GENERAL INSTRUCTIONS
FOR
ESTERLINE-ANGUS MODEL AW GRAPHIC INSTRUMENTS

These instructions are a guide to the correct operation of Esterline-Angus graphic instruments. These instructions should be read by the person who uses or services the instruments, and should be kept in a convenient place for reference. Additional copies of this instruction book will be furnished on request.

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UNPACKING

Esterline-Angus instruments are carefully packed; carriers are responsible for damage in transit. If the packing case shows damage, make a notation to that effect on your express receipt or freight bill. If it is found that the shipment has been damaged, notify the carrier at once.

Included with each shipment will be found a packing list, showing every item in the shipment. Check off each item as the goods are unpacked, and if any item appears to be missing, go through the packing material carefully before it is thrown away. The missing articles may have been overlooked when the packing material was removed.

Each instrument is carefully inspected at the Esterline-Angus factory and then sealed before shipment. New instruments are shipped complete with necessary multiplier boxes and leads, one record chart, and a box of accessories containing one two-ounce bottle of red ink, one inkwell filler, one pen filler, and one spare glass pen. Two charts and two accessory boxes are furnished with twin instruments.

On an instrument which is to be permanently installed, it is advisable to leave the seal intact until the instrument is required for use.

INSTALLING

Front switchboard, wall, and flush instruments should be mounted LEVEL in a clean, light place, with the bottom of the instrument about four feet from the floor. The instrument should be mounted where it will not be subjected to vibration or extremes of temperature. If unusual steam, smoke, moisture, dust, or corrosive fumes are present, a protective cabinet should be built around the instrument. Drilling dimensions furnished by the factory should be followed when mounting instruments on panels. Front or flush switchboard instruments can be mounted either on slate or steel panels, the

drilling dimensions being furnished for the kind of panel specified when the instrument was ordered. Front switchboard DC instruments are specially calibrated if they are to be mounted on a steel panel. A switchboard DC instrument, if calibrated for the customary insulating panel, will read low if mounted on a steel panel.

Multipliers for front switchboard and wall type instruments are housed in separate boxes and marked with the instrument serial number. Multipliers for portable and flush instruments are attached directly to the instrument case. All separate multipliers must be mounted vertically. Never put a multiplier in a closed compartment or obstruct the flow of air through it.

Do not locate instruments close to bus bars or cables carrying large currents. This is especially important for DC wattmeters. Bus bars should be kept at least three feet from the meter case.

Switchboard type shunts must be mounted with the blades vertical to permit free circulation of air. Shunts should be mounted with at least three feet of unbroken bus bar extending from both ends. Never crowd a shunt into the bus structure between other shunts, or install it above another shunt.

The cases of portable, front switchboard, and wall type instruments have latches that can be sealed with standard meter seals or locked with a small padlock. Padlocks can be supplied by THE ESTERLINE-ANGUS COMPANY. All flush instruments have a lock built in the case door. Two keys are furnished with each instrument and these keys fit any flush case lock.

SETTING UP FOR USE

To place an instrument in service, break the seal and take off the front cover as follows: Open the latch on top of the case, swing the top of the cover open about six inches and slide the lower end toward the instrument case to disengage the hinges. Lay the cover aside until the instrument is charted and inked. Always keep the cover closed when the instrument is in use. Flush instruments have a door which should be unlocked and swung open for access to the mechanism.

To protect the instrument mechanism during shipment, a cardboard retainer is fitted over the drive roll and pen table and extends into the movement compartment where it engages the pen fork to prevent unnecessary swinging of the moving element. The pen element is carried by two ears on this cardboard cover. Remove the pen element and lay it aside. Pull out the cardboard according to the directions printed on it. The instrument is then ready for filling with ink and inserting the chart, as described later.

CONNECTING

Do not connect the instrument without first referring to the wiring diagrams in this book. A wrong hook-up may cause the instrument to read incorrectly or may cause permanent damage. All terminals are marked with an identifying letter or voltage. Positive instantaneous polarity is indicated by a prime mark (′). This mark appears both on the instrument terminals and on the connection diagrams.

Current leads are furnished with meters used with external shunts, and are marked with the meter serial number. These meters are calibrated for the correct voltage drop AT THE SHUNT END OF THE LEADS furnished with them, and only these leads can be used. Other connections should be made with #14 wire or larger.

A set of leads is furnished with portable instruments. These leads have taper plugs on the instrument end and open spade terminals on the other end. Keep the plugs and terminals clean to insure good contact. All meter terminals for plug connections are threaded inside so the instrument can also be used with binding post connections. Binding posts can be obtained from THE ESTERLINE-ANGUS COMPANY by giving the serial number of the instrument. Do not use binding posts on any meter operated from shunts. For connections between meter and shunts, only the calibrated leads furnished with the meter may be used.

INSERTING THE RECORD CHART

See instruction plate on the chart drive for brief instructions for threading the chart and operating the chart drive. Complete instructions are given in the section of this instruction book entitled "Instructions for the Operation and Care of Chart Drives".

The chart drive instructions should be read carefully because satisfactory service from the instrument depends, to a great extent on the chart drive performance.

INSPECTING THE RECORD

The chart can be pulled from the reroll to examine the record. The reroll operates like a window-shade. A sudden release of tension on the unrolled chart will lock the reroll, removing tension from the chart and allowing it to be examined at leisure. To rewind the chart, first pull it forward slightly, then let it wind slowly on the reroll. Any amount of chart can be pulled from the reroll without damaging the mechanism.

FEEDING CHART THROUGH BOTTOM OF CASE

On all instrument cases except the flush, provision is made for feeding the chart through a slot in the bottom of the case. To feed through instead of rerolling, remove the metal or rubber strip at the lower edge of the case cover. The end of the chart which hangs out of the case should be weighted with a paper clamp. Do not pull or jerk on the end of the chart or it may be thrown out of time.

REMOVING THE RECORD CHART

To remove the rerolled chart, grasp the chart with the left hand and push down the spring clip which holds the pivot on the right end. Pull the chart reroll forward out of the instrument.

To remove the chart from the reroll pull the plug out of the right end with the disk and then the chart can be pulled off the tube by holding to the disk on the gear end. If the chart sticks on the tube, twist the tube in the direction to unwind the chart as the tube is being withdrawn from the chart.

The chart is then ready for inspection or filing. An Esterline-Angus Chart Inspector is a useful device for routine examination of record charts and we suggest it be purchased if a number of charts are to be studied.

RECORD CHARTS

All record charts are six inches wide and are 103 feet long. Time figures are printed along the margin as follows: Charts for 3/4, 1 1/2 and 3 inches per hour have time figures every three inches and are marked A. M. and P. M., using light faced type for A. M. and bold faced type for P. M. Charts for 6 inches per hour have time figures every six inches and also have the A. M. and P. M. designations. Charts for 12 inches per hour have time figures every six inches but do not have the A. M. and P. M. designations. This reduces the amount of chart paper lost when an E-feed chart is set to time.

A letter after the chart number indicates the feed. When ordering charts, be sure to specify the feed by adding the proper letter as follows: "A" for 3/4, "B" for 1 1/2, "C" for 3, "D" for 6, "E" for 12 inches per hour, and "X" for no time markings. The "X" chart without time markings is useful on instruments operated only at minute speeds, or instruments where the chart is operated intermittently.

The minimum running time of charts on various feeds is as follows:

SPEED Inches Per Hour	Feet Used Per Day	Feet Used Per Week	*Minimum Running Time in Days
3/4	1 1/2	10 1/2	65-2/3
1 1/2	3	21	32-1/3
3	6	42	15-2/3
6	12	84	7-1/3
12	24	168	3-2/3

SPEED Inches Per Minute	Feet Used Per Hour	Feet Used Per Day	Minimum Running Time in Hours
3/4	3-3/4	90	26-2/3
1 1/2	7-1/2	180	13-1/3
3	15	360	6-2/3
6	30	720	3-1/3

*Actual running time may exceed the above minimum, depending upon starting time.

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FILLING WITH INK

First raise the scale plate and remove the pen element. Take out the inkwell by lifting the two handles and pulling it forward. Fill the inkwell through the pen opening, about three quarters full, using the ink and the inkwell filler furnished with the instrument. Replace the inkwell, being careful that it is under the spring clips which hold it in place.

Set the pen element in the pen fork properly, with the knife edges of the element seated in the slots in the fork. The pen element is correctly balanced at the factory WHEN FULL OF INK, and will stay off the chart until the pen is filled. Fill the pen by means of the pen filler furnished with the meter, proceeding as follows: Compress bulb of the pen filler, lay flat side of soft rubber tip on the chart, insert glass pen into hole in rubber tip, and let filler suck ink through the pen until no bubbles are visible in the glass pen. Then remove pen element from filler and the pen should rest lightly on the chart.

Swing the pen across the chart several times. If it does not write properly, the pen probably has an air bubble in it, in which case the pen filling operation must be repeated. Lower the scale plate and make certain that

the pen is properly seated in the pen fork and does not rub on the inkwell or scale plate. The indicating target above the glass pen must not touch the scale plate. If the pen is clean and properly primed with all bubbles removed, it will write for long periods without further attention.

CARE OF THE INKING SYSTEM

Use only Esterline-Angus graphic meter ink. It is made especially to satisfy the exacting requirements encountered in recording instruments. Keep the bottle tightly capped to prevent dirt from getting into the ink. Ink begins to thicken at low temperatures and heat must be provided in the instrument if the temperature stays below 20 degrees Fahrenheit.

The inking system should be inspected once a week. Fresh ink should be added to the inkwell; any dirt, lint or dried ink should be removed from the glass pen point, and some ink should be drawn through the pen element by means of the pen filler. Once a month, or oftener on "QUICK TRIP" meters, the inkwell and pen element should be emptied, washed and refilled.

To clean the inkwell, pry off the cover and wash the parts in water. See that the vent holes in the cover are open and that the cover is not bent when removing it. The pen element is best cleaned by blowing water through it with a pen filler. Intermittent writing, failure of the pen to write on sudden swings, a dark purplish color of the record line instead of the normal bright red, or a tendency of the ink to spread in the paper and produce a broad, fuzzy line, are all indications that the ink in the inkwell has thickened and oxidized and that the inking system should be serviced more often. Instruments that operate at high temperatures and instruments involving high chart speeds require special attention to the inking system.

Instruments are shipped with the pen elements properly balanced WHEN FULL OF INK and the balance adjustment should not be changed unless necessary. The pen balance should be such that when the chart is tapped lightly with one finger, the pen will bounce up and down on the chart. Too heavy a pen pressure on the chart will cause the pen to drag toward the center of the chart or will noticeably reduce the speed of response of the pen. Accordingly, if maximum response speed is desired, the pen pressure must be no greater than is necessary for satisfactory inking. Handle the pen element carefully; a bent element will cause incorrect readings. The writing tip of the glass pen must be exactly 4-3/8 inches from the knife edge. The arc line, drawn by the pen, is approximately 1/8 inch in front of the curved edge of the chart feeder which extends over the pen table.

The glass writing pen is a taper fit in a metal pen tube and is easily removed by twisting it out. The pen is ground at the factory to give a suitable

line for most requirements, but extra-fine points can be furnished. If a wider line is desirable, grind the point with a fine white Arkansas stone wet with water, being sure to grind the face of the point square. If a glass pen is broken off in the pen tube, it can be removed by running a fine wire clear through the broken pen and tube, tying a small knot in the wire, and then pulling the broken pen out with the wire. Sometimes it may be necessary to slightly heat the tube around the pen to get the pen loose. In replacing a glass pen, be sure it rests perpendicular to the chart, otherwise it will not write properly. It is convenient to have one or more extra pen elements on hand. These can be cleaned in the shop and changed in the field, without taking the meter out of service.

Do not spill ink on the instrument. Remove any spilled ink with a rag or blotter immediately. If any ink is accidentally spilled on the clothing, wash it out as soon as possible, using warm water and any good soap which will not injure the fabric. By persistant washing and scrubbing the ink spots can be completely removed. Ordinary soap and water will remove ink stains from the hands, but the sooner they are removed, the easier the job is accomplished.

TECHNICAL INFORMATION

Esterline-Angus graphic instruments are accompanied by a technical data sheet, giving information pertaining to the instrument. This data sheet is a part of the instruction book and should be kept for reference. Part of this information will also be found on the nameplate inside of the case at the bottom. On the back of the data sheet will be found an original record made by the instrument as it was checked at the factory.

SUPPLIES AND PARTS

To obtain the most benefit from the investment which instruments represent, they should be kept in continuous service. Portable instruments should be moved to another job as soon as one job is finished. If the purpose for which the instrument was originally purchased has been fulfilled, the instrument should be used elsewhere to keep it active and thus to distribute its cost over a greater number of jobs.

Although the ESTERLINE-ANGUS factory is prepared to ship charts and ink the same day the order is received, the user should forecast his need for these essential items so that his instrument need never be idle for want of supplies. Keep on hand at all times enough charts and ink to operate each meter for at least one month. By purchasing in larger quantities, worthwhile savings can be made on these items.

Record charts should be ordered by number. This number will be found on the right hand edge of the used chart. When charts of various ranges are available for use on the same meter, a list of such charts is included in this instruction book.

Esterline-Angus ink is supplied in two colors: Red and Green, and is put up in two-ounce and one-pint bottles. Red ink is standard and will be furnished unless otherwise specified.

When ordering parts for this recorder, always give the serial number. This number is stamped on the nameplate inside the meter case, also on the scale plate and on the chart drive name plate.

GUARANTEE

Esterline-Angus instruments are guaranteed to be free from defects due to faulty materials or workmanship. Any instrument proving defective within one year from date of shipment will be repaired or replaced free of charge when returned to our works prepaid, provided the instrument has not been tampered with or misused. We do not assume responsibility for repairs made outside our plant.

PACKING FOR SHIPMENT

If the instrument is to be returned to the factory for repairs, send for shipping instructions and at the same time state clearly the reason for return. If time does not permit this normal handling, the following procedure should be observed: Wash out inkwell and pen element, remove pen element from pen fork and tie it across top of scale plate. Remove studs from switchboard instruments. Protect glass front with a small board and wrap instrument in heavy paper to prevent excelsior from sifting into the mechanism.

BE SURE TO RETURN ANY SEPARATE MULTIPLIERS, AND BE SURE TO RETURN THE LEADS FOR DC WATTMETERS OR AMMETERS; We MUST have these items at the factory when the meter is to be repaired or recalibrated. Return the entire set of leads furnished with portable meters. If the meter being returned is a speed recorder, return the tachometer generator and any indicators used with it. If only the clock is in need of repair, it should be removed from the meter, eliminating the necessity of shipping the entire instrument.

Use a strong, substantial packing box, large enough to permit at least eight inches of dry excelsior on all sides of the instrument. Ship by prepaid express and mark: "Electrical Instrument, Handle Carefully."