

PPG INDUSTRIES, INC.
INDUSTRIAL CHEMICAL DIVISION
LAKE CHARLES, LOUISIANA

OHC-EDC PILOT PLANT
OPERATING MANUAL

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I. INTRODUCTION

PPG has operated a commercial OHC-EDC plant successfully since early 1969. The advantage of this process over the usual method for making EDC is that it consumes HCl rather than Cl_2 . HCl is a by-product of the thermal cracking of EDC to produce vinyl chloride (VCM) and the OHC-EDC process makes it possible to produce VCM without by-product HCl. The OHC-EDC process can also, of course, take HCl by-product from other sources such as liquid phase chlorination of EDC (known at Lake Charles as the Tetra unit).

The commercial catalyst for PPG's OHC-EDC process is Attapulugus clay impregnated with copper and potassium chloride. PPG R & D has been working for several years on improvements in catalysts to achieve higher heat transfer coefficients (increased reactor capacity), higher purity product and improved raw material utilizations. In 1971 the 28-inch pilot OHC reactor was installed at Lake Charles (from the Natrium Technical Center where the early process development was done) to provide a large-scale facility to test various improved catalysts shown to be promising in smaller-scale laboratory work. The large-scale pilot reactor provides data to allow scale-up to commercial reactors in the areas of raw material conversions, heat transfer and corrosion/erosion rates.

This manual contains a description of the pilot plant equipment, general operating procedures, safety considerations and various charts beneficial to those persons charged with the operation of the facility. The section on startup and shutdown procedures is general as these can be a function of the particular test and/or catalyst being evaluated. More detailed instructions will be given the operating personnel by the engineer in charge at the appropriate time.

II. EQUIPMENT DESCRIPTION

A. Feed System

1. C₂H₄

C₂H₄ is supplied to the pilot plant from tie-ins downstream from the No. 1 and No. 2 commercial reactor preheaters. Supply can come from either reactor system but preferably should be lined up to the operating reactor if the other one is down. The C₂H₄ passes through the rotameter and then mixes with the HCl and N₂ feeds to the reactor windbox. The piping from the point of mixing with HCl and N₂ up to just before the reactor is steam jacketed with 250 psig steam to provide superheat and prevent condensation in the windbox and lower portion of the reactor.

2. HCl

HCl is supplied to the pilot plant from two possible sources. The most desirable and highest quality HCl comes from a tie-in to the new 6" HCl header from the VCM unit. This line contains only VC-HCl with no contamination from EC, TCE or Tetra. There are also tie-ins to each of the Nos. 1 and 2 commercial reactor preheaters. This HCl contains all the contaminants in the HCl distribution system.

The HCl from the VC unit should be used whenever available as this makes interpretation of the pilot plant results, particularly crude quality, much more meaningful.

3. Oxygen

Oxygen to the pilot plant comes from tie-ins to the Nos. 1 and 2 commercial reactor O₂ preheaters. It is fed to the reactor through a rotameter and preheat system (250 psig steam jacketed). As in the commercial plants, O₂ is sparged into the fluid bed separately from the C₂H₄ and HCl (mixed feed) to prevent prereaction.

4. Nitrogen

Nitrogen comes to the pilot plant from the main N₂ system in OHC. It is metered (rotameters) to both the mixed feed and the O₂ piping systems for fluidization for startups, shutdowns, and periods of reactor outage. A small N₂ stream is fed with the O₂ to provide a material balance tie-component to allow calculation of the reactor vent.

B. Dowtherm System

The reactor temperature is controlled by circulating Dowtherm A through the internal coils. Since Dowtherm A boils at about 500°F., no pressure will be required to keep it in a liquid state.

The Dowtherm will be used to heat the reactor for startups as well as cool it during operation.

When used to heat the reactor, the Dowtherm will flow from the circulating pump to the Hynes heater. From the heater, the stream goes to an orifice section where the circulation rate is measured, then to the inlet header where the flow is distributed to the five coils. From the reactor the flow is bypassed around the cooling system and returns to the pump.

Dowtherm temperature control (and, therefore, reactor temperature control) is essentially a manual operation accomplished by adjusting the flow of Dowtherm through the shell and tube Dowtherm cooler. There is an automatic valve in the cooler by-pass loop but the nature of the system is such that it only provides a fine-tuning type of control ($\pm 5-10^{\circ}\text{F.}$). However, as long as feeds are maintained steadily to the reactor, steady temperature operation is not difficult.

The Dowtherm cooling in the reactor is accomplished by a system of five parallel tube banks of serpentine tubes. There are valves in the inlet side of each of these tube banks to allow isolation of individual banks. This is to provide versatility to the reactor system. Normally under OHC-EDC conditions, all five banks are used.

Dowtherm for changing the system comes from a tie-in at the No. 2 commercial reactor cooler. This tie-in is left open during pilot plant operation which allows the No. 2 reactor system to provide expansion room as the Dowtherm expands and contracts.

C. Reactor

The reactor is constructed entirely of Inconel 600 and is 28 inches in diameter. Drawings are included in the appendix.

1. Windbox and Feed Distribution Plate

The feeds are distributed in the reactor in a manner similar to the system in the commercial reactors. Ethylene and HCl (no recycle) are mixed in the windbox and fed to the reactor through 2" high vertical nozzles. The oxygen is fed separately through nozzles that are 17" longer, thus the oxygen is introduced at a higher point in the bed.

The plate which supports the feed nozzles is designed for a maximum of 15 pounds difference between the windbox and the reactor. That is, if the windbox were at 20 pounds pressure and the reactor at 1 pound pressure, an unsafe condition would exist and the plate might fail. The windbox pressure must never exceed the reactor pressure by more than 15 psig.

2. Cooling Coils

The reactor shell is not jacketed. Cooling is entirely accomplished by five banks of Inconel hairpin-type tubes. It is important that these tubes do not corrode. The best protection is keeping the coil temperature always above 300°F. Flow should be kept on the coils at all times, even while the reactor isn't running. When the reactor is down, the Dowtherm temperature can be kept at or above 300°F. with the Hynes heater.

D. Condensing System

The condensing system consists of three single-pass Karbate condensers in series. The #3 condenser is refrigerated. The primary condenser is upflow, but the secondary and refrigerated condensers are downflow.

A cyclone has been installed to remove some of the catalyst fines. This should be drained once per shift.

E. Product Recovery

The condensed liquid is degassed in a level-controlled degassing chamber and forced by reactor pressure into the commercial plant intermediate crude storage system. For material balance purposes, a phase separator has been installed to allow measurement of the organic and acid phases. During normal operation, the phase separator will be bypassed.

F. Vent System

The non-condensed gases are purged off the bottom of the refrigerated condenser. A control valve controls the operating pressure of the system. The vent gas is piped to the main plant scrubber. A tap is provided for taking vent gas samples. There is a knock-out pot which returns entrained liquid to the phase separator.

III. STARTUP AND SHUTDOWN PROCEDURES

A. Dowtherm Startup

1. Circulation and Air Purging

Once the reactor is completely assembled (except for the bottom head and rupture disc), the Dowtherm can be added to the system. This should be done carefully and slowly to prevent trapping air or N_2 in the piping which can cause the pump to vapor lock. If the piping is filled by sections, there are enough bleeds to purge most of the air in the system without significant Dowtherm loss. The system should be purged with dry N_2 and checked for moisture before adding Dowtherm. Steam tracing on the charge line and around the flow metering section should be on before charging.

The circulation pump can now be started. Make sure the seal flush system is lined up through a filter, the two coolers and back through the seal. Be sure the water to the seal flush coolers is on full. The pump should be hand rotated before starting to prevent damage to the mechanical seal faces.

To assure that the pump is not dead-headed at anytime, the by-pass around the Dowtherm temperature control valve should be opened such that about a 40% flow is obtained on the flow indicator with the TCV closed. Flow should be lined up through the heater during Dowtherm system startup. All five reactor banks should be open until good circulation is established. The bleed in the Dowtherm line on the south side of the reactor top deck should be carefully cracked open occasionally until no more gas escapes. It is also a good practice to alternately force all the flow through each reactor cooling tube bank by closing the other four valves on the north side of the reactor. This provides a high velocity flow to force as much trapped air out of the coils as possible. When all five banks have been cleared, the valves can be opened again.

2. Dowtherm Heater

When flow has been established through the heater, the heater can be turned on. The breaker for the heater is in the upstairs breaker room of the old OHC control building. The Dowtherm pump breaker is also located there on the same panel as the heater. Both are clearly marked.

Once the heater breakers are engaged, the heater is started by setting the on-off temperature controller at the heater above the temperature indication on the controller. The three heater switches should be on. A click can be

heard when the heaters become activated. With the insulation in good repair, the heater should provide about 15-20°F. per hour heat-up rate to the fluidized reactor bed.

Once the reactor has been started up and the heater is no longer required, the heater can be turned off by lowering the set point to 300°F. on the controller.

A small flow should be maintained through the heater even when it is off. This assures that the relatively large Dowtherm volume in the heater loop stays hot, allowing a quicker heat-up period after a reactor shutdown.

3. Dowtherm Cooling

As the heat of reaction is picked up by the Dowtherm system after reactor startup, a point will be reached where it will become necessary to remove this heat by circulating a portion of the Dowtherm through the cooler. Prior to this time the Dowtherm valves on both sides of the cooler should be closed.

To put the cooler in service, a good water flow must first be established. Before starting water flow, make sure both Dowtherm valves are closed. Next open the lower (inlet) Dowtherm valve (plug cock) fully. The outlet (globe) valve can now be opened slowly. Feel the piping to this valve; when it starts to get warm you will know that Dowtherm is flowing. As soon as a small flow is established, check the reactor and Dowtherm temperature responses on the control room L & N recorder. Add more cooling carefully and slowly, allowing time for the system to fully respond.

It is a good idea to set the Dowtherm automatic TCV about 1/2 to 2/3 open on manual until the desired, lined-out temperatures are established. The controller can be put on automatic once the reactor and Dowtherm temperature are lined out at the desired point.

The Dowtherm TCV provides only a $\pm 5^\circ\text{F.}$ control so that larger upsets such as rate changes, heavy rain, etc. may require further manual adjustment using the cooler outlet valve. The temperature response to changes in the cooler outlet valve is very sensitive. Care should be taken to not operate more than 1/4 turn at a time.

The above description assumes an initial startup. If the system has been previously running and is being started up to approximately the same conditions, the cooler downstream valve will be open to the previous setting. In this case startup of the cooler can be achieved by slowly opening the upstream plug cock. This will make the reactor easier to line out.

B. Reactor Startup

1. Catalyst Charging and Heatup

Catalyst is charged to the reactor through the rupture disc nozzle. Before adding catalyst, N_2 flow to the reactor should be set at such a rate as to provide about 0.6 ft./sec. superficial velocity. If the vapor piping to the cyclone is in place, flush water should be on the primary condenser, the condensing system should be draining to the pad and the valves at the bottom of the cyclone and dipleg should be open. This will prevent fines blown out during the charging operation from accumulating in the system.

Once all of the catalyst has been added, the reactor rupture disc can be installed. Before installing the disc, make sure that the reactor PCV is open to the plant scrubber.

Reactor heatup can now proceed. The set point on the heater control can be set at 500°F. The reactor should begin to heat up at 15-20°F./hour.

2. Reactor Startup

Once the reactor has reached startup temperature (usually about 425-435°F. with Florex catalyst), the startup (feed introduction) can begin. All parts of the system should be double checked for proper valve positions, etc. Flush H_2O to the primary should be on and water to the condenser shells should be on. Brine should be circulating through the refrigerated condenser. The steam to the feed line preheaters must be on and the jackets hot.

Prior to startup the supervising engineer will enter the following information in the logbook:

- a. Final desired feed rates in mole/hour and rotameter settings (% scale and pressure)
- b. Desired reactor superficial velocity
- c. Reactor temperature (hot spot and/or average)
- d. Reactor pressure
- e. Any other vital information as deemed necessary

Tags should be made to post at the rotameters so there is no confusion during startup. It is advisable that two people be present during startup, at least until the operating people gain startup experience. Normally, one man can be in the field with a radio pack and one man can be in the control room watching temperatures and communicating with the field man by radio.

Introduction of feeds should follow the sequence below:

- a. Add HCl at desired final rate and simultaneously cut out 1/2 of N₂ to the windbox.
- b. Shortly after step (a), the water draining to the pad from the condensing system will turn green, indicating strong acid. The reactor temperature will also begin to rise from the adsorption of HCl by the catalyst. At this time the condensing system should be opened to the degasser and the drain to the pad shut off.
- c. Add C₂H₄ at the desired final rate and reduce N₂ flow to windbox to zero. Do not block off N₂ to windbox tightly until it is ascertained that there are no serious leaks, etc., which might necessitate shutting off HCl and C₂H₄ for a period of time.
- d. Begin adding O₂ slowly to about 1/4 the desired final rate. Do not reduce N₂ to the O₂ header at this time.
- e. If the reactor temperature starts to increase noticeably after this O₂ addition, add more O₂ to about 1/2 rate. N₂ can now be reduced to the final setting specified in the logbook.
- f. At this point, a sample of the vent should be taken and analyzed for % O₂. Additionally the bed temperature should respond to the additional O₂.
- g. If the O₂ in the vent is below 8% and the bed temperature is still rising, more O₂ can be added to 3/4 of full rate.
- h. As the bed temperature approaches the desired operating temperature, the heater set point should be lowered and a small flow started through the cooler.
- i. O₂ can now be added at the final rate. For startups with catalyst other than the "standard" Florex type, another vent sample should be taken before this final step. With the "standard" Florex catalyst, it is well established that as long as temperatures are responding and the bed is over 500-525°F., O₂ in the vent will be > 8%.
- j. The vent should be analyzed at this point and % burning and C₂H₄ conversion calculated.
- k. All that remains at this point is lining out temperatures by adjusting the Dowtherm flow through the cooler as described in the Dowtherm startup section.

By adjusting the heater by-pass valve, a small flow can be left through the heater. This is advisable so as not to shock the system during a shutdown. This procedure will greatly shorten a reactor turnaround for minor maintenance.

C. Reactor Shutdown

1. Normal Shutdown

To shut the reactor down in a routine orderly manner, the following steps should be followed:

- a. Turn on primary condenser flush water.
- b. Take out O_2 feed and increase N_2 to O_2 system to fluidization rate (noted on the rotameter glass). Open reactor PCV fully on manual.
- c. Replace C_2H_4 with equivalent amount of N_2 to windbox.
- d. Remove HCl feed and simultaneously increase N_2 to windbox to full fluidization rate.
- e. Block Dowtherm to cooler (upstream valve only).
- f. Set up Dowtherm heater controller if startup in the near future is anticipated. This step will depend on the circumstances of the shutdown.

The important criteria to remember are:

- a. O_2 is the last feed added and the first removed during startups, shutdowns and rate adjustments.
- b. Flush water to the primary condenser should be on when O_2 is not being fed.
- c. The reactor PCV should be wide open on manual except during times of operation at higher-than-atmospheric rates.

2. Emergency and/or Automatic Shutdown

In case of an OHC plant emergency, the pilot plant can be partially shut down from the control room by activating the shutdown switch behind the west control panel. All pilot plant operating personnel should become familiar with the location of this switch. When activated, this switch causes an automatic valve in the O_2 line to the pilot plant to close. HCl and C_2H_4 continue to flow. As soon as conditions permit, C_2H_4 and HCl flows should be stopped and N_2 added. The reactor PCV should be opened immediately.

Loss of HCl flow is the most serious problem which can occur in the pilot plant. This would result in feeding C_2H_4 and O_2 to the reactor in a mixture which would be flammable. To prevent this, low HCl feed pressure as monitored at the rotameter, automatically closes the valve in the O_2 line. There is an alarm which warns the operator of falling HCl pressure in advance of the shutdown. This is to allow time to adjust for small pressure upsets as opposed to actual loss of HCl supply. When the system trips, it will not reset automatically. This feature prevents O_2 from flowing uncontrolled to the reactor when the HCl pressure returns. The O_2 rotameter valves should be closed manually before resetting the shutdown system. The reset button is located just below the shutdown switch behind the west (Tetra plant) control board.

IV. DATA AND SAMPLES

A. Data Sheets and Logbook

Data sheets are provided for recording the various flows, temperatures, levels and pressures. The frequency of recording will be specified by the supervising engineers and communicated in the logbook. Normally, data are recorded hourly.

The engineer's logbook serves to record unusual observations, instructions and results of analyses. It is perhaps most valuable as a communication tool between shift engineers and between the supervising engineer and the shift engineer. Entries in the logbook should be written clearly and in ink with no skipping of pages (for patent purposes). Remember, it is better to write too much than not enough. It is a good practice to write down events as they occur if possible, rather than waiting until the end of the shift and relying on memory.

B. Samples

General control analyses will be run by the shift engineers. These will consist of:

- a. Reactor vent gas (Fisher GC)
- b. Reactor crudes (F&M GC)
- c. Acid phase titrations

The frequency of these will be determined by the supervising engineer and normally has been two vents, two crudes and four acid analyses per shift. Catalyst samples will be taken while charging, when draining and, perhaps, periodically during a run.

Special analyses and/or more complete analyses will be run by the main lab on an as needed basis.

V. SAFETY

A. General

The pilot plant handles no materials not common to the commercial plants (with the exception of catalysts). The safety section of the main OHC operating manual should be reviewed by all concerned with the pilot plant. Safety should be the prime consideration in making any decisions regarding the operation of the pilot plant.

All pilot plant personnel should maintain good contact with the lead operator and be aware of any problems in the plant. Conversely, the pilot plant engineers should keep the lead operator informed of pilot plant status at all times. This communication cannot be over-emphasized. The pilot plant shift engineer should wear a radio pack when in the unit to maintain contact with the control room.

A hazard for the pilot plant people to be particularly aware of is the main plant gas-fired Dowtherm heater. Know when it is on and know how to shut it down if you have to. A major C_2H_4 break could have serious repercussions with this heater in operation. The heater can be shut down both from the control room and the field.

B. Alarms and Responses

Listed below are the alarms on the pilot plant and normal responses that should be made if they sound. Of course, special situations could dictate different responses.

a. Reactor High Temperature

Response: Increase cooling if from a cooling deficiency. Shut down if this fails.

b. Degasser Level

Response: This alarm sounds on both high and low level. In either case, correction should be made with the level control valve. High level can result from insufficient reactor pressure to force the liquid product into the plant system. If a slight reactor pressure increase does not produce a lower level, the possibility of a plugged line must be considered.

c. High Reactor Pressure

Response: Open reactor PCV. If pressure does not come down, shut down immediately. It may not be possible to fluidize with N_2 after shutdown, depending upon the cause of the high pressure.

d. Dowth rm Pump

Response: Try to restart immediately. If restart fails, take out O_2 immediately. Loss of cooling will cause high reactor temperature.

e. Low HCl Pressure

Response: If the alarm is due to a momentary fluctuation or upset at VC, station yourself by the HCl rotameter and keep the flow steady as the pressure comes back. If it is apparent that it is not coming back, shut down reactor. If pressure gets too low, the shutdown system will trip out O_2 .

f. Shutdown System

Response: If caused by a momentary HCl pressure loss and the pressure has been restored, station yourself by the O_2 rotameter, have someone in the control room reset the shutdown system and make sure the O_2 flow never exceeds the setting prior to the shutdown. Do this only after HCl flow has stabilized and providing the reactor temperature has not fallen below $500^\circ F$.

Another hazardous situation which can arise and is not automatically alarmed is O_2 concentration in the vent. This must not be allowed to exceed 8% O_2 . If the vent analysis shows high O_2 , it is an indication of either loss of reaction or feed imbalance. If a check of the feed rates shows the proper flows, then O_2 should be reduced slightly (say 1 or 2 rotameter divisions). If this fails to lower O_2 sufficiently, N_2 can be added to the feeds to dilute the vent. If you are unable to lower the concentration, shut the unit down and notify the supervising engineer.

APPENDIX

REACTOR

Reactor

28" O.D. x 24' Inconel 600
Wall thickness 3/8"

Tubes - 2" Inconel Schedule 40
157.91 ft.² total heat transfer area

CONDENSERS

E-1, E-2 Primary & Secondary Condensers - Single Pass Tube Side

Manufacturer & Model - National Carbon Division of
Union Carbide Corporation
Series 7000 "Karbate" Size 10-144

Material of Construction - Karbate Tubes Steel Shell

Area - 122 ft.²(outside)

Design Pressure & Temperature - 75 psig & 338°F.

Tubes - 31 - 7/8" I.D. - 1 1/4" O.D. x 12"

SAC No. 71-1372 (secondary)
71-1370 (primary)

E-3 Refrigerated Condenser - Single Pass Tube Side

Manufacturer & Model - National Carbon Division of
Union Carbide Corporation
Series 6800 "Karbate" Size 6-108

Material of Construction - Karbate tubes, steel shell

Area - 26.5 ft.² (outside)

Design Pressure & Temperature - 75 psig and 338°F.

Tubes - 9 - 7/8" I.D. - 1 1/4" O.D. x 9'
SAC No. 71-1371

HEAT EXCHANGERS

E-4 Dowtherm Cooler

Manufacturer & Model - Doyle & Roth LL864-12H

Material of Construction - Steel tube and shell

Area - 94 ft.² - four pass

Design Pressure & Temperature - 150 psig & 400°F.

Tubes - (40) 3/4" O.D. x #16 BWG Steel tubes 12'-0" long

SAC #71-660

E-5 Dowtherm Heater

Manufacturer & Model - Hynes Dowtherm Vaporizer

60 Kilowatt - 460 volt - 3 phase

Tubes - (6) 3" Sch. 40 x 10'-0" heater length, steel

Design Pressure & Temperature - 150 psig at 750°F.

SAC # 71-1373

TANKS

T-1 Degasser
Haveg 41 - design 40 psig & 200°F.
3' 6" x 8' 9 1/4"
SAC # 60-965

T-2 Phase Separator
Haveg 41 - design 40 psig & 200°F.
3' 6" x 8' 9 1/4"
SAC # 60-1011

PUMPS & MOTORS

P-1 Dowtherm Circulation Pump

Type - Duriron Centrifugal WHJ3-0130

Material of Construction - Durimet 20

SAC # 55-1745

Driver - 20 HP, 1170 RPM electric motor

Frame 286 T

SAC # 50-2068

RUPTURE DISCS & RELIEF VALVES

RD - 1 Top of Reactor

10" Karbate rupture disc
40 psig bursting pressure

SRV - 1 Dowtherm Heater

Loneran # 23-W-223 safety relief valve
150 psig set pressure

SRV-2 Dowtherm Cooler

Series 1870 - 1/2" D1 Farris safety relief valve
150 psig set pressure

ROTAMETERS

- R-1 HCl Feed
 FP-1 1/2 - 27 - G tube
 1 1/2 BNSVT - 83 SS float
 77.4 scfm at 0 psig & 70°F.
 SAC # 80-7265
- R-2 Ethylene Feed
 FP - 1 - 35 - G tube
 1 BNSVT - 63 SS float
 51.8 scfm at 0 psig & 70 °F.
 SAC # 80-7263
- R-3 Nitrogen Feed - MF Header
 FP - 1 - 35 - G tube
 1 GNSVT - 65 SS float
 41.6 scfm at 0 psig and 70°F.
 SAC # 80-7264
- R-4 Oxygen Feed
 FP-3/4 - 27 - G tube
 3/4 BNSVT - 53 SS float
 22.4 scfm at 0 psig & 70°F.
 SAC # 80-7262
- R-5 Nitrogen Feed - Oxygen Header
 FP - 3/4 - 21 - G tube
 3/4 BNSVT - 54 SS float
 11.3 scfm at 0 psig & 70°F.
 SAC # 80-7266
- R-6 Nitrogen Pressure Transmitter Purge
 FP 1/8 - 08 - P - 3/37 tube
 SS float
 900 sec/min. air at 14.7 psia & 70°F.

CONTROL VALVES

TCV-201 Dowtherm Temperature Control Valve

4" C.S. Kielley Mueller Valve
SAC # 80-5655

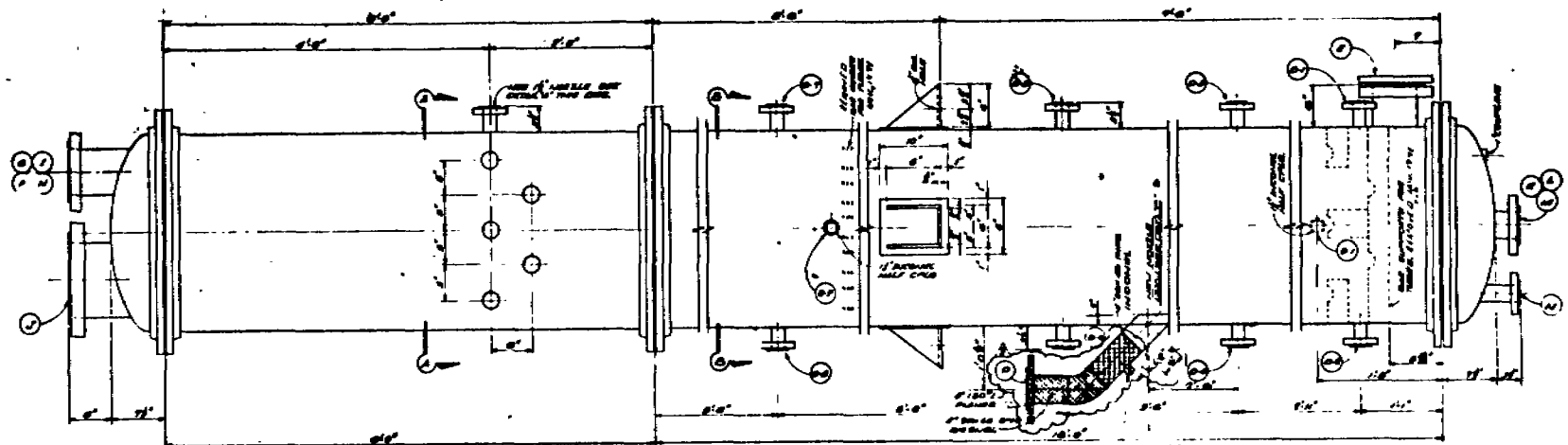
ILCV-603 Degaser Level Control Valve

WKM - V-200 - 1" ball valve
SAC # 80-4673

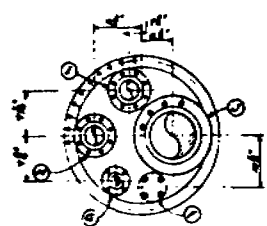
PCV-503 Vent Pressure Control Valve

Fisher/Grinnel 2" Weir type valve
SAC # 80-6589

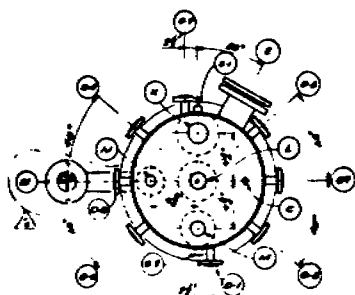
REVISIONS	
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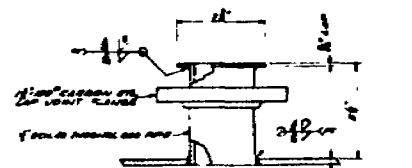
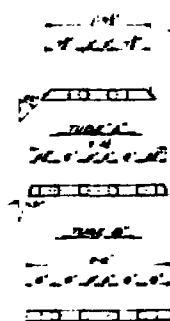
ELEVATION



ORIENTATION TOP HEAD (ONLY)



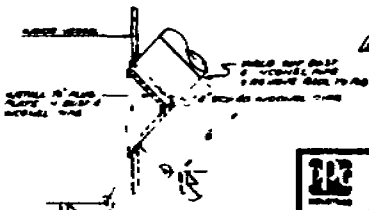
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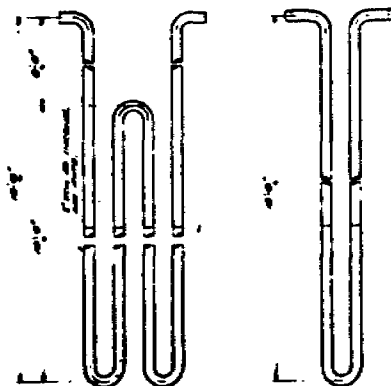
DETAIL A

GENERAL NOTES

SAC 14-50-24

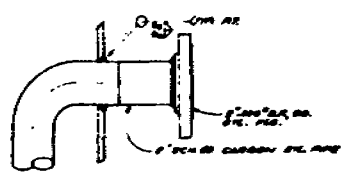


DETAIL C

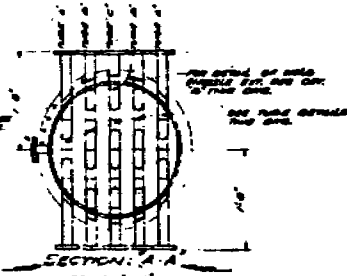


TUBE B (F. 10000)

TUBE C (F. 10000)



DETAIL B

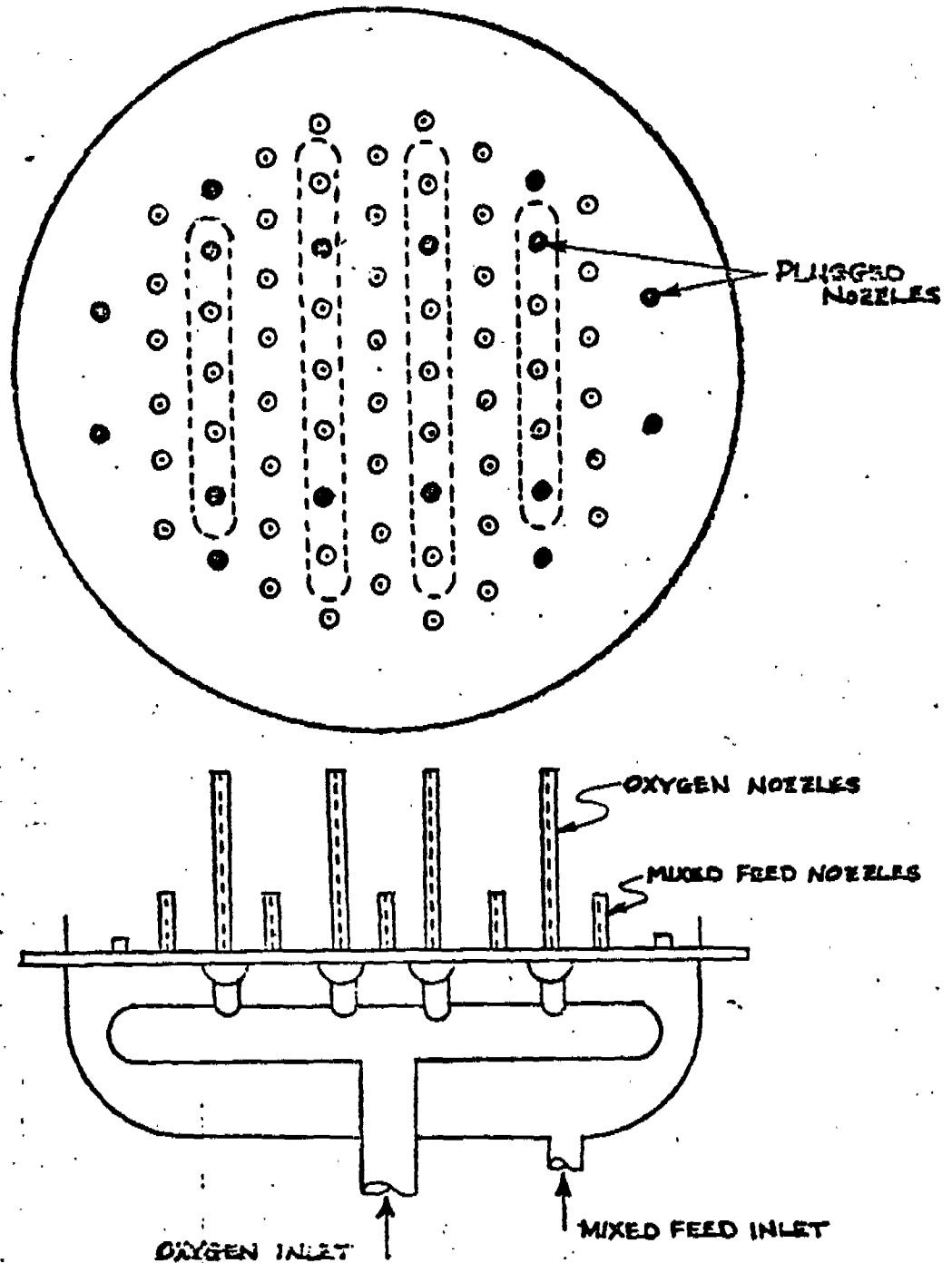


SECTION A-A

SL 050366

INDUSTRIAL CHEMICAL DIVISION LANSING, MICHIGAN	
DRAWN BY: J. L. BROWN CHECKED BY: J. L. BROWN APPROVED BY: J. L. BROWN	DATE: 10-1-54 SCALE: 1/2" = 1'-0" SHEET: 1 OF 1

FIGURE



100
100
100

INDUSTRIAL CHEMICAL DIVISION
LAKE CHARLES LOUISIANA

TITLE 28" OHC REACTOR

DESIGNED BY
CHECKED BY
DATE

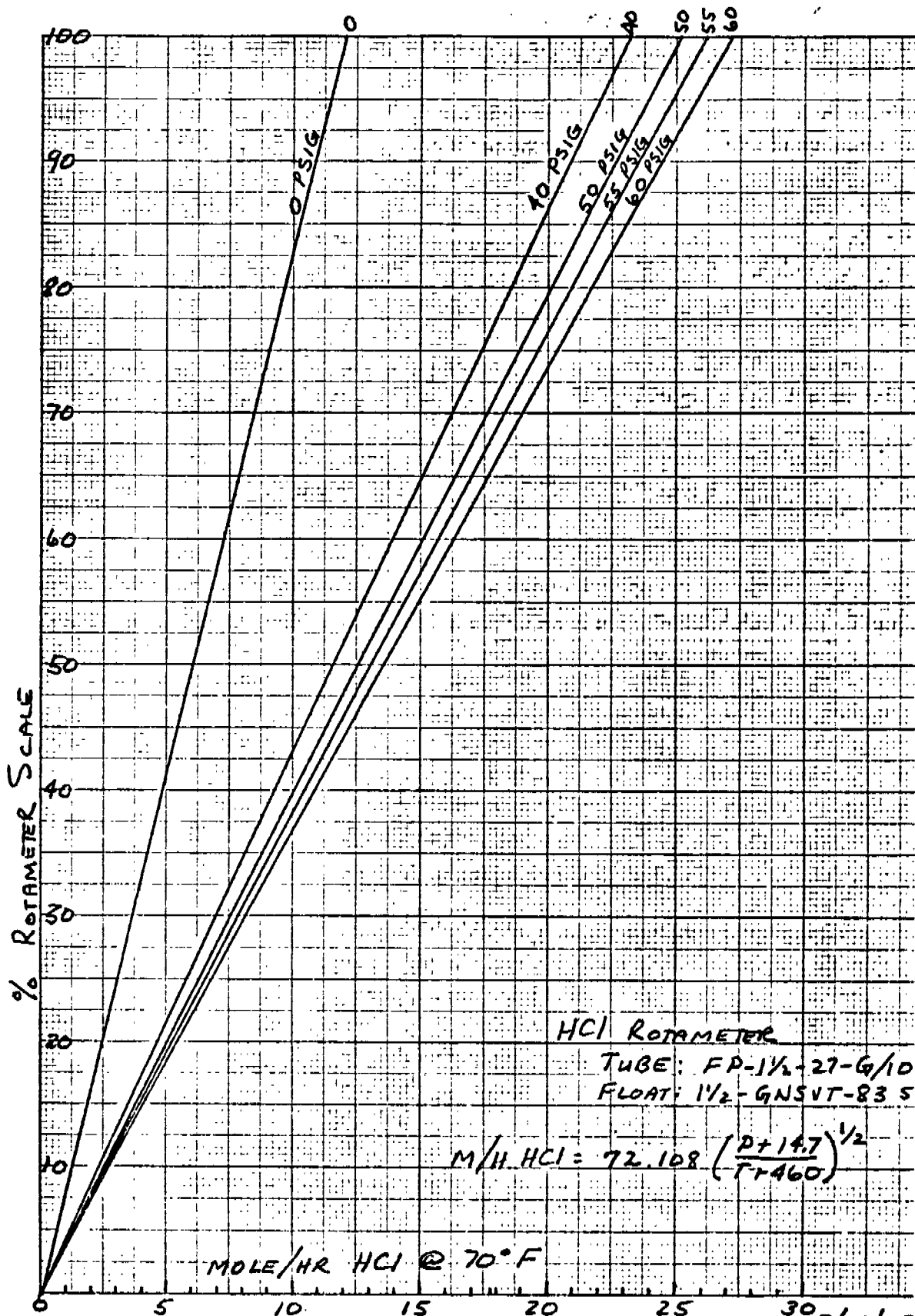
DATE
DATE

SCALE
CHANGE

DWG. NO. SL 050367

DATE OF MATERIAL

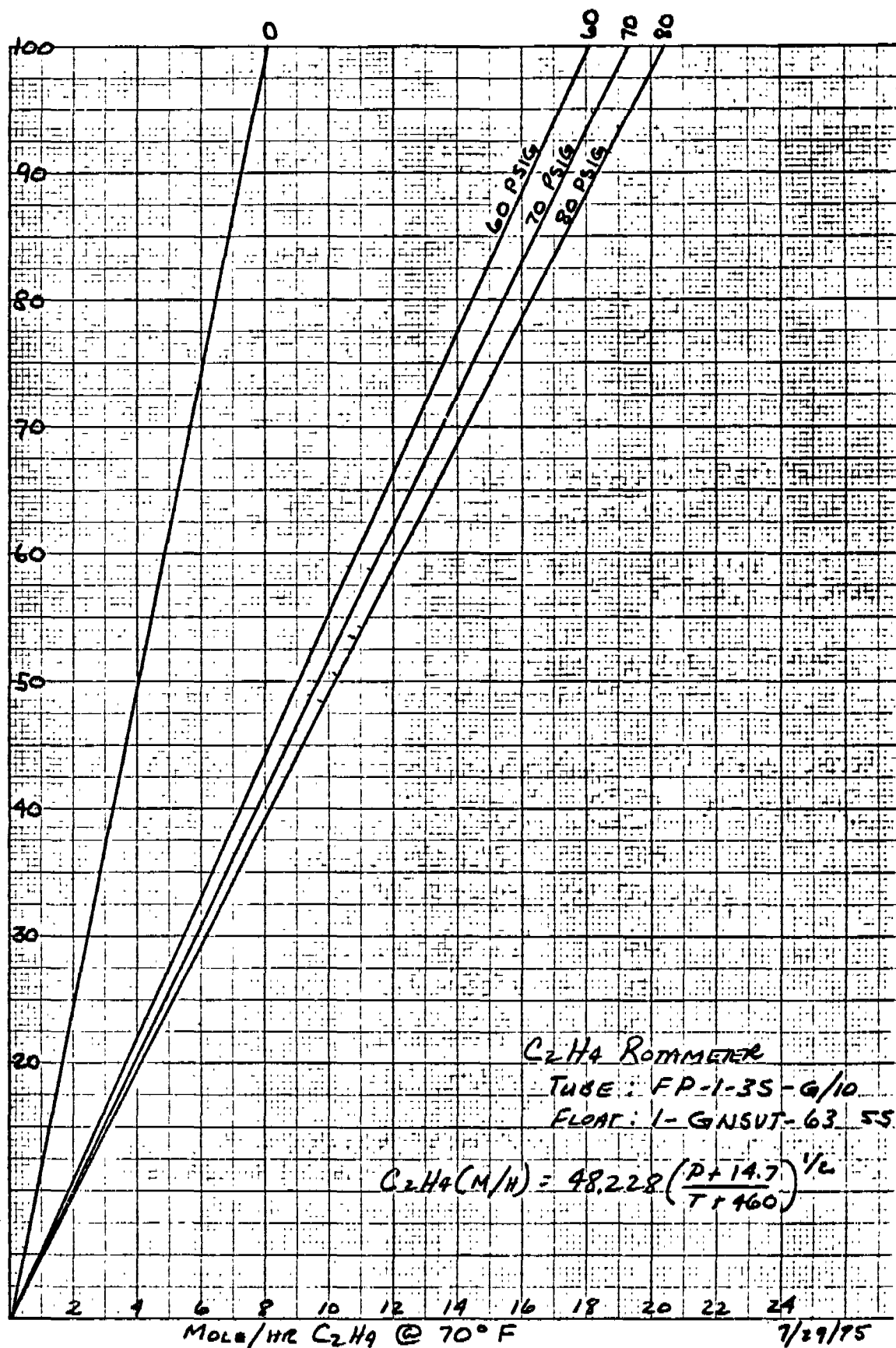
K₀E 20 X 20 TO THE INCH 48 1242
7 1/2 X 10 INCHES
MADE IN U.S.A.
VEUFFEL & EBBEN CO.



SL 050368

7/29/75
CDL

K-E 30 X 20 TO THE INCH 46 1242
7 1/2 INCHES
KEUFFEL & ESSER CO.



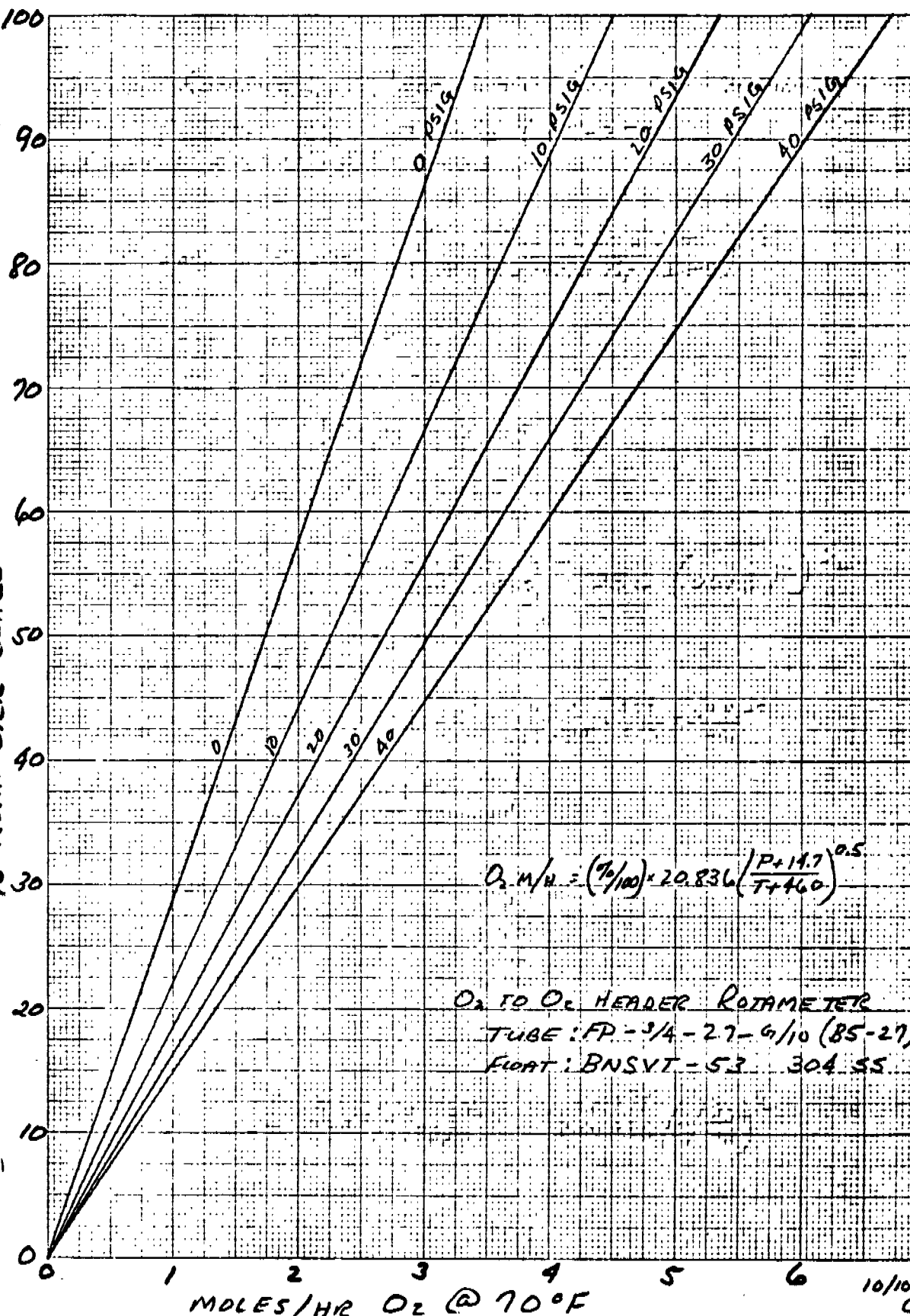
7/29/75
COL

SL 050369

EUGENE DIETZGEN CO.
MADE IN U. S. A.

NO. 340R-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

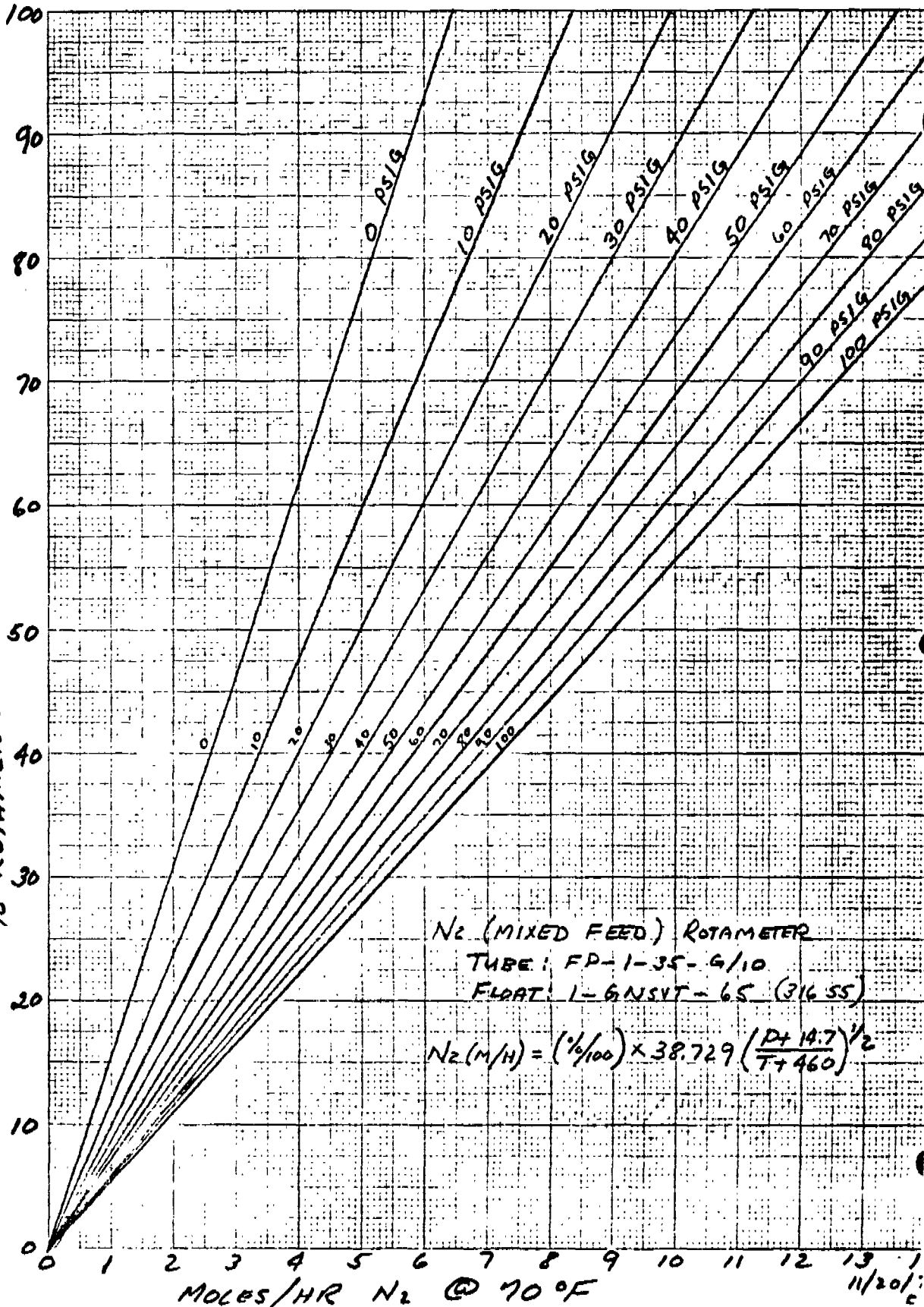
% ROTAMETER SCALE



EUDENE DIETZGEN CO.
MADE IN U. S. A.

NO 340R-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

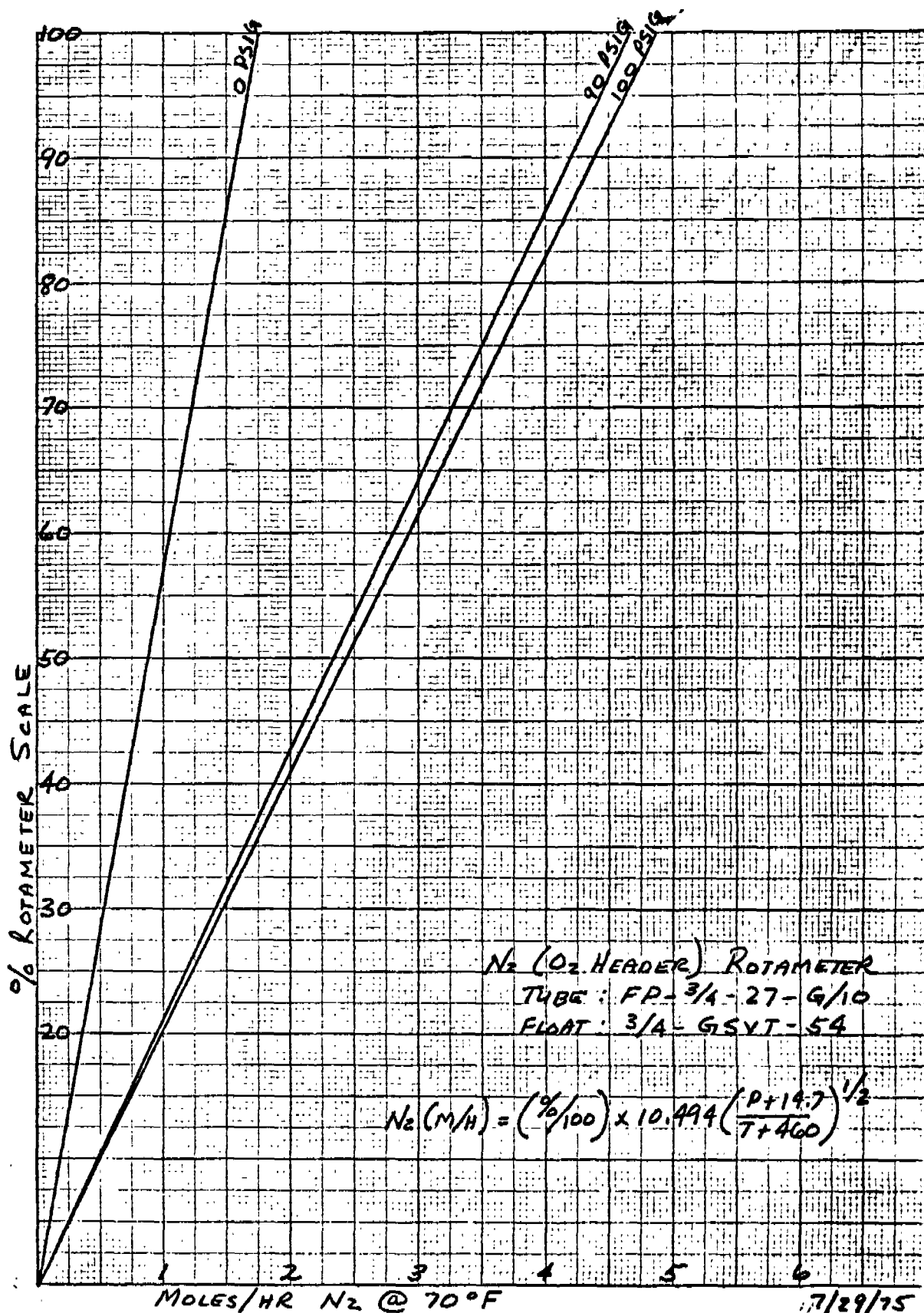
% ROTAMETER SCALE



N₂ (MIXED FEED) ROTAMETER
TUBE: FP-1-35-4/10
FLOAT: 1-6 NSVT-65 (316 SS)
$$N_2(M/H) = (\% / 100) \times 38.729 \left(\frac{P + 14.7}{T + 460} \right)^{1/2}$$

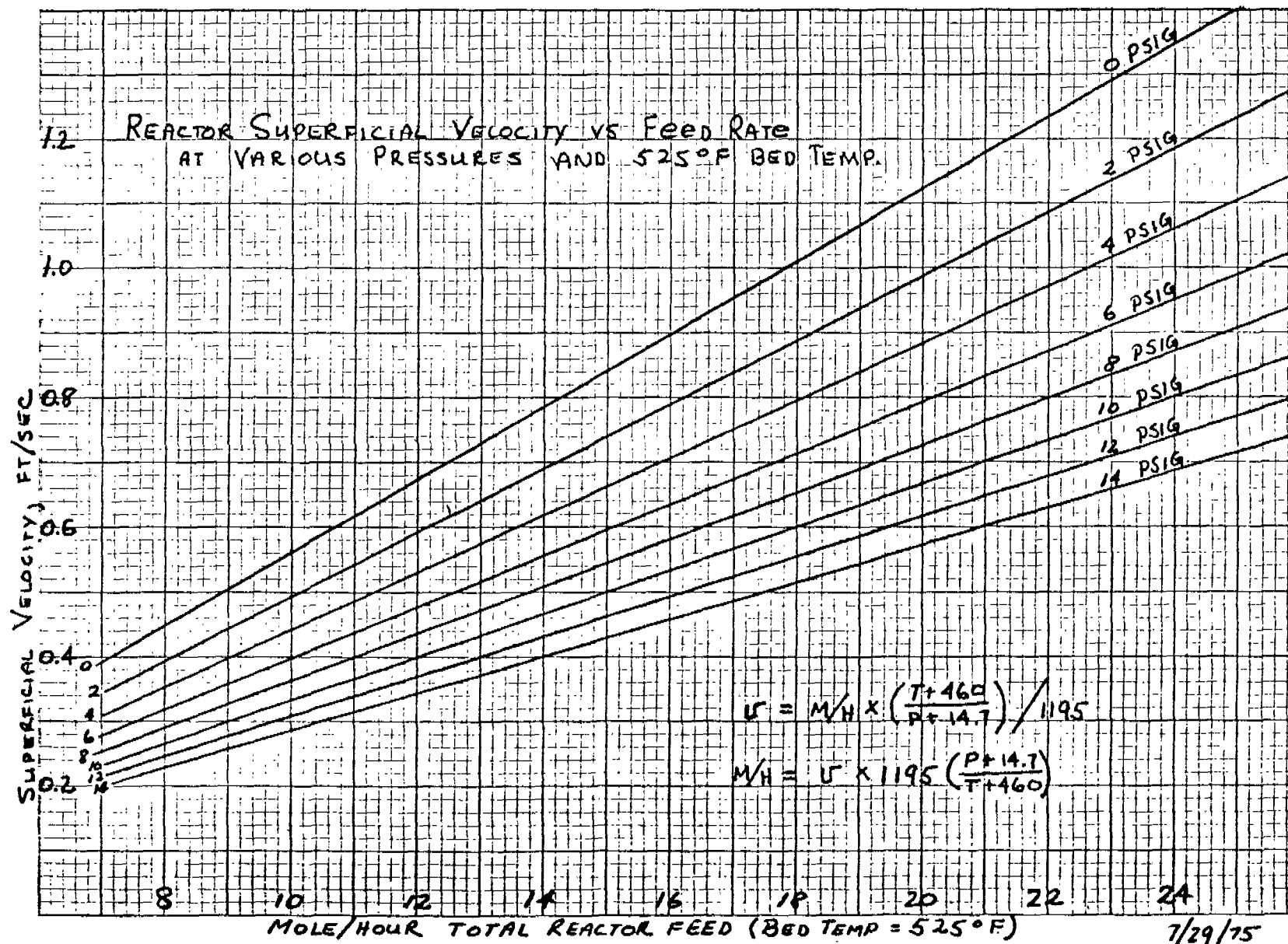
SL 050371

K-E 20 X 20 TO THE INCH 46 1242
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



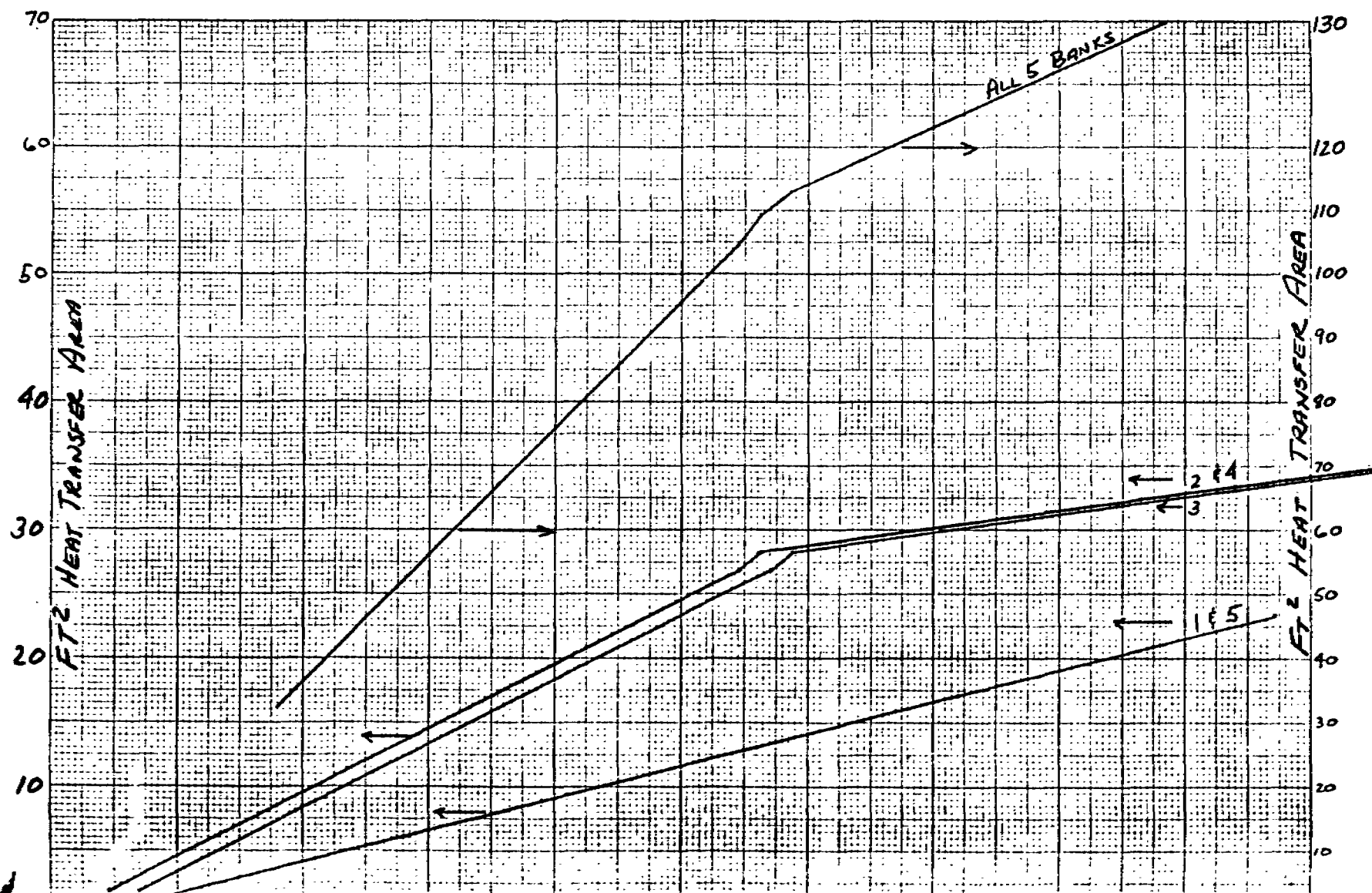
7/29/75
CDL

SL 050372



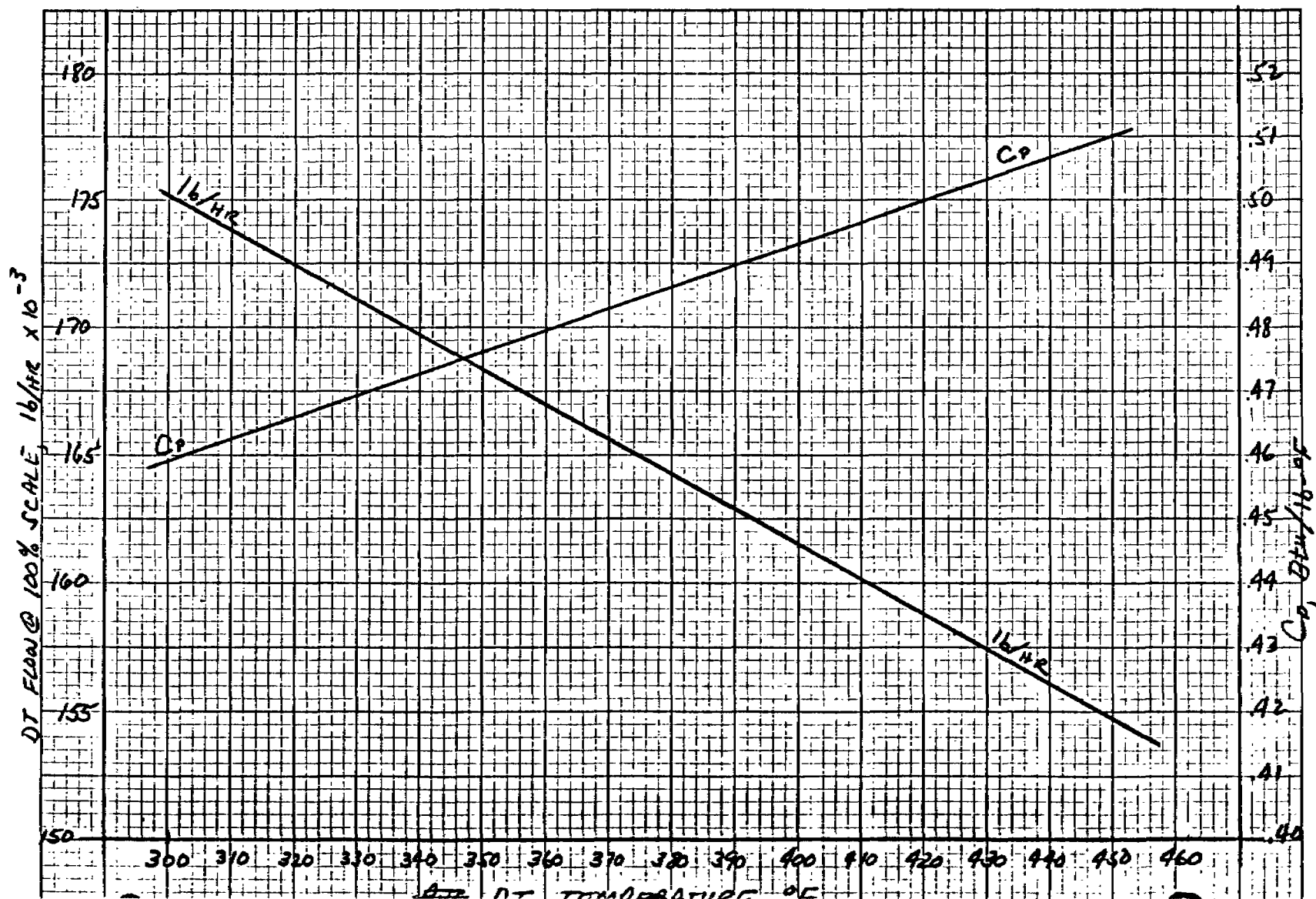
NO. 34DR-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.



SL 050374

K&E 5 X 5 TO 1/2 INCH 46 0860
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



SL 050375

