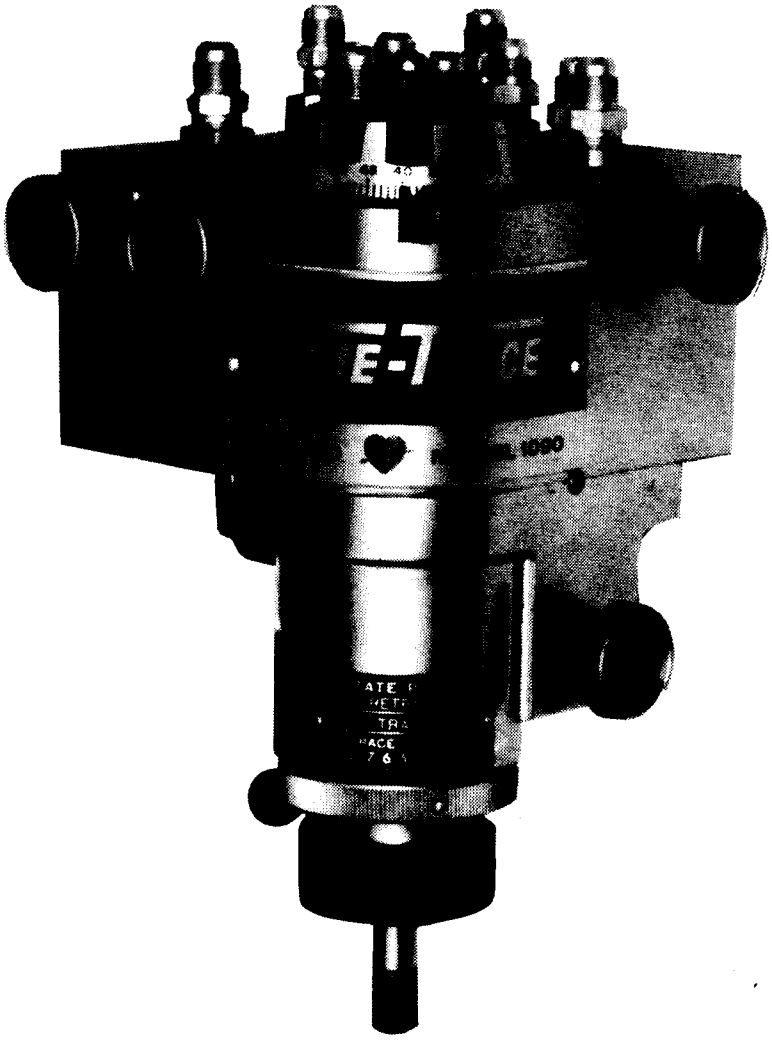
SERVICE MANUAL

BULLETIN
D-300

10/20/65

B360-3D

CONTROL SYSTEM 1224 (10/20/65)



TRUE-TRACE CORPORATION El Monte, California

F2776

Foreword

This manual is prepared to give service and parts information for the B-360-3D Tracer Control, system number shown on the front cover. If your milling machine, adapted with a True-Trace Control does not have a CONTROL SYSTEM NUMBER NAME PLATE it will be necessary for you to identify your control installation by comparing the model numbers on each of the major component items used on your installation to the System Number product list. (Section 1)

For Servicing and Parts Identification, the majority of this manual may be applicable to different System Numbers, so long as the Model Numbers are the same.

Contents

SYSTEM IDENTIFICATION

To assist in the servicing of True-Trace Control Systems that may be adapted to various types of machines, a SYSTEM NUMBER has been assigned to each control system that is made up of the Same Major "Building Block" Control Products. Only the control "Building Block" products are considered when identifying a Control System Number. Minor parts, such as hoses, attaching bracketry, local manifold blocks, etc., may vary when making an installation of the same control system on various models of machines. Such variation will not constitute difference major enough to require a new Control System Number.

This Service Manual covers Control System Number 1224 (10-20-65) The major "Building Block" products used in this system are shown below.

PHASE "A" AND "B" CHANGE

MODEL NUMBER	DESCRIPTION
1090-02	B-360-3D Tracer Valve
1090-03	B-360-3D Tracer Valve
1090-04	B-360-3D Tracer Valve

Transmission Drives, Cylinder, Power Unit etc. are supplied by customer.

For Servicing and Parts Identification, the majority of this Manual may be applicable to different System Numbers, so long as the Model Numbers are the same.

Notes on Installation

MACHINE TOOL SLIDE CHECKOUT - (Cylinders)

The True-Trace Tracer Valve is designed to meter flow into and meter flow out of the two actuator ports (in some cases with Synchro-Turn or Synchro-Trace, oil is only metered out). The hydraulic circuit is extremely simple in its basic form as shown in the illustration below. The rate of feed at which the slide will move is a direct function of the oil flow across the control edges of the Tracer Valve. The greater the flow area, the higher the rate of flow in direct proportion.

Basic Hydraulic Circuit for Controlling Slide Motion

With a constant supply pressure and a constant pressure drop across the actuator, the feed rate will remain constant so long as the two metering valves are set to a fixed flow area. In Tracer Valves using the 4-way spool and sleeve contruction, flow is metered both in and out. Whenever the spool is moved, both the metering edge on the inlet and the outlet are adjusted simultaneously to change their aperture to a greater or lesser amount. That is, if the movement is to increase the area, it will increase the area of both metering edges as shown in the first part of the illustration above. (The illustration shows only one leg of the 4-way valve. For complete description of the Tracer Valve see Section 4.)

With this type of control, optimum operation is obtained by providing a large pressure drop on each of the control edges of the Tracer Valve and a small pressure drop across the fluid actuator.

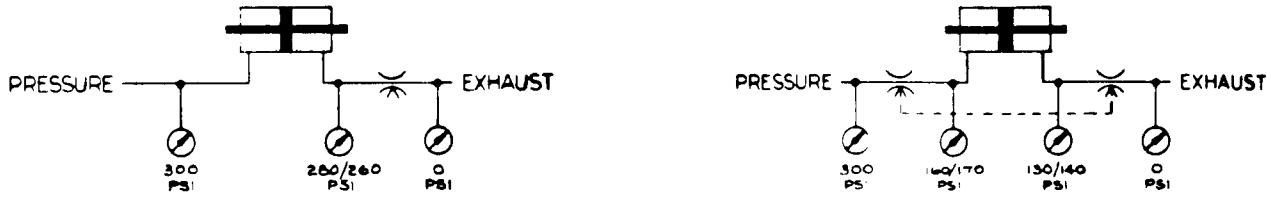
The fluid actuator should be sized so that changes in load due to the cutting tool, or other conditions that may exist in the machine, will change this pressure drop across the fluid actuator by a very small amount. Since most parts are machined by first making rough passes where higher tool loads may be encountered than in making a finish pass, it is usually satisfactory to test the machine without any tool load present. The performance of the system running without any tool load is very similar to that encountered during the finishing operation where critical tolerance and surface finish are required. A departure from the ideal pressure relationships during rough cuts with high tool loads has no undesirable consequences as surface finish and tolerance are not critical at that time.

Components used on different tracer control systems are usually rated for some nominal value of pressure and flow. In many True-Trace systems the nominal pressure is 300 PSI. This is particularly so when using cylinders as hydraulic actuators. With this type of system the basic pressure distributed along the circuit when checking out

Notes on Installation (Continued)

MACHINE TOOL SLIDE CHECKOUT (Continued)

the machine slideways and actuators should be as shown in the illustration below.



It should be noted that the pressure drop across the cylinder varies between 20 PSI and 40 PSI. In the illustration a double rod cylinder was used for the sake of simplicity. If the cylinder had 20 square inches of area, then the total force available would be 20 square inches times 20 PSI or 400 pounds in one case, or 20 square inches time 40 PSI or 800 pounds in the other case. It should be noted that this force is not the net force available at the tool, but rather the force required to overcome friction in the actuator and the slide assembly. The pressure drop across the two actuator ports together with the net piston area allow a computation of force available.

When checking the machine slides for frictional loads, the simplest test set-up is the one shown in the second part of the illustration above. This set-up will yield the necessary information about the slide actuators even though the Tracer Valve is a 4-way valve. If it is found in checking the slide in this manner that the pressure distribution is much different from that described above (such as 100 PSI pressure drop across the actuator ports), the tracer system will operate, but under considerable penalty. If the pressure drop across the actuator is constant throughout the length of the stroke, and the slide may be made to move very slowly (by adjusting the needle valve) and still have a smooth movement, good tracer performance can still be expected even with a relatively high pressure differential. The primary difference in tracing capabilities will be in lower tolerance due to increase in crossover. Crossover is defined as the amount of stylus deflection that is required from a point where the slides stop their motion until they restart their motion in the opposite direction. The greater the pressure differential across the actuator, the greater the crossover.

Another factor that influences the crossover is leakage between the actuator ports. In the case of cylinder actuators this leakage can be as low as zero. However, certain types of piston seals do permit leakage, and when fluid motors are used, a considerable leakage may be present. The crossover is affected by a combination of these two factors (actuator pressure drop and leakage). If both values are high (a large pressure drop is required to move the actuator and a large leakage exists), the crossover will be large. In some systems the pressure differential may be quite large while the

MACHINE TOOL SLIDE CHECKOUT (Continued).

leakage is zero, and therefore the crossover may be nominal. Tracer systems with a minimum amount of crossover (sometimes in the order of 0.00005 inches) can exist when both the pressure drop is low and leakage is low or zero.

Another important consideration in checking machine slides while they are being driven by the hydraulic actuator is to identify the slowest rate of feed at which the slide will move smoothly. To run this test the same procedure as described above and shown in the illustration on the previous page is used with the addition of a dial indicator to me measure slide motion. The recommended method for performing this test is as follows:

1. Close the needle valve and turn on the hydraulic power unit. Mount a dial indicator which reads in 0.001" or finer increments to show slide movement.

2. Gradually open the needle valve, and watch the pressure gage on the outlet port of the cylinder as well as the dial indicator.

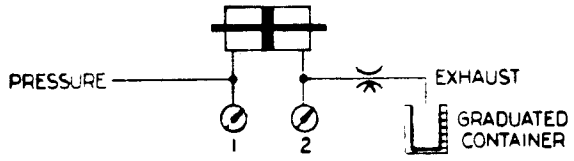
3. When the dial indicator first shows motion, note the pressure reading. Also note if the pressure abruptly changes when motion starts. If the pressure changes more than 5 PSI, the slide ways may be subject to "stick-slip" problems.

4. Leave the needle valve set to just permit the slide to move, and identify if the movement of the pointer on the dial indicator is moving smoothly. If it is not, open the needle valve gradually until a smooth motion occurs.

5. Time the movement of the slide for a small increment of distance, and note the minimum feed rate at which the slide may be operated smoothly.

Machines giving the best performance will move as slowly as 0.002 inches per minute smoothly. Also, the change in the pressure gage reading from just prior to the start of motion to the point immediately after the motion starts will be less than 5 PSI.

It is also possible to check for internal leakage of the cylinder while performing the above test. This is done by permitting the exhaust line to run into a container when the needle valve is opened.



1. Crack the needle valve open to permit a pressure drop across the cylinder which is just less than enough to cause the slide to move (refer to the pressure noted in Step 3 of the preceding test). Close the needle valve.

MACHINE TOOL SLIDE CHECKOUT (Continued).

2. If there is no leakage across the piston in the cylinder, this pressure drop will remain steady. If the pressure drop decreases (gage #2 pressure increases to equalize with gage #1 pressure), there is leakage in the cylinder.

3. If there is cylinder leakage, it will be found that, in order to hold this pressure drop steady, it is necessary to close the needle valve slightly but not all the way. Oil will continue to flow out of the exhaust line into the container.

NOTE: A certain initial portion of this oil flowing is not due to leakage, but due to a reduction of density of the oil on the exhaust side of the cylinder. This amount of oil will vary from almost nothing to no more than 1 cc. depending upon the size of the cylinder and the position of the piston in the cylinder. It is possible that excessive flow is not due to cylinder leakage, but due to air in the oil. Make sure that there is no air in the oil if cylinder leakage is indicated.

Since the slides move very slowly in the above test, it is difficult to ascertain whether or not this condition will exist throughout the entire stroke. Also, when a needle valve is used, any small impurities in the oil will tend to block the orifice due to silting and the flow will be reduced and change the feed rate through no fault of the cylinder and slide assembly, but entirely because of the flow passageway in the test set-up. In practice, if the slide is permitted to move from one end of the stroke to the other at a reasonable feed rate and the pressure holds constant, it can usually be assumed that the conditions throughout the stroke are the same. All tests should be conducted in both directions.

When the slides are actuated by hydraulic motors instead of cylinders, the pressure drop across the motor ports is usually much higher. The tracer system normally will provide for a higher nominal pressure when using fluid motors to accommodate this greater pressure drop. However, all tests described above still apply, and the tracing capabilities will also follow the same theory as described above.

Lubrication

MACHINE WAYS LUBRICATION

Lube oils SAE-80, P-47 or Mobil Vactra No. 2 are recommended for the slideways of a small mill. (Large Mills and Planers use Vactra #4 or it's equivalent). These lubricants have been found to effectively reduce friction on the ways and consequently help to attain smooth tracing operation with a minimum load on cylinders or hydraulic motors. Slideways should be lubricated every four (4) hours of operation (or oftener) on machines that do not incorporate automatic lubrication. Care should be taken that no chips or dirt are lodged between the two sliding surfaces. If an excessive amount of dirt or hard chips are encountered in the operation of the machine-tool ways, wipers and/or curtains should be provided to eliminate the possibility of scoring the ways.

The above slideways lubrication recommendations is for a machine with reasonably well flaked surfaces (on the order of approximately 20% to 30% bearing). If the ways are worn to the extent of smoothness where the oil has no pockets in which to lodge, then a more frequent lubrication may be necessary to maintain a smooth operation of the machine under hydraulic control.

HYDRAULIC OIL SPECIFICATIONS FOR TRUE-TRACE POWER SUPPLY

Use only hydraulic oils with: Rust, Oxidation and Foam Inhibitors, that conform to the following specifications: (For machines equipped with cylinders.)

Physical Requirements:

Viscosity SSU at 100° F.	78/83
Viscosity SSU at 210° F.	37
Color ASTM	L 1.0
Flash COC, F	345 Min.
Fire COC, F	410 Max.
Pour Point ° F	25 Max.
Neut. No., Mg. KOH/g	.20 Max.
Con Carb, wt%	.03 Max.

Performance Requirements - (Equivalent to Velocite "S" Oil)

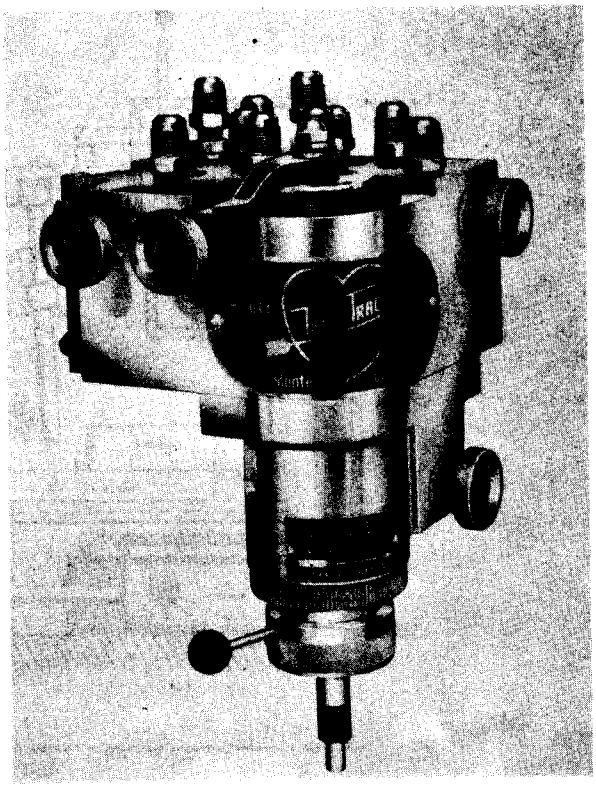
1. #D943-54 ASTM Oxidation Test Hours To Neut. No. of 2.0	1000 Hrs. Preferred 250 Hrs. Minimum
2. #D1401 ASTM Emulsion separation Test Time for Complete Separation	30 Min. Max.
3. #D892 ASTM Foam Test - Seq. 1 after 5 min.	No Foam
4. #D665 ASTM Rusting Test Procedure	"B" Pass

Use Velocite "S" oil, or its equivalent where applicable. In some Systems with Hydraulic Motor Drives, a heavier Viscosity may be necessary.

Including Notations for
Lot #6 Phase "A" Change
and Phase "B" Change
See Section 6 of this Manual
for Complete Parts List.

operation and service

SERIES
B-360-3D
3-DIMENSIONAL HYDRAULIC TRACER VALVE



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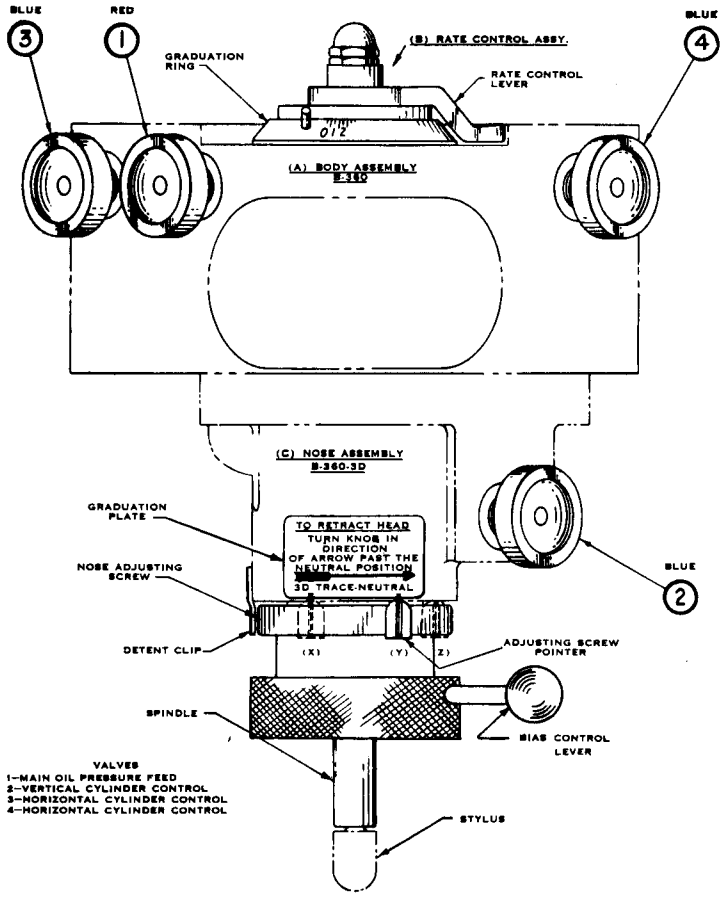
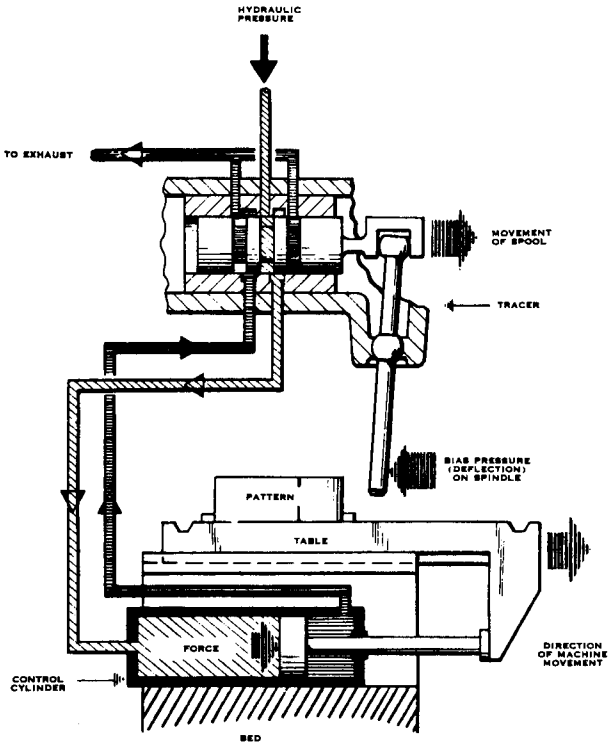


FIGURE NO. 1
OPERATIONAL CONTROLS
MODEL B-360-3D TRACER



HOW SPINDLE MOVEMENT CHANGES DIRECTION OF OIL FLOW IN CYLINDERS

FIGURE NO. 2
TYPICAL BASIC FORCE SYSTEM OF TRUE-TRACE TRACERS
(GRAPHIC DIAGRAM)

PREFACE

This Service Manual provides the trade with general and special information regarding the purpose, design, function, operation and maintenance of Model B-360-3D Tracer.

The information is basic and fundamental for all of the many applications of this Tracer.

Detailed instructions are included which facilitate the proper installation of the Tracer and allied equipment.

Recommendations for hydraulic components and other equipment to be used with all True-Trace installations are also included.

The most important feature of this Service Manual is the detailed instruction provided for adjustment and operation of the Tracer itself. The close observance of these instructions will enable a competent operator to make the adjustments necessary to keep the equipment operating at peak efficiency at all times.

True-Trace Tracers will react to tracing-finger movements of as little as .0002 of an inch. This indicates their extreme sensitivity.

True-Trace experience and service records prove that 95% (approximately) of all difficulties with tracing are NOT caused by the True-Trace Units, but are caused by faulty adjustments of the machine, or lack of respect by the operators for the instructions contained in the Service Manual. This publication is furnished for True-Trace users to expressly provide them the benefit of our past experience and to assure the most efficient, accurate and economical operation of True-Trace controlled machines.

The Trouble-shooting Chart is a handy time-saving reference guide for the operator in determining and isolating the probable cause and remedy for any difficulty with his Tracer.

A complete catalog of all parts used in the Model B-360-3D is contained in the Parts List for the B-360 Body, and the Parts List for the 3D Nose, and Figures No. 20, 21 and 22.

When ordering spare parts, the MODEL NUMBER, PART NAME, and the correct PART NUMBER should always be used. To avoid confusion in correspondence, conversation and when giving supervison or instruction on the Tracer the correct part designation should likewise be used.

The encircled Index Numbers, known as "callouts," on the drawings are for quickly identifying parts referred to in the text and the parts list. They are **not** used when ordering parts.

The units described in this Service Manual are manufactured to instrument tolerances necessary to perform the precision work required of this Tracer. High quality production requires respect for these tolerances.

Engineering, tooling, production, supervisory and training personnel should especially familiarize themselves with the particular sections of this Service Manual which pertain to their operation. Careful study of the instructions, and strict observance of the recommendations and suggestions in the text will promote efficient operation, and insure top production from True-Trace controlled machines.

GLOSSARY OF TERMS

Affixed — Bolted, clamped, or otherwise fastened.

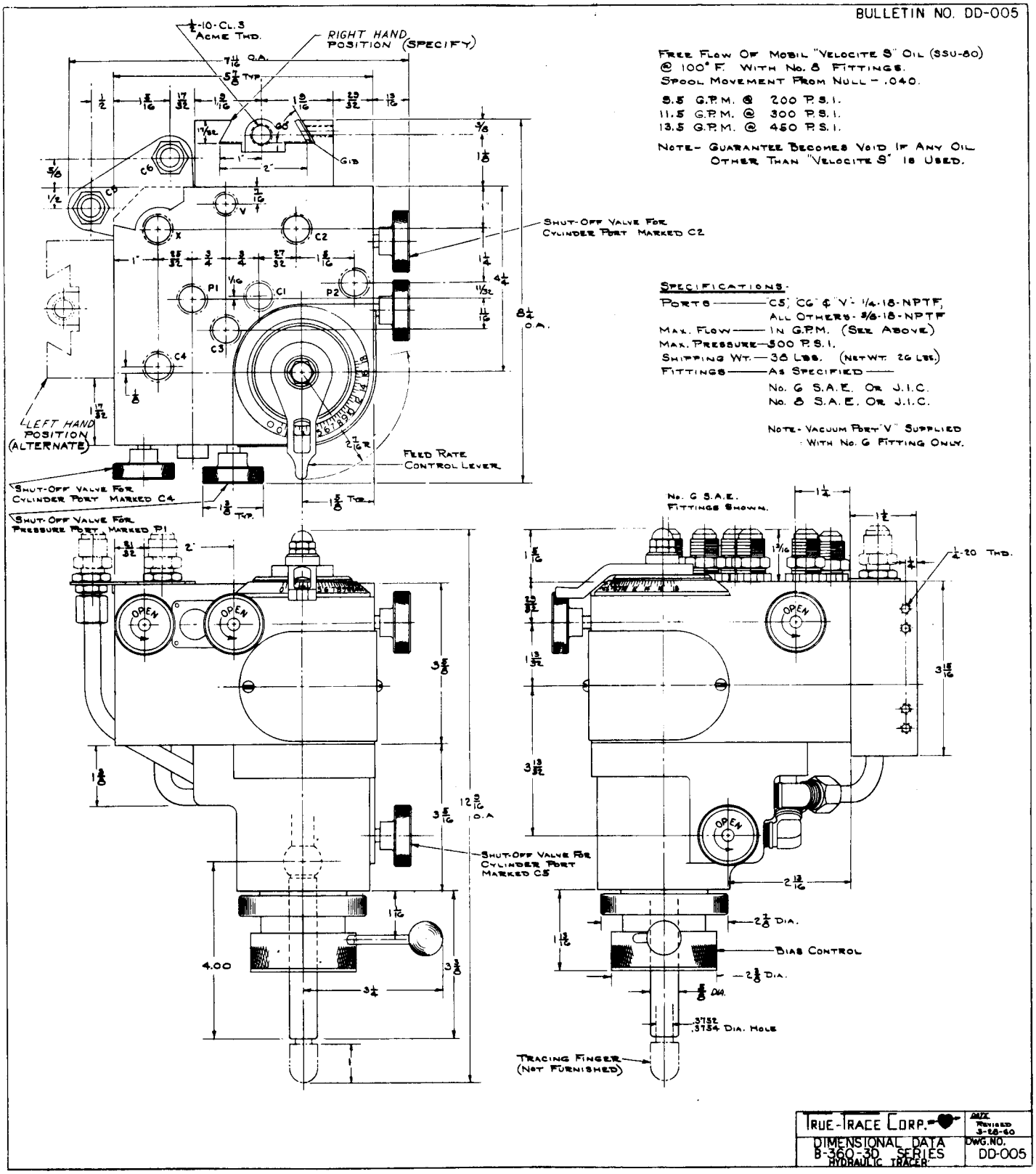
Bias Pressure — Pressure applied to tracer spindle or stylus at an angle to the line of travel. Pushing the spindle with the fingers, against the pattern causing it to follow the contour.

Cylinder — "Cylinder" is used synonymously with "piston" regardless of whether the hydraulic **piston** is fixed to the **Bed or Base** of the machine and the hydraulic **cylinder** is fixed to the moving machine **element** or vice-versa.

Servo-Valve — The combination of the grooved sleeve and the grooved sliding spool assembly.

Valve Sector — The sleeve and sliding spool which together form a valve, used synonymously with Servo Valve.

BULLETIN NO. DD-005



FREE FLOW OF MOBIL "VELOCITE S" OIL (SSU-60) @ 100° F. WITH No. 8 FITTINGS.
SPOOL MOVEMENT FROM NULL – .040.

8.5 G.P.M. @ 200 P.S.I.
11.5 G.P.M. @ 300 P.S.I.
13.5 G.P.M. @ 450 P.S.I.

NOTE- GUARANTEE BECOMES VOID IF ANY OIL OTHER THAN "VELOCITE S" IS USED.

SPECIFICATIONS-

PORTS ——— C5, C6 & V- 1/4-18-NPTF, ALL OTHERS- 3/8-18-NPTF
MAX. FLOW ——— IN G.P.M. (SEE ABOVE)
MAX. PRESSURE—500 P.S.I.
SHIPPING WT.—38 LBS. (NET WT. 26 LBS.)
FITTINGS ——— AS SPECIFIED ——
No. 6 S.A.E. OR J.I.C.
No. 8 S.A.E. OR J.I.C.

NOTE- VACUUM PORT "V" SUPPLIED WITH No. 6 FITTING ONLY.

TRUE-TRACE CORP.	DATE REVISED 3-28-60
DIMENSIONAL DATA B-360-30 SERIES HYDRAULIC TRACER	DWG. NO. DD-005

FIGURE NO. 3
DIMENSIONAL DATA

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