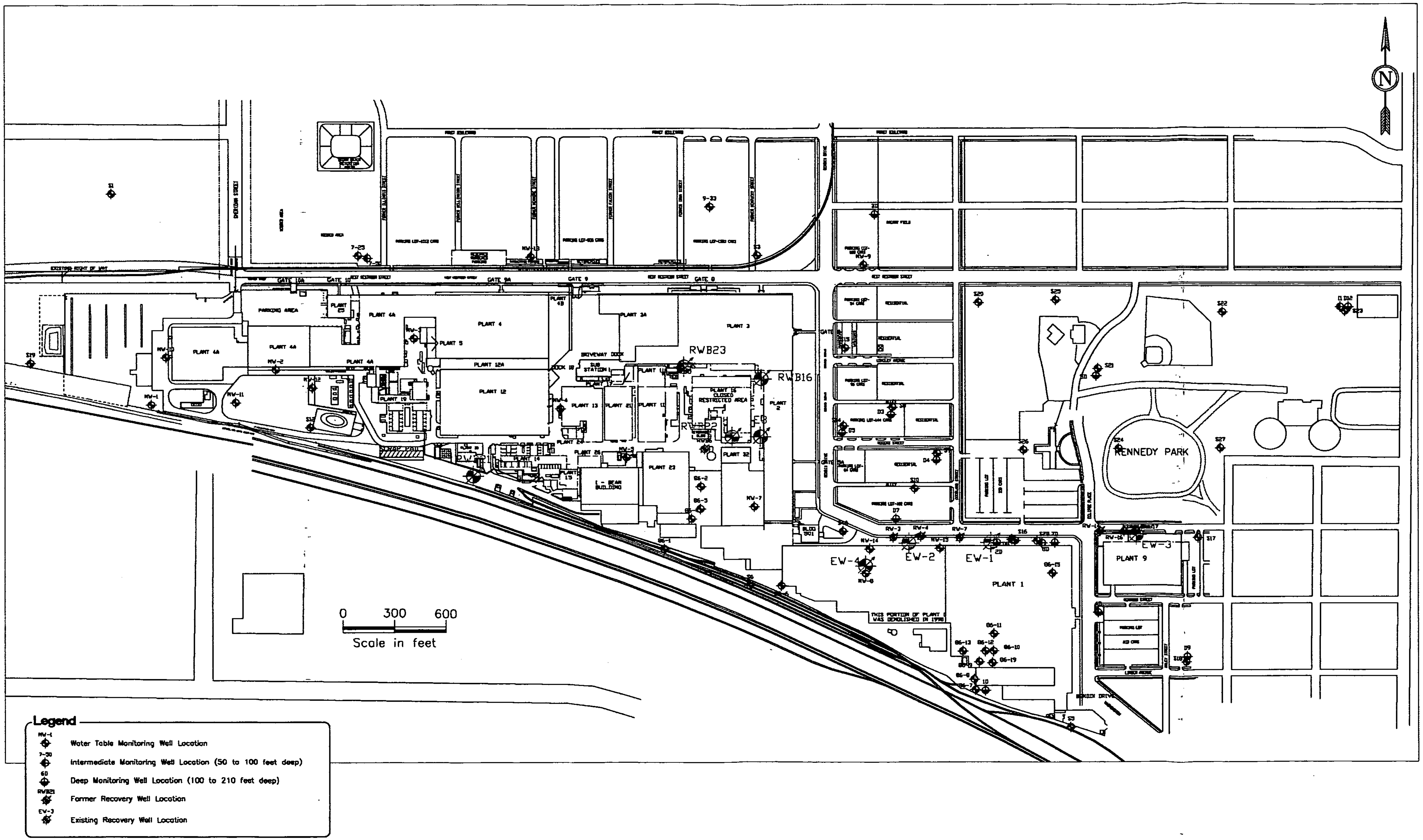
5.2 PRODUCT RECOVERY

Product recovery is currently occurring at three locations at the South Bend Industrial Complex, RWB23, E3, and EW-4. As previously discussed, RWB23 system was brought on-line in January 1999. Since system enhancements, product recovery totals per year are as follows[3]:

Year 1999	470 gallons
Year 2000	990 gallons
Year 2001 through May 18, 2001	1,045 gallons

[3] Product disposal records provided by Honeywell International, Inc., Aircraft Landing Systems.

Product, which is recovered into ASTs, is disposed of when tank is full or at a maximum of every 90 days. Facility personnel and groundwater extraction system operation and maintenance contractor monitor product recovery systems weekly in compliance with established facility requirements.

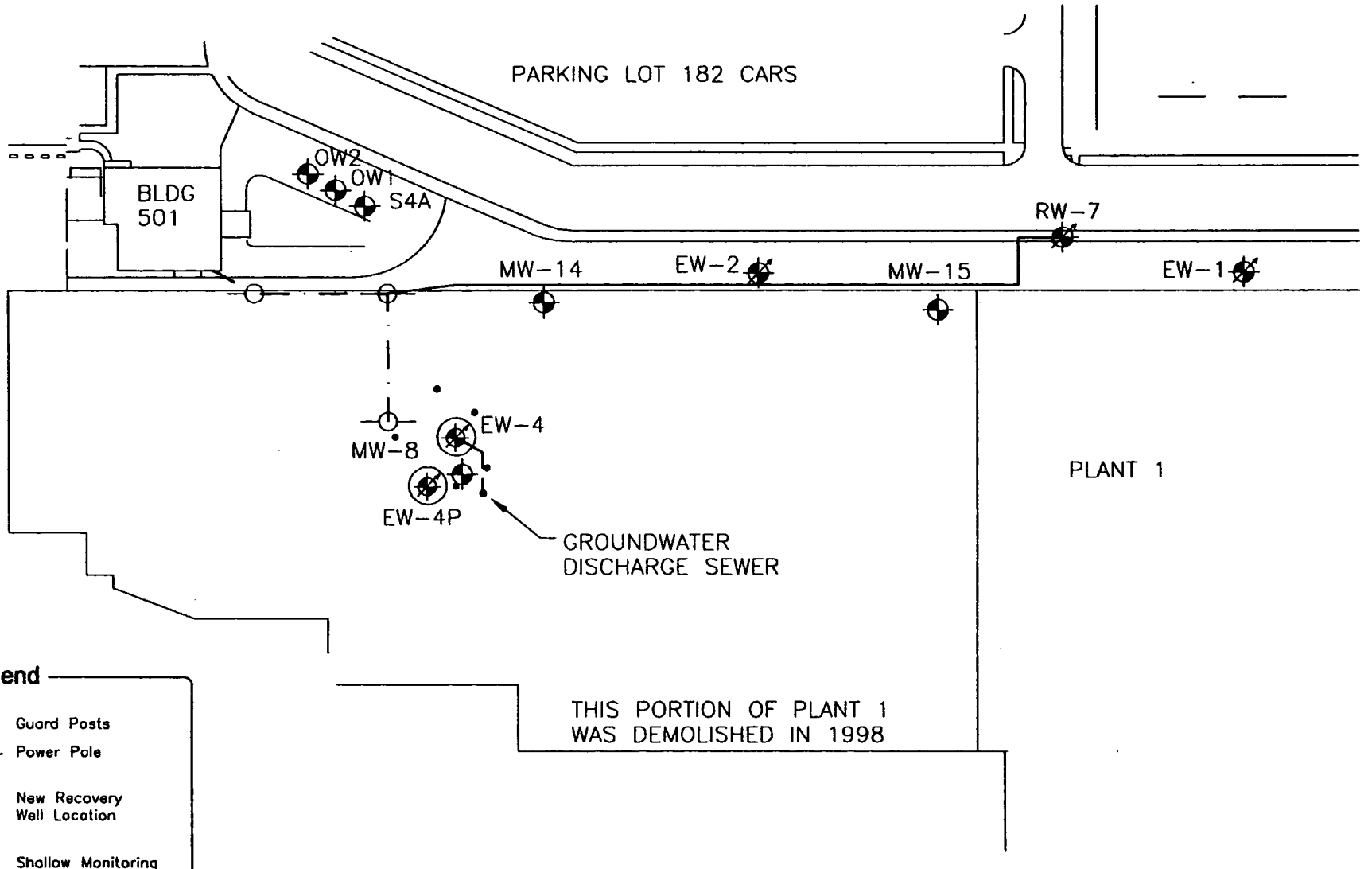


Harding ESE
A MACTEC Company

Monitoring Well and Recovery Well Network
Honeywell Industrial Complex
South Bend, Indiana

FIGURE 1

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
SDM	52040		05/21/2001	



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248-926-4008

FIGURE 2

EW-4 DUAL-WELL RECOVERY SYSTEM ELECTRIC LAYOUT HONEYWELL INDUSTRIAL COMPLEX SOUTH BEND, INDIANA

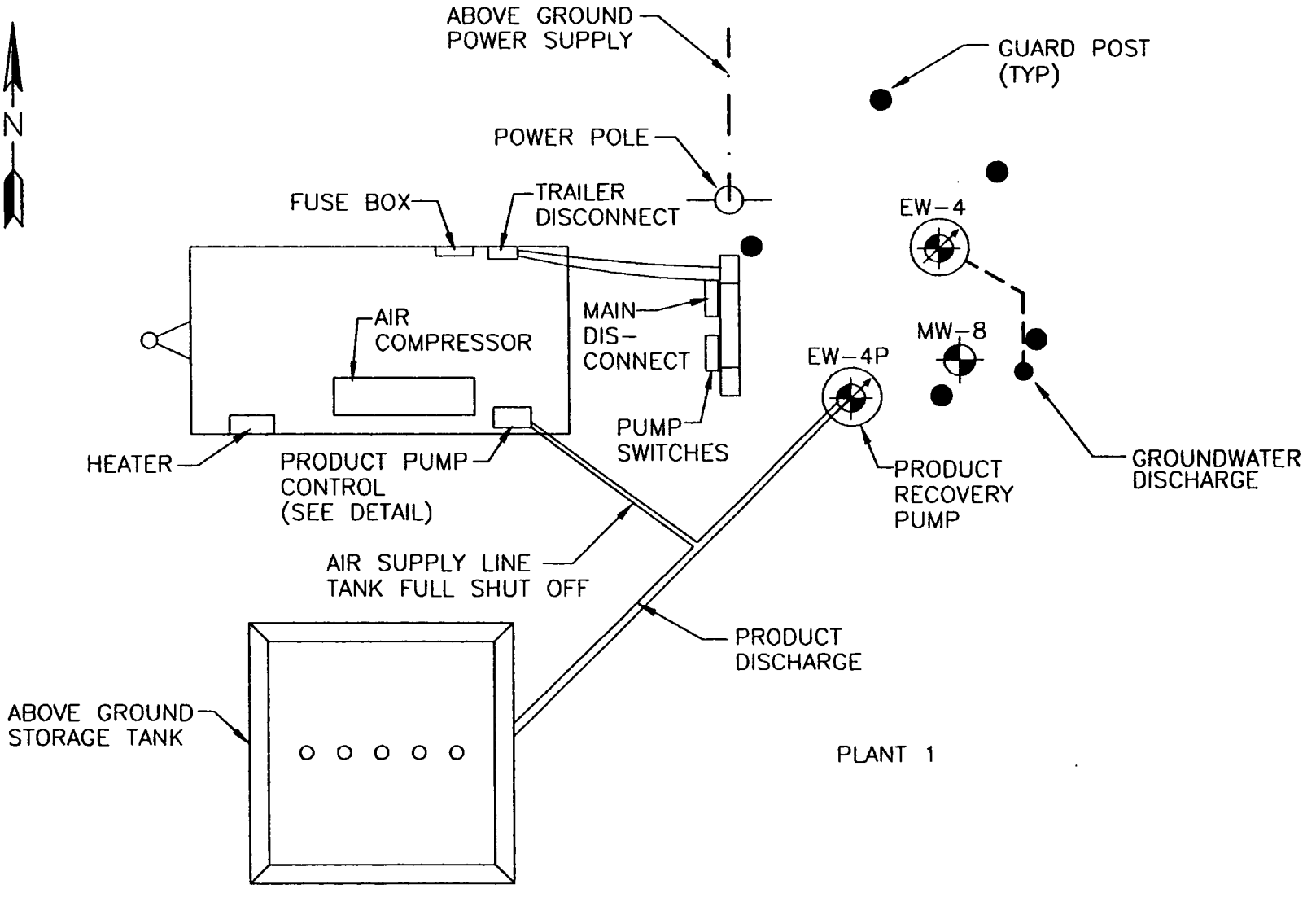

FIGURE 3

EW-4 DUAL-WELL RECOVERY SYSTEM LAYOUT
HONEYWELL INDUSTRIAL COMPLEX
SOUTH BEND, INDIANA

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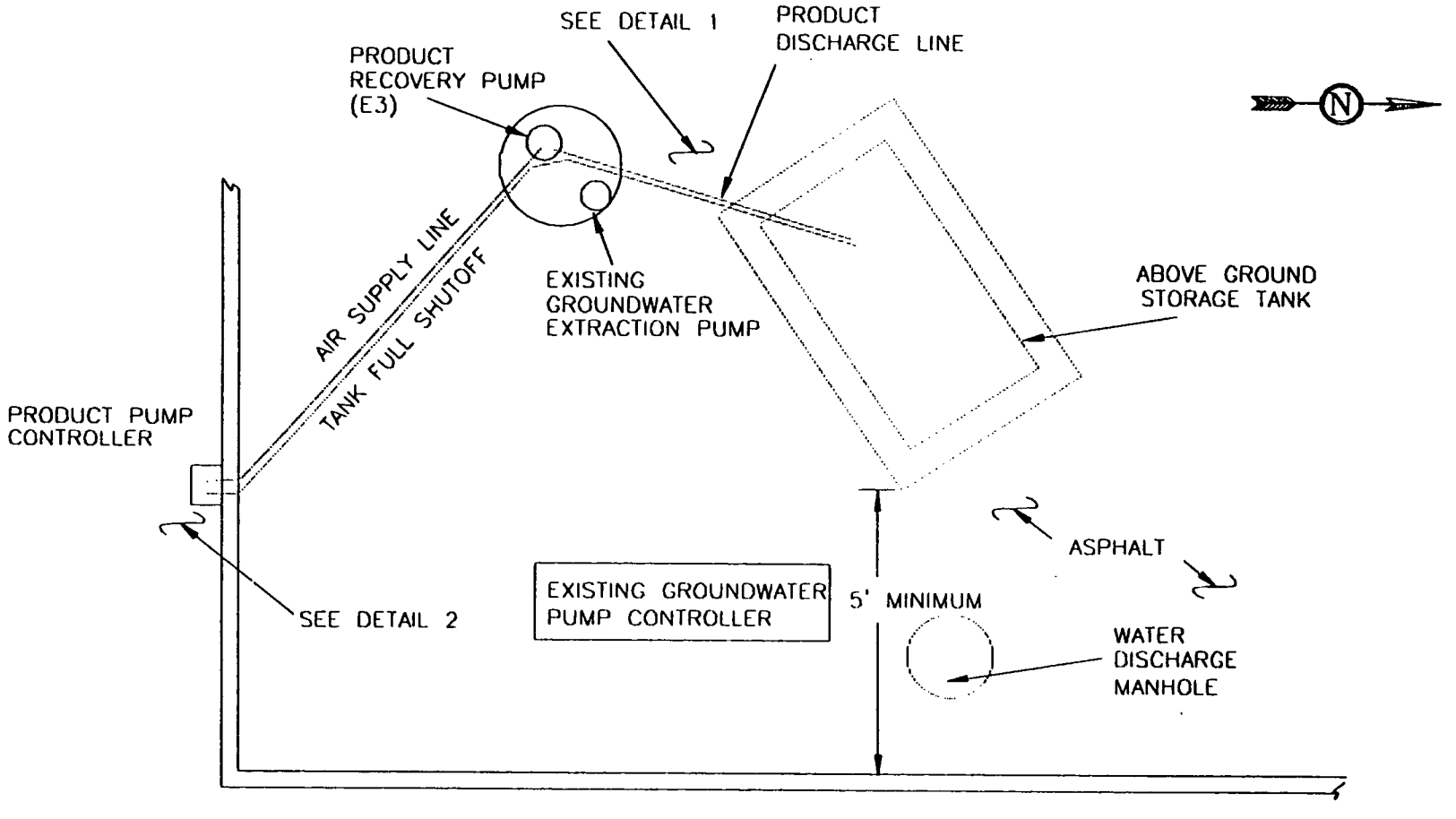
248-926-4008



PLANT 2

p:\ALLIED\52040\DWG\52040002.DWG Drawn: SDM 05/15/2001 Chkd:

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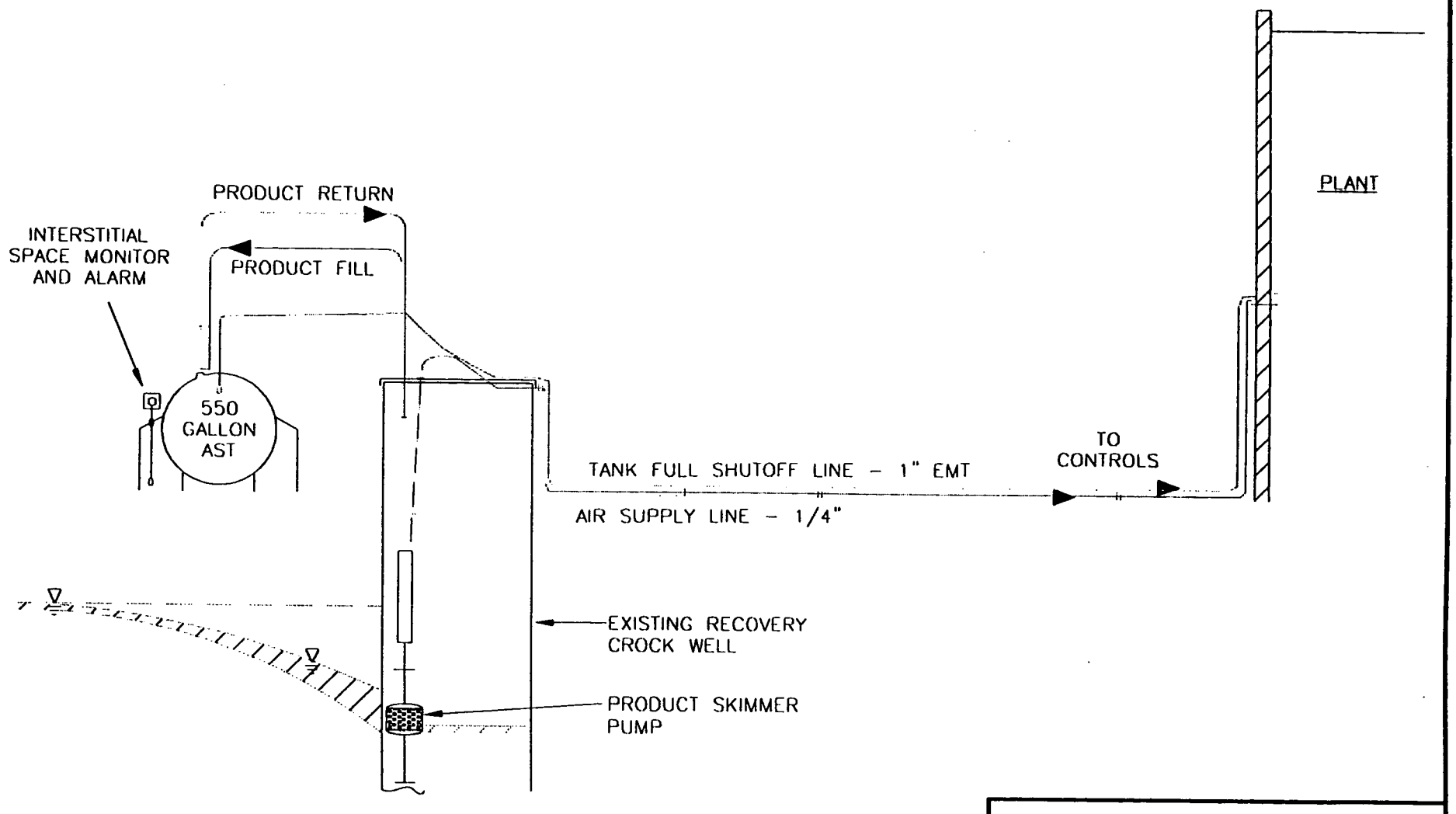
248-926-4008

FIGURE 4
E3 PRODUCT RECOVERY SYSTEM LAYOUT
HONEYWELL INDUSTRIAL COMPLEX
SOUTH BEND, INDIANA



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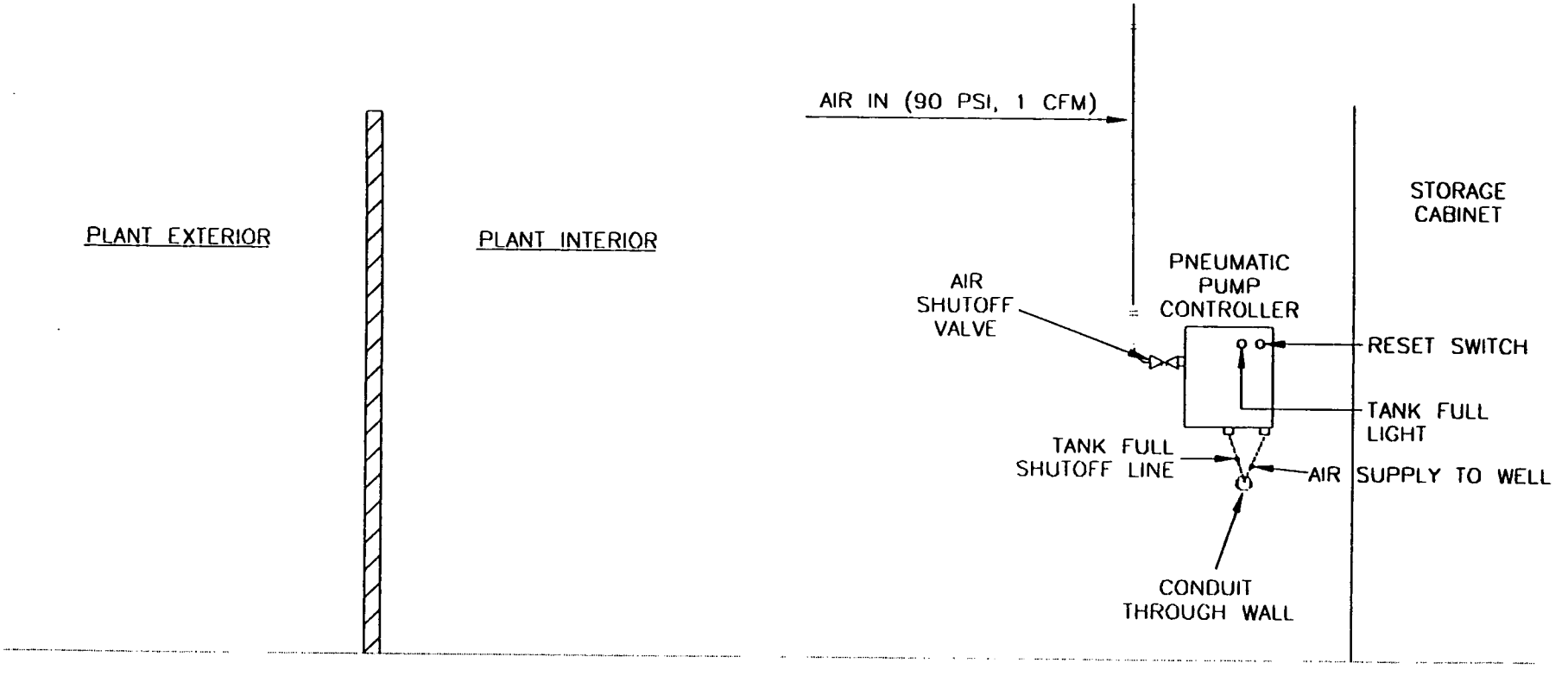
Novi, MI 48377
248-926-4008

FIGURE 5
E3 PRODUCT SKIMMER UPGRADE
HONEYWELL INDUSTRIAL COMPLEX
SOUTH BEND, INDIANA



NOT TO SCALE

Harding ESE
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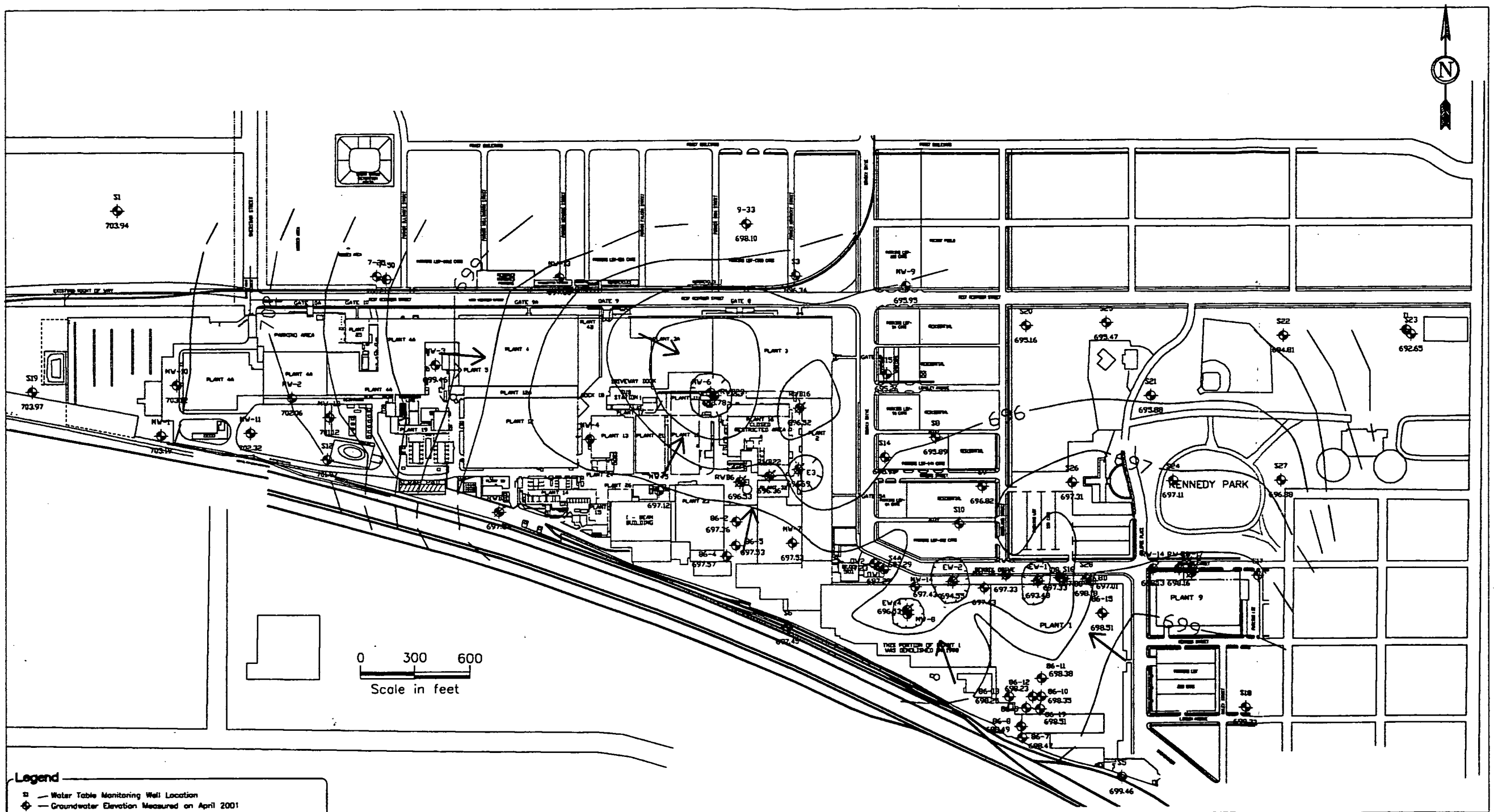
Novi, MI 48377
248-926-4008

FIGURE 6
E3 PRODUCT
SKIMMER CONTROLS
HONEYWELL INDUSTRIAL COMPLEX
SOUTH BEND, INDIANA

P:\52040\dwg\52040003.DWG Drawn: sdm 05/15/2001 Chkd:



Harding ESE
A MACTEC Company

Potentiometric Surface Map, Shallow Wells, April 2001
Honeywell Industrial Complex
South Bend, Indiana

FIGURE 7

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
SDM	47971		01/22/2001	

APPENDIX A

BORING LOGS

Harding ESE
A MACTEC COMPANY

Boring:	: EW-4	Drilling Method:	: 4.25/12.25 H.S.A
Project Number:	: 52040-001	Sampling Method:	: 2' split-spoons
Contractor:	: Stearns Drilling	Logged by:	: N. Rogers, S. Murray
Drill Crew:	: D. Giffels, D. Cooper	Date Started:	: 2/20/01
Drill Rig:	: L9000 Truck Rig CME 95	Date Completed:	: 2/21/01

ALLIEDSIGNAL INDUSTRIAL COMPLEX
SOUTH BEND, INDIANA

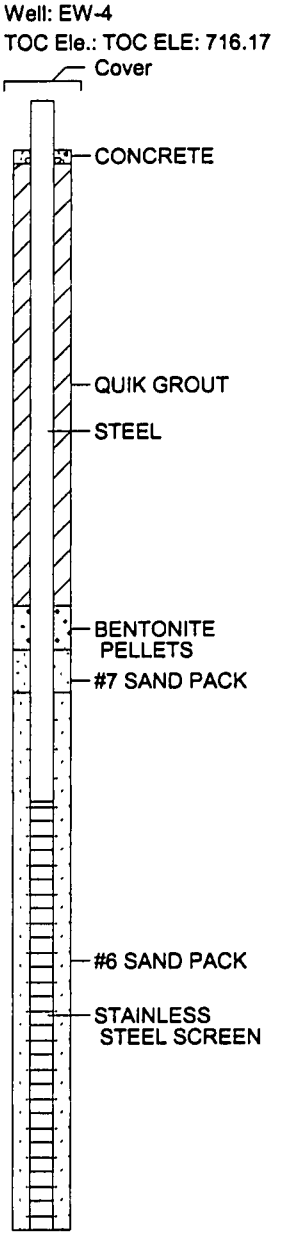
Weather: 15 Degrees, cloudy, windy.

Observations: Lithology taken from EW-4, approximately 10' northeast of EW-4P.

Sampler Type
SS Split Spoon

Depth in FEET	USCS	GRAPHIC	Sampler Type	PID (ppm)	DESCRIPTION
0					Blind Drilled to 14' bgs., logged from cuttings.
5	SM				SILTY-SAND, medium grained, poorly graded, dry, slight solvent odor, black.
10	SP		SS	1.9	SAND, medium grained, poorly graded, moist, light brown, tan, slight solvent odor. Started Splitspoon Sampling @ 14' bgs. on 5' intervals. black, highly stained, strong odor, very soft-soft, moist
15					
20	GW		SS	0.0	SANDY-GRAVEL, some fine gravel, wet, completely stained black, strong odor.
25	SP		SS	0.0	SAND, some fine gravel, well graded sands, wet, stained black, strong odor,soft-firm.
	GW				GRAVEL,fine gravel, well graded, soft, wet, some black staining, strong odor.
30	SP		SS	0.0	SAND, medium-fine grained, well graded, soft-firm, wet, some staining, strong odor.
35			SS	0.0	firm water in augers, low recovery, fine gravel
40	SW		SS	0.0	SAND, medium-fine grained, well graded,soft-firm, wet, dark gray, black, strong odor.
45			SS	0.0	
50	GW		SS	0.0	SANDY-GRAVEL, trace fine gravel .5' well sorted, fine grained silt .2', light gray, wet, strong odor.
	SC		SS	0.0	
55			SS	0.0	SANDY-SILT, fine grained, well graded, 52-53' fine grained silt, poorly graded, slight odor.
60					Boring Terminated @ 56' bgs.

Blow Count Graph: 10 50



Well Construction Information

WELL CONSTRUCTION
Contractor : Stearns Drilling
Date Compl. : 2/21/01
Hole Diameter : 14-inch
Drill. Method : HSA

WELL CASING
Material : Steel
Diameter : 6-inch ID
Joints : Welded

WELL SCREEN
Material : Stainless Steel
Diameter : 6-inch ID
Joints : Welded
Opening : .010 slot

SAND PACK : #6 quartz
: #7 quartz

SEAL : Bentonite
: Pellets

GROUT : Bentonite

WELL COVER : Pro Cover
Cap : Aluminium

NOTES
Development Details, EW-4 was developed for 3 hours, until well was free of fine grained sediments.

05-10-2001 P:\INDUSTRIAL\ALLIED\52040\RPT\EW-4.BOR

STEARNS DRILLING COMPANY

6974 Hammond SE
Dutton, Michigan 49316-9116
616/698-7770
FAX 616/698-9886

Job No. 01-8918-2

LOG OF TEST BORING NO. EW-4

Sheet: 1 of 2

Project: Honeywell Plant/Area 15

Location: South Bend, Indiana

Date Completed: February 20, 2001

Crew Chief: Giffels, Dennis
Drill Rig: CME 95
Boring Method: 4 1/4" pilot hole to 54.0', 12 1/4" H.S.A. to 50.0'
Hole Plugged With:

GROUNDWATER:

Encountered @	16.00	ft.
After completion		ft.
After hrs.		ft.
Seepage:		ft.
Boring Caved at:		ft.

MONITOR WELL DATA:
Pipe/Type: 6" black steel
Length: 33.0'
Above Ground: 3.0'
Cap: Flip cap

Screen/Type: 6" stainless
Size: 6" x 20'
Slot: .010"
Set @ 30.0' - 50.0'
Backfilled: #6 sand 25' - 50', #7 sand 23' - 25'
Bentonite Seal: Pellets 21.0' - 23.0'
Grout/Type: Quik-Grout
Depth: 1.0' - 21.0'
Protective Casing:
Materials Cleaned:
Development:

REMARKS:

LEGEND:
BlowCount/Blows per 6"
w/140# hammer x 30" drop
SS-2" Split Spoon Sampler
LS-Brass Liner Sample
ST-Shelby Tube Sample
SNR-Sample not recovered
LB-Large Bore

Sample Type	REC	Blow Count	Depth Feet	SOIL DESCRIPTION
			0	10" concrete
			0.8	Gray fine to medium sand
			5	
			7.0	Brown fine to medium sand
			10	
		3		
SS		4	15	
		5		
		5	16.0	Black medium to coarse sand, fine gravel
		6		
SS		9	20	
		11		
		9		
		3		
SS		6	25	
		10		
		8		
		3		
SS		4	30	
		5		
		5		

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Dutton, Michigan 49316-9116
616/698-7770
FAX 616/698-9886

Job No. 01-8918-2

LOG OF TEST BORING NO. EW-4

Sheet: 2 of 2

Project: Honeywell Plant/Area 15

Location: South Bend, Indiana

Date Completed: February 20, 2001

Crew Chief: Giffels, Dennis
Drill Rig: CME 95
Boring Method: 4 1/4" pilot hole to 54.0', 12 1/4" H.S.A. to 50.0'
Hole Plugged With:

GROUNDWATER:

Encountered @	16.00	ft.
After completion		ft.
After hrs.		ft.
Seepage:		ft.
Boring caved at:		ft.

MONITOR WELL DATA:

Pipe/Type: 6" black steel
Length: 33.0'
Above Ground: 3.0'
Cap: Flip cap

Screen/Type: 6" stainless
Size: 6" x 20'
Slot: .010"
Set @ 30.0' - 50.0'
Backfilled: #6 sand 25' - 50', #7 sand 23' - 25'

Bentonite Seal: Pellets 21.0' - 23.0'
Grout/Type: Quik-Grout
Depth: 1.0' - 21.0'
Protective Casing:
Materials Cleaned:
Development:

REMARKS:

LEGEND:
BlowCount/Blows per 6"
w/140# hammer x 30" drop
SS-2" Split Spoon Sampler
LS-Brass Liner Sample
ST-Shelby Tube Sample
SNR-Sample not recovered
LB-Large Bore

Sample Type	REC	Blow Count	Depth Feet	SOIL DESCRIPTION
				Black medium to coarse sand, fine gravel
		11		
SS		18	35	
		10		
		4		
		4		
SS		8	40	
		9		Gray fine to medium sand
		11		
		4		
SS		6	45	
		8		
		14		
			49.0	
		0		Gray fine to medium sand, trace of silt
SS		3	50	
		9		
		17		
		4		
SS		7		
		11		
		15		
		5		
SS		6	55	
		9		Gray fine sand and silt
		13		
				E.O.B. @ 56.0'
			60	

STEARNS DRILLING COMPANY

6974 Hammond SE
Dutton, Michigan 49316-9116
616/698-7770
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Job No. 01-8918-2

LOG OF TEST BORING NO. EW-4P

Sheet: 1 of 1

Project: Honeywell Plant/Area 15

Location: South Bend, Indiana

Date Completed: February 21, 2001

Crew Chief: Giffels, Dennis
Drill Rig: CME 95
Boring Method: 12 1/4" to 23.0'

Hole Plugged With:

GROUNDWATER:

Encountered @	15.00	ft.
After completion		ft.
After hrs.		ft.
Seepage:		ft.
Boring Caved at:		ft.

MONITOR WELL DATA:
Pipe/Type: 6" black steel
Length: 16.0'
Above Ground: 3.0'
Cap: Flip cap

Screen/Type: Stainless Plate Bottom
Size: 6" x 10'
Slot: .010"
Set @ 13.0' - 23.0'
Backfilled: #6 sand 11' - 23', #7 sand 10' - 11'
Bentonite Seal: Pellets 8.5' - 10.0'
Grout/Type: Quik-grout dry bag & sand
Depth: 1.0' - 21.0'
Protective Casing:
Materials Cleaned:
Development: Bailed

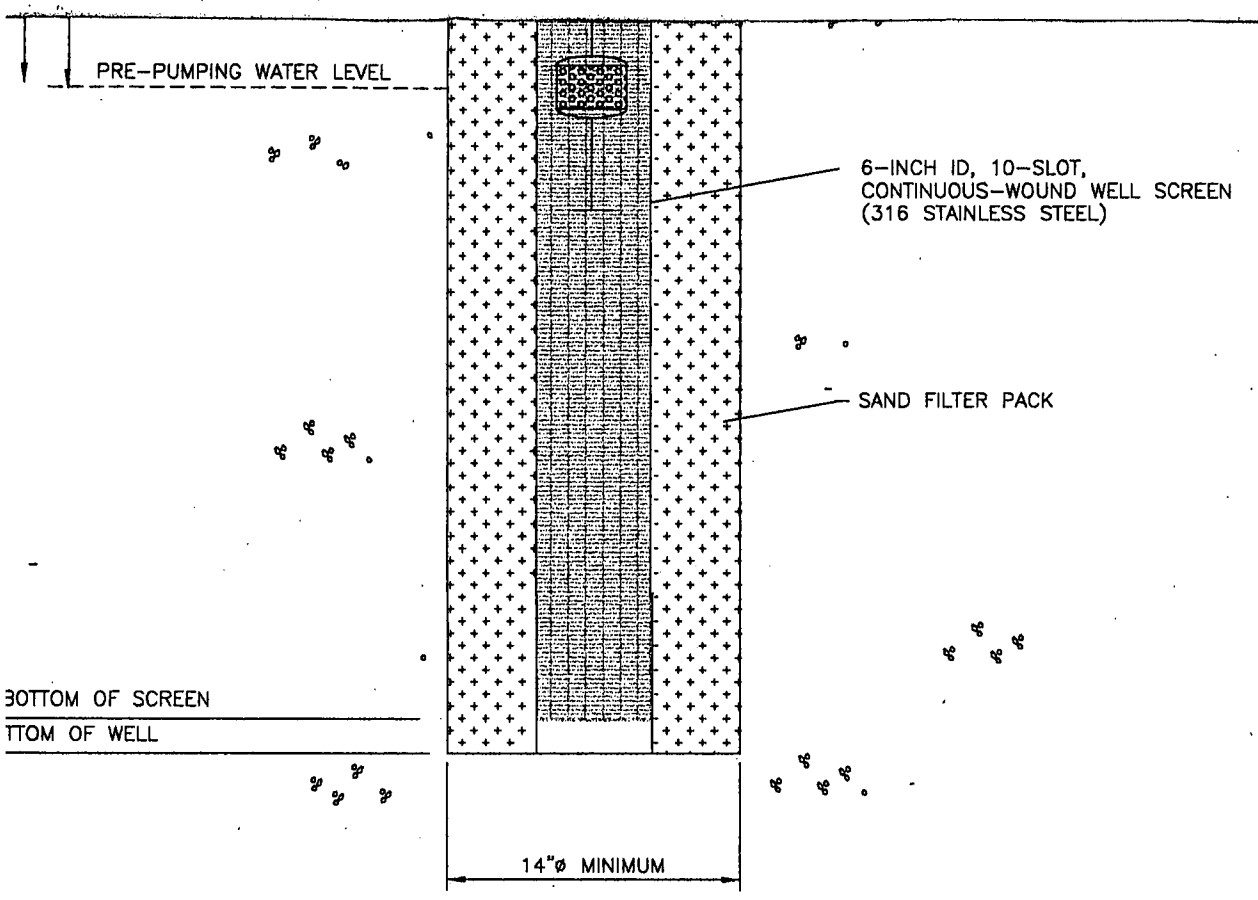
REMARKS:

LEGEND:
BlowCount/Blows per 6"
w/140# hammer x 30" drop
SS-2" Split Spoon Sampler
LS-Brass Liner Sample
ST-Shelby Tube Sample
SNR-Sample not recovered
LB-Large Bore

Sample Type	REC	Blow Count	Depth Feet	SOIL DESCRIPTION	T W
				8" concrete augured	
				Gray fine to medium sand	
			5		
			7.0		
				Brown fine to medium sand	
			10		
			15		
			16.0		
				Black medium to coarse sand, fine gravel	
			20		
			25		
				E.O.B. @ 23.0'	
			30		

APPENDIX B

DUAL-WELL SYSTEM CONSTRUCTION DETAILS



:E PRODUCT RECOVERY
LL MECHANICAL DETAIL
NOT TO SCALE

(1) CASE DRAWING

"CONSTRUCTION REPORT
FREE PRODUCT RECOVERY 6/2001
SYSTEM ENHANCEMENTS"
HONEYWELL INDUSTRIAL COMPLEX
SITE # 698060

TRIAL COMPLEX
, INDIANA

CONSTRUCTION DETAILS
FOR DUAL WELL RECOVERY SYSTEM
HONEYWELL INDUSTRIAL COMPLEX
SOUTH BEND, INDIANA

DRAWING NO:
C-98220101

APPENDIX C

GROUNDWATER EXTRACTION EQUIPMENT –

MANUFACTURER CUT SHEETS

WELL PUMP

MAKE: Grundfos

MODEL: 40S15-5

HORSE POWER:

VOLTAGE: 460

PHASE: 3

DROP PIPE SIZE: 2"

DROP PIPE TYPE: PVC Schedule 80 T & C

PUMP SETTING DEPTH: 28.0'

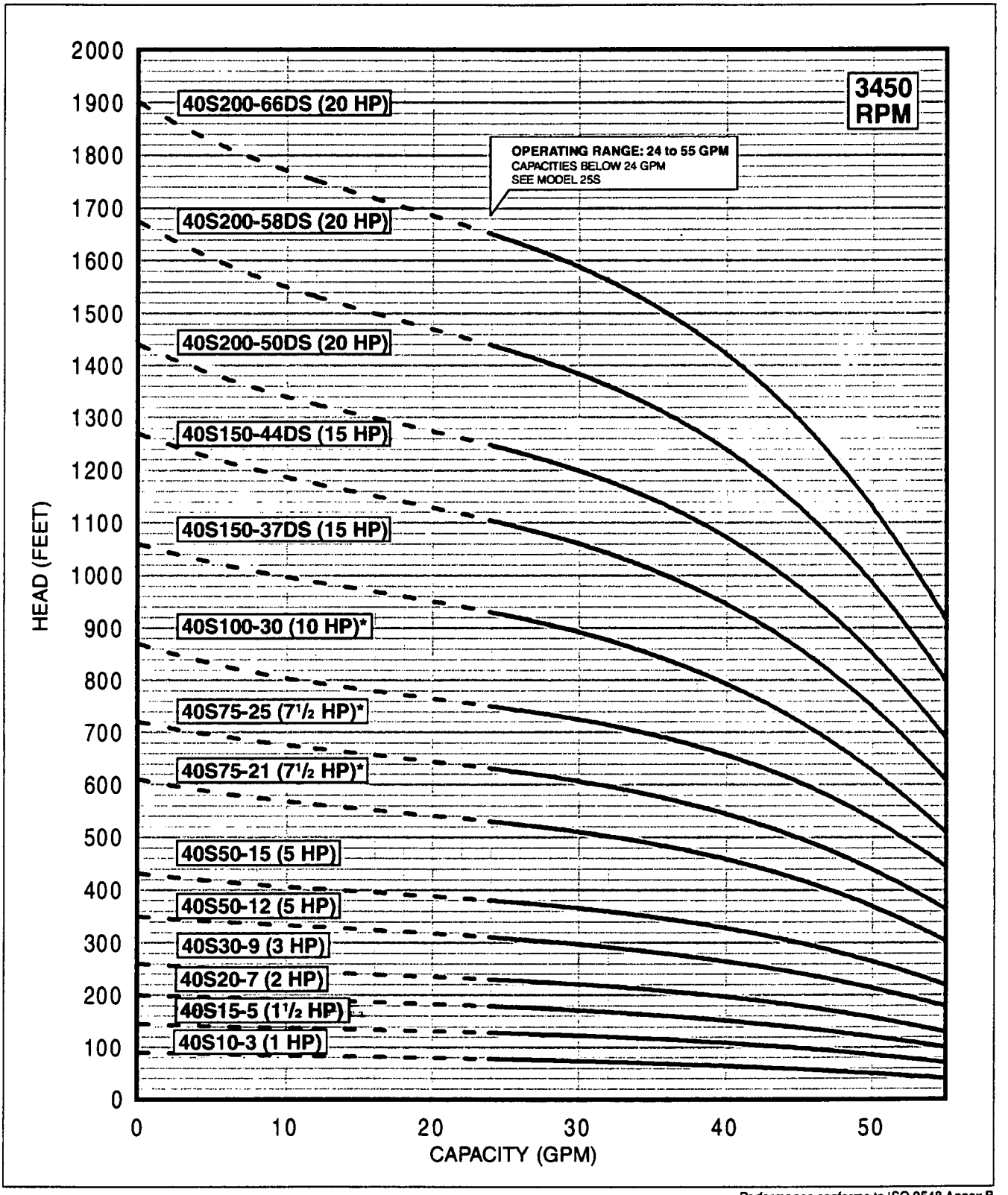
WIRE SIZE: 12-3 with Ground Twisted

PITLESS MAKE: Merrill

PITLESS MODEL: 2" MHB 300

Model 40S 40 GPM Performance Curves

FLOW RANGE: 24 - 55 GPM **OUTLET SIZE: 2 " NPT** **NOMINAL DIA. 4"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 1-10 HP/3450 RPM.
6" MOTOR STANDARD,15-20 HP/3450 RPM.
* Also available with 6" motor.

Performance conforms to ISO 2548 Annex B
@ 5 ft. min. submergence.

GRUNDFOS

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
40S10-3	A	1	4"	2" NPT	24.6	11.8	12.8	3.8	3.9	32
40S15-5	A	1 1/2	4"	2" NPT	29.7	13.6	16.1	3.8	3.9	37
40S20-7	A	2	4"	2" NPT	34.5	15.1	19.4	3.8	3.9	41
40S30-9	A	3	4"	2" NPT	43.3	20.6	22.7	3.8	3.9	65
40S50-12	A	5	4"	2" NPT	51.3	23.6	27.7	3.8	3.9	78
40S50-15	A	5	4"	2" NPT	56.2	23.6	32.6	3.8	3.9	84
40S75-21*	A	7 1/2	4"	2" NPT	74.6	29.6	45.0	3.8	5.4	120
40S75-25*	A	7 1/2	4"	2" NPT	81.2	29.6	51.6	3.8	5.4	124
40S100-30*	A	10	4"	2" NPT	103.7	43.9	59.8	3.8	5.4	181
40S150-37DS	A	15	6"	2" NPT	99.5	28.0	71.5	5.4	5.4	244
40S150-44DS	A	15	6"	2" NPT	111.0	28.0	83.0	5.4	5.4	340
40S200-50DS**	B	20	6"	2" MPT	136.0	30.6	105.4	5.4	5.5	319
40S200-58DS**	B	20	6"	2" MPT	149.2	30.6	118.6	5.4	5.5	334
40S200-66DS**	B	20	6"	2" MPT	162.4	30.6	131.8	5.4	5.5	394

NOTES: All models suitable for use in 4" wells, unless otherwise noted.
Weights include pump end with motor in lbs.
* Also available with 6" motor.
** Built into sleeve 2" MPT discharge, 6" min. well dia.

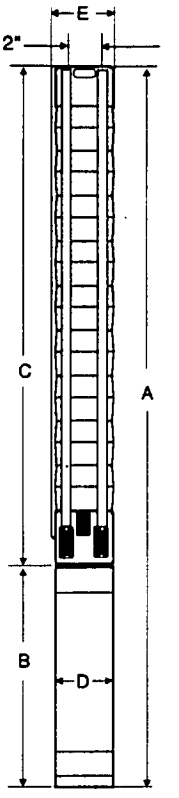


Fig. A

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (3-44 Stgs.)	DEEP SET (50-66 Stgs.)
Check Valve Housing	304 Stainless Steel	304 Stainless Steel
Check Valve	304 Stainless Steel	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel	304 Stainless Steel
Impeller	304 Stainless Steel	304 Stainless Steel
Suction Interconnector	304 Stainless Steel	304 Stainless Steel
Inlet Screen	304 Stainless Steel	304 Stainless Steel
Pump Shaft	431 Stainless Steel	431 Stainless Steel
Straps	304 Stainless Steel	304 Stainless Steel
Cable Guard	304 Stainless Steel	304 Stainless Steel
Priming Inducer	316 Stainless Steel	316 Stainless Steel
Coupling	329/420/431 Stainless Steel **	329/ 416 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Top Bearing	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Impeller Seal Ring	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Intermediate Bearings	NBR/316 Stainless Steel	NBR/316 Stainless Steel
Shaft Washer	LCP (Vectra®)	LCP (Vectra®)
Split Cone	304 Stainless Steel	304 Stainless Steel
Split Cone Nut	304 Stainless Steel	304 Stainless Steel
Sleeve	Not Required	316 Stainless Steel
Sleeve Flange	Not Required	Zincless Bronze*
Coupling Key	Not Required **	302/304 Stainless Steel

NOTES: Specifications are subject to change without notice.
Vectra ® is a registered trademark of Hoechast Calanese Corporation.
***Stainless Steel option available.**
** If using 6" non-standard motors, refer to 416 Stainless Steel for coupling and 302/304 for the coupling key.

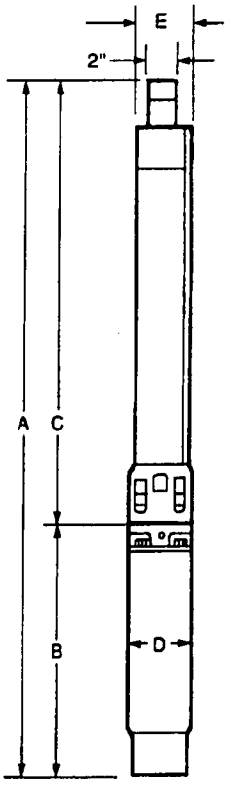


Fig. B

GRUNDFOS
GRUNDFOS PUMPS CORPORATION • 2555 Clovis Avenue • Clovis, CA • 93612
Area Centers: Allentown, PA • Atlanta, GA • Chicago, IL • Clovis, CA • Dallas, TX • Seattle, WA
(800) 333-1366 • FAX (800) 333-1363
Canada: Mississauga, Ontario • **Mexico:** Apodaca, N.L.

LSP-TL-1040 6/96
PRINTED IN USA

MERRILL

RED BRASS PITLESS ADAPTERS

QUALITY FEATURES/BENEFITS

- ☑ Brass male part of adapter is tapered. BENEFIT: Easy connection of female and male parts.
- ☑ Brass female part is also tapered. BENEFIT: Tight connection and easy removal.
- ☑ Replaceable O-ring seal in solid brass casting. BENEFIT: Easily replaced not a seal from factory only.
- ☑ Molded gasket for positive outside seal on discharge, plus O-ring or gasket glued in place, for seal on inside of casing. BENEFIT: Glued gasket does not fall off during installation.
- ☑ Solid brass collar made for perfect fit and positive seal between molded gasket to discharge and outside of casing. BENEFIT: Insures sanitary watertight seal to casing.
- ☑ Extra-wide solid brass nut. BENEFIT: To accommodate wrench for easier installation.

ONLY MERRILL STILL OFFERS HEAVY WEIGHT CASTINGS WITH THE QUALITY YOU NEED AT PRICES YOU WANT.

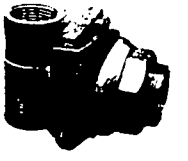
ORDER NO.	UPC BAR CODE (QTY. 1)	DROP & DISCHARGE	DISCHARGE LENGTH	CASING SIZES	WILL* SUPPORT	HOLE SAW	APPROX. WT./LBS.	CARTON QTY.	MODEL SERIES
MB50	6 42367 01799 6	1" (Brass)	1.8" (Long Model)	5" - 8"	300'	1 3/4"	2.4	4	IMPORTED 50 SERIES
MB200	6 42367 01797 2	1" (Brass)	1.8" (Long Model)	5" - 8"	400'	1 3/4"	2.8	4	IMPORTED 200 SERIES
MBI100	6 42367 04294 3	1"	1.8" (Long Model)	5" - 8"	400'	1 3/4"	3.0	4	IMPORTED 200 SERIES
MB225	6 42367 01798 9	1 1/4" (Brass)	1.8" (Long Model)	5" - 8"	300'	2 1/4"	4.6	2	IMPORTED 200 SERIES
MBI125	6 42367 04179 3	1 1/4"	1.8" (Long Model)	5" - 8"	300'	2 1/4"	5.0	2	IMPORTED 200 SERIES
MB60 (DPM No. 002½B)	6 42367 04271 4	1"	1.8" (Long Model)	5" - 8"	300'	1 3/4"	2.6	15	MERRILL-USA 60 SERIES
MB100 (DPM No. 002B)	6 42367 01791 0	1"	1.8" (Long Model)	5" - 8"	400'	1 3/4"	3.2	1	MERRILL-USA 100 SERIES
MB100N (No outside thread)	6 42367 04307 0	1"	1.8" (Long Model)	5" - 8"	400'	1 3/4"	2.5	1	MERRILL-USA 100 SERIES
MBP100	6 42367 01825 2	1" ILL. CODE	1.8" (Long Model)	5" - 8"	400'	1 3/4"	3.2	12	MERRILL-USA 100 SERIES
MB125	6 42367 01794 1	1 1/4"	1.8" (Long Model)	5" - 8"	300'	2 1/4"	5.0	2	MERRILL-USA 100 SERIES
MB125N (No outside thread)	6 42367 04308 7	1 1/4"	1.8" (Long Model)	5" - 8"	300'	2 1/4"	3.8	2	MERRILL-USA 100 SERIES
MBP125	6 42367 01826 9	1 1/4" ILL. CODE	1.8" (Long Model)	5" - 8"	300'	2 1/4"	5.0	12	MERRILL-USA 100 SERIES
MHB100 (DPM No. 001B)	6 42367 01883 2	1" HEAVY DUTY	1.8" (Long Model)	5" - 12"	800'	1 13/16"	5.7	1	MERRILL HEAVY DUTY SERIES
MHB125 (DPM No. 003B)	6 42367 01884 9	1 1/4" HEAVY DUTY	1.8" (Long Model)	5" - 12"	700'	2 1/4"	6.3	1	MERRILL HEAVY DUTY SERIES
MHB300 (DPM No. 004B)	6 42367 01885 6	2" HEAVY DUTY	1.7" (Long Model)	6" - 12"	600'	2 7/8"	12.5	1	MERRILL HEAVY DUTY SERIES
MHB400 (DPM No. 005B)	6 42367 01886 3	1 1/4" x 1" HEAVY DUTY	1.7" (Long Model)	5" - 8"	N/A	HOLE GUIDE	9.7	1	MERRILL HEAVY DUTY SERIES

* When properly installed, MERRILL PITLESS ADAPTERS will support a length of schedule 40 steel pipe full of water and pump indicated in table above. **Other companies may claim more support - but have little or no safety factor.**


MB50


MB200/MBI100


MB225/MBI125


MB100


MHB100


MHB300

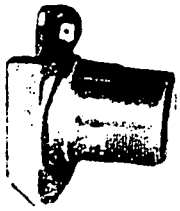

MHB400

MERRILL
RED BRASS PITLESS ADAPTER PARTS

Merrill Brass Pitless Adapters have passed **CERTIFIED WATERTIGHT STANDARDS PAS-1** established and regulated for the industry by the Pitless Adapter Division of Water System Council.

MALE PART

MALE PART O-RING

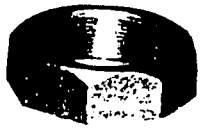


FEMALE PART

FEMALE PART O-RING

GASKET

COLLAR



NUT

MODEL NO.	MB50	MB200	MBI100	MB225	MBI125	MB60	MB100	MB125	MHB100	MHB125	MHB300	MHB400
PART NO.	MBM50	MBM20	MBIM10	MBM22	MBIM12	MBM60	MBM10	MBM12	MHM10	MHM12	MHM30	MHM40
APPROX. WT./LBS.	.96	1.17	1.23	2.01	2.06	1.09	1.23	2.06	2.33	2.59	5.54	3.82
UPC Bar Code (Qty. 1)	6 42367 04652 1	6 42367 04653 8		6 42367 04654 5		6 42367 01817 7			6 42367 01899 3		6 42367 01901 3	
	6 42367 01819 1	6 42367 01820 7		6 42367 04201 1		6 42367 01818 4			6 42367 01900 6		6 42367 01902 0	

MALE PART O-RING

PART NO.	OR222	OR326	OR326	OR326	OR326	OR222	OR326	OR326	OR326	OR327	OR332	OR326
APPROX. WT./LBS.	.004	.008	.008	.008	.008	.004	.008	.008	.008	.01	.012	(2) .008
UPC Bar Code (Qty. 1)	6 42367 06572 0	6 42367 06573 7		6 42367 06573 7		6 42367 06573 7			6 42367 06573 7		6 42367 06575 1	
	6 42367 06573 7	6 42367 06573 7		6 42367 06572 0		6 42367 06573 7			6 42367 06574 4		6 42367 06573 7	

PART NO.	MBF50	MBF20	MBIF10	MBF22	MBIF12	MBF60	MBF10	MBF12	MHF10	MHF12	MHF30	MHF40
APPROX. WT./LBS.	.91	1.09	1.04	1.74	1.81	.84	1.04	1.81	2.17	2.29	4.33	3.35
UPC Bar Code (Qty. 1)	6 42367 04658 3	6 42367 04659 0		6 42367 04660 6		6 42367 01804 7			6 42367 01891 7		6 42367 01893 1	
	6 42367 01806 1	6 42367 01807 8		6 42367 04204 2		6 42367 01805 4			6 42367 01892 4		6 42367 01894 8	

FEMALE PART O-RING

PART NO.	MBFG10	MBFR20	MBFR20	MBFR22	MBFR22	MBFG10	MBFR20	MBFR22	MBFR20	MBFG12	MBFG30	MBFG12
												6 42367 01809 2
APPROX. WT./LBS.	.064	.020	.020	.022	.022	.064	.020	.022	.020	.033	.086	.033 Top .064 Bottom
UPC Bar Code (Qty. 1)	6 42367 01808 5	6 42367 01810 8		6 42367 03494 8		6 42367 01810 8			6 42367 01810 8		6 42367 06576 8	MBFG10
	6 42367 01810 8	6 42367 03494 8		6 42367 01808 5		6 42367 03494 8			6 42367 01809 2			6 42367 01808 5

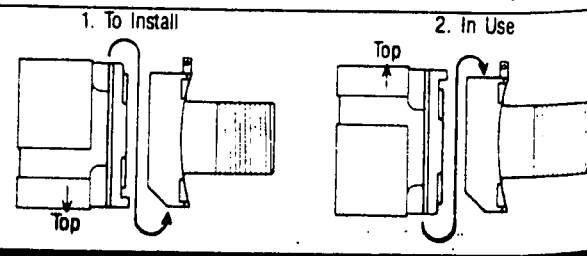
PART NO.	MBG20	MBG20	MBG20	MBG22	MBG22	MBG20	MBG20	MBG22	MHG10	MBG22	MBFG30	MBFG12
												6 42367 01809 2
APPROX. WT./LBS.	.032	.032	.032	.060	.060	.032	.032	.060	.032	.060	.086	.033 Top .064 Bottom
UPC Bar Code (Qty. 1)	6 42367 01815 3	6 42367 01815 3		6 42367 01816 0		6 42367 01815 3			6 42367 01895 5		6 42367 06576 8	MBFG10
	6 42367 01815 3	6 42367 01816 0		6 42367 01815 3		6 42367 01816 0			6 42367 01816 0			6 42367 01808 5

PART NO.	MBC20	MBC20	MBC10	MBC22	MBC12	MBC10	MBC10	MBC12	MHC10	MHC12	MHC30	MHC40
APPROX. WT./LBS.	.24	.24	.22	.34	.36	.22	.22	.36	.67	.73	1.20	1.16
UPC Bar Code (Qty. 1)	6 42367 01802 3	6 42367 01800 9		6 42367 01801 6		6 42367 01800 9			6 42367 01887 0		6 42367 01889 4	
	6 42367 01802 3	6 42367 01803 0		6 42367 01800 9		6 42367 01801 6			6 42367 01888 7		6 42367 01890 0	

PART NO.	MBN50	MBN20	MBIN10	MBN22	MBN12	MBN60	MBN10	MBN12	MHN10	MHN12	MHN30	MHN12
												6 42367 01904 4
APPROX. WT./LBS.	.17	.23	.21	.46	.48	.20	.23	.48	.32	.52	.99	.52 Top .32 Bottom
UPC Bar Code (Qty. 1)	6 42367 04677 4	6 42367 04678 1		6 42367 01822 1		6 42367 01821 4			6 42367 01903 7		6 42367 01905 1	MHN10
	6 42367 01823 8	6 42367 01824 5		6 42367 04206 6		6 42367 01822 1			6 42367 01904 4			6 42367 01903 7

NOTE:
For use with Concrete Tile - no outside thread models.
MB100N - MBM10 - MBR10 - MBF10N
MB125N - MBM12 - MBR12 - MBF12N

NOTE: Merrill Pitless Adapters are designed for easier installation.



PUMP STARTER

MAKE: Furnas

MODEL: ESP 100

SIZE: Nema 0

STARTER VOLTAGE: 460 Volt

COIL VOLTAGE: 110 Volt

Protecting Your Motor with

ESP100™

Furnas

Furnas

The Right Choice

Congratulations!

You have purchased the world's finest industrial motor starter—the Furnas ESP100. It's a state-of-the-art device offering extra starter performance by combining a rock-solid NEMA rated contactor with a solid state overload relay.

Development of ESP100 is based on years of research and experience in electronic, melting alloy and bimetal overload relays. The result is unprecedented motor protection.

This unique technology comes from our desire to provide you with the best possible control for heavy duty motor applications. This guide was written to help you take full advantage of the increased motor protection provided by ESP100—the first major advancement in NEMA rated starters in more that 20 years.

ESP100™

NEMA rated starter with a solid state overload for extra starter performance and even greater motor protection.

- Heaterless Construction
- True Phase Loss Protection
- 2:1 FLA Adjustment Range
- NEMA Sizes 0-6

Easily Replaces Sizes 0-1:

Cutler Hammer Allen Bradley
Square D Westinghouse
GE

Problem-Solving ...at a Glance

When the ESP100 Trips... First, check amps in all 3 phases.

When the 3 phase currents are balanced...

If trip is on start up...

1. Check for proper class of overload. Class 20 is the recommended protection for most American motors (see below for more details).
2. Make sure load is not too heavy for motor to handle.
3. Adjustable frequency drives or DC injection (electronic) brakes will cause nuisance tripping.
4. The overload may be misadjusted (see below right for the details).

If trip is during normal operation...

2. Make sure load is not too heavy for motor to handle.
3. Adjustable frequency drives or DC injection (electronic) brakes will cause nuisance tripping.
4. The overload may be misadjusted (see below right for the details).
5. Check for the correct overload adjustment when using the looping option. Multiply the FLA by the number of times the motor lead passes though the sensing window to determine the proper adjustment.

Always check for proper class of overload:

A key ingredient in protecting a motor is the selection of the class of overload relay for the acceleration time of the motor and its FLA (Full Load Amperage). An overload relay may trip before the motor accelerates to its full rated speed if starting current extends beyond the overload relay trip curve. Using a class of overload too fast to allow the motor to accelerate to full speed will cause nuisance tripping. Change to the correct class of overload relay (i.e. Class 10 instead of Class 20).

When the overload trips within 3 seconds on start up...

If there is current in 2 phases only...

6. Phase loss is in the motor branch circuit (the motor is single phased).

Restore 3 phase power.

If there is a severe phase imbalance...

7. Current is present in all 3 phases, but large differences (2:1) exist between the phases. This may indicate a loss of phase ahead of the motor branch circuit or a damaged motor.

Restore missing primary phase or repair/replace motor winding.

Tools needed:

Clamp-on ammeter, continuity checker and tools to tighten connections.

(For more detailed information, see following pages.)

When the overload is adjusted too low:

A. ESP100 is very accurate, taking up to 6 or more clicks of the dial to cover the same range as one heater coil. Adjusting upward just one or two clicks may solve the problem.

B. Some applications take advantage of the motor service factor, or a short load cycle versus a long unloaded cycle, to operate the motor at currents above the motor FLA. The NEC 430-34 allows an overload setting of up to 10% over motor FLA if the motor cannot be started or run at the motor FLA setting.

1. When ESP100 trips on startup

Various types of motors require different types of overload relays to provide adequate protection. There are three different levels of overload relay protection available. These levels are differentiated by the assignment of a trip "class" number as follows:

Class 20 is the designation assigned to a "standard trip" overload relay and is designed to protect standard industrial motors including T-frame motors. Most NEMA rated General Purpose motors will be protected by a Class 20 overload relay.

Class 10 or "quick trip" overload relays are designed to protect low thermal capacity motors. Examples would include motors used for hermetic refrigeration compressors, submersible pumps and similar applications.

Class 30 refers to "slow trip" overload relays which are designed to protect *special* motors driving high inertia loads (long start up times). Some examples include ball mills, reciprocating pumps, loaded conveyors, etc.

The time required for an overload relay to trip under locked-rotor (stalled) motor conditions is ideally the time that permits use of the available motor horsepower and starting torque. The overload must allow sufficient time for the motor and its load to accelerate to rated speed. Nuisance tripping occurs when an overload relay, or its adjustment, is selected that does not allow the motor to reach proper operating speed or performance ratings. This may cause the user to adjust the FLA upward, which will result in reduced protection.

Section 430-34 of the National Electric Code (NEC) permits a user to adjust the overload relay 10% higher than appropriate for the motor FLA, under certain conditions. These conditions include (a) when the properly adjusted overload relay trips before the motor can accelerate to its rated speed, and (b) provided the overload relay is adjusted no greater than 130% of motor FLA for service factor 1.0 motors, or not greater than 140% of motor FLA for motors with a service factor of 1.15. Rather than give up running protection by adjusting the FLA, a user should select a higher class of overload relay. This will provide more time for motor and load acceleration, yet retain the level of overload protection specified by the NEC. The graph (Fig. 1) illustrates the danger of an overload relay class that is too fast for its motor.

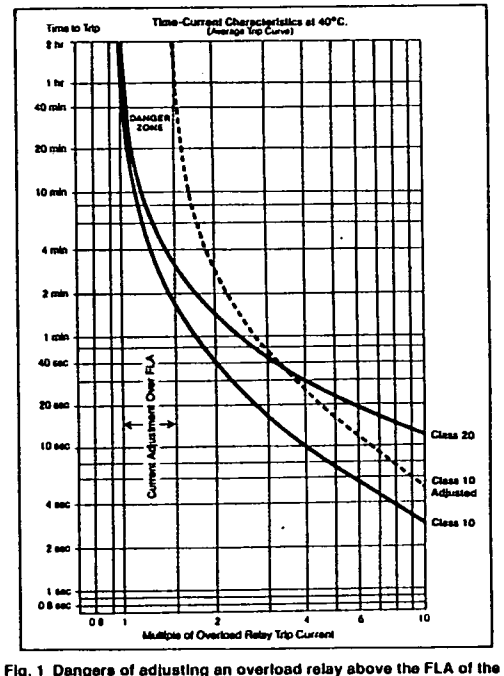


Fig. 1 Dangers of adjusting an overload relay above the FLA of the motor to prevent nuisance tripping on start up. Trip curve moves to the right and lessens or negates motor running protection.

2. Motor Overloaded

An electric motor is not capable of knowing when it is being worked too hard. If a load placed on a motor is too great, it will simply draw extra current and continue to handle the increased load. If this situation persists, it will eventually cause the overload to trip.

In contrast, temporary overloads may be handled easily if brief enough in duration to not cause overheating.

Typical overloading is caused by problems such as increased friction (bad bearings, poor lubrication, etc.), over feeding machinery (too heavy a cut, excess material, etc.) or too heavy a weight (conveyors, cranes, etc.).

The solution is to locate and remove the cause of the overload. The motor must also be allowed to to cool down before a restart is attempted.

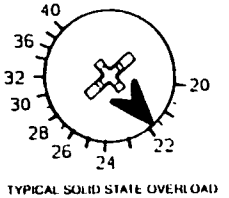
3. The ESP100 overload is rated 50/60 Hertz, AC only

Other frequencies will change the calibration of the overload relay and possibly cause nuisance tripping. A DC injection brake will be mistaken by the overload relay for a phase loss condition and will subsequently cause tripping. The ESP100 *should not* be applied on circuits containing adjustable frequency drives or DC injection brakes. The ESP100 *can be* applied with a soft start or solid state starter rated 50 or 60 Hertz.

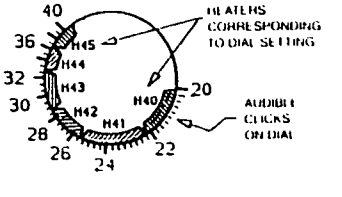
4. Overload Misadjustment

There is a tendency to set the current adjustment of the ESP100 overload relay *too low*. This is contrary to most people's experiences with thermal overload relays, which if misadjusted tend to be set *too high*. In fact, on retrofit applications in which oversized heater coils are used to prevent nuisance tripping, there is still a tendency to adjust the overload to less than motor rated full load current. *There seems to be a misconception that the high accuracy of a solid state overload relay necessitates setting the current adjustment below the motor's rated FLA.* This practice certainly protects the motor, but will not allow the motor to be used up to its rated horsepower.

Heater coils for thermal overload relays are sized in 10% steps. The adjustable ESP100 can have as many as 6 or more settings (clicks) to cover the same current range as one heater element. Adjusting upward one or two clicks tends to solve a nuisance tripping problem. This has been found to be particularly true on punch presses and other types of machinery where die sizes can vary widely and jogging set up may be necessary.



TYPICAL SOLID STATE OVERLOAD ADJUSTMENT DIAL MARKINGS



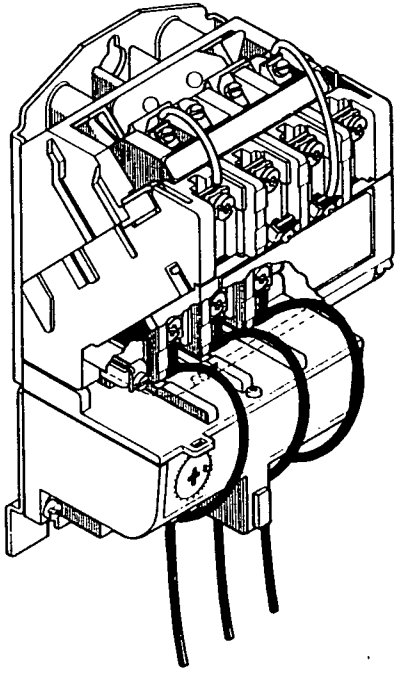
Other factors to consider:

1. Was the overload relay set to the maximum motor load? It has been found that when the overload relay was initially set with a small die in a press, it later tripped when the largest die was in operation. **Remember** that as many as 6 clicks of the ESP100 adjustment dial equals the same current range as one heater coil.

2. Some machinery or applications make deliberate use of the service factor of the motor to operate the motor temporarily or continuously at currents above the motor's rated FLA. Theoretically a motor may be used continuously at its service factor without harm (i.e. a motor with a service factor of 1.15 being used at 115% of rated FLA). This type of motor application is found on conveyors, air compressors, and light duty machinery. The ESP100 overload must be set at the motor FLA actually being used.

3. The duty cycle of the application may have allowed the use of an undersized motor to withstand short overloads providing the loaded cycle is not long enough to overload the motor.

5. Correct overload relay adjustment when using the looping option



Math errors being common, it is always worth double checking to see that the ESP100 overload relay has been adjusted properly when using the looping option. By passing the current to the motor through the ESP100's sensing windows more than once the current range can be extended downward. This allows the overload relay to sense two, three, four, or more times the current which is actually flowing to the motor. Using this option does not decrease motor protection in any way.

The easiest way to determine the correct ESP100 setting is to multiply the motor FLA by any whole number which falls within the current adjustment of the relay. For example, you have a motor rated at 5 full load amps and a 9-18 amp ESP100 overload relay. Five amps times two equals ten amps so that the motor loads can be **looped once** around the relay and the motor lead passes through the sensing window twice. The correct ESP100 setting would be 10 amps as the overload relay is sensing twice the 5 amps the motor is drawing. Using the same motor and relay as an example, the motor leads could be **looped twice** so that they pass through the sensing window three times (5 amps x 3 = 15 amp setting) and the correct ESP100 overload relay setting would be 15 amps.

The following table demonstrates how the looping process reduces the current setting of the overload by the number of times the wires pass through the windows of the overload.

All current values are expressed in Amps.

	Overload Current Range	# of Loops	# of Times Wire Passes Thru Window
Shown on label	9-18	0	1
	4.5-9.0	1	2
	3.0-6.0	2	3
	2.25-4.50	3	4
	1.80-3.60	4	5
	1.50-3.00	5	6

6. Phase loss (only 2 of 3 phases present)

Phase loss as used in this guide refers to a loss of a single phase of a three phase motor branch circuit. The ESP100 is designed to react to phase loss within three seconds. A continuity check will normally pinpoint this problem quickly. The most typical cause of phase loss is a blown fuse. Single phasing is an important cause of motor failure and deserves immediate attention.

7. Severe Phase Imbalance

In this situation there will still be current in all three phases, but large differences (2:1) exist between the phases. The most likely two causes of this situation are:

A. *Loss of phase in the primary of the circuit.*

For example one of the test manufacturing plants was operating on a severe phase imbalance due to a loss of phase in the utilities power lines. The operating motors in the plant then acted as generators and produced some current in the missing phase. Overload relays are *not* designed to protect against phase imbalance. Various phase monitoring relays on the incoming power lines is perhaps the most popular way to provide this protection.

B. *A damaged or defective motor winding can also be the cause of severe current imbalance.*

During one in-plant test, two motors with damaged windings were found. One had a 51.5% current imbalance. These damaged motors were operating completely undetected by thermal overload relays. The ESP100 allowed the defective motors to be pinpointed and repaired or replaced before they could burn out at a critical time.

ESP100 Specifications

- Available in NEMA Sizes 0-6 (0-4 on self-reset)
- Dual voltage coils readily available
- Front mounted auxiliary contacts
- Common coil for Sizes 0-2½
- Snap-in coil through Size 4
- Encapsulated coils on all sizes
- Inspectable contacts through Size 4
- Replaceable contacts on all sizes
- Key hole/slot mounting through Size 4
- Trips in 3 seconds on phase loss condition
- Class 10, 20 or 30 overload protection
- NO or NC isolated alarm contacts for overload relay*
- Trip free overload mechanism*
- Overload contact test function*
- Tamper proof cover for overload dial
- 4:1 FLA adjustment range up to 10A, 2:1 above 10A
- Visible trip indication on overload relay*
- Overload relay is impervious to short circuit currents
- Thermal memory on overload relay
- NEMA A600 contacts on overload relay (NEMA B300 on self-reset)
- Sizes 0 & 1 provide mounting dimensions of competitive devices for easy retrofitting
- Heaterless construction
- Ambient insensitive
- Overload relay is close coupled to contactor - not panel mounted
- Overloads above 10A can be looped to extend range to 4:1 for more versatility

* Not available on self-reset versions

NOTES

Furnas

ESP100™

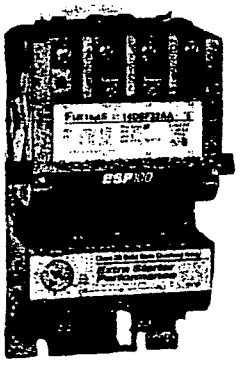
REPLACEMENT PARTS

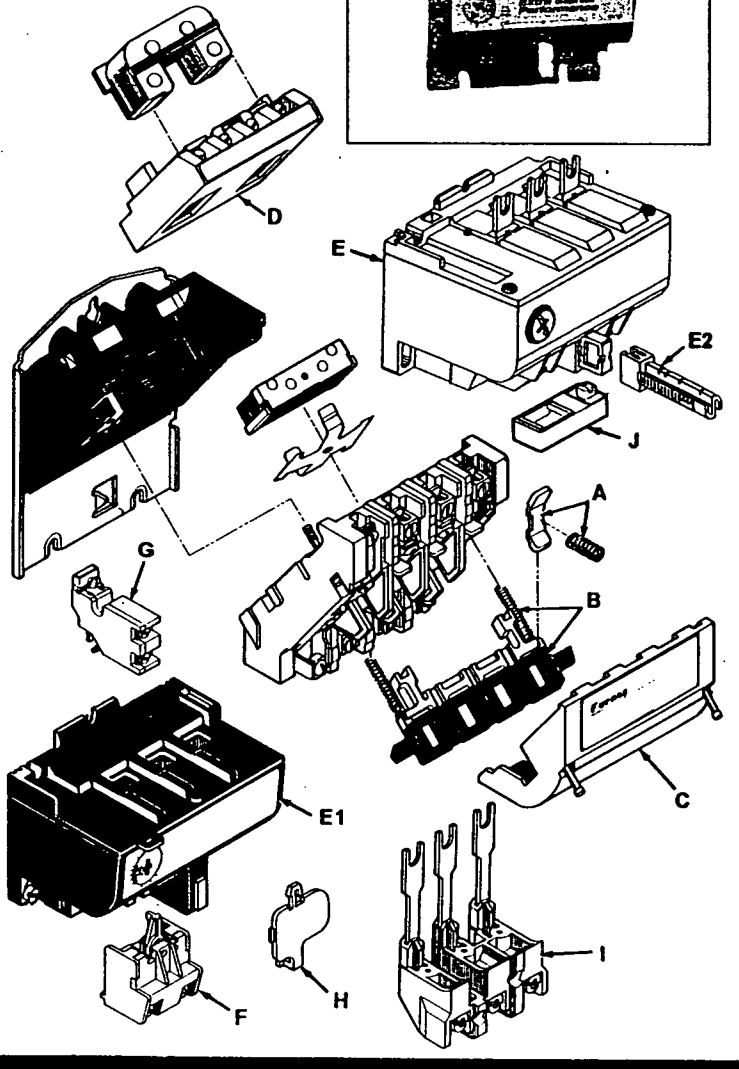
Class 14
Starters & Contactors
Sizes: 0, 1 & 1¾
14CS, 14DS, 14ES

Furnas

Replacement Parts 14-GES

September, 1994
Supersedes Issue of
July, 1993





9/94

Starters & Contactors
0, 1 & 1 3/4

Class 14
14CS, 14DS, 14ES

Item	Part Description			Part Number
A	Contacts & Spring, One Complete Pole			
	Power Pole	Size	0	75CF14
			1	75DF14
			1¾	75EF14
	Interlock Pole (includes spring retainer)	All Sizes		75AF14
B	Cross Arm (less contacts) With Cross Arm Springs			75P1000
C	Contact Board Cover			D29079001
D	Coil			
	60 Hertz	50 Hertz		
	120V	110V		75D73070F
	110-120V/220-240V	110V/190-220V		75D73070A
	220-240V/440-480V	190-220V/380-440V		75D73070C
	550-600V	550V		75D73070E
	(For other voltages specify the number stamped on the coil).			

E Overload Relays - 3 Phase

Size	Amps	Class 10	Class 20	Class 30
0, 1	0.25-1	48ASA3M10	48ASA3M20	48ASA3M30
0, 1	0.75-3	48ASB3M10	48ASB3M20	48ASB3M30
0, 1	2.5-10	48ASD3M10	48ASD3M20	48ASD3M30
	Overload Relays - Single Phase			
0, 1	0.75-3	48ASB1M10	48ASB1M20	48ASB1M30
0, 1	2.5-10	48ASD1M10	48ASD1M20	48ASD1M30
0, 1	5.0-16	48ASE1M10	48ASE1M20	48ASE1M30

E1 Overload Relays - 3 Phase

Size	Amps	Class 10	Class 20	Class 30
0, 1	3-6, 5-10 Old style *(use styles on above table)*			
0, 1	9-18	48ASE3M10	48ASE3M20	48ASE3M30
1, 1¾	13-27	48ASF3M10	48ASF3M20	48ASF3M30
1¾	20-40	48ASG3M10	48ASG3M20	48ASG3M30

E2	Reset Extender			49ASRE
F	Auxiliary Contact Overload Kit-NO Contact			49ASNO
			NC Contact	49ASNC
G	Front Mtg. Auxiliary Interlock SPST-NO			49AAFO
			NC	49AAFC
H	Tamper Resistant Cover	9-40A		49ASTC
I	Lug Extender (Size 0, 1)	9-40A		49ASLE
J	Dust Seal			49ASDS

NOTE: When ordering replacement parts, give catalog number of control and part name and number

Furnas Electric Company 1000 McKee Street, Batavia, Illinois 60510

Furnas

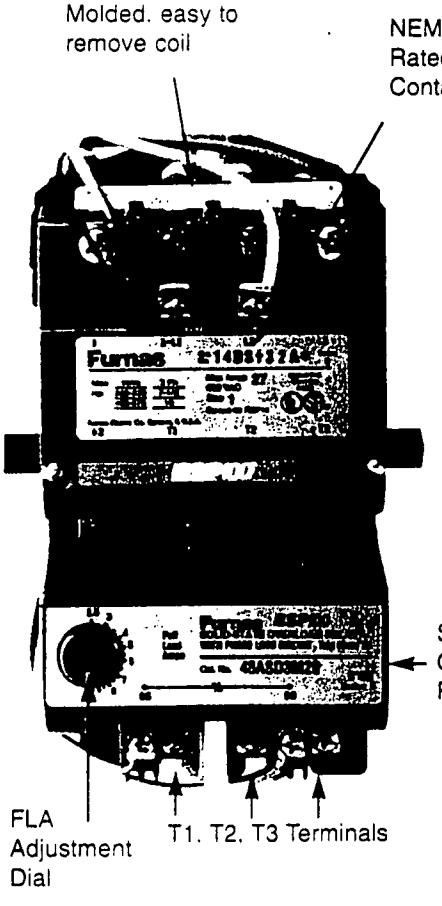
Furnas Electric Company
Batavia, Illinois 60510
(708) 879-6000
FAX (708) 879-0867

Furnas Electric Company
Markham, Ontario L3R 1G3
(416) 475-1798
FAX (416) 475-8630

14-GES 9/94

ESP100™

EASY TO INSTALL
EASY TO MAINTAIN



Motor Minder

The Smart Way to Protect Your Pump Investment

MODEL
301B

CONTROL or PILOT
VOLTAGE 115 VAC

☑ 301B-CT1 3 PHASE

UP TO 7.5 H.P.
208/230/460/575 VAC LOAD

10 TO 20 H.P.
460/575 VAC LOAD

☐ 301B-CT2 3 PHASE

10 TO 30 H.P.
208/230 VAC LOAD

20 TO 100 H.P.
460/575 VAC LOAD

SET-UP AND CALIBRATION:

1. Set "FULL LOAD" adjustment knob clockwise, and the "TRIP POINT" knob counter-clockwise.

2. Start motor and run under normal load conditions. The top light of the bar graph should come on. Turn the "FULL LOAD" knob counter-clockwise until light is below full-scale but above half-scale of the bar graph indicator.

3. Turn "TRIP POINT" knob clockwise until second light comes up towards, but below the "FULL LOAD" light setting. Slowly continue rotating the "TRIP POINT" knob clockwise until the "TRIP POINT INDICATOR" light starts to glow: this is close to the trip point. Back off the "TRIP POINT" setting slightly. Repeat this step (Step #3) until desired sensitivity is obtained.

4. If unit trips, the light on the bar graph will blink. Reset the unit manually by pressing the "MANUAL RESET" button, or allow the unit to Auto Restart by setting the "TIME-OFF" switch to the desired recovery time.

TIME-OFF SWITCH SETTINGS:
(Switch settings in hr:min)

- 0:09	5 - 1:22	9 - 2:35	D - 3:47
0:36	6 - 1:48	A - 3:02	E - 4:15
0:45	7 - 2:00	B - 3:11	F - 4:24
1:12	8 - 2:34	C - 3:38	0 - Manual

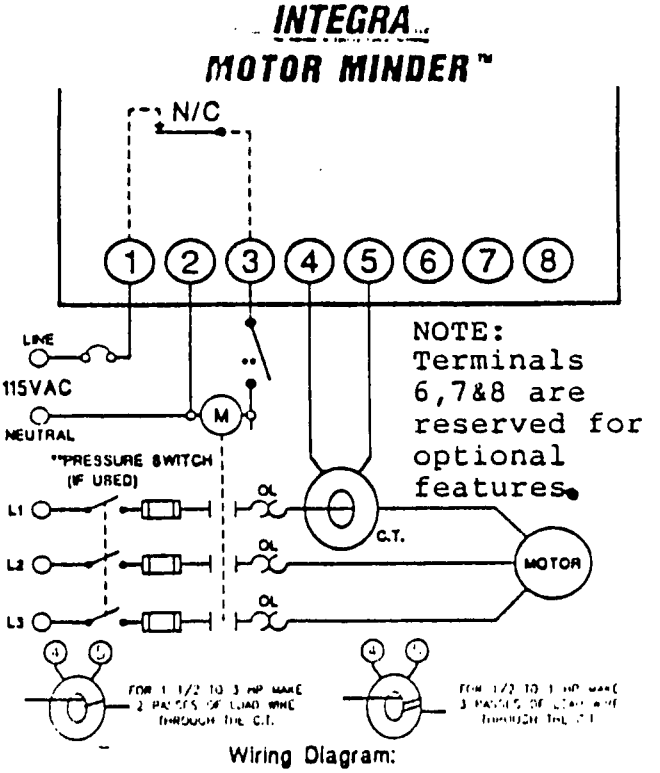
INSTALLATION:

1. Follow the wiring diagram below.

2. Use copper conductors ONLY.

3. Overload protection in accordance with NEC is required.

4. Terminal torque is 15 in/oz.

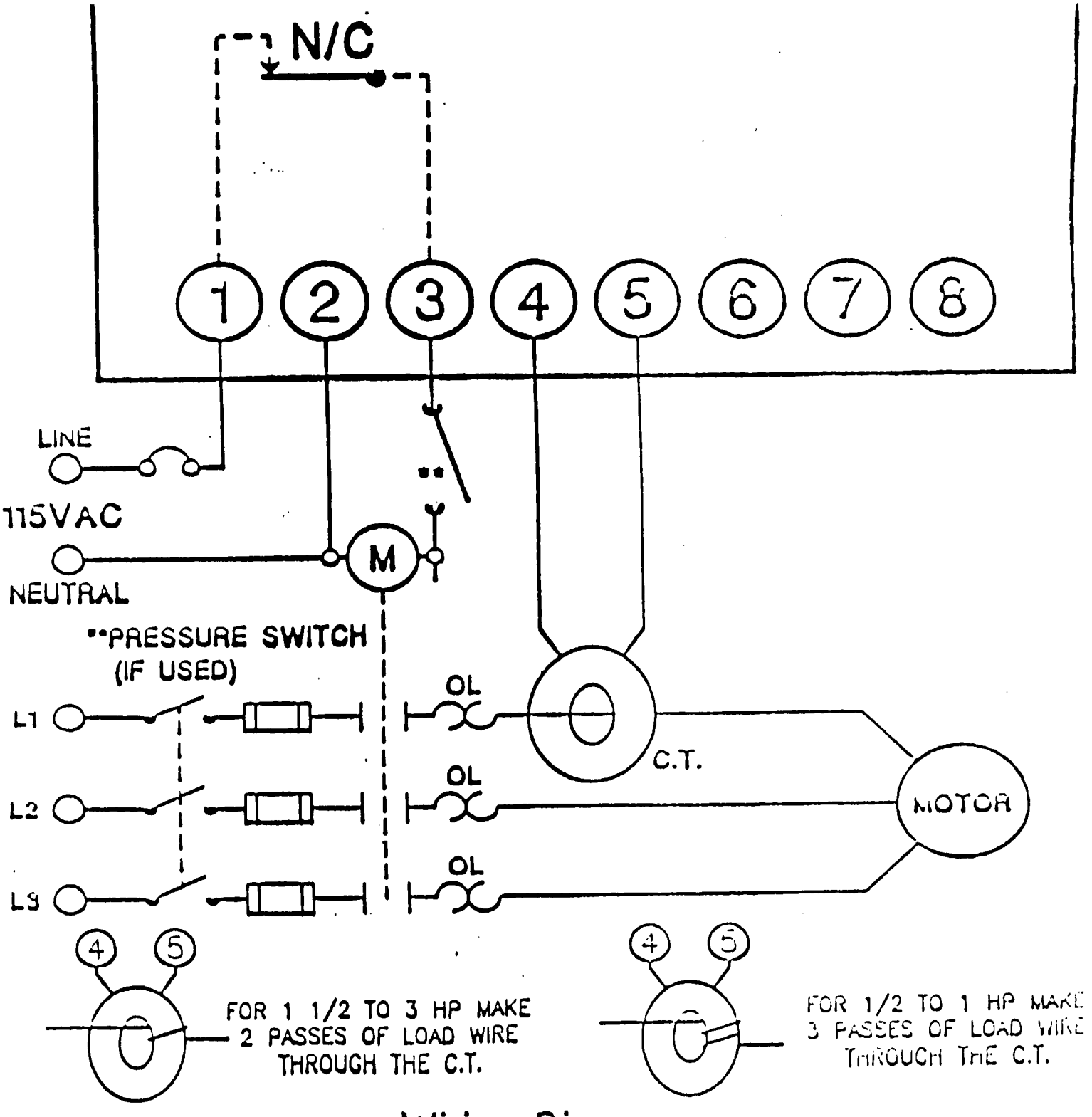


Wiring Diagram:
Motor Minder Model 301B

INTEGRA LLC

INTEGRA...

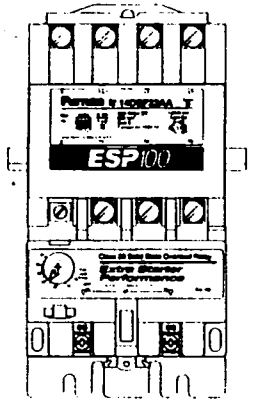
MOTOR MINDER™

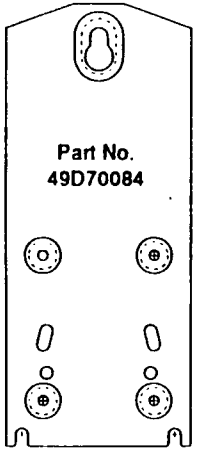


Wiring Diagram:
Motor Minder Model 301B

1 MOUNTING

No drilling required for retrofitting:





The Furnas ESP100 FVNR size 0-1¾ have as standard universal mounting which fits the following:

Cutler Hammer-
Citation Series
Freedom Series

GE- 300 Line

Square D- Type S

An additional adapter plate is required to retrofit the following:

Allen Bradley Bulletin 509
Bulletin 709

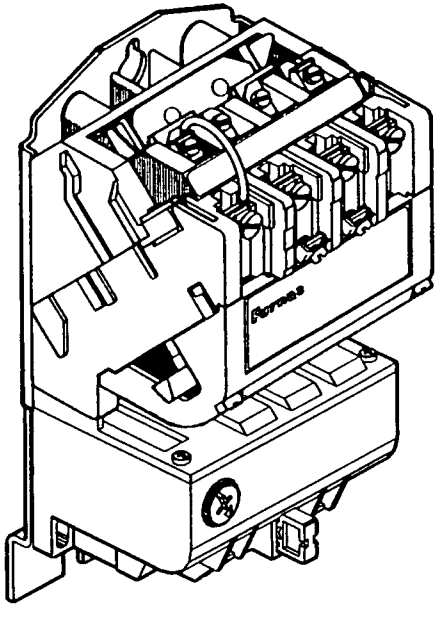
Westinghouse- Series A200

The ESP100 with it's existing backplate mounts onto the piggy back mounting plate and is secured in place with three mounting screws.

2 WIRING

Connect the motor leads to terminals T1, T2, and T3 on the ESP100 overload.

For contactor, wire per the enclosed wiring diagram. Use with motors at 50 or 60 Hz.

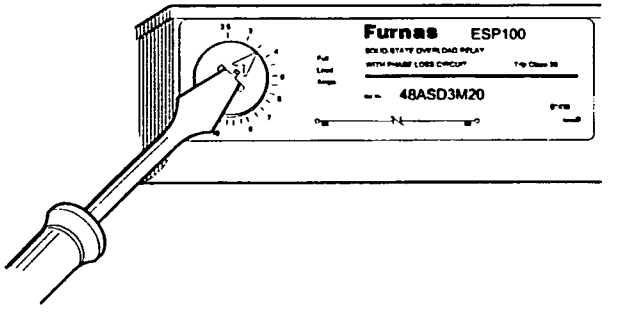


Single Phase versions are also available.

3 FLA ADJUSTMENT

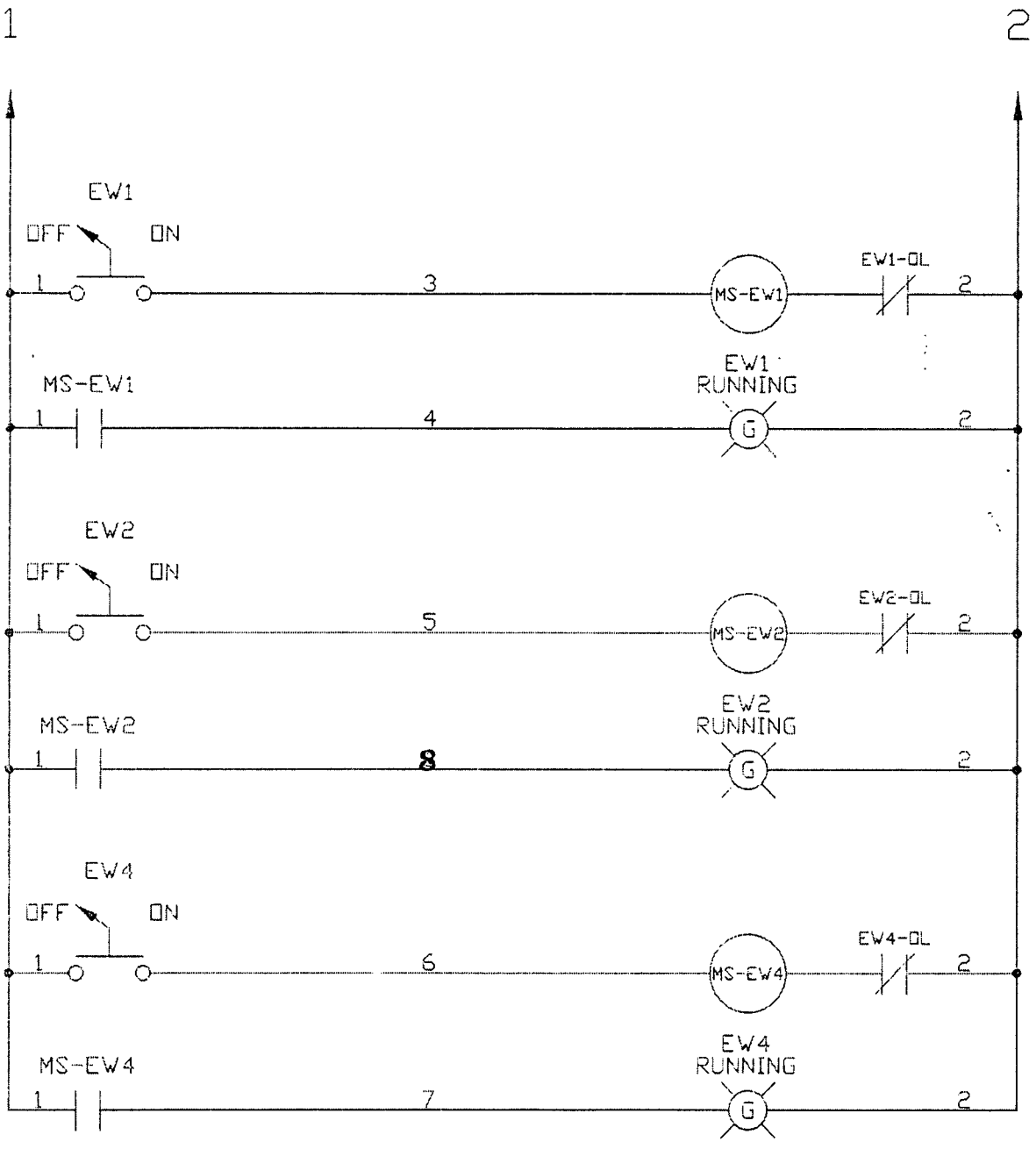
Set the adjustment dial on the overload to the Full Load Amps on the motor nameplate.*

In addition to the markings on the dial there are audible clicks which allow for extremely fine tuning. Note that while thermal overloads require a heater selection based on a relatively wide ampere range the overload on the ESP100 will have many clicks covering the same ampere range.



After the correct Full Load Amps have been selected, the gray adjustment cap can be removed to resist unwanted tampering with the setting. Pull the adjustment cap tab directly out from the face of the overload. To reinstall the cap, line up the arrow on the cap with the line on the red disk and push into place. The setting can then be adjusted.

*Service factor 1.0 ≈ amps x 0.9



STATUS:
PLOT DATE:

TRANS TECH
ELECTRIC, INC.
A Rockwell Automation Company
SOUTH BEND, IN (219)278-9473

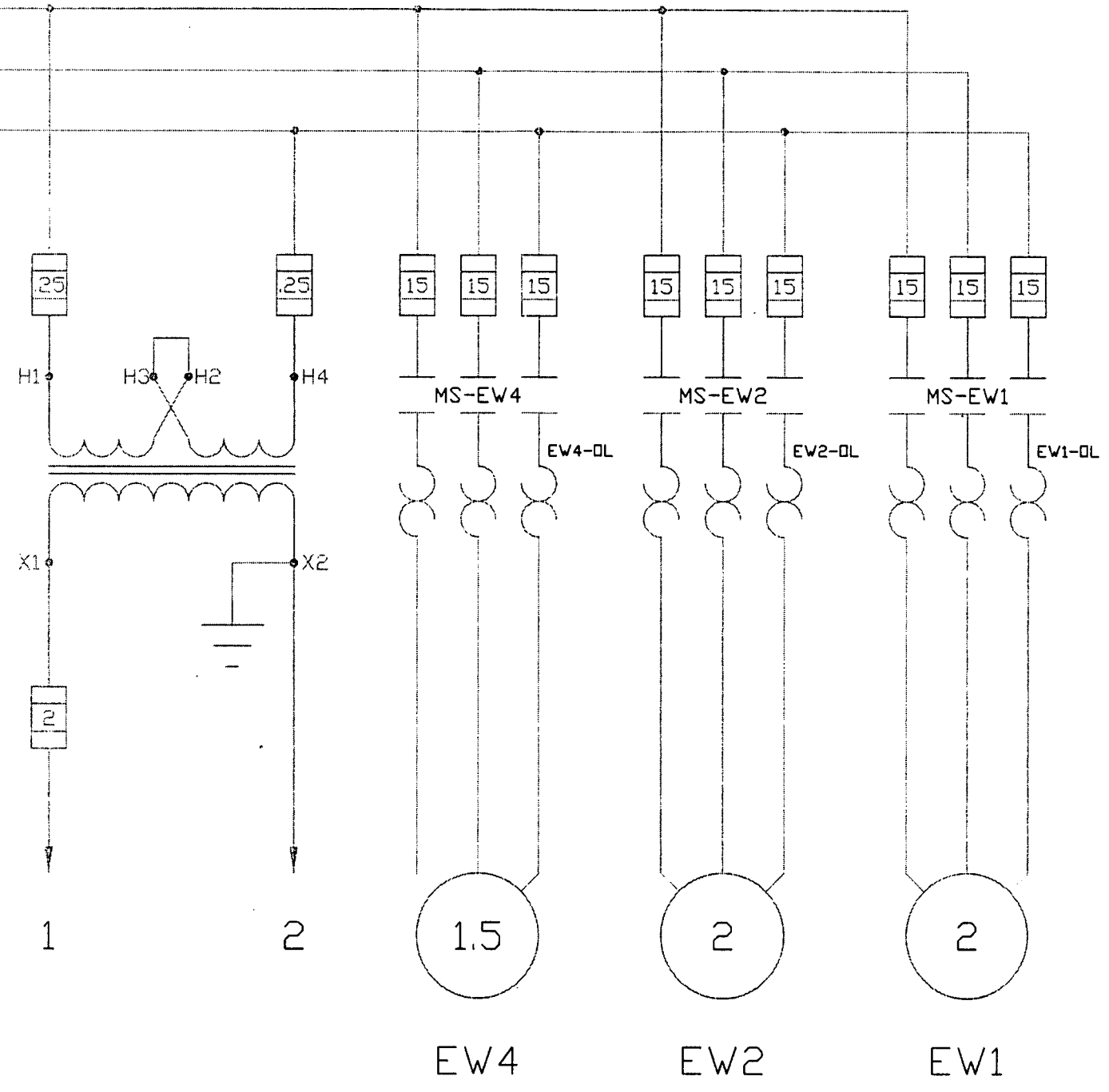
DETAIL NUMBER / SHEET ON/FROM — SECTION LETTER / SHEET ON/FROM

TOLERANCES UNLESS OTHERWISE SPECIFIED
.XX ±.01
.XXX ±.005
FRACTIONAL ±1/64
ANGULAR ±1°

TITLE:

CAD FILE NAME				SCALE	JOB NO.
DRN	DATE	DEPT.	DISC.	SIZE	ENTITY	DRAWING NO.
SHT. NO. of	PREVIOUS DRAWING		NEXT DRAWING			

REVISIONS



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ELECTRIC INC.
A Kimball Electronics Company
SOUTH BEND, IN (219)-276-9673

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SECTION LETTER / SHEET ON/FROM

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DRN	DATE	DEPT.	DISC.	SIZE	ENTITY	DRAWING NO.
SHT. NO. OF	PREVIOUS DRAWING		NEXT DRAWING			

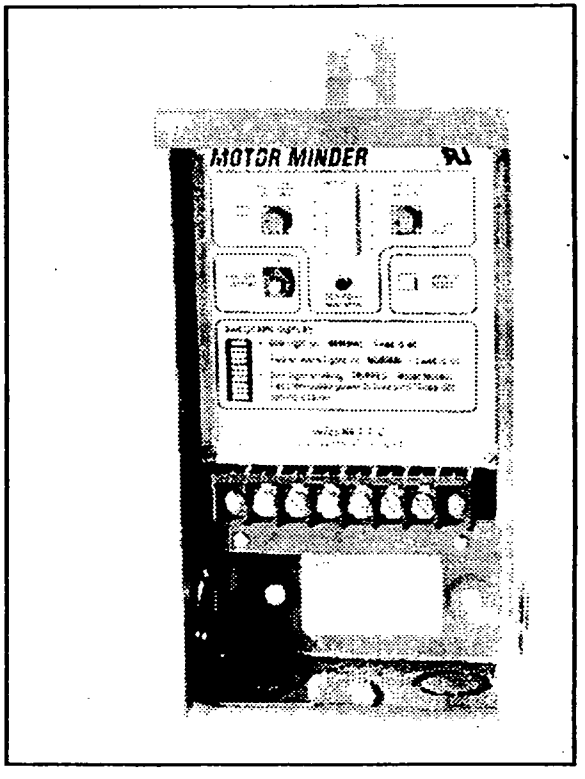
REVISIONS

PUMP CONTROLLER

MAKE: Integra

MODEL: Motor Minder

INTEGRA, LLC
The Innovator In Electrical Control Technology



MOTOR MINDER™

Installation Manual

Table of Contents

Installation Guide

Thank you for purchasing the Motor Minder. The first step for a successful installation is to verify that you have selected the appropriate Model for your installation. You will need to verify the model number, voltage, phase and horsepower. The first step in verifying the model number is to remove the cover. Loosen the screw at the bottom of the unit until you can lift the cover up and slide out. Upon having removed the cover, look at the UL sticker on the bottom of the base unit, check the model number and rating for voltage, phase, and horsepower (see Diagram 1). Verify that the load of your motor matches the Motor Minder horsepower rating, phase and voltage rating. In the event that it does not match-up with your unit, please immediately contact the company you purchased the unit from. **DO NOT INSTALL UNLESS YOU HAVE PURCHASED THE PROPER MODEL.**

Note: If you have purchased a panel mount version of the Motor Minder (no enclosure), the UL sticker is on the top bracket.

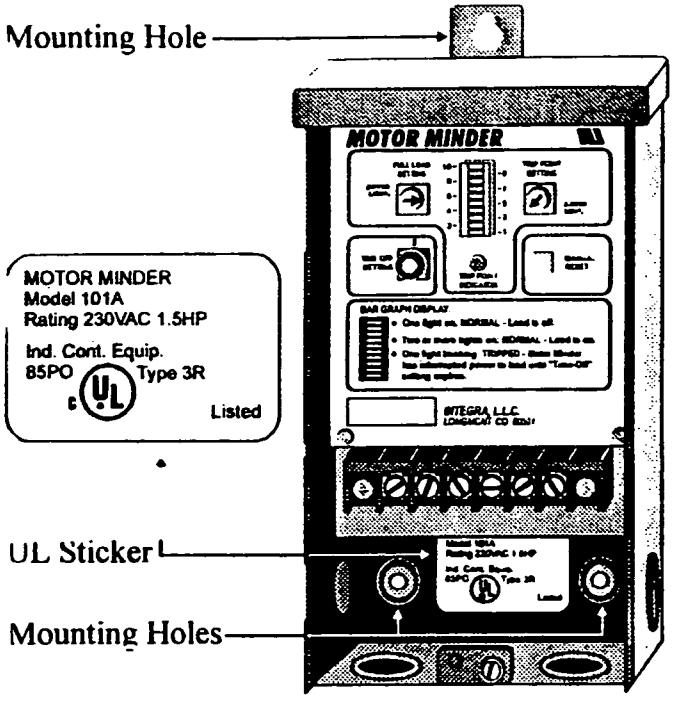


Diagram 1 — Motor Minder

Single Phase Installation

Upon verifying that the unit you have purchased is correct, select a suitable location for mounting your Motor Minder. This unit is in a UL type enclosure and is suitable for mounting outdoors. Two mounting holes are on the bottom next to the UL label and one is on top of the unit (see Diagram 1). Once you've completed mounting the unit, connect the appropriate conduit and pull in the line, load, and ground wires.

115 VAC Installation

If you are installing a 115 volt unit refer to Diagram 2 and/or the wiring diagram on the inside cover of the unit you purchased.

Connect 115 volt wire to terminal #1 and the neutral (white) wire connects to terminal #2.

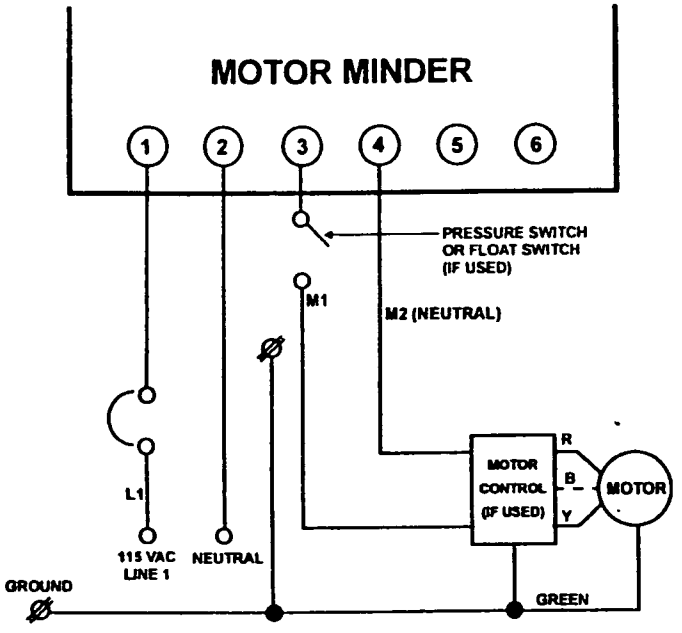


Diagram 2 — Single Phase Installation 115 VAC Wiring

Terminal #3 connects to the hot side of the motor (M1). Terminal #4 connects to the neutral side of motor (M2).

Connect the ground wire to the green ground screw located on the tab at the bottom of the enclosure.

Note: In our standard models there are no connections required for terminals #5 and #6, these are reserved for other options.

230 VAC Installation
If you are installing a 230 volt system refer to diagram #3 and/or the wiring diagram on the inside cover of the unit you purchased.

Connect 230 volt line to terminals #1 and #2.

Terminal #3 connects to motor (M1) and terminal #4 connects to motor (M2).

Connect the ground wire to the green ground screw located on the tab at the bottom of the enclosure.

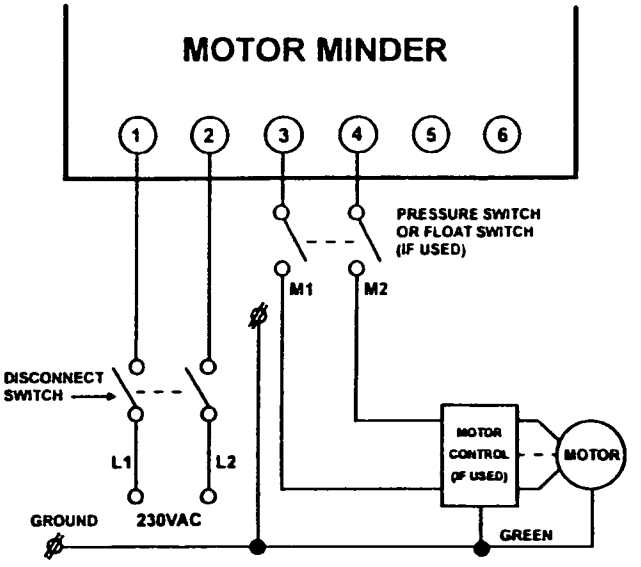


Diagram 3 — Single Phase Installation 230 VAC Wiring

Three Phase Installation

Upon verifying that the unit you have purchased is correct for the installation you plan to do, verify that the control voltage matches the voltage rating on the motor starter coil. Select a suitable location for mounting your Motor Minder. This unit is in a UL type enclosure and is suitable for mounting outdoors. The mounting holes are on the bottom next to the UL label at the top of the unit. Following Diagram 4, the control voltage connects to terminals #1 and #2 and to one side of the magnetic starter coil; terminal #3 on the Motor Minder connects to the other side of the magnetic starter coil. Remove the protective foam from the current transformer. Find one of the three phase wires that are going to the motor and pass this wire through the hole in the current transformer, as Diagram 5 indicates: If you have a 1-1/2 to 3 horsepower motor make two passes (loops) of this wire through the hole; for 3/4 to 1 horsepower motor make three passes (loops) of this wire through the hole in the current transformer; for 5 horsepower and above motor, make only one pass (loops) through the current transformer. After the proper turns through the current transformer, connect the wire to the remaining phase on the motor starter.

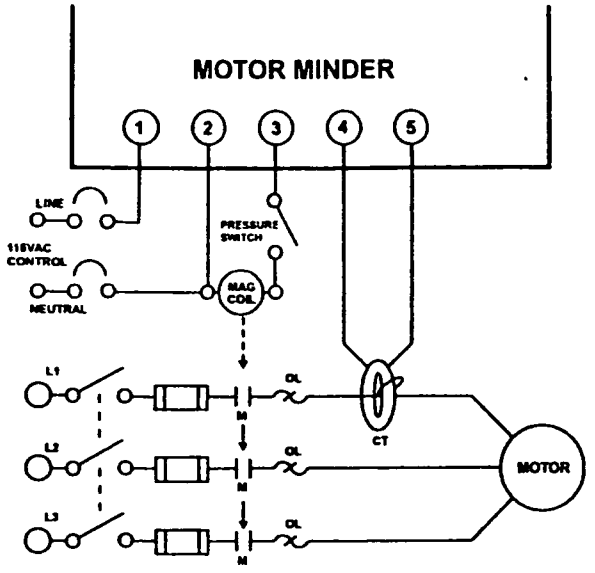


Diagram 4 — Three Phase Installation

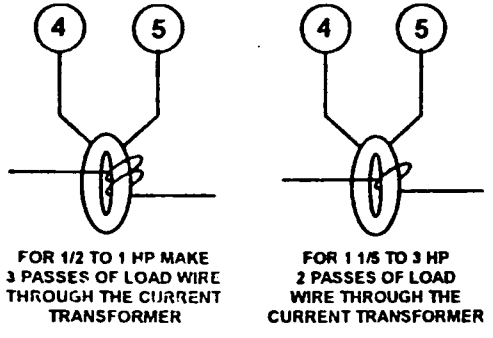


Diagram 5 — Current Transformer

You have now completed Installation. Please double check all connections, maximum terminal torque is 15 in/oz. You are now ready for set-up and calibration.

Set-up and Calibration

Move the **"Full Load"** adjustment knob **clockwise** until you feel the stop point. DO NOT try to move the adjustment knob past this point as you will break the knob (refer to Diagram 6).

Adjust the **"Trip Point"** knob **counter clockwise** until you feel the stop position, again DO NOT try to force the unit past the stop position (refer to Diagram 6).

Start motor and run under normal load conditions, if the motor is on and correctly running the top light of the bar graph will be lit. The light will be on at the Number 10 position which is full scale. Turn the "Full Load" knob counter clockwise slowly until the top light drops into the 6 to 9 range (refer to Diagram 7).

Slowly turn the "Trip Point" knob clockwise until you notice a second light coming up the scale. Continue to turn the knob upscale until the "Trip Point" indicator light begins to glow (refer to Diagram 7).

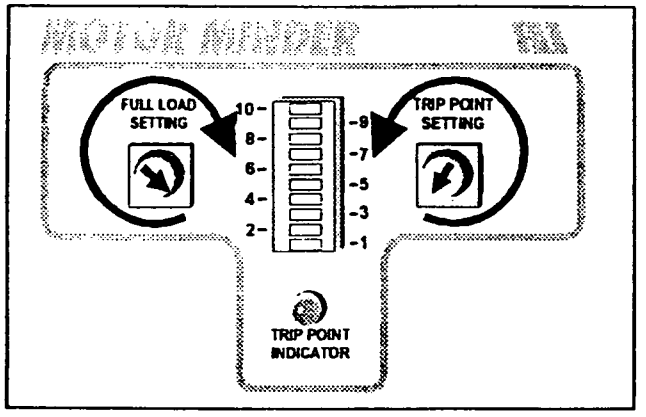


Diagram 6 — "Full Load" and "Trip Point" Initial Settings

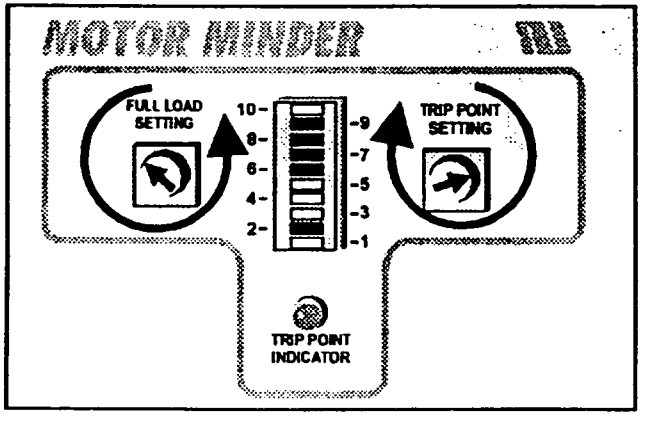


Diagram 7 — "Full Load" and "Trip Point" Settings

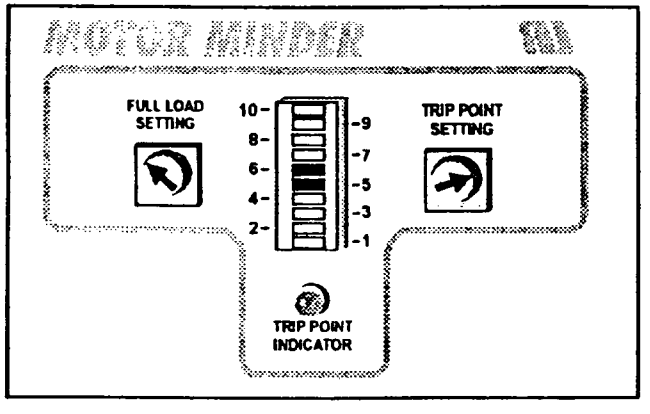


Diagram 8 — Motor Minder's most sensitive position

Once you've got the "Trip Point" indicator light to glow, you will now need to back-off that setting slightly until the light no longer glows. At this point you have reached the most sensitive setting. In the event that you desire the setting not to be at its most sensitive point, continue to back-off (Counter Clockwise) the "Trip Point" setting. You will notice the two lights on the bar graph begin to indicate greater distance between the two points. If it is possible to simulate an under load condition, do so at this time, the "Trip Point" indicator light (the small red one at the bottom) should come on and the Motor Minder should trip and shut off the motor. If the light does not come on, increase your sensitivity (trip point knob) until the Motor Minder trips and the motor shuts off. In the event you cannot simulate the under load condition, we recommend using the most sensitive condition when you do your installation. Again the most sensitive position would be "Trip Point" light setting on #5 and the "Full Load" light setting to #6 (see Diagram 8). When the Motor Minder trips, the "Full Load" setting light will run down off the scale and the "Trip Point" setting light will blink indicating that the Motor Minder is counting down to re-start.

If the unit trips, the light will "blink". Manually restart the unit by pushing the Reset button or auto restart by setting the "Time Off" switch to the desired restart time.

Operational Status from the Motor Minder

The following Diagrams are the Operational Status provided by the Motor Minder (Diagrams 9 - 13).

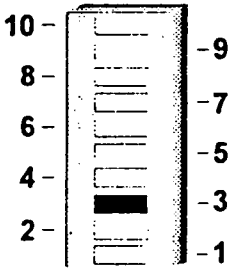


Diagram 9 — Normal, Unit Powered

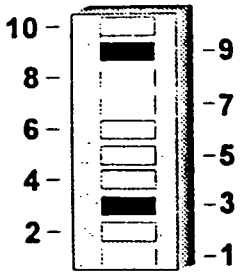


Diagram 10 — Normal, Unit Powered, Motor Running

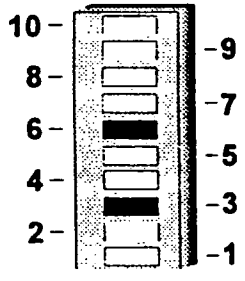


Diagram 11 — Conditions Changing, Unit Powered, Motor Running

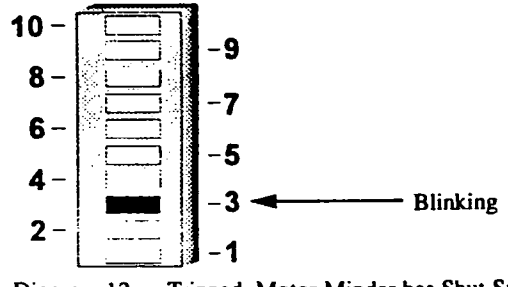


Diagram 12 — Tripped, Motor Minder has Shut System Down

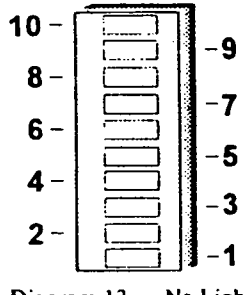


Diagram 13 — No Lights, No Power, Unit and Pump are not powered or Motor Minder is set in by-pass mode (trip point knob set fully counter clockwise) and motor is off.

Time Off Switch Settings

There are sixteen setting points on the Time Off Switch Setting. These settings range from numbers 1 through 9 and then settings A, B, C, D, E, and F. Finally there is a zero (0) setting point for manual restart. When the unit is set to the zero setting, the unit will not restart until you manually restart it. Each setting allows for the load to be in a time out mode for a different length of time. Referring to our Time Off Switch Diagram 14 you will notice the amount of time that the load will be off based upon the setting that you select. As an example, if you select setting 1 the unit will be off for nine minutes. If you select setting 5, the unit will be off for one hour and twenty two minutes and if you select setting A the unit will be off for three hours and two minutes during normal operation.

In the event that you desire to manually reset the unit at any point in time, simply press the Manual Reset button located on the middle right hand side of the unit or turn off power for 15 or more seconds. Select the proper setting for your Time Off Switch. You are now ready to put the cover back on.

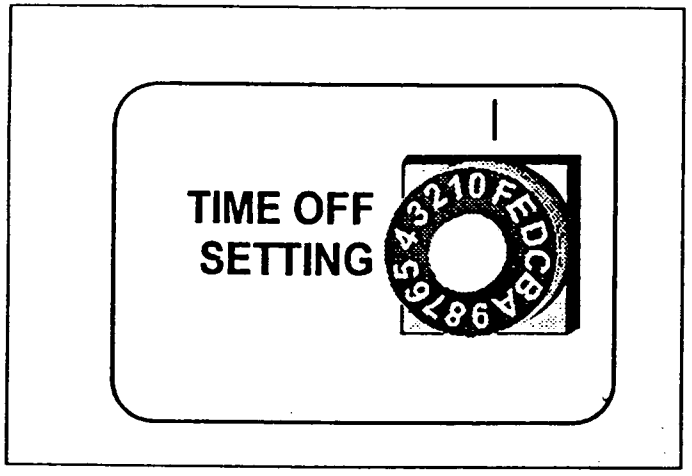


Diagram 14 — Time Off Switch (shown in position "0")

Switch Settings

Switch Settings	Time Off Hr./Min.	Switch Settings	Time Off Hr./Min.
1 —	0:09	9 —	2:35
2 —	0:36	A —	3:02
3 —	0:45	B —	3:11
4 —	1:12	C —	3:38
5 —	1:22	D —	3:47
6 —	1:48	E —	4:15
7 —	2:00	F —	4:15
8 —	2:34	0 —	Manual Reset

Trouble Shooting Guide

CAUTION: Electrical shock hazard may exist. Trouble shooting electrical control systems should only be performed by qualified personnel.

What to do if there is no power?	Check for blown fuses or tripped circuit breaker. Check fuses for recommended size. Check all power source connections. Repair or replace loose, dirty or corroded connections. Check for faulty wiring. Using a volt meter, check for proper incoming line voltage from power company.

What to do if there is power to the Motor Minder but the motor will not run	Check all connections on the Motor Minder terminal block. Check for proper voltage at the Motor Minder terminal block and on the terminals feeding the load. A) If there is no voltage on these terminals Motor Minder is defective and will need repair or replacement. B) If there is the proper voltage on these terminals then check the following: Open or faulty wiring between Motor Minder and the motor. ✔ Defective pressure or float switch. ✔ Defective motor starter or control box. ✔ Defective motor.
What to do if the motor starts and immediately shuts down	When the motor starts, watch for the top light on the Motor Minder bar graph to come on and then immediately and rapidly descend down and off scale. This indicates that the motor is trying to start but is tripping. Check for the following: ✔ Locked rotor caused by seized bearing or jammed impeller. ✔ Defective starter winding. ✔ Defective control box on 3 wire submersible pumps. ✔ Defective motor starter. ✔ Short or grounded wiring in starting circuit. (Check for the above per the motor manufacturers instruction).

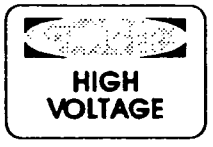
What to do if the motor starts and the Motor Minder trips immediately	Start the motor and observe the "Trip point indicator light". If the trip point indicator light comes on immediately, the sensitivity is set to tight. Back off (turn counter clockwise) the "trip point setting control" or recalibrate per the instruction manual.
What to do if the motor starts and stops several times in rapid succession and the Motor Minder trips?	In a pressurized system, this is known as rapid cycling where the pressure switch oscillates on and off due to loss of air in the pressure tank. The Motor Minder is designed to detect this condition and shut down the pump to prevent system damage. To restore the system to normal, check for a defective bladder and/or recharge pressure tank per manufacturers instructions.
What to do to by-pass the Motor Minder	At times it may be desirable to by-pass the Motor Minder to trouble shoot other parts of the system. This can be accomplished by turning the "trip point control" fully counter clockwise until the bottom light on the bar graph display goes down and off scale. At this setting, the Motor Minder will not trip and can be considered to be in the by-pass mode. **CAUTION: Be sure to return the trip point setting to it's original setting when finished.**

What to do if the Motor Minder will not automatically reset	Check to see if the trip point setting light is blinking. The blinking light indicates that the Motor Minder has tripped and activated the internal count down timer. Check the setting on the rotary restart timer switch. If the switch is in any position other than "zero", the Motor Minder should reset within plus or minus 20 seconds of the time setting. (See timer chart, page 12). If it does not reset, the unit is defective and will need repair or replacement. If the timer switch is in position "zero", the automatic re-start mode is ignored (inactive). Re-start can only be done manually.

MOST COMMONLY ASKED QUESTIONS

QUESTION	ANSWER
Can the Motor Minder be installed outdoors.	Yes, the standard Motor Minder comes mounted in a NEMA 3R enclosure.
Is the Motor Minder available without an enclosure.	YES, a stand alone panel mount model is available that meets the UL 508 Industrial Control Standards and is listed as a UL Recognized component that can be mounted in panels containing other UL Recognized electrical devices.
Will the Motor Minder work on 2 or 3 wire submersible pumps.	YES.
Is the Motor Minder UL Listed and CSA approved.	YES. Meets UL 508 and CSA Industrial Control Standards
Can the Motor Minder be manually reset other than pushing the reset button.	YES. Manual reset can be accomplished by disconnecting power for 15 or more seconds.
Can the Motor Minder be electrically installed before or after the pressure switch.	YES.
Are there accessories or options available to the standard unit.	YES. Consult factory.
Are any special tools required for installation and/or calibration.	NO.
Is the set up and calibration of the 3 phase Motor Minder different from the single phase unit.	NO.
Does the Motor Minder have to be re-calibrated after a power failure.	NO.

SAFETY WARNING



MAKE SURE ALL POWER IS TURNED OFF BEFORE INSTALLATION. DO NOT EXCEED #8 COPPER WIRE ON THE TERMINAL BLOCK. USE COPPER CONDUCTORS ONLY. MOUNT THE UNIT USING QTY. (3) #8 SCREWS APPROPRIATE FOR THE TYPE OF MATERIAL THE UNIT IS BEING MOUNTED ON. ALL UNITS MUST BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE. USE THE GREEN GROUND SCREW PROVIDED IN THE UNIT FOR GROUNDING.

Tools Required for Installation

- ✔ Flat Head Screwdriver
- ✔ Wire Strippers
- ✔ Drill for mounting unit

If Using Conduit

- ✔ 1/2" or 3/4"conduit bender

Other Required Materials

- ✔ Conduit fittings (1/2" to 3/4") depending upon installation
- ✔ Appropriate size wire is required in accordance with the National Electrical Codes standards.

REQUIRED: Appropriate overload protection in accordance with the national electrical codes (NEC) standards.

INTEGRA, LLC
The Innovator in Electrical Control Technology

LIMITED WARRANTY

INTEGRA, LLC, warrant each new product against defects in material or workmanship for a period of one year from date of installation or 18 months from date of manufacture. This warranty excludes all other warranties, expressed or implied, and no liability is assumed for damage due to accident, abuse, lack of reasonable care, loss of parts, or subjecting the instrument to input values of a magnitude in excess of those specified.

This warranty is in lieu of any other expressed or implied warranties including warranty of merchantability or fitness for a particular purpose and of any other obligation on the part of the seller. INTEGRA, LLC neither assumes nor authorizes any person to assume for it any other liability in connection with the sale of its equipment. This warranty will not apply to any equipment which shall have been repaired or altered outside of INTEGRA, LLC, factory in any way so as, in INTEGRA, LLC, judgment, to affect its stability, or reliability, nor which has been subject to misuse, negligence, or accident.

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.

Toll Free: (800) 208-3008

Motor Minder

The Smart Way to Protect Your Pump Investment

MODEL
301B

CONTROL or PILOT
VOLTAGE 115 VAC

☑ 301B-CT1 3 PHASE
UP TO 7.5 H.P.
208/230/460/575 VAC LOAD

10 TO 20 H.P.
460/575 VAC LOAD

☐ 301B-CT2 3 PHASE
10 TO 30 H.P.
208/230 VAC LOAD

20 TO 100 H.P.
460/575 VAC LOAD

SET-UP AND CALIBRATION:

1. Set "FULL LOAD" adjustment knob clockwise, and the "TRIP POINT" knob counter-clockwise.

2. Start motor and run under normal load conditions. The top light of the bar graph should come on. Turn the "FULL LOAD" knob counter-clockwise until light is below full-scale but above half-scale of the bar graph indicator.

3. Turn "TRIP POINT" knob clockwise until second light comes up towards, but below the "FULL LOAD" light setting. Slowly continue rotating the "TRIP POINT" knob clockwise until the "TRIP POINT INDICATOR" light starts to glow: this is close to the trip point. Back off the "TRIP POINT" setting slightly. Repeat this step (Step #3) until desired sensitivity is obtained.

4. If unit trips, the light on the bar graph will blink. Reset the unit manually by pressing the "MANUAL RESET" button, or allow the unit to Auto Restart by setting the "TIME-OFF" switch to the desired recovery time.

TIME-OFF SWITCH SETTINGS:
(Switch settings in hr:min)

1 - 0:09	5 - 1:22	9 - 2:35	D - 3:47
2 - 0:36	6 - 1:48	A - 3:02	E - 4:15
3 - 0:45	7 - 2:00	B - 3:11	F - 4:24
4 - 1:12	8 - 2:34	C - 3:38	0 - Manual

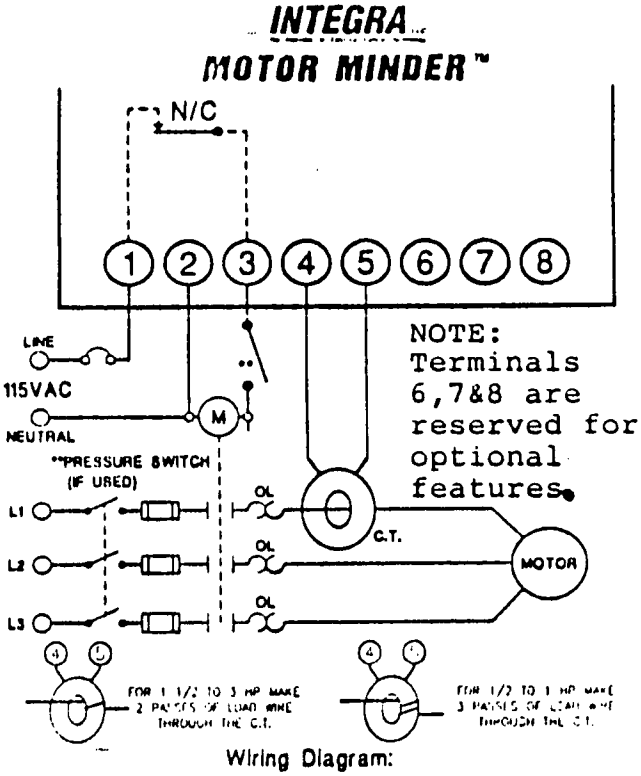
INSTALLATION:

1. Follow the wiring diagram below.

2. Use copper conductors ONLY.

3. Overload protection in accordance with NEC is required.

4. Terminal torque is 15 in/oz.

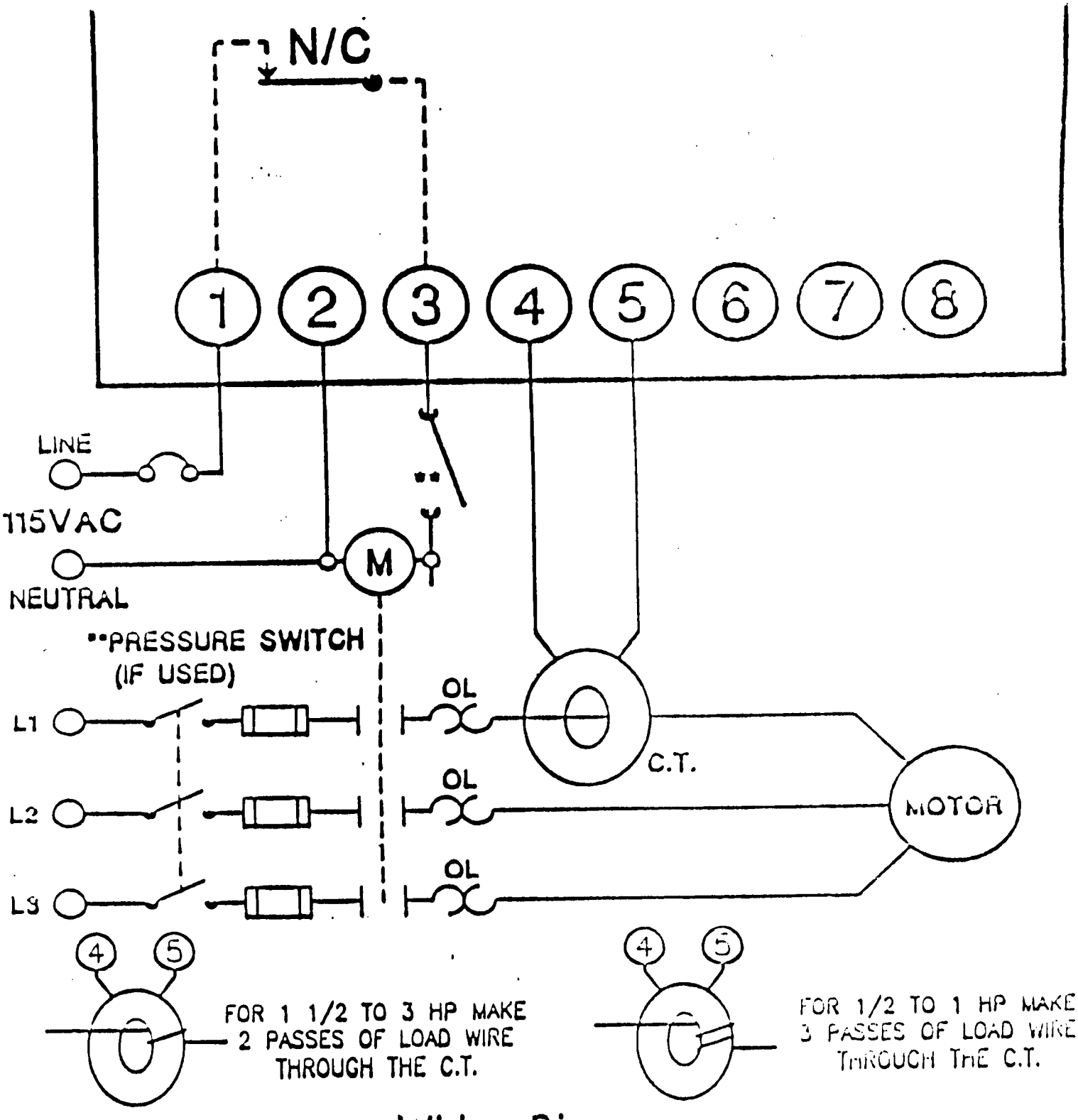


Wiring Diagram:
Motor Minder Model 301B

INTEGRA LLC

INTEGRA...

MOTOR MINDER™



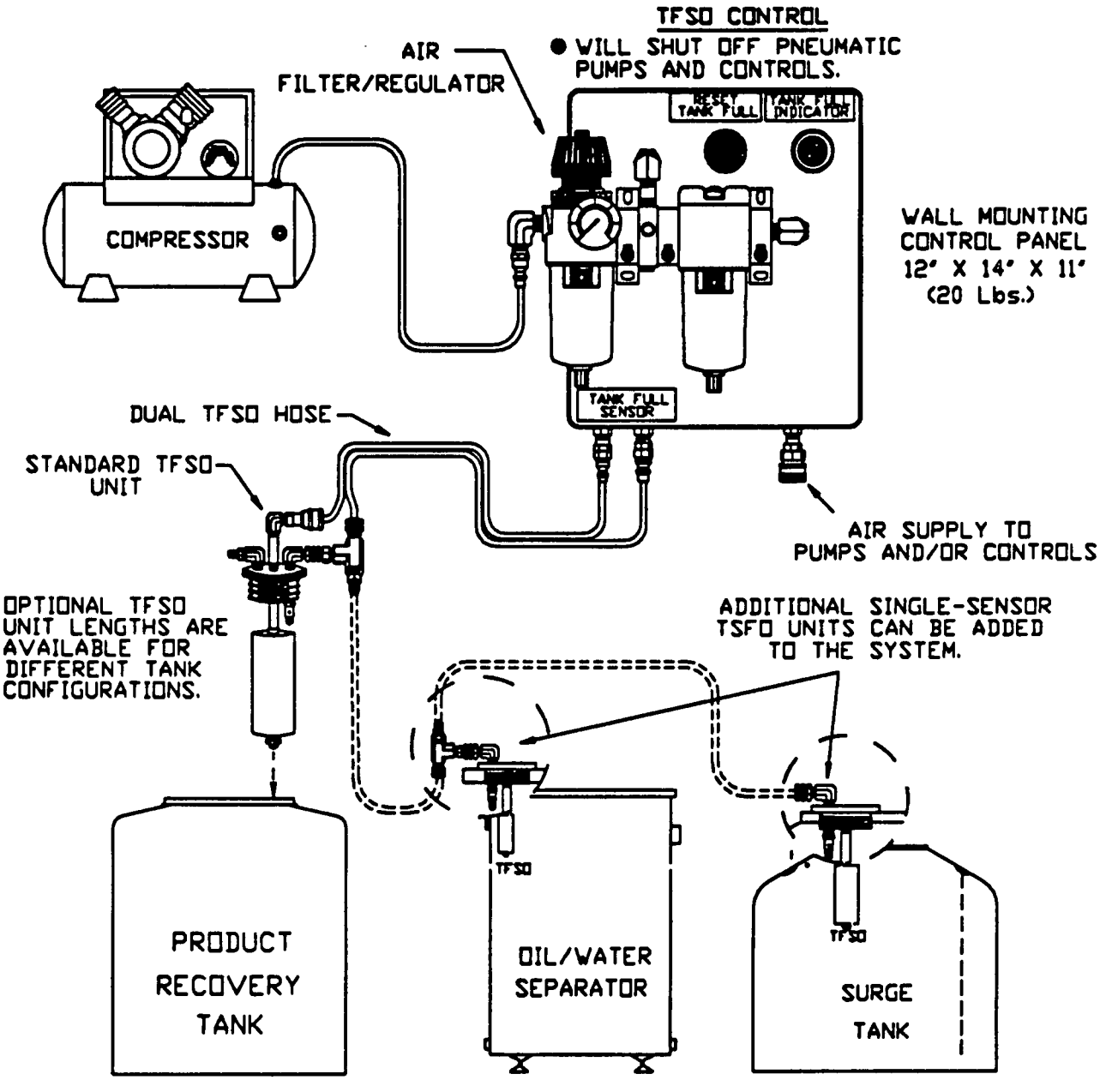
Wiring Diagram:
Motor Minder Model 301B

APPENDIX D

PNEUMATIC SELECTIVE OIL SKIMMER SYSTEM – MANUFACTURER CUT SHEETS

DUAL TANK FULL SHUT OFF (TFSO) SENSOR SYSTEM

THE CEE TFSO SYSTEM PROTECTION EXTENDS BEYOND THE CLASSIC PRODUCT TANK-FULL CONDITION. IT ALSO INCLUDES THE SENSOR HOSES FOR ADDED SITE SAFETY. IN ADDITION, ALL EQUIPMENT RECEIVING AIR THAT IS FED BY, AND DOWNSTREAM OF, THE TFSO CONTROL, INCLUDING FLUID EXTRACTION PUMPS AND SKIMMERS, WOULD ALSO BE SHUT DOWN.



- IF ANY SENSOR HOSE IS DISCONNECTED, THE SYSTEM WILL SHUT DOWN.
- IF ANY DUAL SENSOR HOSE IS PINCHED OR CUT, THE SYSTEM WILL SHUT DOWN.
- IF ANY SINGLE TANK ARMED WITH A TFSO UNIT SHOULD FILL, THE SYSTEM WILL SHUT DOWN.

CLEAN ENVIRONMENT ENGINEERS, INC.
EQUIPMENT FOR FUEL SPILL REMEDIATION AND GROUNDWATER CLEAN-UP
5835 DOYLE STREET, SUITE 102
EMERYVILLE, CA 94608
(510) 654-4240 (800) 537-1767 FAX (510) 654-4193

TOLERANCES UNLESS OTHERWISE SPECIFIED ANGULAR : 30' FRAC : XXX : .005 XX : .01 XXXX : .0005	APPROVALS	DATE	TITLE DUAL TANK FULL SHUT OFF (TFSO) SENSOR SYSTEM
	DRAWN TONY RAMIREZ	6-19-92	
	DESIGNER		MODEL No. / REV
MATERIAL	CHECKED		
FINISH	APPROVED		SCALE NONE / SHT 1 OF 1

BUILT.VL

CLEAN ENVIRONMENT EQUIPMENT

SOS SELECTIVE OIL SKIMMER (FOR 2" AND 4" WELLS)

FUNCTION:

The Selective Oil Skimmer can essentially remove all free floating hydrocarbon on groundwater without removing any water. It can remove the hydrocarbon to a sheen or about two-hundredths (.02") of an inch. Alternate size SOS skimmers are available for operating in 2" (5 cm) and 4" (10 cm) diameter wells to a depth of 250 feet.

METHOD OF OPERATION:

The skimmer float slides up and down on a guide tube which serves to center the device in the well and also carry oil from the skimmer up out of the well. The skimmer float can then follow the fluctuation of water level in the well and maintain its designed inlet level at the oil/water interface. A semi-permeable screen inside the skimmer float allows oil to pass into the skimmer, but repels water. Water will be excluded unless the skimmer float is forcibly submerged 2 inches beneath the water.

There are no electrical switches or sensors in or around the skimmer. When the oil has been removed to a sheen, the skimmer merely passes air to the pumps, which are designed to be able to run dry without damage. Air-driven double diaphragm pumps or SOS product bladder pumps can be used with this skimmer. The SOS skimmer can be used with water draw-down to draw more oil into the well.

The skimmer can be steam cleaned without damage.

FLOW RATE:

2" Skimmer: 0.25 gallons (0.9 liters) per minute / 360 gpd

4" Skimmer: 0.7 gallons (2.6 liters) per minute / 1000 gpd

SIZE:

2" Skimmer: Floating skimmer head at 1.75" (4.4 cm) in diameter and 8" (20 cm) in height

The full skimmer is 36" (91 cm) long including a 30" (76 cm) guide tube and 1.8" (4.6 cm) diameter centering disk

SIZE (cont'd):

4" Skimmer: Floating skimmer head at 3.7" (9.4 cm) in diameter and 6" (15 cm) in height

The full skimmer is 48" (122 cm) long including a 30" (76 cm) guide tube and 3.8" (9.6 cm) diameter centering disk

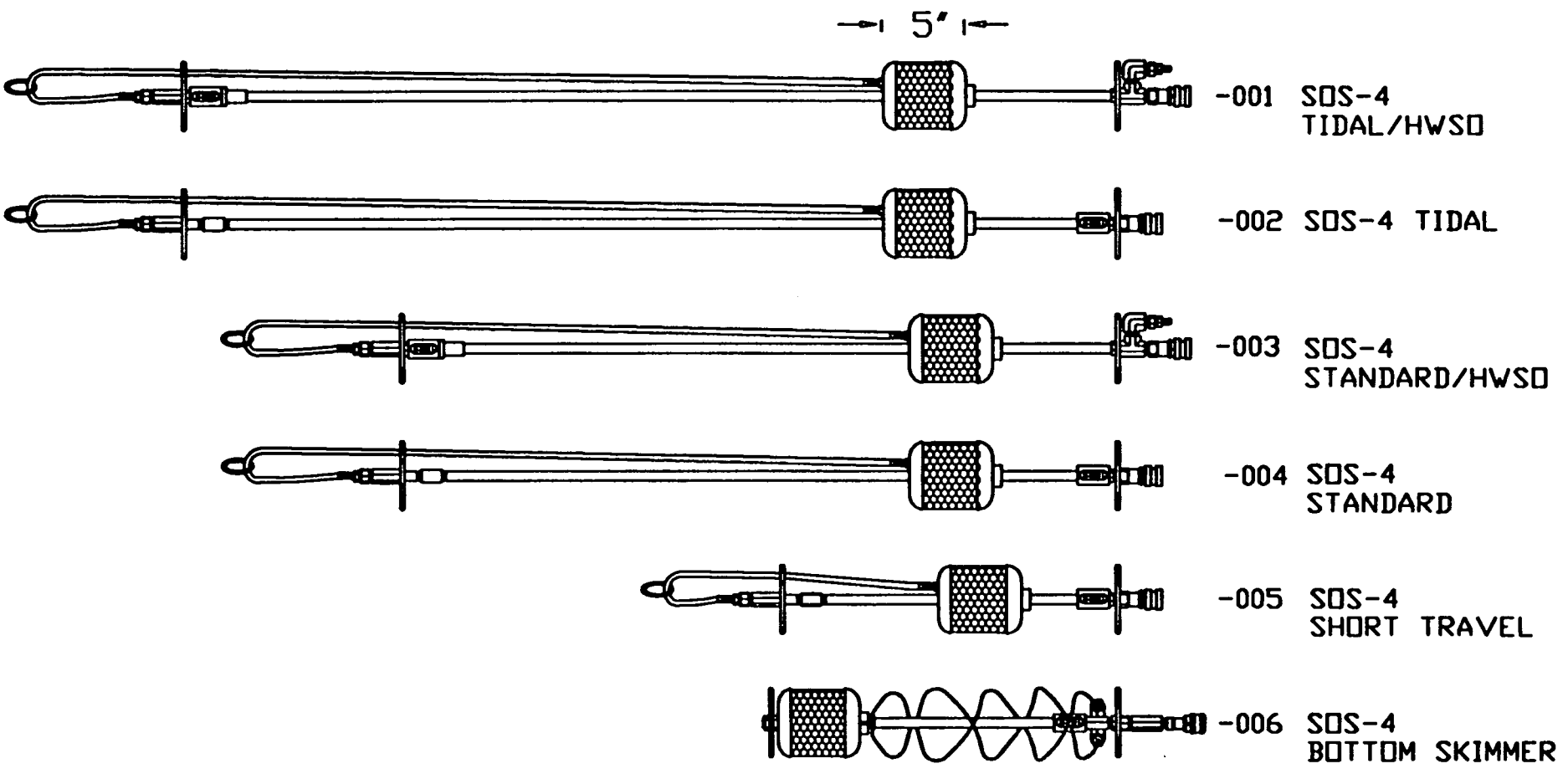
WEIGHT:

2" Skimmer: 2 pounds (.9 kg)

4" Skimmer: 3.5 pounds (1.6 kg)

MATERIAL OF CONSTRUCTION:

Stainless Steel, Brass, Aluminum, Polymer Plastics, Delrin and Nylon



	FLOAT RANGE	MINIMUM WATER REQ'D	FULLY EXTENDED LENGTH	WEIGHT Lb. (Kg)
-001	51" (130 cm)	45" (114 cm)	102" (259 cm)	5 Lbs (2.25 Kg)
-002	51" (130 cm)	45" (114 cm)	101" (257 cm)	5 Lbs (2.25 Kg)
-003	21" (53 cm)	30" (76 cm)	59" (150 cm)	4 Lbs (2 Kg)
-004	23" (58 cm)	30" (76 cm)	59" (150 cm)	4 Lbs (2 Kg)
-005	9" (23 cm)	22" (56 cm)	37" (94 cm)	3 Lbs (1.5 Kg)
-006	9" (23 cm)	5" (13 cm)	24" (61 cm)	3 Lbs (1.5 Kg)

CLEAN ENVIRONMENT ENGINEERS, INC.
EQUIPMENT FOR FUEL SPILL REMEDIATION
AND GROUNDWATER CLEAN-UP
5835 BOYLE STREET, SUITE 102
EMERYVILLE, CA 94608
(510) 654-4248 (800) 537-1767 FAX (510) 654-4193

TOLERANCES UNLESS OTHERWISE SPECIFIED ANGULAR : .30° FRAC : XX : .XXX : .XXXX : .XXXXX

APPROVALS	DATE
DRAWN TONY RAMIREZ	9-22-91
DESIGNER	
CHECKED RICK WEBB	9-22-91
APPROVED	

MATERIAL

FINISH

TITLE: 4" SELECTIVE OIL SKIMMERS

MODEL No.: SOS-4's

REV

SCALE: NONE

SHT 1 OF 1

4" SELECTIVE OIL SKIMMERS

CLEAN ENVIRONMENT EQUIPMENT

SOS PRODUCT BLADDER PUMP

FUNCTION:

This pump operates inside a well and draws oil up, out of the skimmer and pushes it to the surface. It can operate at depths of 0 to 250 feet. The SOS bladder pump can operate in wells as small as 2" (5 cm) in diameter. The pump is designed to meet stringent air quality standards. Hydrocarbon never comes in contact with the air inside the pump. Therefore, the exhausted air is very clean compared to that exhausted from a direct contact pump.

METHOD OF OPERATION:

Compressed air is introduced to the pump which collapses a bladder inside the pump. When the air is released the bladder expands drawing oil inside. Check valves at the inlet and outlet prevent oil from flowing back down towards the skimmer.

The pumps can be steam cleaned without damage.

FLOW RATES:

PP2-24

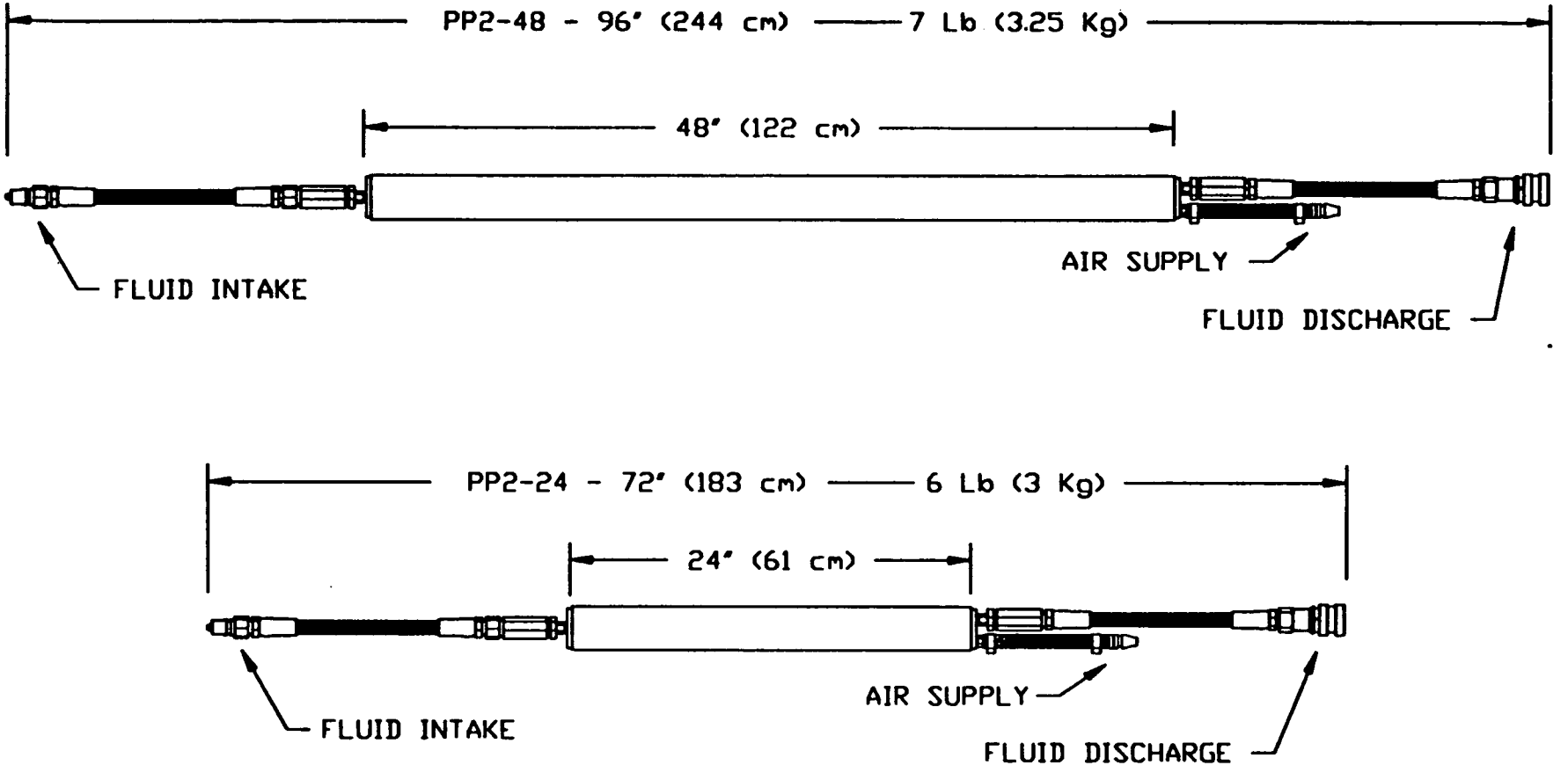
- 160 gallons per day with a cycle rate of 4 times per minute
- **Size:** The body is 24" long; however, with the check valves and hoses extends to a full 70" (5'10"long)
- **Diameter:** 1.5" (3.8 cm)
- **Weight:** 4 pounds (1.8 kg)

PP2-48

- 320 gallons per day with a cycle rate of 4 timer per minute
- **Size:** The body is 48" long; however, with the check valves and hoses extends to a full 96" (8 ft)
- **Diameter:** 1.5" (3.8 cm)
- **Weight:** 6 pounds (2.7 kg)

MATERIALS OF CONSTRUCTION:

Stainless Steel, Brass, Teflon and Viton



DEEP WELL PRODUCT BLADDER PUMPS

CLEAN ENVIRONMENT ENGINEERS, INC.

EQUIPMENT FOR FUEL SPILL REMEDIATION
AND GROUNDWATER CLEAN-UP

5835 DOYLE STREET, SUITE 102
EMERYVILLE, CA 94608

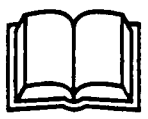
(510) 654-4240 (800) 537-1767 FAX (510) 654-4193

TOLERANCES UNLESS OTHERWISE SPECIFIED	APPROVALS	DATE	TITLE
ANGULAR : .30° FRAC : .XXX : .005 .XX : .01 .XXXX : .0005	DRAWN TONY RAMIREZ	10-3-91	DEEP WELL PRODUCT BLADDER PUMPS
MATERIAL	DESIGNER		MODEL No. PP2-24 AND PP2-48 REV
FINISH	CHECKED		SCALE NONE SHT 1 OF 1
	APPROVED		

DEV-002

INGERSOLL-RAND
AIR COMPRESSORS

Ingersoll-Rand Company
Reciprocating Compressor Division
Small Compressor Business Unit
Campbellsville, KY 42718



Important information! Read and follow these instructions. Retain for reference.

Owner's Manual
Installation, Operation and Maintenance Instructions for T30 Models 2340, 2475 and 2545

CONTENTS

WARRANTY

An extended, two-year warranty is available for compressors that use All Season T30 Select® synthetic compressor lubricant from start-up and continue operating solely with All Season T30 Select for the entire two-year period. This warranty applies to the bare compressor pump only. The use of other lubricants limits warranty to one year.

Other components on packaged compressors (motor, engine, etc.) are subject to the component manufacturer's warranty.

Warranties or other terms and conditions of sale shall be in accordance with Ingersoll-Rand's standard terms and conditions of sale for such products which are outlined in the warranty registration card provided with each compressor.

SAFETY

DEFINITIONS

DANGER! WILL cause DEATH, SEVERE INJURY or substantial property damage.

WARNING! CAN cause DEATH, SEVERE INJURY or substantial property damage.

CAUTION! WILL or CAN cause MINOR INJURY or property damage.

BREATHING AIR PRECAUTION

Ingersoll-Rand air compressors are not designed, intended or approved for breathing air. Compressed air should not be used for breathing air applications unless treated in accordance with all applicable codes and regulations.

GENERAL SAFETY PRECAUTIONS

- Do not directly inhale compressed air.
- Follow precautions on container labels before spraying materials such as paint, insecticide and weed killer.
- Wear a respirator and safety glasses when spraying.
- Do not over-pressurize the receiver tank or similar vessels beyond design limits.
- Do not use a receiver tank or similar vessels that fail to meet the design requirements of the compressor. Contact your distributor for assistance.
- Do not drill into, weld or otherwise alter the receiver tank or similar vessels.
- Do not remove, adjust, bypass, change, modify or make substitutions for safety/relief valves, pressure switches or other pressure control related devices.
- Do not use air tools or attachments without first determining the maximum pressure recommended for that equipment.
- Do not point air nozzles or sprayers toward anyone.
- Do not touch the compressor pump, motor or engine or discharge tubing during or shortly after operation. These parts become hot.
- Wear eye protection when operating or servicing compressor.
- Do not operate where flammable or explosive liquids or vapors such as gasoline, natural gas and solvents are present.
- Do not operate with guards or shields removed, damaged or broken.
- Do not remove, paint over or deface decals. Replace any missing decals.

RECEIPT & INSPECTION

Ensure adequate lifting equipment is available for unloading and moving your compressor to the installation site.

NOTE: Lifting equipment must be properly rated for the weight of the compressor.

Lift the compressor by the shipping skid only.

CAUTION! Do not work on or walk under the compressor while it is suspended.

Before signing the delivery receipt, inspect for damage and missing parts. If damage or missing parts are apparent, make the appropriate notation on the delivery receipt, then sign the receipt. Immediately contact the carrier for an inspection. All material must be held in the receiving location for the carrier's inspection. Delivery receipts that have been signed without a notation of damage or missing parts are considered to be delivered "clear." Subsequent claims are then considered to be concealed damage claims. Settle damage claims directly with the transportation company.

If you discover damage after receiving the compressor (concealed damage), the carrier must be notified within 15 days of receipt and an inspection must be requested by telephone with confirmation in writing. On concealed damage claims, the burden of establishing that the compressor was damaged in transit reverts back to the claimant.

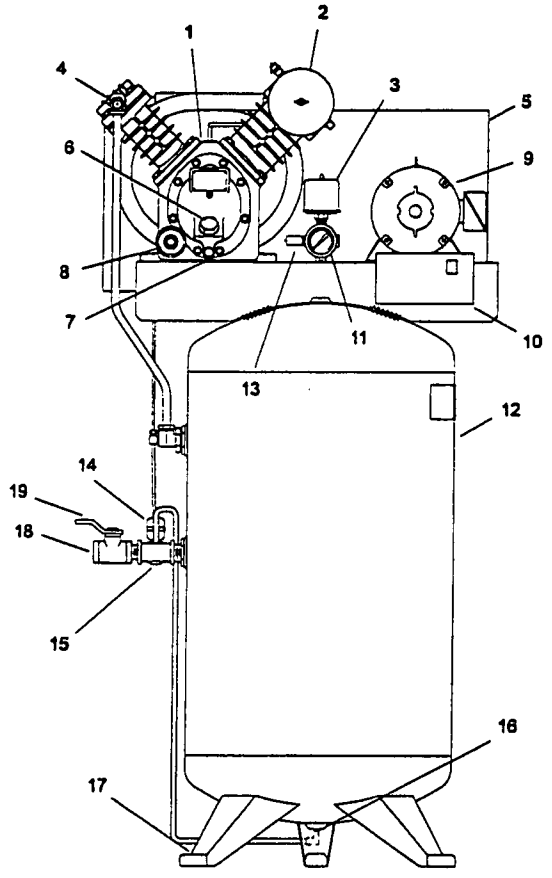
Read the compressor nameplate to verify it is the model ordered, and read the motor nameplate to verify it is compatible with your electrical conditions. Make sure electrical enclosures and components are appropriate.

Printed in U.S.A.

Form SCD-748B
August 1998
Replaces SCD-748A

Typical Receiver Tank Mounted, Electric Motor Driven Model. Gasoline engine driven models also available.

Component locations and appearance may vary. Designs and specifications are subject to change without notice or obligation.



(1) Bare compressor pump

(2) Air inlet filter assembly

(3) Pressure switch

(4) Discharge safety/relief valve

(5) Beltguard

(6) Lubricant fill

(7) Lubricant drain

(8) Low oil level switch (if provided)

(9) Electric motor

(10) Motor starter (if provided)

(11) Pressure gauge

(12) Air receiver tank

(13) Air receiver tank safety/relief valve

(14) Automatic drain valve (if provided)

(15) Manual drain valve (location when supplied with automatic drain valve)

(16) Manual drain valve (location when not supplied with automatic drain valve)

(17) Mounting holes

(18) Air outlet

(19) Service valve

* Air-cooled aftercooler in back, if provided (not shown)

INSTALLATION

LECTING A LOCATION

General. For electric motor driven models, select a well-lighted indoor area with plenty of space for proper cooling air flow and accessibility. Locate the ompressor at least 15 inches (38 cm) from walls, and make sure the main ower supply is clearly identified and accessible.

For gasoline engine driven models, keep the engine at least 3 feet (1 m) away from building walls and other equipment. Do not install or operate in a confined rea.

emperature. Ideal operating temperatures are between 32°F and 100°F (0°C and 37.8°C). If temperatures consistently drop below 32°F (0°C), install the compressor inside a heated building. If this is not possible, you must protect afety/relief valves and drain valves from freezing. If temperatures are onsistently below 40°F (4.4°C), consider installing a crankcase heater kit, especially if the compressor has difficulty starting.

CAUTION! Never operate in temperatures below -15°F (-26.1°C) or above 125°F (51.0°C).

Humid Areas. In frequently humid areas, moisture may form in the pump and produce sludge in the lubricant, causing running parts to wear out prematurely. Excessive moisture is especially likely to occur if the compressor is located in n unheated area that is subject to large temperature changes.

Two signs of excessive humidity are external condensation on the compressor when it cools down and a "milky" appearance in petroleum lubricant.

You may be able to prevent moisture from forming in the pump by increasing entilation, operating for longer intervals or installing a crankcase heater kit.

Noise Considerations. Consult local officials for information regarding acceptable noise levels in your area. To reduce excessive noise, use vibration isolator pads or intake silencers, relocate the compressor or construct total enclosures or baffle walls. Contact your Distributor for assistance.

MOUNTING

WARNING! Remove the compressor from the skid before mounting.

Bolt the compressor to a firm, level foundation (such as a concrete floor). Do not bolt uneven feet tightly to the foundation, as this will cause excessive stress on the receiver tank. Use metal shims under the "short" feet if necessary.

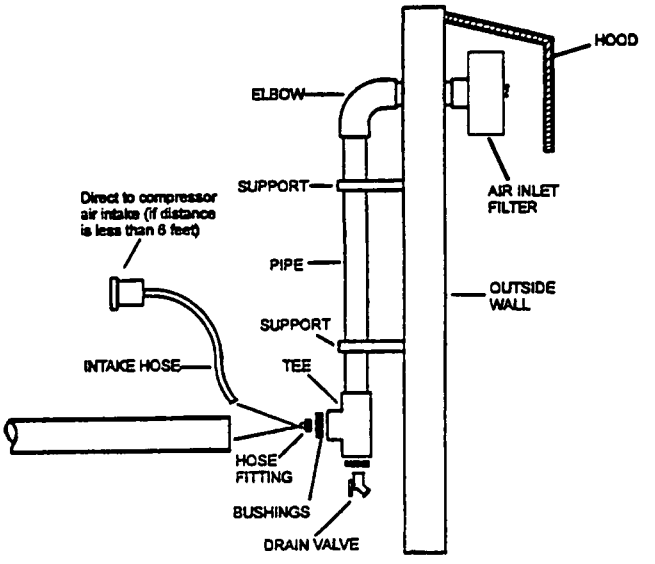
Gasoline engine driven models mounted on truck beds must be fastened securely without applying excessive stress on the receiver tank. We recommend installing a vibration isolator kit.

INSTALLING REMOTE AIR INLET PIPING

CAUTION! Do not operate without air inlet filter.

If the air around the compressor is relatively free of dirt, install the air inlet filter at the inlet connection at the pump. If the air is dirty, pipe the filter to a source of clean air. Use PVC plastic tubes. Do not use black pipe or galvanized pipe, as these promote sweating and rust. Consider installing an in-line type filter for ease of cleaning and replacement. Make the line as short and direct as possible and as large, or larger, than the diameter of the inlet connection on the pump. Do not install piping with a diameter lower than that of the compressor intake.

Typical Remote Air Inlet Piping.



Increase the pipe diameter one size for every 10 feet (3 m) of length or every 90° bend. Make sure the piping is adequately braced.

If you pipe the filter outdoors, cover it with a hood to prevent the entrance of rain or snow.

Heavy duty filter elements and filtration equipment for fine airborne dust, such as cement and rock dust, are available through your Distributor.

INSTALLING DISCHARGE PIPING

WARNING! Do not use plastic pipe, soldered copper fittings, rubber hose, or lead-tin soldered joints anywhere in the compressed air system.

CAUTION! If you will be using All Season T30 Select lubricant, all downstream piping material and system components must be compatible. Refer to the following material compatibility list. If there are incompatible materials present in your system, or if there are materials not included in the list, contact your Distributor.

Suitable

Viton®, Teflon®, Epoxy (Glass Filled), Oil Resistant Alkyd, Fluorosilicone, Fluorocarbon, Polysulfide, 2-Component Urethane, Nylon, Delrin®, Celcon®, High Nitrile Rubber (Buna N. NBR more than 36% Acrylonitrile), Polyurethane, Polyethylene, Epichlorohydrin, Polyacrylate, Melamine, Polypropylene, Baked Phenolics, Epoxy, Modified Alkyds
(® indicates trademark of DuPont Corporation)

Not Recommended

Neoprene, Natural Rubber, SBR Rubber, Acrylic Paint, Lacquer, Varnish, Polystyrene, PVC, ABS, Polycarbonate, Cellulose Acetate, Low Nitrile Rubber (Buna N. NBR less than 36% Acrylonitrile), EPDM, Ethylene Vinyl Acetate, Latex, EPR, Acrylics, Phenoxy, Polysulfones, Styrene Acrylonitrile (San), Butyl

NOTE: All compressed air systems generate condensate which accumulates in any drain point (e.g. tanks, filters, drip legs, aftercoolers, dryers). This condensate contains lubricating oil and/or substances which may be regulated and must be disposed of in accordance with local, state, and federal laws and regulations.

General Requirements. The piping, fittings, receiver tank, etc. must be certified safe for at least 250 psig (18 kg/cm²) working pressure. Use hard-welded or threaded steel or copper pipes and cast iron fittings that are certified safe for the compressor's discharge pressure and temperature. DO NOT USE PVC PLASTIC. Use pipe thread sealant on all threads, and make up joints tightly to prevent air leaks.

Main Air Distribution Line. The main compressed air distribution line should be of sufficient pipe size to minimize the pressure drop between the air supply and the point of use. Slope the piping downward in the direction of air flow to aid in the removal of condensation at all drain points along the line. The piping must be as short and direct as possible, and adequately braced.

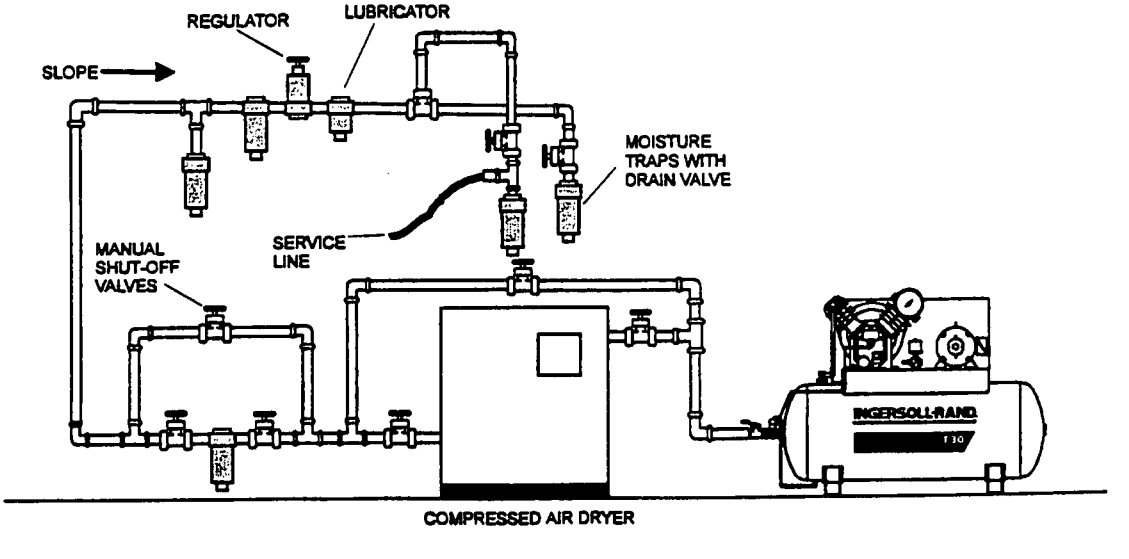
Drip Legs. A drip leg is a pipe extending downward from the main line to collect condensation. Drip legs should be installed at the lowest points in the air line and at any point where the line goes around an obstruction. A drain valve should be installed on the bottom of each drip leg.

Drop Legs. A drop leg is a pipe originating from the main air distribution line that feeds air to an outlet for air tools or other air operated devices. Drop legs are taken off the top of the main line so that condensation does not easily flow into them. Drop legs should be designed so that the air outlet comes off the side of the drop leg, rather than the bottom. By doing this, condensation which is carried from the main line collects below the outlet and prevents moisture from entering the tool or device using the air. A drain valve should be installed on the bottom of each drop leg.

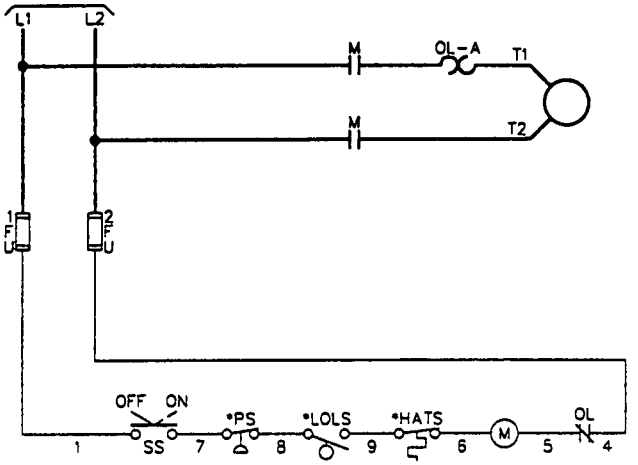
Condensate Discharge Piping. If installing a condensate discharge line, the piping must be at least one size larger than the connection, as short and direct as possible, secured tightly and routed to a suitable drain point. Condensate must be disposed of in accordance with local, state, and federal laws and regulations.

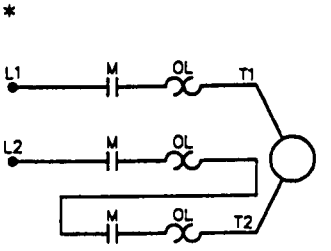
WARNING! If an aftercooler, check valve, block valve, or any other restriction is added to the compressor discharge, install a properly-sized ASME approved safety/relief valve between the compressor discharge and the restriction.

Typical Compressed Air System.

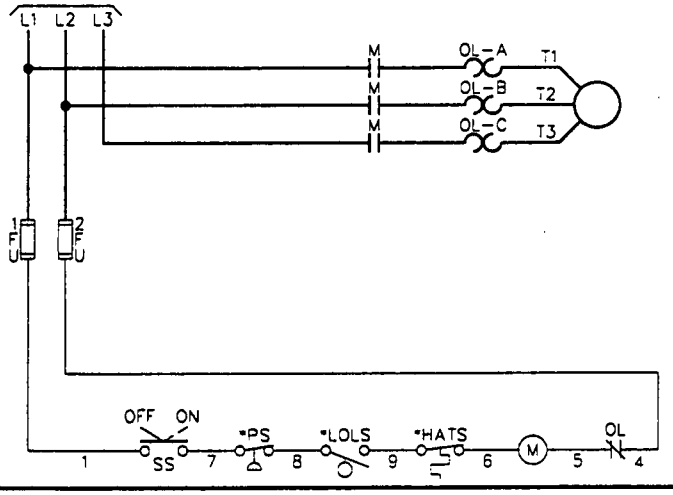


Single Phase Wiring





Three Phase Wiring

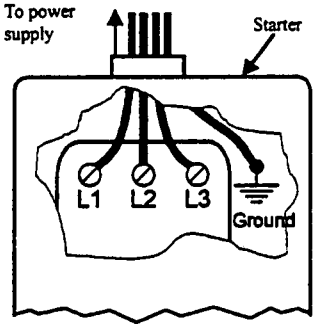


T	Supply Line Terminal
L	Load Terminal
FU	Control Circuit Fuse
HATS	High Air Temperature Switch (#)
LOLS	Low Oil Level Switch (#)
M	Motor Starter Coil
OL	Motor Starter Overload
PS	Pressure Switch
SS	Selector Switch (#)
*	Alternate wiring for converting 3 phase starter to 1 phase application

(#) = if provided

NOTE: ON UNITS REQUIRING A STARTER, CONNECT LINE POWER TO THE STARTER. DO NOT CONNECT LINE POWER TO THE PRESSURE SWITCH.

- Connect ground wire to ground lug
- L3 used for 3-phase motors & starters only



WIRING (ELECTRIC MOTOR DRIVEN MODELS)

WARNING! Electrical installation and service should be performed by a qualified electrician who is familiar with all applicable local, state and federal laws and regulations.

General. The motor rating, as shown on the motor nameplate, and the power supply must have compatible voltage, phase and hertz characteristics.

Wire Size. The electrical wiring between the power supply and electric motor varies according to motor horsepower. Power leads must be adequately sized to protect against excessive voltage drop during start-up. Information for selecting the proper wire size and securing connections should be provided with the motor. If other electrical equipment is connected to the same circuit, the total electrical load must be considered in selecting the proper wire size. Do not use undersize wire.

Magnetic Starter. If the motor installed on your compressor has a motor reset button, it does not require a magnetic starter. If the motor does not have this button and the compressor does not have a factory-installed starter, install a magnetic starter with thermal overload protection. Follow the manufacturer's instructions for installation. Ingersoll-Rand cannot accept responsibility for damages arising from failure to provide adequate motor protection.

Fuses. Refer to the National Electric Code to determine the proper fuse or circuit breaker rating required. When selecting fuses, remember the momentary starting current of an electric motor is greater than its full load current. Time-delay or "slow-blow" fuses are recommended.

Pressure Switch. On compressors without a factory-installed pressure switch, wire a pressure switch in accordance with the appropriate wiring schematic in this manual. Mount the pressure switch in accordance with the manufacturer's recommendations. The connecting line to the receiver tank must be as short and direct as possible, and certified safe for at least 250 psig (18 kg/cm²).

CONNECTING A BATTERY (GASOLINE ENGINE DRIVEN MODELS)

NOTE: If you will be making connections to a remote battery, the compressor engine must be equipped with an alternator.

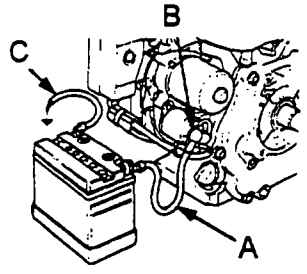
Battery. A 12 volt battery with a minimum current rating of 250 CCA (cold cranking amps) and minimum ampere-hour rating of 24 Ah should be sufficient for cranking most electric start engines.

Battery Cables. Refer to the following table for size and length recommendations.

Cable Size (GA)	Maximum Length
6	5' (1.5 m.)
4	7'-2.5" (2.1 m.)
2	12' (3.6 m.)

Connection Procedures. (1) Connect the battery positive (+) cable (A) to the starter solenoid terminal (B). (2) Connect the battery negative (-) cable (C) to an engine mounting bolt. Secure the wire in place by screwing a suitably-sized nut onto the bolt and down onto the terminal. (3) Connect the battery positive (+) cable (A) to the battery positive (+) terminal. (4) Connect the battery negative (-) cable to the battery negative (-) terminal. (5) Coat the terminals and cable ends with corrosion-preventive grease.

Battery Connections.



WARNING! Remove the cable from the negative (-) side of the battery before servicing.

Refer to the engine manufacturer's instructions for more information.

FUEL PUMP INSTALLATION (GASOLINE ENGINE DRIVEN MODELS)

Some engines use an optional fuel pump to supply gasoline to the engine directly from a vehicle's onboard fuel system. Install the fuel pump within 12 inches of the bottom surface of the vehicle's fuel tank. Protect the pump from contamination by installing a fuel isolation valve and an inline filter between the pump fuel system.

COMPRESSOR LUBRICATION

CAUTION! Do not operate without lubricant or with inadequate lubricant. Ingersoll-Rand is not responsible for compressor failure caused by inadequate lubrication.

All Season T30 Select. Ingersoll-Rand recommends All Season T30 Select synthetic lubricant from start-up. See the WARRANTY section for extended warranty information.

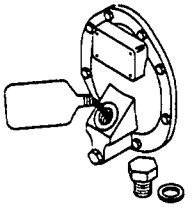
Alternate Lubricants. You may use a petroleum-based lubricant that is premium quality, does not contain detergents, contains only anti-rust, anti-oxidation, and anti-foam agents as additives, has a flashpoint of 440°F (227°C) or higher, and has an auto-ignition point of 650°F (343°C) or higher. Remember using a lubricant other than All Season T30 Select from start-up limits warranty to one year.

See the petroleum lubricant viscosity table below. The table is intended as a general guide only. Heavy duty operating conditions require heavier viscosities. Refer specific operating conditions to your Distributor for recommendations.

Temperature Around Compressor	Viscosity @ 100°F (37.8°C)		Viscosity Grade	
	SUS	Centi-stokes	ISO	SAE
40°F (4.4°C) & below	150	32	32	10
40°F to 80°F (4.4°C to 26.7°C)	500	110	100	30
80°F to 125°F (26.7°C to 51.0°C)	750	165	150	40

If you use a petroleum-based compressor lubricant at start-up and decide to convert to All Season T30 Select later on, your compressor must be decarbonized by your Distributor before conversion.

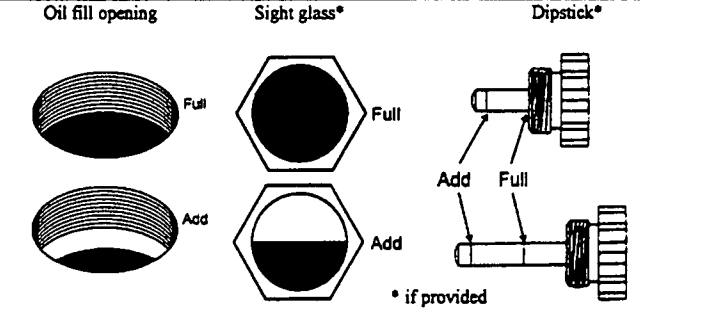
Filling Procedures. (1) Unscrew and remove the oil fill plug. (2) Fill the crankcase with lubricant.



Refer to the following table for crankcase capacity.

Model	Crankcase Capacity
2340	28 oz. (827 ml.)
2475	41 oz. (1212 ml.)
2545	73 oz. (2158 ml.)

Use one of the following methods illustrated to determine when the crankcase is full.



(3) Replace the oil fill plug HAND TIGHT ONLY.

OPERATION

START-UP (ELECTRIC MOTOR DRIVEN MODELS)

(1) Release pressure by opening the service valve. (2) Close the service valve and start the compressor.

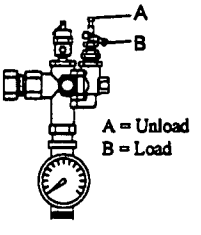
CAUTION! Unusual noise or vibration indicates a problem. Do not continue to operate until you identify and correct the source of the problem.

NOTE: Ensure direction of rotation is correct per the arrow cast on the beltwheel. Compressors with a sheetmetal type beltguard also have a directional arrow decal applied to the beltguard side facing the front of the unit. If rotation is incorrect on three-phase units, interchange any two of the three leads.

START-UP (GASOLINE ENGINE DRIVEN MODELS)

WARNING! Do not operate gasoline engine driven units in an enclosed area.

Unloader.



(1) Release pressure by opening the service valve. (2) Turn on engine gasoline supply. (3) Put choke in "on" position. (4) Close service valve and put unloader lever in "unload" (A) position for Kawasaki and Honda engine driven models, "load" (B) position for Kohler engine driven models. (5) Start engine, release choke, and allow engine to warm up for two to three minutes. (6) Return unloader lever to "load" (B) position on Kawasaki and Honda engine driven models.

NOTE: Turn gasoline supply off when compressor is not being used.

NOTE: Some gasoline engine driven compressors require 5-8 break-in hours of operation before reaching full capacity and speed.

NOTE: After 20 hours of operation, engine idle speed may increase slightly. If this should happen, your Distributor may need to make a slight adjustment.

COMPRESSOR CONTROLS

Automatic Start & Stop Control. This type of control applies to electric motor driven models 2340, 2475, and some 2545 units.

NOTE: Automatic Start & Stop Control is intended for use when the motor will start no more than 6 times per hour.

When the receiver tank pressure reaches the factory pre-set maximum pressure (usually 175 psig), the pressure switch stops the compressor. When the receiver tank pressure drops below the factory pre-set minimum (usually 135 psig), the pressure switch resets and restarts the compressor.

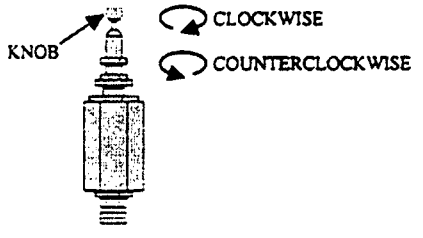
Constant Speed Control. This type of control applies to gasoline engine driven model 2475.

When the receiver tank pressure reaches the factory pre-set maximum pressure (usually 175 psig), the unloader slows down the engine and the compressor stops pumping. When the receiver tank pressure drops to the factory pre-set minimum (usually 145 psig), the unloader resets, the engine returns to full speed, and the compressor resumes pumping.

Dual Control. This type of control applies to some Model 2545 units. Select either automatic start and stop control or constant speed control by adjusting the knob on the auxiliary valve. For automatic start and stop control, turn the knob on the auxiliary valve fully clockwise to disable the auxiliary valve. The pressure switch will then start and stop the compressor.

NOTE: For dual control models, automatic start and stop is preferred.

Auxiliary Valve.



Select constant speed control if the compressor restarts in less than 10 minute intervals or runs more than 40 minutes per hour. Turn the knob fully counterclockwise to run the compressor continually. When the receiver tank pressure reaches 170 psig, the compressor runs but does not pump.

NOTE: The auxiliary valve is factory pre-set at 5 psig lower than the factory pressure switch setting.

CAUTION! Running unloaded for more than 20 minutes per hour or more than 15 minutes continually with the use of constant speed control will cause oil pumping and should be avoided.

PRESSURE SWITCH ADJUSTMENT

WARNING! High voltage is present at the pressure switch contacts when the power supply is connected. Disconnect, lock and tag main power supply before making adjustments.

CAUTION! Do not adjust the pressure switch to exceed the maximum discharge pressure of the compressor.

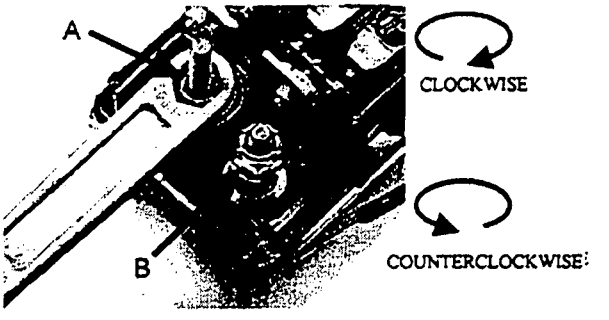
NOTE: Adjust the pressure switch only if adjustments are absolutely necessary.

Cut-In & Cut-Out. The cut-out (compressor shut-down) is the pressure at which the switch contacts open, and the cut-in (compressor restart) is the pressure at which the switch contacts close. See COMPRESSOR CONTROLS.

Adjustment Controls. All pressure switches have a range adjustment control (A) . Some pressure switches also have a differential adjustment (B) control. On switches without a differential adjustment control, the span between cut-in and cut-out pressure levels switches is factory set for 40 ± 4 PSIG and cannot be adjusted.

NOTE: Some pressure switches are equipped with an on-off lever used to open and close the electrical contacts inside the switch. THIS LEVER IS NOT A DIFFERENTIAL ADJUSTMENT CONTROL. The pressure switches with the on-off lever do not have a differential adjustment control.

Pressure Switch Adjustments.



Adjustment Procedures (Switches without differential adjustment control). (1) Remove the pressure switch cover. (2) Adjust the range by turning the range adjustment nut clockwise (in) to increase the cut-out point or counter-clockwise (out) to decrease the cut-out point. NOTE: One full turn changes the setting approximately 2 psig. (3) Replace cover, reconnect power supply and start the compressor. (4) Note the pressure gauge reading at which the compressor cuts out. (5) Repeat adjustment procedure if necessary.

Adjustment Procedures (Switches with differential adjustment control). (1) Remove the pressure switch cover. (2) Set the cut-in pressure with the range adjustment nut. Turn the nut clockwise (in) to increase the pressure or counter-clockwise (out) to decrease the pressure. NOTE: One full turn changes the setting approximately 2 psig. (3) Set the cut-out pressure with the differential adjustment. Turn the differential adjustment nut clockwise (in) to increase the pressure or counter-clockwise (out) to decrease the pressure. NOTE: One full turn changes the setting approximately 2 psig. (4) Replace cover, reconnect power supply and start the compressor. (5) Note the pressure gauge reading at which the compressor cuts out. (6) Repeat adjustment procedure if necessary.

The minimum possible differential is approximately 20% of cutout pressure. It is advisable to have as wide a differential as possible to avoid frequent starting and stopping of the compressor. Note the pressure gauge reading at which the compressor cuts-out and re-establish this point if necessary.

Note the interaction between the range and diferential adjustments, i.e., if the cut-out is increased, the differential will also increase, or if the differential is narrowed, the cut-out will be reduced, etc. These factors must be considered when adjusting the switch and compensated for accordingly.

MAINTENANCE

WARNING! Disconnect, lock and tag main power supply and release air pressure from system before performing maintenance.

NOTE: All compressed air systems contain maintenance parts (e.g. lubricating oil, filters, separators) which are periodically replaced. These used parts may be, or may contain, substances that are regulated and must be disposed of in accordance with local, state, and federal laws and regulations.

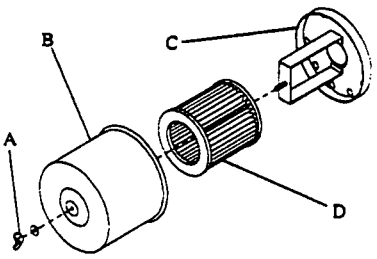
NOTE: Take note of the positions and locations of parts during disassembly to make reassembly easier. The assembly sequences and parts illustrated may differ for your particular unit.

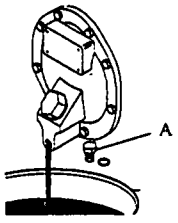
Daily or Before Each Operation	● Check lubricant level. Fill as needed. ● Drain receiver tank condensate (if automatic drain valve is not provided). Open manual drain valve and collect and dispose of condensate accordingly. ● Check for unusual noise and vibration. ● Ensure beltguards and covers are securely in place. ● Ensure engine (if supplied) is filled with fuel and lubricant according to the manufacturer's recommendations. ● Ensure area around compressor is free from rags, tools, debris, and flammable or explosive materials.
Weekly	● Clean screen in automatic drain valve (if provided). Open manual drain valve at bottom of automatic drain valve to blow out debris. Collect and dispose of condensate accordingly. ● Check safety/relief valves by pulling rings. Replace safety/relief valves that do not operate freely. ● Inspect air filter element(s). Clean if necessary.
Monthly	● Inspect for air leaks. Squirt soapy water around joints during compressor operation and watch for bubbles. ● Check tightness of screws and bolts. Tighten as needed. ● Clean exterior.
3/500 *	● Change petroleum lubricant while crankcase is warm.
12/2000 *	● Install maintenance pak — or — ● Change All Season T30 Select lubricant while crankcase is warm. ● Replace filter element.

* indicates months/operating hours, whichever occurs first.

FILTER INSPECTION & CLEANING

(1) Unscrew and remove the wing nut (A) securing the filter housing (B) to its base (C). (2) Remove the filter housing and withdraw the old filter element (D). Clean the element with a jet of air or vacuum. (3) Replace the filter element and





OIL CHANGE

(1) Remove the oil drain plug (A) and allow the lubricant to drain into a suitable container. (2) Replace the oil drain plug. (3) Follow the filling procedures in OPERATION section.

KITS & SERVICE PARTS

RECOMMENDED KITS & SERVICE PARTS

Keep these kits and service parts on-hand to avoid prolonged down time for routine maintenance or service. Consider purchasing extra kits and service parts for applications in which interruptions in service are not acceptable. Detailed instructions for inspection and service are included with each kit.

Start-Up Kits. Each start-up kit contains the necessary quantities of All Season T30 Select lubricant and air filter element(s) to start-up and maintain your compressor for the first year. Start-Up kits for gasoline engine driven models also include a replacement engine air filter, engine oil filter, and engine lubricant. See the engine manufacturer's instructions for more detailed engine care information.

PART NO.	DESCRIPTION
32305880	KIT, START-UP — 2340
32305880	KIT, START-UP — 2475 WITH ELECTRIC MOTOR
32305872	KIT, START-UP — 2475 WITH KOHLER ENGINE
32498511	KIT, START-UP — 2475 WITH KAWASAKI ENGINE

Maintenance Paks. Maintenance paks contain all the parts necessary for one complete 12 month/2000 hour maintenance service of your compressor. All-Season T30 Select lubricant, air filter elements, gaskets, drive belts, and instructions are standard with all maintenance paks.

PART NO.	MODEL
38485132	PAK, MAINTENANCE — 2340 (ALL UNITS)
38485157	PAK, MAINTENANCE — 2475N7.5
38485165	PAK, MAINTENANCE — 2475N5
38485173	PAK, MAINTENANCE — 2475F11G
38485181	PAK, MAINTENANCE — 2475F11GKA
38485082	PAK, MAINTENANCE — 2545E10
38485082	PAK, MAINTENANCE — 2545E10V

All Season T30 Select Lubricant

PART NO.	DESCRIPTION
32318875	LUBRICANT, ALL SEASON T30 SELECT - 1 Q (.946 L) BOTTLE
32318883	LUBRICANT, ALL SEASON T30 SELECT - CASE OF (12) 1 Q (.946 L) BOTTLES

Air Filter Elements

PART NO.	DESCRIPTION
32012957	ELEMENT, FILTER - STANDARD (2545)
32170979	ELEMENT, FILTER - STANDARD (2340, 2475)

Step Saver Kits. Step Saver Kits provide all of the parts required to perform common repair tasks such as piston ring replacement or valve replacement. An instruction sheet is provided with each Step Saver Kit.

PART NO.			DESCRIPTION
2340	2475	2545	
32304610	32301426	32307118	KIT, VALVE/GASKET (1)
32304602	32301517	32307084	KIT, RING/GASKET (2)
32127359	32301509	32204307	KIT, BEARING/CONNECTING ROD (3)
—	32301434	32307126	KIT, GASKET (4)
32319451	32319469	32319477	KIT, OVERHAUL (5)

(1) Valve wearing parts and head gaskets that are destroyed in replacing valve parts.

(2) Complete set of piston rings, a crankshaft seal, and gaskets that are destroyed in breaking the unit down to replace the rings.

(3) Set of connecting rods, main bearings, and a crankpin bushing. A gasket set is recommended with this kit.

(4) Complete set of gaskets that are destroyed in breaking the unit down for inspection and service. Recommended with bearing/connecting rod kits.

(5) All of the above for complete overhaul service.

OTHER KITS & SERVICE PARTS

Automatic Drain Valve Timer Kits. An automatic drain valve timer kit resolves application problems in which an existing automatic drain valve cycles too infrequently. A timer generates the pneumatic signals for actuating the automatic drain valve. With a timer, the automatic drain valve operates independently of the compressor unload cycles.

This accessory is recommended for:

- Duplex units.
- 100% duty cycle applications.

- Extremely heavy duty cycles where unloading is too infrequent to permit effective use of an over-sized reservoir on compressor-controlled drain valves.
- Controlling multiple automatic drain valves used on air system devices such as self-draining filters, dryers and drip legs.

NOTE: The electric timer is available only in a NEMA 1 enclosure.

PART NO.	DESCRIPTION
32499964	KIT, ELECTRIC TIMER - AUTOMATIC DRAIN VALVE

Automatic Drain Valves, Kits & Service Parts. The automatic drain valve removes condensed water and oil from compressed air systems without restricting air flow, creating pressure drops or opening the system to the atmosphere. Its unique design maintains systems pressure and volume during operation, and increases productivity.

REF. NO.	PART NO.	DESCRIPTION
REF.	32296238	VALVE, AUTOMATIC DRAIN (SIMPLEX UNITS)
REF.	32310690	VALVE, AUTOMATIC DRAIN (DUPLEX UNITS)
1	32310971	KIT, WATER CAP ASSEMBLY
2	32314924	KIT, BODY/PISTON ASSEMBLY (FOR 32296238 VALVE)
2	32310989	KIT, BODY/PISTON ASSEMBLY (FOR 32310690 VALVE)
3	32310997	KIT, ONE WAY VALVE
4	32496317	RESERVOIR, STANDARD CAPACITY
4	32496309	RESERVOIR, HIGH CAPACITY *
5	32311060	ELBOW, TUBE — 1/4"

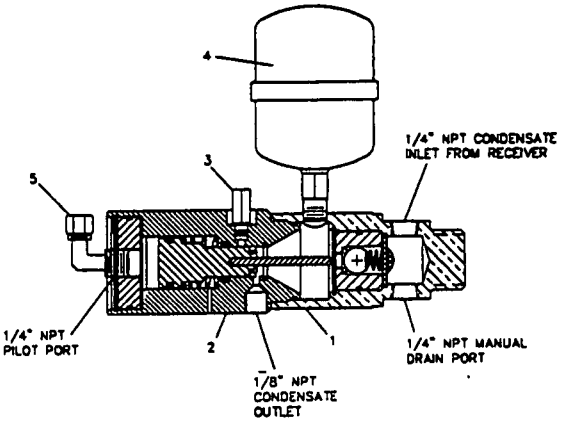
* The high capacity reservoir gives the automatic drain valve twice as much condensate storage capacity during the pumping cycle. This larger reservoir is available as an upgrade. A larger reservoir is recommended for use on heavily-loaded simplex compressors with long pumping cycles and/or operating in extremely humid environments. If the pumping cycle exceeds one hour, then an electric timer kit should be used.

Crankcase Heater Kits. Crankcase heaters are recommended when ambient temperatures are consistently below 32°F (0°C). An easy-to-install external crankcase heater kit is intended for aftermarket use. Two kits may be required for some applications.

PART NO.	DESCRIPTION
97330385	KIT, CRANKCASE HEATER

Vibration Isolator Kits. Vibration isolator kits are specifically designed for mounting gasoline engine driven compressors to truck beds.

PART NO.	DESCRIPTION



PART NO.	DESCRIPTION
32309346	KIT, VIBRATION ISOLATOR

Vibration Isolator Pads. Vibration isolator pads are designed to absorb 40%-60% of the sound and vibration of your compressor.

PART NO.	DESCRIPTION
32320681	PAD, VIBRATION ISOLATOR - 4" X 4" SP-NR
32320699	PAD, VIBRATION ISOLATOR - 5" X 5" SP-NR
32321002	PAD, VIBRATION ISOLATOR - 4" X 4" NRC
32321028	PAD, VIBRATION ISOLATOR - 5" X 5" NRC
32321010	PAD, VIBRATION ISOLATOR - 6" X 6" NRC

SP-NR: Steel plate bonded between a NR pad and a non-skid oil-resistant ribbed neoprene top pad.

NRC: Two ribbed neoprene pads bonded to ½" cork pad.

TROUBLESHOOTING

This section provides a list of the more frequently encountered compressor malfunctions, their causes and corrective actions. Some corrective actions can be performed by the operator or maintenance personnel, and others may require the assistance of a qualified electrician or your Distributor.

PROBLEM	CHECK POINT
Abnormal piston, ring or cylinder wear	4, 8, 9, 19, 28, 35
Air delivery drops off	1, 6, 15, 16, 18, 19, 29
Automatic drain valve leaks or does not drain automatically	16
Auxiliary valve chatters or leaks around stem	23, 24
Broken intercooler or aftercooler tubes	36
Compressor does not come up to speed	2, 6, 12, 15, 21
Compressor is slow to come up to speed	26, 27, 33, 34
Compressor runs excessively hot	3, 14, 15, 22
Compressor will not unload cycle	23, 24, 26
Compressor will not unload when stopped	26, 33
Excessive noise during operation	2, 6, 15, 16, 21, 27, 32
Excessive starting and stopping	5, 11, 16, 32, 43
Knocks or rattles	2, 15, 17, 19, 20, 21
Lights flicker or dim when running	12, 13
Moisture in crankcase or "milky" appearance in petroleum lubricant or rusting in cylinders	9, 10
Motor overload trips or draws excessive current	5, 6, 12, 13, 14, 15, 16, 19, 20, 21, 34
Oil in discharge air (oil pumping)	4, 7, 9, 18, 19, 25, 35
Oil leaking from shaft seal	25
Safety/relief valve "pops"	1, 5, 29, 30
High interstage pressure	30
Low interstage pressure	31
Engine cranks slowly or will not start	6, 14, 37, 38
Motor will not start	12
Engine will not start	39
Automatic drain valve leaks air at discharge after compressor is shut off	40
Automatic drain valve leaks air at drain port while compressor is running	41
Automatic drain valve cycles too infrequently	42

CHECK POINT	POSSIBLE CAUSE	POSSIBLE SOLUTION
1	Clogged or dirty inlet and/or discharge line filter.	Clean or replace.
2	Loose beltwheel or motor pulley, excessive end play in motor shaft or loose drive belts.	Check beltwheel, motor pulley, crankshaft, drive belt tension and alignment. Repair or replace as required.
3	Inadequate ventilation around beltwheel.	Relocate compressor for better air flow.
4	Lubricant viscosity too low.	Drain existing lubricant and refill with proper lubricant.
5	Air leaks in air discharge piping.	Check tubing and connections. Tighten joints or replace as required.
6	Lubricant viscosity too high.	Drain existing lubricant and refill with proper lubricant.
7	Lubricant level too high.	Drain excess lubricant.
8	Lubricant level too low.	Add lubricant to crankcase to proper level.
9	Detergent type lubricant being used.	Drain existing lubricant and refill with proper lubricant.
10	Extremely light duty cycles.	Run compressor for longer duty cycles.
	Compressor located in damp or humid location.	Relocate compressor or install crankcase heater kit.
11	Pressure switch differential too narrow.	Adjust pressure switch to increase differential, if differential adjustment is provided. Install pressure switch with differential adjustment feature if differential adjustment is desired.
12	Improper line voltage.	Check line voltage and upgrade lines as required. Contact electrician.
	Wiring or electric service panel too small.	Intall properly sized wire or service box. Contact electrician.
	Poor contact on motor terminals or starter connections.	Ensure good contact on motor terminals or starter connections.
	Improper starter overload heaters.	Install proper starter overload heaters. Contact electrician.
13	Poor power regulation (unbalanced line).	Contact power company.
14	Drive belts too tight or misaligned.	Adjust belts to proper tension and alignment.
15	Compressor valves leaky, broken, carbonized or loose.	Inspect valves. Clean or replace as required. Install Valve/Gasket Step Saver Kit. See KITS & SERVICE PARTS.
16	Automatic drain valve clogged, leaking or defective.	Inspect valve and clean, repair or replace as required.
17	Carbon build-up on top of piston(s).	Clean piston(s). Repair or replace as required.
18	Piston rings damaged or worn (broken, rough or scratched). Excessive end gap or side clearance.	Install Ring/Gasket Step Saver Kit.
	Piston rings not seated, are stuck in grooves or end gaps not staggered.	Adjust piston rings.
19	Cylinder(s) or piston(s) scratched, worn or scored.	Repair or replace as required.
20	Connecting rod, piston pin or crankpin bearings worn or scored. Loose bearing spacer on crankshaft.	Inspect all. Repair or replace as required. Install Bearing/Connecting Rod Step Saver Kit. See KITS & SERVICE PARTS.
21	Defective ball bearings on crankshaft or motor shaft.	Inspect bearings and replace if required. Install Bearing/Connecting Rod Step Saver Kit. See KITS & SERVICE PARTS.
22	Wrong beltwheel direction of rotation.	Check motor wiring for proper connections. Reverse two leads on three-phase motors.
23	Leaking, broken or worn inlet unloader parts.	Inspect parts and replace as required.
24	Auxiliary valve dirty or seats worn.	Inspect parts. Clean, adjust or replace as required.
25	Crankshaft seal worn or crankshaft scored.	Replace seal. Install shaft sleeve if required. Install Bearing/Connecting Rod Step Saver Kit. See KITS & SERVICE PARTS.
26	Leaking or maladjusted centrifugal pilot valve.	Replace pilot valve o-ring. Adjust pilot valve.
27	Leaking check valve or check valve seat blown out.	Replace check valve.
28	Extremely dusty atmosphere.	Install remote air inlet piping and route to source of cleaner air. Install more effective filtration.
29	Defective safety/relief valve.	Replace.
30	High pressure inlet valve leaking.	Inspect, clean or repair as required.
31	Low pressure discharge valve leaking.	Inspect, clean or repair as required.
32	Automatic start and stop mode is not suitable for air demand.	Adjust auxiliary valve for constant speed operation.
33	Pressure switch unloader leaks or does not work.	Realign stem or replace.
34	Ambient temperature too low.	Install crankcase heater kit. Convert to All Season T30 Select lubricant. See KITS & SERVICE PARTS. Relocate compressor to warmer environment.
35	Worn cylinder finish.	Deglaze cylinder with 180 grit flex-hone.
36	Beltwheel out of balance, tubes not braced or secured, wrong pulley speed.	Check vibration level, change pulley or beltwheel if required, tighten tube clamps.

CHECK POINT	POSSIBLE CAUSE	POSSIBLE SOLUTION
37	Engine not grounded properly.	Ground battery to engine as recommended.
38	Gasoline exceeds storage time or contains water.	Replace gas, add fuel stabilizer.
39	No fuel in tank.	See manufacturer's instructions for refueling.
	Fuel valve closed.	Open fuel valve.
	Low oil pressure.	See manufacturer's instructions.
40	Screen dirty or blockage in drain tube between bottom of receiver tank and automatic drain valve.	Open manual drain valve at bottom of automatic drain valve to blow out debris. Clean out drain tube.
41	Internal seal on check valve is worn.	Replace water cap assembly. See KITS & SERVICE PARTS.
42	Piston seals are worn.	Replace body/piston assembly. See KITS & SERVICE PARTS.
43	Excessive condensate in receiver tank.	Drain receiver tank with manual drain valve or install automatic drain valve.

Stand Alone Battery Installation

12 V DC External Power Supply Installation

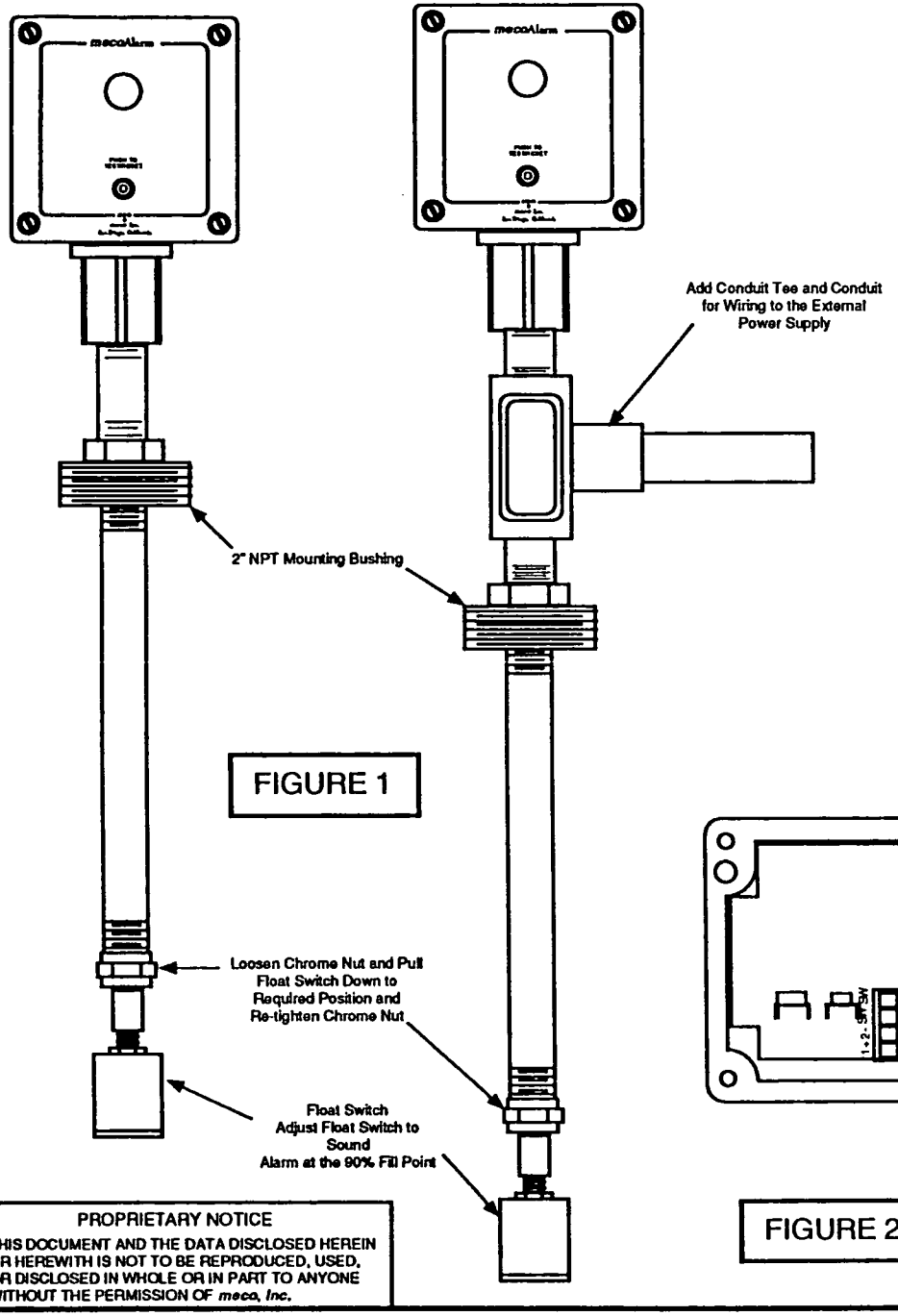


FIGURE 1

FIGURE 2

*meco*Alarm Installation Instructions

STAND ALONE BATTERY INSTALLATION.

1. Remove four cover screws and remove cover.
2. Plug 9 V battery into terminals provided. For longest life and for use in climates with temperatures below -4° F, the Ultralife 9 V Lithium battery is recommended. Ultralife batteries are available from Radio Shack.
3. Close cover using care not to pinch wires between the cover and the case and replace four screws.
4. Test unit for proper operation.
   a. Press the Test/Reset Button and insure the alarm sounds while the button is depressed and the alarm stops when the button is released.
   b. Turn unit upside down and insure alarm sounds. While unit is upside down, press and release the Test/Reset Button and insure the alarm stops.
5. Adjust the Float Switch for the proper trip point prior to installing into tank. To adjust the Float Switch, loosen the chrome nut and extend the switch to the desired length and tighten the chrome nut. DO NOT OVER TIGHTEN THE CHROME NUT, a snug fit is all that is required. The nut is properly tightened when the Float Switch cannot be moved in or out of the 1/2" pipe.
6. Install the alarm in the tank.

BEFORE FILLING ANY TANK WITH THE ALARM INSTALLED, ALWAYS TEST THE ALARM BY PRESSING THE TEST/RESET BUTTON AND INSURE THE ALARM SOUNDS.

To insure maximum battery life, after the tank is full and the alarm has sounded, turn off the alarm by pressing the Test/Reset Button. Battery life is significantly reduced if the alarm is left on.

EXTERNAL POWER SUPPLY INSTALLATION.

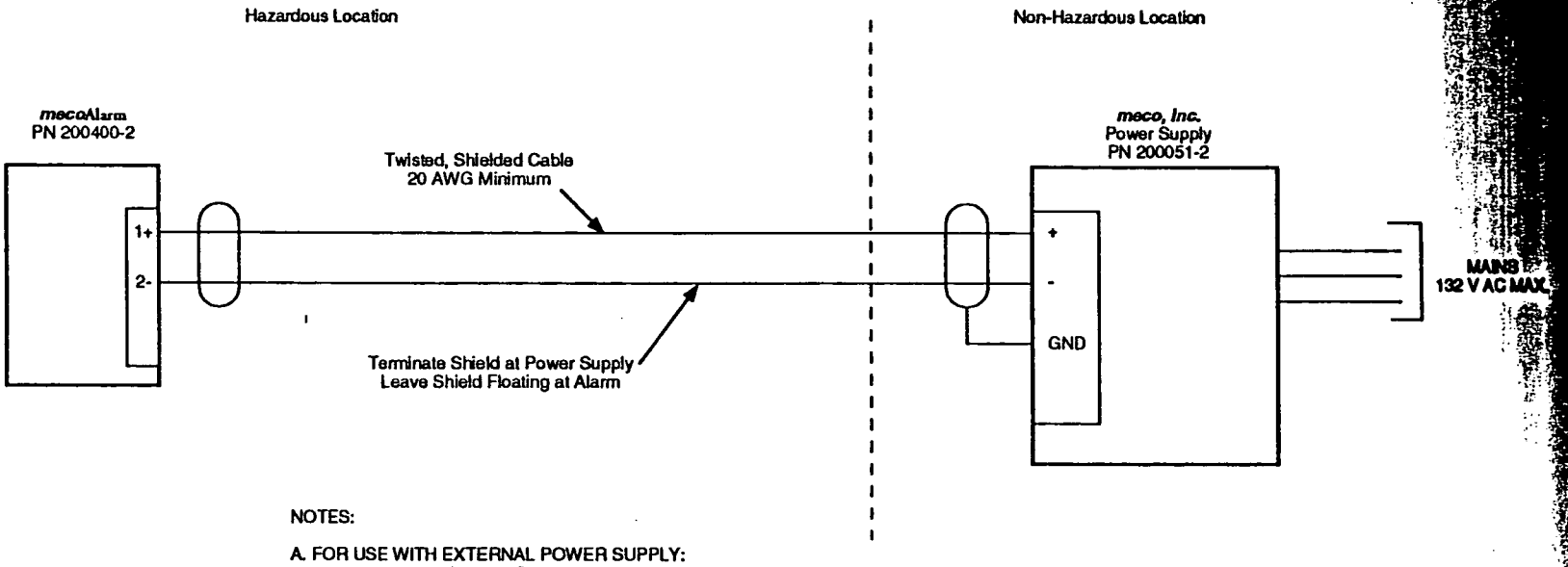
1. Remove Alarm head and nipple from 2" bushing.
2. Install a conduit tee and conduit to the Non-Hazardous location that the power supply is located in (see Figure 1). Install the power supply in accordance with CD200051.
3. Connect the Alarm to the power supply in accordance with CD200400-2. Remove four cover screws and remove cover. (see Figure 2 for Alarm internal connections.)
4. Close cover using care not to pinch wires between the cover and the case and replace four screws.
5. Test unit for proper operation.
   a. Press the Test/Reset Button and insure the alarm sounds while the button is depressed and the alarm stops when the button is released.
   b. Turn unit upside down and insure alarm sounds. While unit is upside down, press and release the Test/Reset Button and insure the alarm stops.
6. Adjust the Float Switch for the proper trip point prior to installing into tank. To adjust the Float Switch, loosen the chrome nut and extend the switch to the desired length and tighten the chrome nut. DO NOT OVER TIGHTEN THE CHROME NUT, a snug fit is all that is required. The nut is properly tightened when the Float Switch cannot be moved in or out of the 1/2" pipe.
7. Install the Alarm in the tank.

BEFORE FILLING ANY TANK WITH THE ALARM INSTALLED, ALWAYS TEST THE ALARM BY PRESSING THE TEST/RESET BUTTON AND INSURE THE ALARM SOUNDS.

To insure maximum battery life, after the tank is full and the alarm has sounded, turn off the alarm by pressing the Test/Reset Button. Battery life is significantly reduced if the alarm is left on.

meco, Inc.
6326 Lake Dora Ave., San Diego, CA. 92119

INSTALLATION INSTRUCTIONS, *meco*Alarm		
DATE: 9/21/98	DWG. NO. 200408	
REV.	SCALE: NONE	SHEET 1 OF 1



NOTES:

A. FOR USE WITH EXTERNAL POWER SUPPLY:
1. *meco*Alarm REQUIRES THE *meco* 12 V DC POWER SUPPLY PART NUMBER 200051-2 HAVING THE FOLLOWING CHARACTERISTICS:
Vmax = 22.1 V DC
Imax = .61 A

2. THE MAXIMUM CABLE LENGTH IS 1000 ft AND REQUIRES A CABLE MEETING THE FOLLOWING CHARACTERISTICS:
Cable Capacitance = 60 pF/ft Maximum
Cable Inductance = .20 µH/ft Maximum
20 AWG Minimum

B. FOR USE WITH INTERNAL BATTERY:
1. FOR THE LONGEST BATTERY LIFE THE RECOMMENDED BATTERY FOR ALL INSTALLATIONS IS THE Ultralife 9 V DC LITHIUM BATTERY PART NUMBER U9VL. IN CLIMATES HAVING A TEMPERATURE RANGE OF -40° F TO +158° F, THE Ultralife LITHIUM BATTERY IS REQUIRED.

2. IN CLIMATES WHERE THE MAXIMUM TEMPERATURE RANGE IS -4° F TO +130° F THE FOLLOWING ALKALINE BATTERIES MAY BE USED (EXPECT MUCH SHORTER BATTERY LIFE THAN THE LITHIUM):
DURACELL MN1604
RAYOVAC MAXIMUM A1604
EVEREADY ENERGIZER NO. 522

C. REFERENCE DOCUMENTS:
1. *meco*Alarm INSTALLATION INSTRUCTIONS 200408.

meco, Inc.
6326 Lake Dora Ave., San Diego, CA. 92119

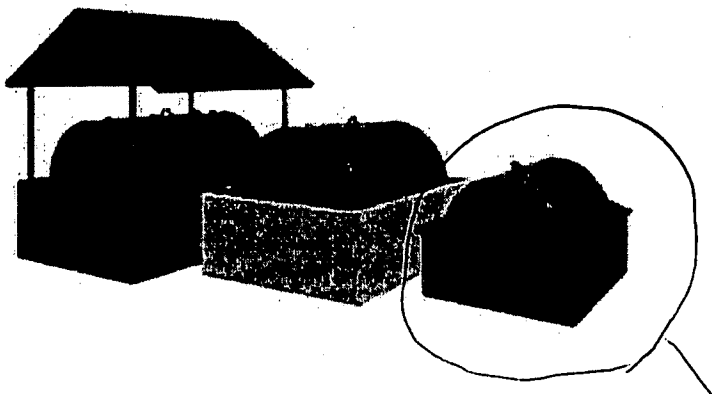
CONTROL DRAWING, *meco*Alarm		
DATE: 9/21/98	DWG. NO. CD200400-2	
REV. -	SCALE: NONE	SHEET 1 OF 1

Clawson Tank for May 30, 2001

Clawson Tank Company, serving the liquid storage needs of its customers for over 50 years!

Home
Underground Storage
Aboveground Storage
Motor Fueling Systems
Pressure Vessels
Processing Tanks
Links
Contact

Containment Dikes



An economical secondary containment system solution, Clawson's Open Top, Canopy and WaterGuard dikes are designed and built to nationally-recognized STI F911-93 fabrication standards for pre engineered secondary containment. To meet NFPA 30 2-3.3.3, dikes incorporate steel walls and can hold capacities from 300 to 20,000 gallons. Each dike provides 110% containment and overspill protection, and allows for easy visual inspection.

To protect the dike from filling up with debris and rain water, the WaterGuard is constructed with heavy-duty rain shields that divert water away from the tank. A roof has been added to an open top protecting Canopy Dike from external elements.

Sizes and Dimensions

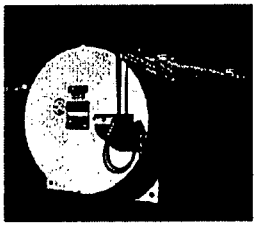
Capacity	Size	Dimensions	Thickness
330-gallon	300-gallon	72"x48"x22"	10ga
683-gallon	560-gallon	94"x60"x28"	10ga
1,100-gallon	1,000-gallon	94"x84"x36"	3/16"
1,256-gallon	1,100-gallon	156"x72"x28"	10ga

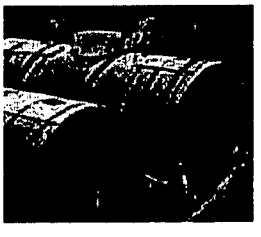
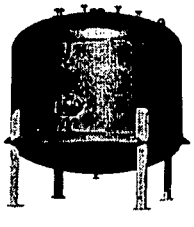
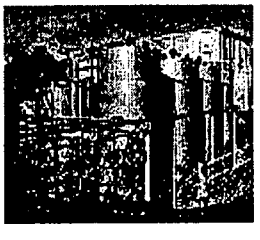
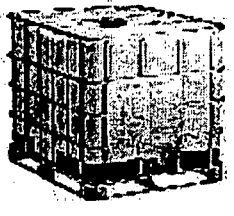
1,600-gallon	1,500-gallon	122"x84"x36"	3/16"
2,200-gallon	2,000-gallon	168"x84"x36"	3/16"
3,300-gallon	3,000-gallon	252"x84"x36"	3/16"
4,400-gallon	4,000-gallon	324"x96"x34" 216"x108"x48"	1/4"
5,500-gallon	5,009-gallon	204"x130"x48"	1/4"
6,600-gallon	6,000-gallon	249"x130"x48"	1/4"
8,800-gallon	8,000-gallon	332"x130"x48"	1/4"
11,000-gallon	10,000-gallon	420"x130"x48"	1/4"
13,200-gallon	12,000-gallon	432"x132"x54"	1/4"
16,500-gallon	15,000-gallon	372"x144"x72"	1/4"
22,000-gallon	20,000-gallon	495"x144"x72"	1/4"

The STI F911 standard dike has been designed and tested to withstand the secondary containment loads for the horizontal tank size indicated.

Need pricing, inventory or tech information?
Click here!

Which Tank do you need?



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