

**PLAINTIFF'S
EXHIBIT**

UC-P-132

**INSTRUMENTATION FLOW PLAN SYMBOLS
FOR FLOW DIAGRAMS**

December 1964

**UNION CARBIDE CORPORATION
Olefins Division
South Charleston, West Virginia**

016629

PURPOSE

The purpose of this report is to provide a system of symbols and identifications to identify the process instrumentation on flow diagrams. The report will establish a uniform system to be followed by the various project groups working on different parts of a project.

SCOPE

This report is intended to be complete enough to satisfactorily define and identify the instrumentation systems necessary for control of the process and to outline process data for auxiliary functions such as data reduction and computer computations. At the same time it is intended to be simplified enough to expedite preparation of flow diagrams and instrumentation performance data.

This schematic presentation does not attempt to detail the specific items or methods of installation of a complete process control loop. Such a detailed drawing will appear on the instrumentation specifications and drawings.

ACKNOWLEDGMENT

The nomenclature and symbols used in this report are generally in agreement with the Instrument Society of America RP 5.1 Tentative Recommended Practice, Instrumentation Flow Plan Symbols, dated 1949.

INSTRUMENT SYMBOLS FOR P&ID DRAWING

A - ANALYZER

AA	Analyzer Alarm - Blind
AI	Analyzer Indicator
AlA	Analyzer Indicating Alarm
AIC	Analyzer Indicating Controller
AR	Analyzer Recorder
ARA	Analyzer Recording Alarm
ARC	Analyzer Recording Controller

ALV, D, S, etc., VFA, etc.

C - CONDUCTIVITY

CA	Conductivity Alarm - Blind
CI	Conductivity Indicator
CI A	Conductivity Indicating Alarm
CIC	Conductivity Indicating Controller
CICA	Conductivity Indicating Controlling Alarm
CR	Conductivity Recorder
CRA	Conductivity Recording Alarm
CR C	Conductivity Recording Controller
CRCA	Conductivity Recording Controlling Alarm

D - DENSITY

DA	Density Alarm - Blind
DI	Density Indicator
DI A	Density Indicating Alarm
DIC	Density Indicating Controller
DR	Density Recorder
DRA	Density Recording Alarm
DR C	Density Recording Controller

F - FLOW

FA	Flow Alarm - Blind
FI	Flow Indicator
FI A	Flow Indicating Alarm
FIC	Flow Indicating Controller
FICA	Flow Indicating Controlling Alarm
FR	Flow Recorder
FRA	Flow Recording Alarm
FR C	Flow Recording Controller
FRCA	Flow Recording Controlling Alarm
FT	Flow Transmitter

Blind only when no instruments are connected.

G - GRAVITY

GA	Gravity Alarm - Blind
GI	Gravity Indicator
GI A	Gravity Indicating Alarm
GIC	Gravity Indicating Controller
GR	Gravity Recorder
GRA	Gravity Recording Alarm
GR C	Gravity Recording Controller

L - LEVEL

LA	Level Alarm - Blind
LI	Level Indicator
LI A	Level Indicating Alarm
LIC	Level Indicating Controller
LR	Level Recorder
LRA	Level Recording Alarm
LR C	Level Recording Controller
LRCA	Level Recording Controlling Alarm

M - MANUAL (through power relay device)

MA	Manual Controller
MAI	Manual Indicating Controller
MR	Manual Reset

PH - pH CONCENTRATION

PA	pH Alarm - Blind
PI	pH Indicator
PI A	pH Indicating Alarm
PIC	pH Indicating Controller
PICA	pH Indicating Controlling Alarm
PR	pH Recorder
PRA	pH Recording Alarm
PR C	pH Recording Controller
PRCA	pH Recording Controlling Alarm

P - PRESSURE

PA	Pressure Alarm - Blind
PI	Pressure Indicator
PI A	Pressure Indicating Alarm
PIC	Pressure Indicating Controller
PICA	Pressure Indicating Controlling Alarm
PR	Pressure Recorder
PRA	Pressure Recording Alarm
PR C	Pressure Recording Controller
PRCA	Pressure Recording Controlling Alarm

P - PRESSURE (Cont'd)

PDC	Pressure Differential Recording Controller
PI	Pressure Indicator
PI A	Pressure Indicating Alarm
PIC	Pressure Indicating Controller
PR	Pressure Recorder
PRA	Pressure Recording Alarm
PR C	Pressure Recording Controller
PT	Pressure Transmitter

S - SPEED

SA	Speed Alarm - Blind
SI	Speed Indicator
SI A	Speed Indicating Alarm
SIC	Speed Indicating Controller
SR	Speed Recorder
SRA	Speed Recording Alarm
SR C	Speed Recording Controller

T - TEMPERATURE

TA	Temperature Alarm - Blind
TI	Temperature Indicator
TI A	Temperature Indicating Alarm
TIC	Temperature Indicating Controller
TICA	Temperature Indicating Controlling Alarm
TR	Temperature Recorder
TRA	Temperature Recording Alarm
TR C	Temperature Recording Controller
TT	Temperature Transmitter

V - VISCOSITY

VA	Viscosity Alarm - Blind
VI	Viscosity Indicator
VI A	Viscosity Indicating Alarm
VIC	Viscosity Indicating Controller
VR	Viscosity Recorder
VRA	Viscosity Recording Alarm
VR C	Viscosity Recording Controller

W - WEIGHT

WA	Weight Alarm - Blind
WI	Weight Indicator
WI A	Weight Indicating Alarm
WIC	Weight Indicating Controller
WR	Weight Recorder
WRA	Weight Recording Alarm
WR C	Weight Recording Controller

X - MISCELLANEOUS

XA	Burner Alarm (Flame Failure Detector)
XL	Motor Load Control
XL R	Motor Load Recorder
XP	Valve Position Indicator
XC	Computer

OTHER

CS	Stop-Start Switch
CS BL	Stop-Start Switch with Running Light
AM	Ammeter
BL	Running Light
ADD	Summing Relay
MULT	Multiplying Relay
DIV	Dividing Relay
SQ RT	Square Root Extract or Relay
EC-M	Computer Manual Stop-on
S	Selector
HA	High Alarm
LA	Low Alarm
HL	High-Low Alarm
FS	Interlock Switch
RA	Recorder Alarm
RAC	Recorder Alarm Controller
RC	Recorder Controller
ESD	Emergency Shutdown System
PCS	Process Shutdown System
OR	Over-Ride

016631

BASIC SYMBOLS

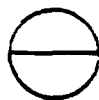


All connections to instrument symbols. Includes instrument process piping, instrument air lines, instrument electrical leads, and instrument capillary tubing.

Locally
Mounted



Panel
Mounted



Basic Symbol for Instrument
with single service

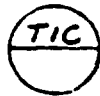
Locally
Mounted



Panel
Mounted



Basic Symbol for Instrument
with two services



Upper half of circle
contains letters to
identify Instrument
System application



Lower half of circle
contains numerals
and/or letters to
identify the Instrument
System Item Number



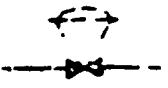
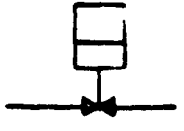
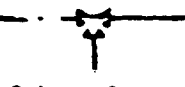
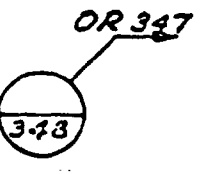
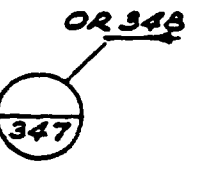
Identify Instrument
System application
of both services in
upper half of circle



016632

Assign only one
Instrument System
Item Number in
bottom half of circle

BASIC SYMBOLS - contd

 Diaphragm Control Valve	 Electrically Operated Valve (Solenoid or Motor)	 Piston Operated Valve (Hydraulic or Pneumatic)	 3-Way Body for any Valve
 Thermometer Test Well	 ESS  PSS  OR Auxiliary Functions: Indicating type of control. "ESS" - Connect to Emergency Inst. Shutdown Hdr. "PSS" - Connect to Planned Shutdown Hdr. "OR" - Override.		
 Instrument System Initiating the action. Show type action along with item number and directional arrow.	 Instrument System Being acted upon. Show type action along with item number and directional arrow.		

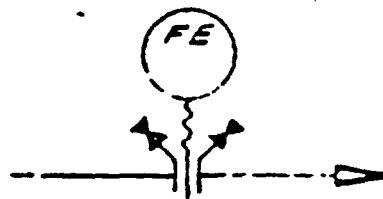
016633

NOTE: A brief explanatory notation may be added alongside a symbol if considered necessary to clarify the function or purpose of an item.

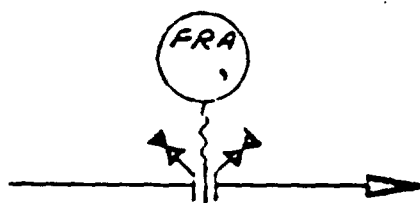
Field transmitters not shown on the Flow Diagram Symbols are understood to be locally mounted.



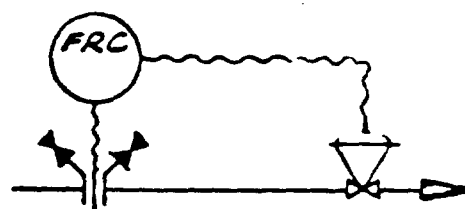
Rotameter or displacement
"In Line" Flow Meter



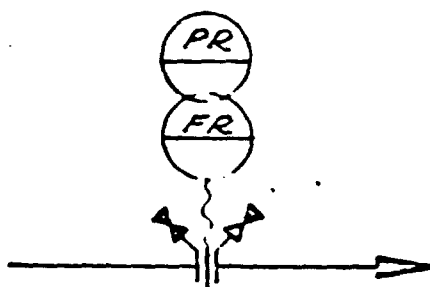
Flow Element
Not connected to instrument



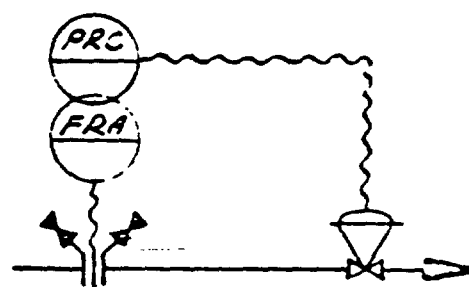
Flow Recorder Alarm



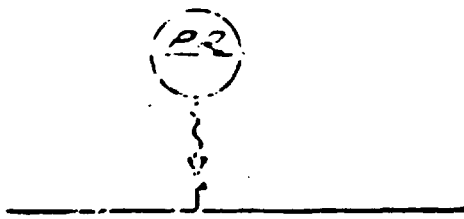
Flow Recording Controller



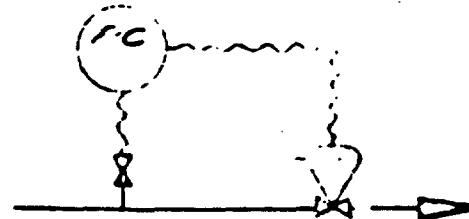
2-pen Recorder of Flow and
Pressure - Recorded on same
instrument and connected to
same orifice



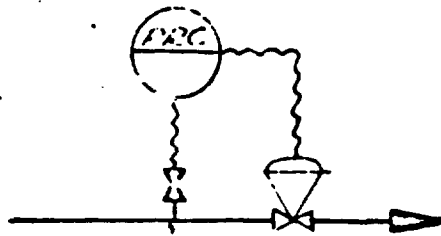
2-pen Recorder, Pressure Recorded
Controlled and flow recorded and
alarmed



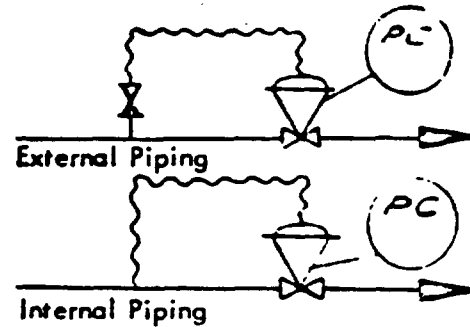
Pressure Recorder



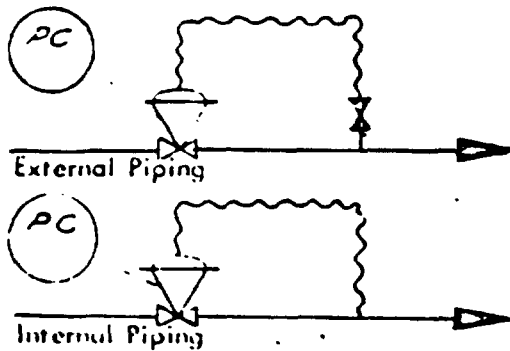
Pressure Controller - Blin.



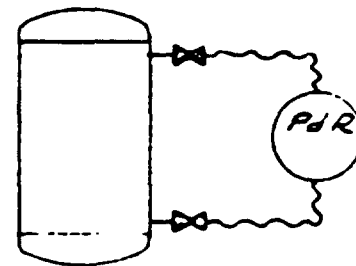
Pressure Recording Controller



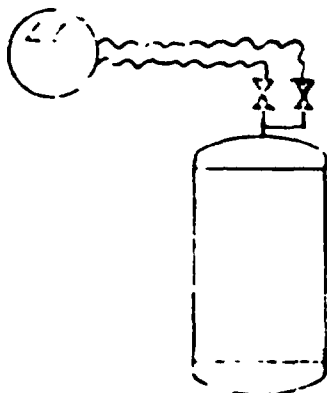
Self-Contained Back Pressure Regulator



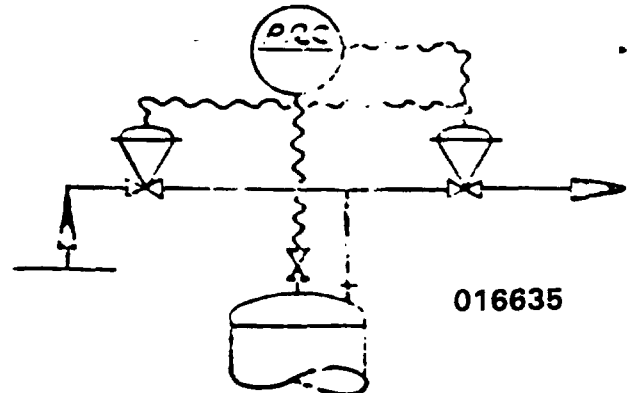
Self-Contained Pressure Reducing Regulator



Differential Pressure Recorder

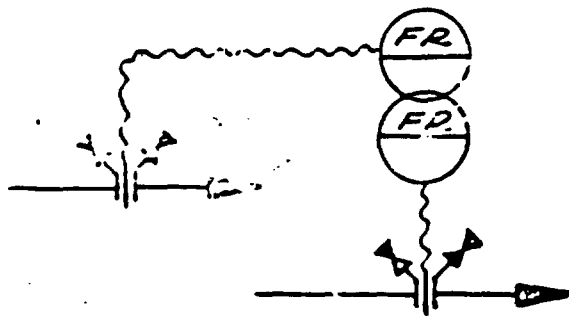


Liquid Level Indicator

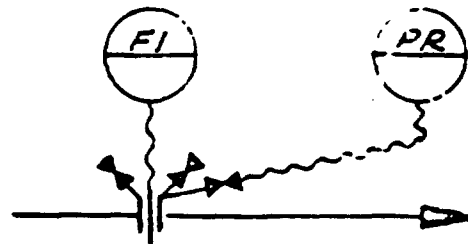


Pressure Recording Controller,
Controlling two Control Valves

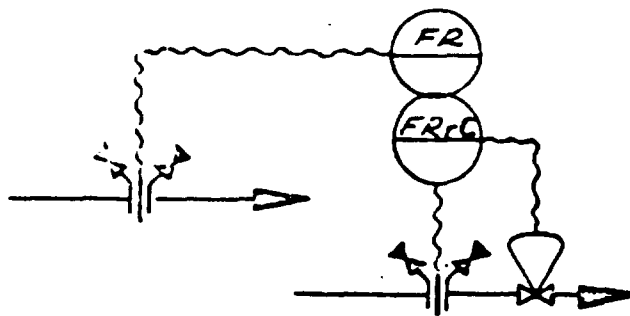
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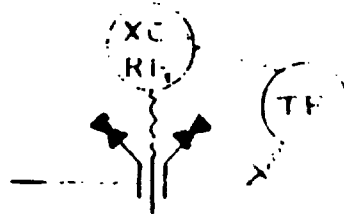
2-pen Recorder, separate variables recorded on same instrument



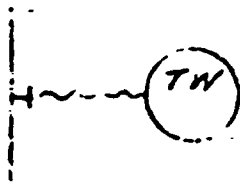
Two separate instruments connected to same orifice



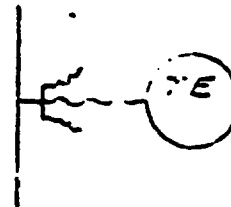
Ratio Control Station, both flows recorded, using Analog Ratio Panel.



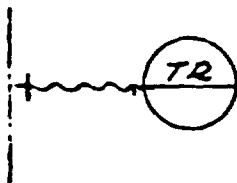
Computer Records Flow, Flow is Temperature Compensated



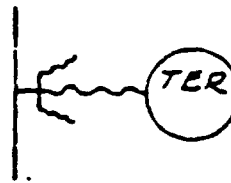
Temperature Well



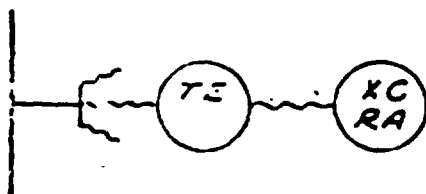
Temperature element, temperature well and measuring assembly (not connected).



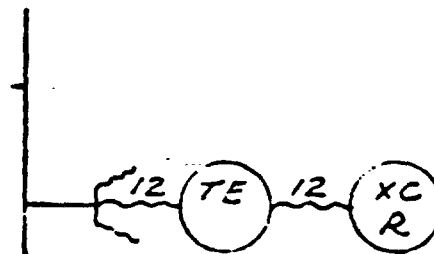
Temperature Element (Bulb Type)
Recorded, Panel Mounted



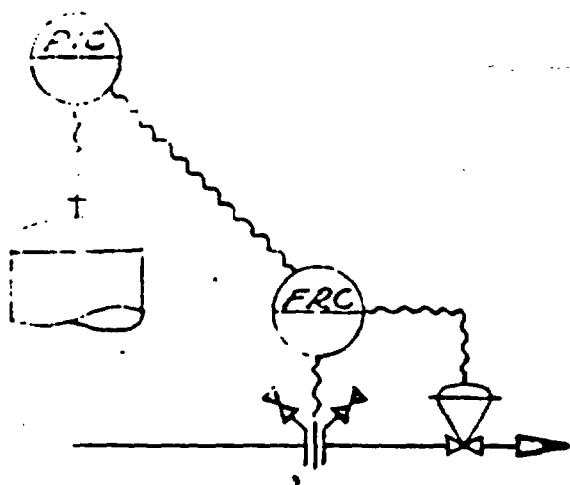
Temperature element, Recorded



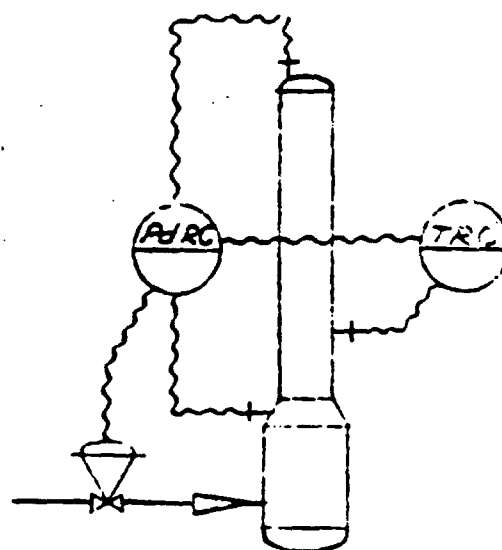
Temperature element
Computer recorded and
alarmed



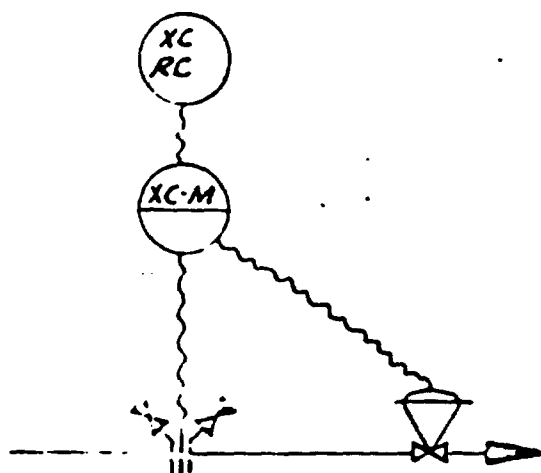
Temperature element
12 temperature elements, 12 computer
recorded



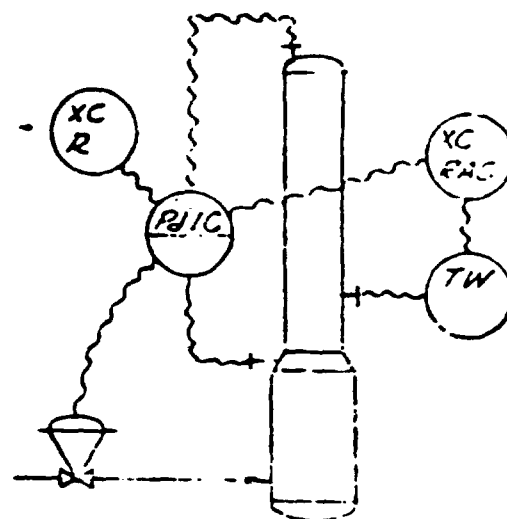
Pressure Indicating Controller,
Resetting Flow Recording Controller



Side Temperature Recording Controller
Resetting Column Differential Recording
Controller, Valve Controlled by Differential

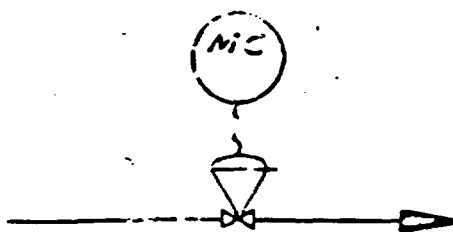


Computer & Control and Controlling
Flow. Panel mounted computer-manual
station.
(Direct digital control through a panel
mounted computer-manual station)

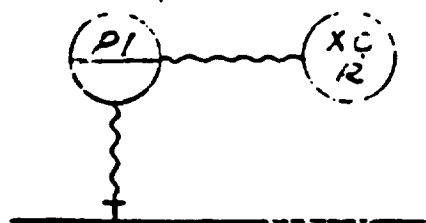


Side Temperature Resetting; Column
Differential Controller, using computer
to set secondary controller, computer record
column differential.

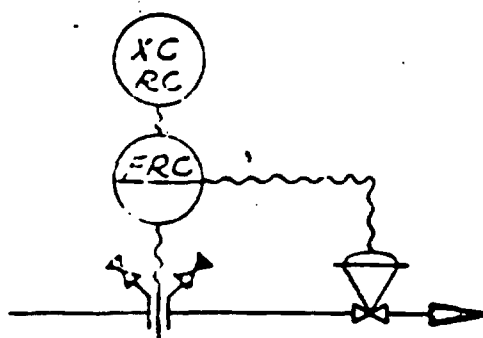
016638



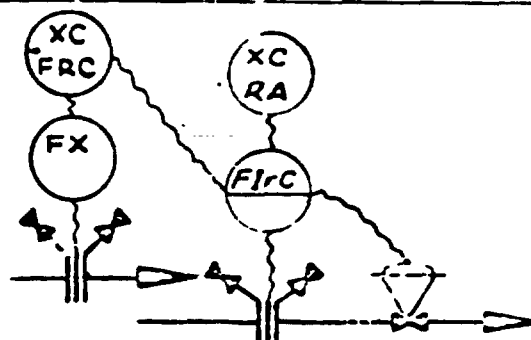
Manual Controlled



Pressure Indicator, with Computer input to be logged on typewriter

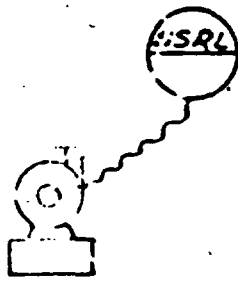


Flow Recording Controller
Input to Computer for logging and
Computer Cascade sets Flow Controller



Ratio Control Station using Computer to
calculate ratio and set Secondary Flow
Controller Computer Records and Alarm
Secondary Flow

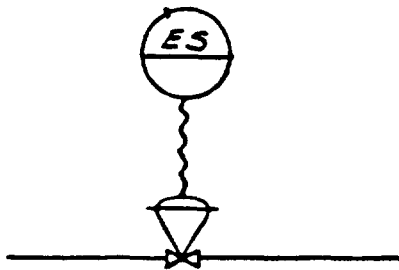
016639



Field Located Pump with Panel Mounted
Stop-Start Switch and Running Light



Field Located Motor with Panel Mounted
Stop-Start Switch and Ammeter



Electric Switch Actuated Valve



Input Signal to Computer. No Bar on Symbol, but it is understood that Computer is in the Control Room.



Input Signal to Computer. Recorded by Computer on typewriter.



Input Signal to Computer. Recorded by Computer on typewriter, and Alarm Scanned by Computer.



Input Signal to Computer. Recorded by Computer on typewriter, Alarm Scanned by Computer, and Control Signal generated by Computer for Cascade Set or Direct Digital Control.



Vibration Sensing Element



Shaft Position Element

016641

APPENDIX B

CABLING SPECIFICATIONS FOR ELECTRONIC
INSTRUMENTATION WITH COMPUTER INSTALLATIONS

Purpose: This specification is designed to establish a standard construction for instrumentation cabling to be used on this project.

Definitions: The following definitions will serve as a means of readily identifying types and service of cabling.

Class I: Single circuit cables

Class II: Multi-circuit cables

Type 1: Analog signals, milliamp or millivolt levels

Digital signals, d.c. milliamp levels

Type 2: Resistance element (RTD)

Type 3: Thermocouples

Type 4: 115VAC power to solenoid valves, motor starters, etc.

Type Suffix-A: Armored construction; does not require conduit or tray systems for mechanical protection in Division II locations.

Type Suffix-B: No mechanical protection; requires conduit or tray systems for mechanical support and protection.

Class I, Type 1-A

Conductors: 15 gauge 7-strand copper
Primary Insulation: 15 mils nominal 90°C PVC or high density polyethylene
Number of Conductors per Group: 2, twisted
Color Code: Black and white
Lay of Twist: 1-1/2" to 2-1/2"
Shield: 100% coverage 1 mil aluminum x 1 mil mylar tape with 18 gauge
7 strand copper drain wire.
Inner Jacket: 20 mils nominal 80°C PVC
Armor: Multiple strands of served 24 gauge soft annealed steel wire,
90% nominal coverage.
Overall Jacket: 30 mils black 80°C PVC
Dekron Part Number 1853-686 or approved equal.

Class I, Type 1-B

Conductors: 16 gauge 7-strand copper
Primary Insulation: 15 mils nominal 90°C PVC or high density polyethylene
Number of Conductors per Group: 2, twisted
Color Code: Black and white
Lay of Twist: 1-1/2" to 2-1/2"
Shield: 100% coverage 1 mil aluminum x 1 mil mylar tape with 18 gauge
7 strand copper drain wire.
Overall Jacket: 30 mils black 80°C PVC
Dekron Part Number 1852-686 or approved equal.

Class I, Type 2-A

Conductors: 16 gauge 7-strand copper
Primary Insulation: 15 mils nominal 90°C PVC or high-density polyethylene
Number of Conductors per group: 3, twisted
Color Code: Black, white and green
Lay of Twist: 1-1/2" to 2-1/2"
Separator: 2 mil mylar tape
Inner Jacket: 20 mils nominal 80°C PVC
Armor: Multiple strands of served 24 gauge soft annealed wire - 90% nominal
coverage.
Overall Jacket: 30 mils nominal black 80°C PVC
Dekron Part Number 1863-686 or approved equal.

Class I, Type 2-B

Conductors: 16 gauge 7-strand copper
Primary Insulation: 15 mils nominal 90°C PVC or high density polyethylene
Number of Conductors per Group: 3, twisted
Color Code: Black, white and green
Lay of Twist: 1-1/2" to 2-1/2"
Separator: 2 mil mylar tape
Overall Jacket: 30 mils nominal 80°C PVC
Dekoron, Part Number 1862-686 or approved equal.

Class I, Type 3-A

Conductors: 16 gauge solid alloy wire matched and calibrated to ISA specifications (RPl - 1.3)
Primary Insulation: 15 mils 105°C PVC
Number of Conductors per Group: 2, twisted
Color Code: ISA color code
Lay of Twist: 1-1/2" to 2-1/2"
Shield: 1 mil aluminum x 1 mil mylar tape and an 18 gauge solid copper drain wire.
Inner Jacket: 20 mils nominal 105°C PVC
Armor: Multiple strands of served 24 gauge soft annealed steel wire, 90% nominal coverage.
Overall Jacket: 30 mils 105°C PVC, ISA color coded.
Dekoron Part Number 1803-656 (typical) or approved equal.

Class I, Type 3-B

Conductors: 16 gauge solid alloy wire matched and calibrated to ISA specifications (RPl - 1.3)
Primary Insulation: 15 mils 105°C PVC
Number of Conductors per Group: 2, twisted
Color Code: ISA color code
Lay of Twist: 1-1/2" to 2-1/2"
Shield: 1 mil aluminum x 1 mil mylar tape and an 18 gauge solid copper drain wire.
Overall Jacket: 30 mils 105°C PVC, ISA color code
Dekoron Part Number 1802-656 (typical) or approved equal.

016644

Class I, Type 4-A

Conductors: 16 gauge 7-strand copper
Primary Insulation: 15 mils nominal 90°C PVC or high density polyethylene
Number of Conductors per Group: 2, twisted
Color Code: Black and white
Lay of Twist: 1-1/2" to 2-1/2"
Shield: 100% coverage 1 mil aluminum x 1 mil mylar tape with 18 gauge
7-strand copper drain wire.
Inner Jacket: 20 mils nominal 80°C PVC
Armor Multiple strands of served 24 gauge soft annealed steel wire, 90%
nominal coverage.
Overall Jacket: 30 mils black 80°C PVC
Dekoron or approved equal.

Class I, Type 4-B

Conductors: 16 gauge 7-strand copper
Primary Insulation: 15 mils nominal 90°C PVC or high density polyethylene
Number of Conductors per Group: 2, twisted
Color Code: Black and white
Lay of Twist: 1-1/2" to 2-1/2"
Shield: 100% coverage 1 mil aluminum x 1 mil mylar tape with 18 gauge
7-strand copper drain wire.
Overall Jacket: 30 mils black 80°C PVC
Dekoron or approved equal.

Class II, Type 1-B

Conductors: 20 gauge 7-strand copper
Primary Insulation: 15 mils 90°C PVC or high-density polyethylene
Number of Conductors per Group: 2, twisted
Color Code: Black and white
Pair Identification: Each pair numbered
Lay of Twist: 1-1/2" to 2-1/2"
Overall Shield: 100% coverage 2-3 mil aluminum - mylar tape with 20 gauge
7-strand copper drain wire.
Overall Jacket: Black 80°C PVC, 60 mils nominal
Communication Pair: To be included in addition to specified number of pairs.
Number of Conductors: As per individual specifications. Either 12 pair or 24 pair.
Dekoron Part Number 1870-01280 (typical) or approved equal.

016645

Class II, Type 2-B

Conductors: 20 gauge 7-strand copper.
Primary Insulation: 15 mils nominal 90°C PVC or high density polyethylenes
Number of Conductors per Group: 3, twisted
Color Code: Black, white and green
Group Identification: Each group numbered
Lay of Twist: 1-1/2" to 2-1/2"
Separator: 2 mils mylar tape
Overall Jacket: Black 80°C PVC, 65 mils nominal thickness
Communication Pair: To be included in addition to groups specified.
Number of Conductors: 12 groups of 3 conductors per cable.
Dekoron Part Number 1880-01280 or approved equal

Class II, Type 3-B

Conductors: 20 gauge solid alloy wire matched and calibrated to ISA specifications (RPl - 1.3)
Primary Insulation: 15 mils nominal 105°C PVC
Number of Conductors per Group: 2, twisted
Color Code: ISA color code
Pair Identification: Each pair numbered
Lay of Twist: 1-1/2" to 2-1/2"
Shield Each Pair: 100% coverage 1 mil aluminum x 1 mil mylar tape with a 22 gauge solid copper drain wire, with separate overwrap of 2 mil mylar.
Overall Shield: 100% coverage 2-3 mil aluminum - mylar tape with a 20 gauge solid copper drain wire.
Overall Jacket: 80°C PVC - ISA color code, 65 mils nominal thickness
Communication Pair: To be included (copper)
Number of Conductors: 12 pairs per cable
Dekoron Part Number 1824-01230 (typical) or approved equal

Class II, Type 4-B

Conductors: 16 gauge 7-strand copper
Primary Insulation: 15 mils nominal 90°C PVC or high density polyethylene
Number of Conductors per Group: 2, twisted
Color Code: Black and white
Lay of Twist: 1-1/2" to 2-1/2"

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Class II, Type 4-B (cont'd.)

Shield: 100% coverage 1 mil aluminum x 1 mil mylar tape with 18 gauge
7-strand copper drain wire.

Overall Jacket: 50 mils black 80°C PVC

Number of Conductors: 12 pair

APPENDIX J
WIRE NUMBERING METHOD

Assume that a Basic Loop Item Number has been assigned, i.e., -219C. The following list the wiring method to be used.

219C+M 219C-M	Measurement signal (i.e., 10-50 ma)
219C+V 219C-V	Controller output signal
219C+SP 219C-SP	Controller cascade set-point signal
219C+AI 219C-AI	Computer analog input signal
219C+DI 219C-DI	Computer digital input signal
219C+AO 219C-AO	Computer analog output signal (except when connected to analog controller set-point)
219C+DO 219C-DO	Computer digital output signal

For those items that are not covered by the above list, the following will apply:

- (a) 115VAC leads to solenoid valve: The leads will be tagged with the solenoid valve Item No., i.e. 413A-1+ (Hot)
413A-1- (Neut.)
- (b) Misc. signals from field such as flow switches, pressure switches, float type switches, etc.: These leads shall be identified with the Item Number of the field device, + and - .
- (c) Misc. items such as signal leads from panel mounted switches or pushbuttons to motor starters shall be identified with the panel instrument item number + and - .

APPENDIX K
WIRE MARKING METHOD

All wires and cables, except those provided as part of the pre-wired console by the console vendor, will be tagged with pre-printed markers such as supplied by Dura-Mark, Inc. A schedule, similar to that prepared for panel name tags, shall be prepared and issued for preparation of the wire markers. This schedule will show the wire O.D. in addition to the required lettering.

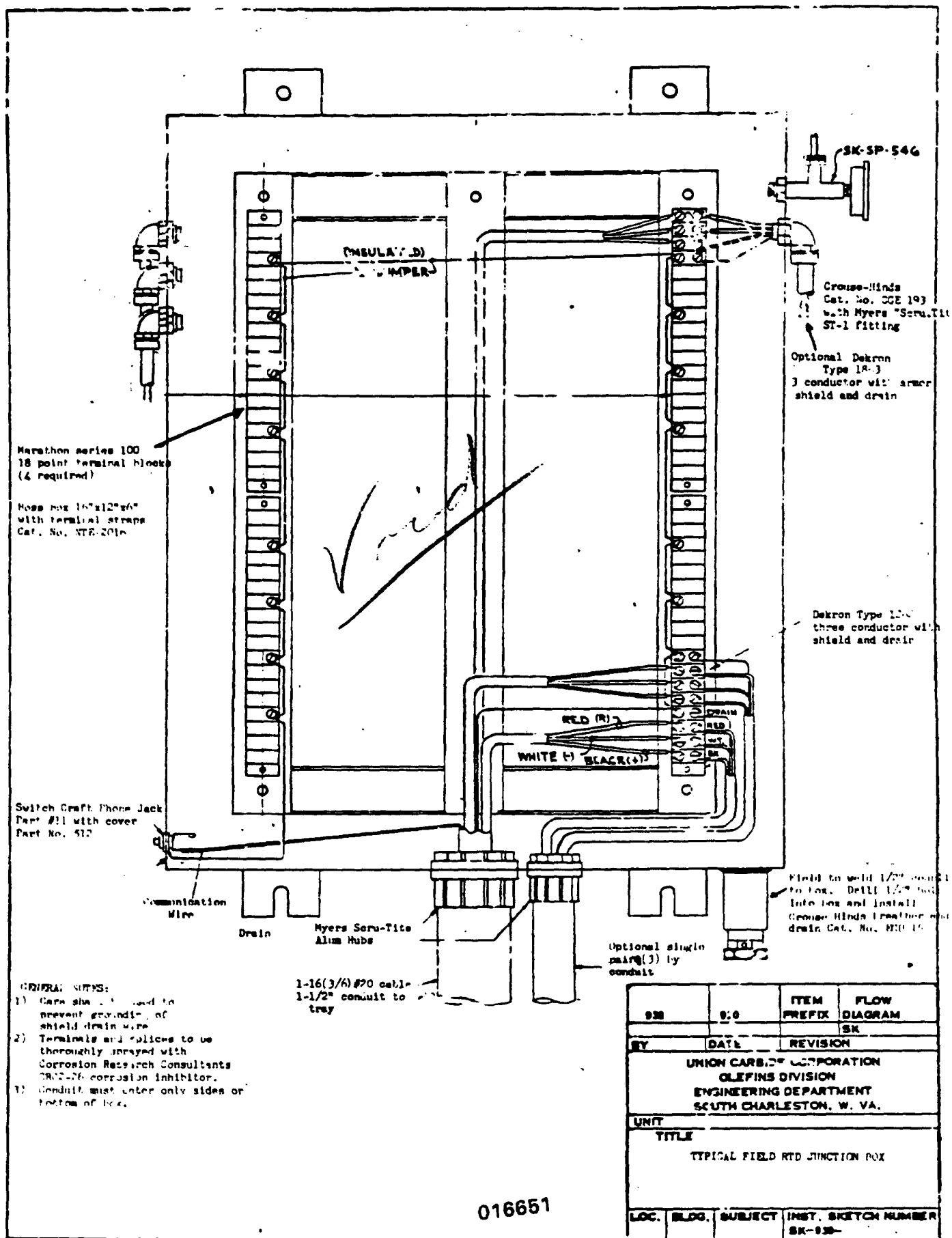
The pre-printed markers will be supplied by Dura-Mark or an approved equal.

DURA-MARK, INC.
2 Secatoga Avenue
Port Washington, New York

APPENDIX L

INSTRUMENT ELECTRICAL CONNECTION BOXES

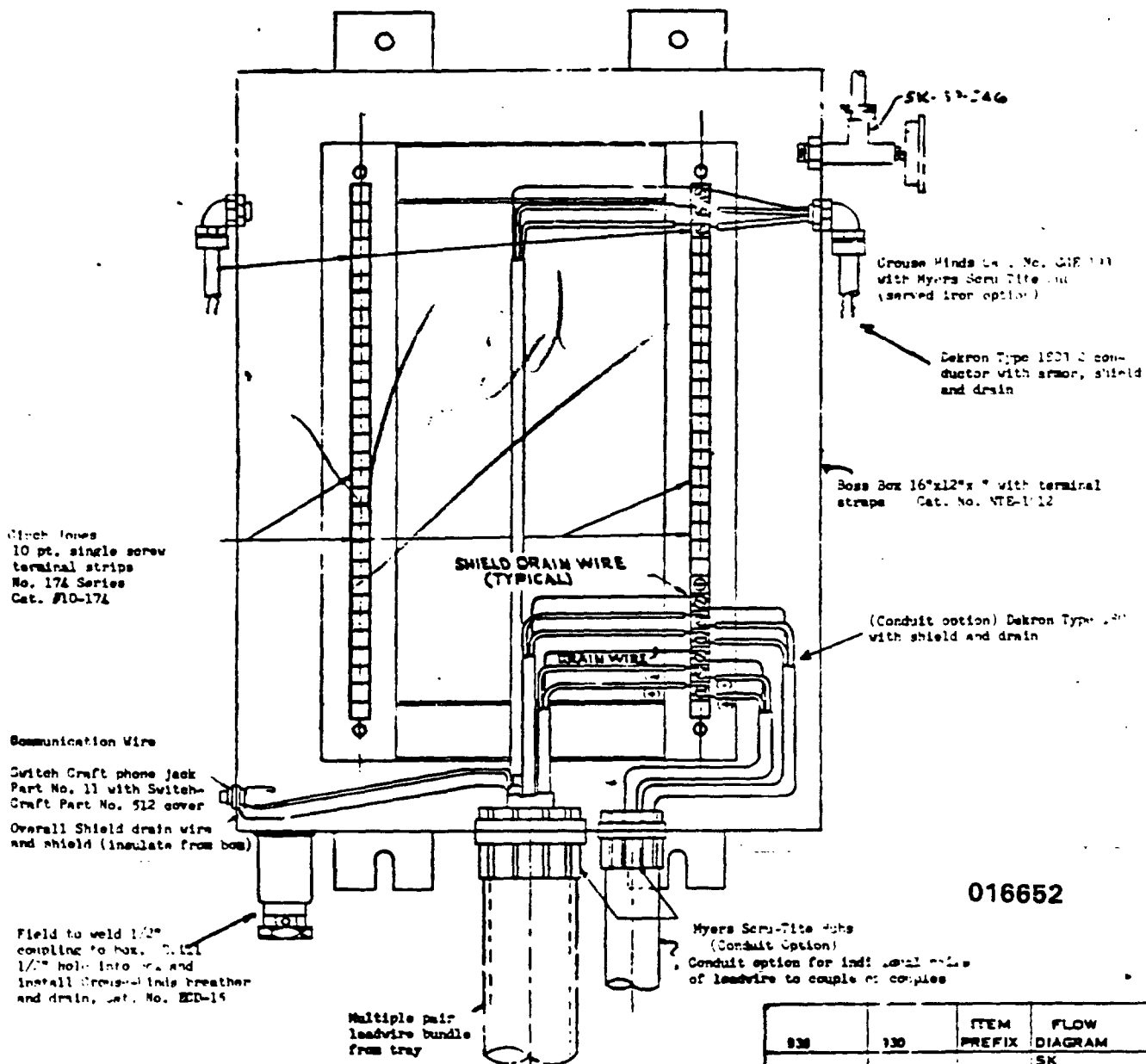
12 pair	Thermocouple Junction Box
12 pair	RTD's Junction Box
12 pair	Instrument Junction Box
24 pair	Instrument Junction Box



- GENERAL NOTES:
- 1) Care should be taken to prevent grounding of shield drain wire.
 - 2) Terminals and splices to be thoroughly sprayed with Corrosion Research Consultants CR-2-26 corrosion inhibitor.
 - 3) Conduit must enter only sides or bottom of box.

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Q38	Q:Q	ITEM	FLOW
		PREFIX	DIAGRAM
BY	DATE	REVISION	SK
UNION CARBIDE CORPORATION			
OLEFINS DIVISION			
ENGINEERING DEPARTMENT			
SOUTH CHARLESTON, W. VA.			
UNIT			
TITLE			
TYPICAL FIELD RTD JUNCTION BOX			
LOC.	BLDG.	SUBJECT	INST. SKETCH NUMBER
			SK-938-



016652

GENERAL NOTES:

- 1) Care shall be used to prevent grounding of shield drain wire. Terminals and solices to be thermally sprayed with Corrosion Research Consultants CRC 2-26 corrosion inhibitor.
- 2) Conduit must enter only sides or bottom of box.

Q30	130	ITEM	FLOW
		PREFIX	DIAGRAM
			SK
BY	DATE	REVISION	
UNION CARBIDE CORPORATION			
CLEFINS DIVISION			
ENGINEERING DEPARTMENT			
SOUTH CHARLESTON, W. VA.			
TYPED			
TYPED			
TYPED			
LOC.	BLDG.	SUBJECT	INST. SKETCH NUMBER
			SK-130-

