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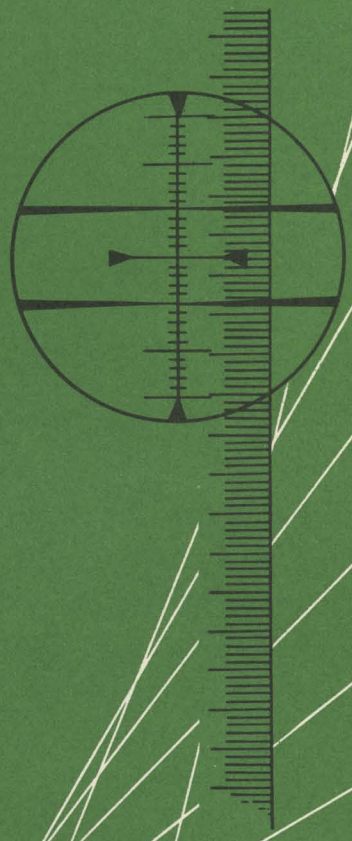
price list dated August 27, 1962

32 page catalog
4 page price list with conversion table of old to new product numbers

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OPTICAL METROLOGY

CATALOG 9



KEUFFEL & ESSER CO.

Here is Your Copy of K+E Catalog 9

The following additional catalogs, covering the K+E product line, are available from the Keuffel & Esser Co., Hoboken, New Jersey, or from the nearest K+E Branch or Distributor:

No.

1 Drafting Media
2 Reproduction Media
3 Stable Base Materials
4 Graphic Charting Media
5 Drawing Instruments and Sundries
6 Drafting Machines and Lettering Equipment
7 Drafting Room Furniture
8 Slide Rules
9 Optical Metrology
10 Surveying Instruments
11 Field Equipment
12 Measuring Tapes

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The Keuffel & Esser Co., established in 1867, first published a general catalog in 1890 and this material forms part of the 43rd edition.

SPECIAL NOTICE

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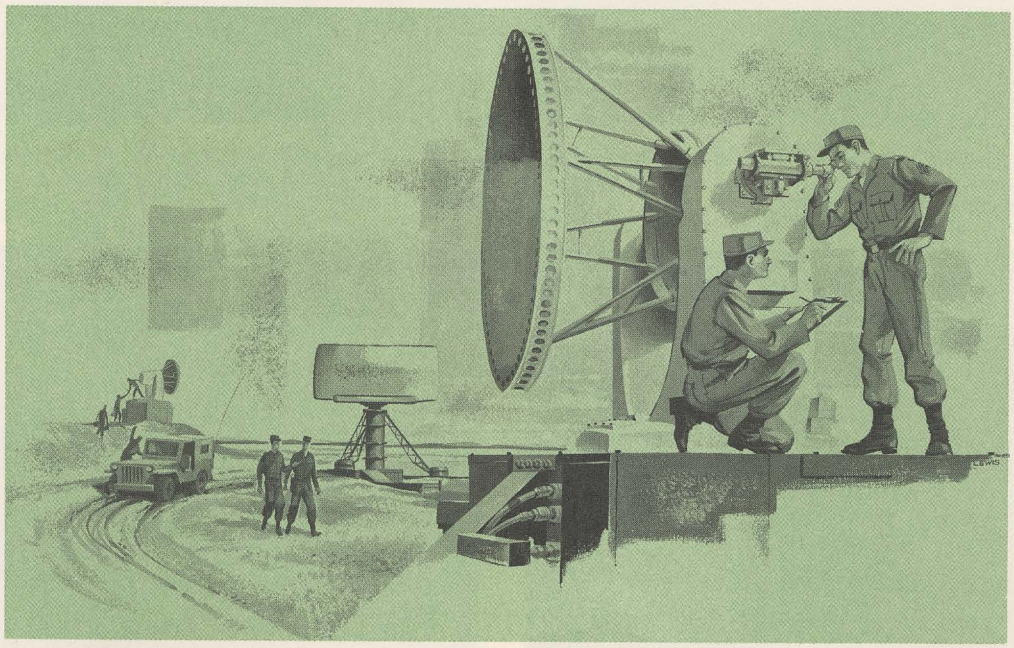
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Introduction . . . The K&E Optics & Metrology Division creates, designs, and manufactures optical, mechanical, and electro-optical systems and components for the precise measurement of lengths and angles. Drawing on more than 90 years of experience and leadership in optical metrology, the Division offers broad facilities and outstanding scientific and engineering personnel capable of handling optical metrological projects, from consultation or basic research to design, development, and quantity production.



Typical Radar Antenna Boresighting Application.

OPTICAL METROLOGY . . . K&E is a world leader in the applied science of optical metrology and alignment. Alignment telescopes, jig transits, collimators, metrological bar systems, and accessories manufactured by K&E achieve consistent linear distance measuring accuracies to within .001 in. over short and long ranges. K&E optical metrological instruments, components, and techniques are invaluable aids in missile launching and tracking systems, orientation of microwave antennas, alignment of atomic particle accelerators, and airframe and missile assembly. K&E optical metrological and alignment products have been widely used in the erection, alignment, and testing of large equipment such as ship propulsion shafts, long bed lathes, turbines and compressors, and paper processing machinery. Almost any application where extremely accurate positioning is mandatory calls for optical alignment.

Electro-Optical Instruments . . . K&E's long experience in the science of measurement has produced precise metrological systems utilizing electronic techniques. For example, the K&E Electronic Tilt-Angle Transducer automatically indicates or records angular deviations with respect to gravity. This electro-optical instrument makes it possible to achieve extremely close alignment tolerances required in radar systems, stable platforms, and missile ground-support equipment.

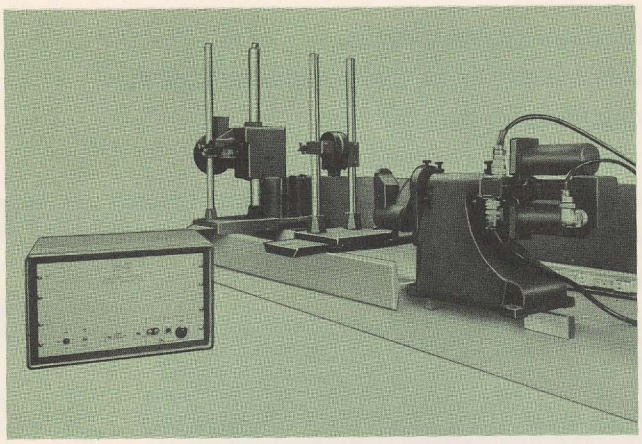
The K&E Electronic Auto-Collimator measures, with a high degree of precision, the angular deviation of a reflective surface with respect to the collimator axis. The output from the Electronic Auto-Collimator can be fed directly into a chart recorder or servomechanism, which makes the system self-correcting.

K&E Research and Development Laboratories are constantly developing new electro-optical instruments for precise measurement of lengths and angles.

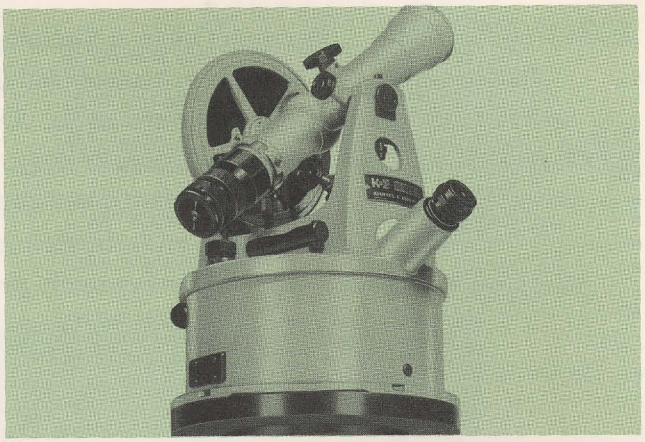
Modification of Instruments . . . Modern metrological and optical applications very often require special instruments or standard instruments modified to meet the needs of a specific problem. K&E has extensive experience in the modification and construction of such instruments, in accordance with the customer's unique requirements. For example, K&E modifies standard theodolites providing for azimuth data only.

Facilities . . . K&E maintains complete, modern facilities required in the development and manufacture of optical-mechanical-electronic systems and components for the precise measurement of lengths and angles. The facilities include optical, electronic, and metrological laboratories and shops capable of producing measuring systems and components where angular accuracies of less than one

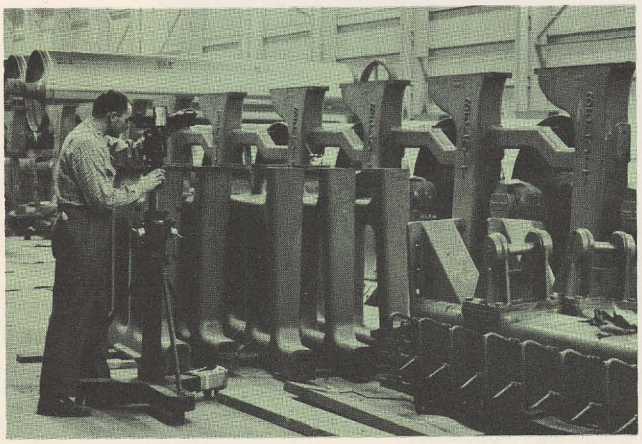
Optical Metrology



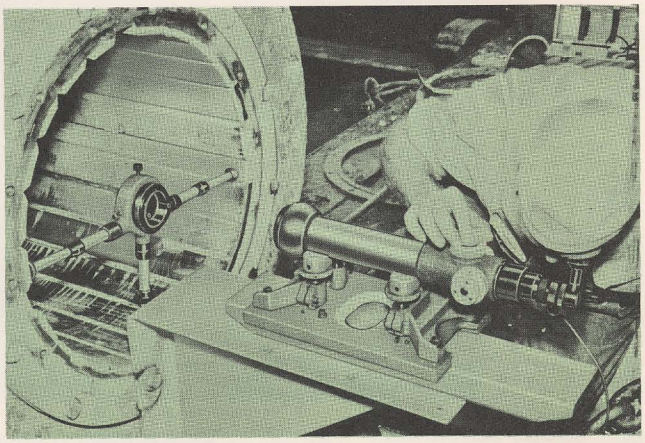
K&E Electro-Optical Surface Contour Gauge, built for checking atomic fuel elements, measures surface contour of inside and outside surfaces and in slots ⅜ in. wide.



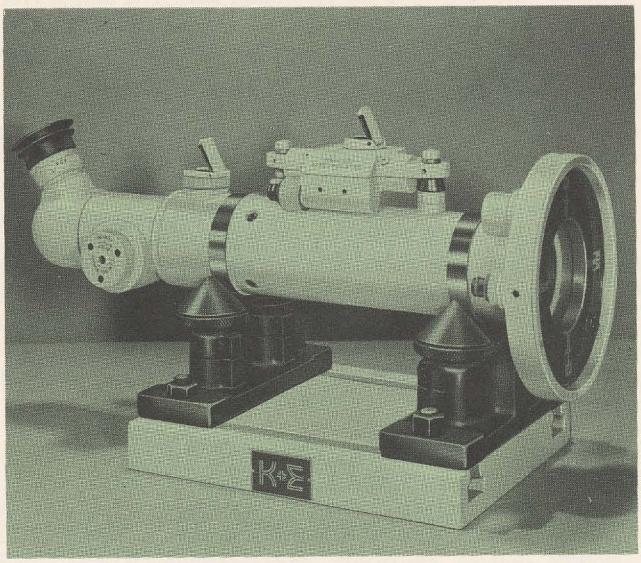
Theodolite: designed and developed in K&E laboratories, incorporates glass circles with precise angular graduations and an optical micrometer system.



Inspecting Critical Alignment of rollers on a paper machine with a K&E Jig Transit. In many cases, present-day tolerances would be impossible without optical devices.



Aligning Main Propulsion Shaft bearings on a large naval vessel with a K&E Alignment Telescope and accessory equipment. Portability eliminates the need for building accurate devices into each setup at critical points.



K&E Radar Boresight Telescope built to meet rigid military specifications.

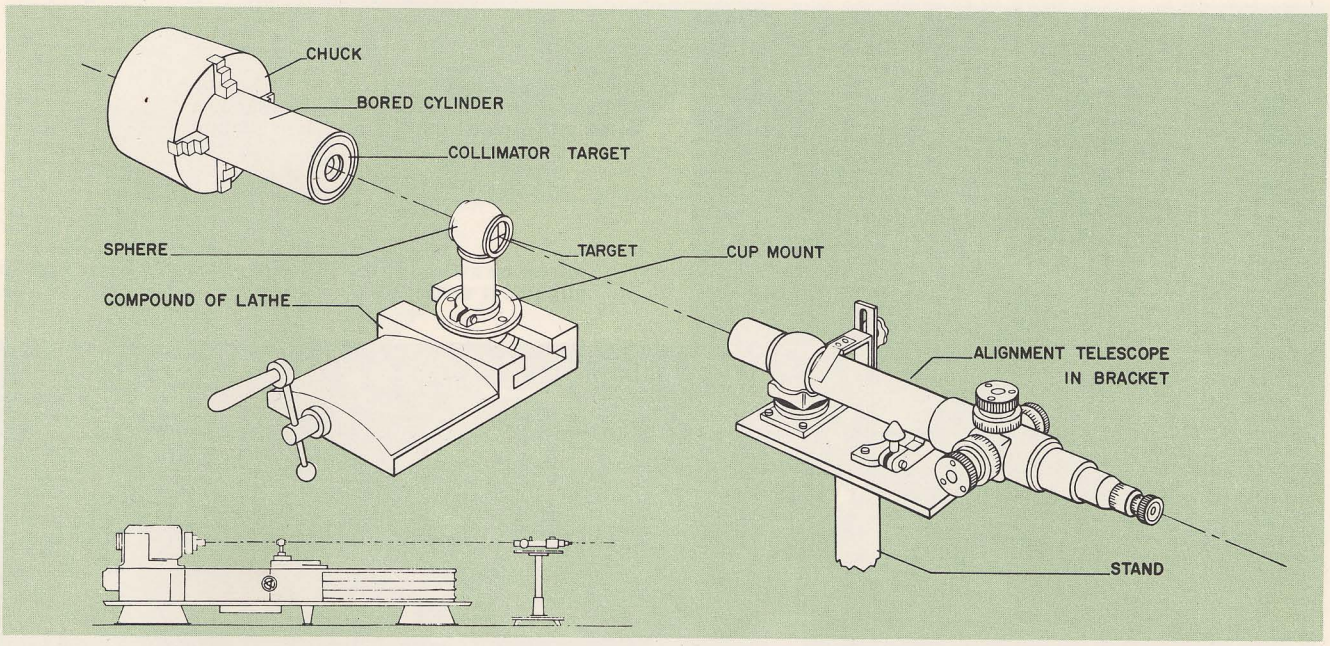
second of arc and linear accuracies in the micron range are required. A complete vacuum coating and graduating laboratory offers a wide variety of optical films and precision linear and circular graduations. An elaborate instrument testing laboratory, complete with environmental chambers, is maintained. Instrument production facilities range from precision machining and optical component fabrication to product assembly, testing, inspection, and packaging.

Contract Activities . . . K&E has applied its knowledge and facilities to solving many alignment, monitoring, and measurement problems in the ordnance, naval, aviation, and missile fields. On a contract basis, K&E offers research and development, prototype construction, production and feasibility studies for complete systems, subsystems, and components for defense applications.

Inquiries concerning special instrument modification or contract activities are cordially invited and should be addressed to:

OPTICS AND METROLOGY DIVISION

Keuffel and Esser Company
Hoboken, New Jersey



Optical Metrological Techniques used in Lathe Alignment.

Four Fundamental Questions

In the erection of industrial equipment, or in the alignment of precision systems, four basic questions must be answered in order to insure proper equipment operation. These four fundamental questions are:

Is It Straight? . . . Is It Flat? . . .

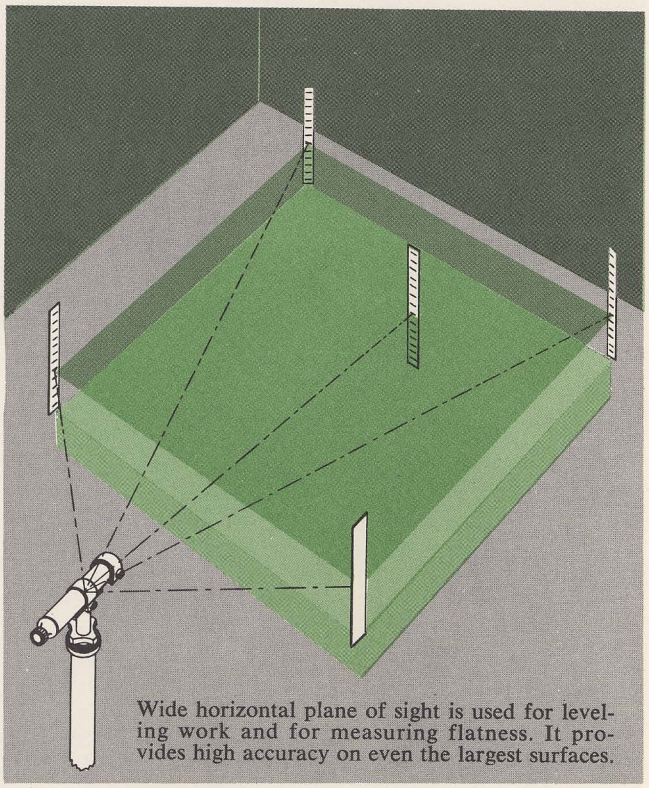
Is It Plumb? . . . Is It Square?

A number of techniques have been developed to make these measurements. However, many of them result in inaccuracies so great that the efficient and precise operation of the equipment involved is seriously endangered.

The new science of optical metrology and alignment, utilizing K&E equipment and techniques, now makes it possible to achieve the highest degree of accuracy in answering these four important questions. It is no longer necessary to extrapolate readings, or to make constant adjustments and calculations. In optical metrology, direct precision measurements are made rapidly and consistently.

Is It Straight? . . . In aligning several points, a tight wire is often used as a reference line. This technique has numerous drawbacks resulting in considerable inaccuracy. First of all, wire has weight, which causes it to sag; over long distances this sag can become considerable. In addition, wire vibrates, can bend or kink, and when stretched in the area to be measured, equipment cannot be moved around for fear of disturbing the wire reference line.

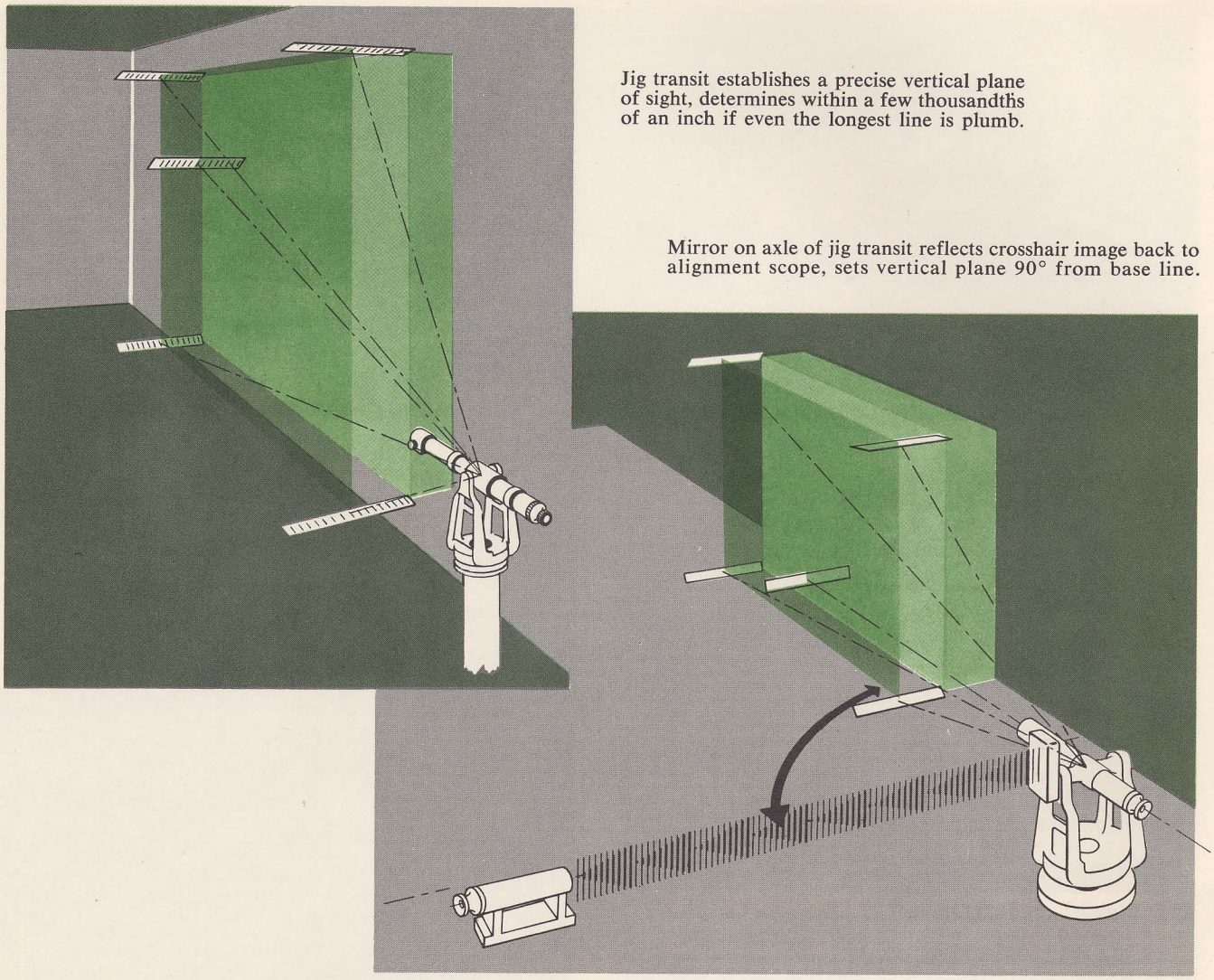
In optical metrological technique, the line of sight of a K&E alignment telescope is used as a reference line, instead of the tight wire. The invisible line of sight reference has no weight, cannot sag, kink, or be disturbed, nor is it a safety hazard. It constitutes a precise, unvarying reference, determining straightness to within thousandths of an inch.



Wide horizontal plane of sight is used for leveling work and for measuring flatness. It provides high accuracy on even the largest surfaces.

Is It Flat? . . . In order to determine flatness for leveling operations, a shop level and a straightedge may be employed. However, over large horizontal areas, the shop level must be moved from part to part. Consequently, one can only tell the degree of flatness of each individual surface upon which the level is placed. Whether the whole area to

Optical Metrology



Jig transit establishes a precise vertical plane of sight, determines within a few thousandths of an inch if even the longest line is plumb.

Mirror on axle of jig transit reflects crosshair image back to alignment scope, sets vertical plane 90° from base line.

be covered is flat is still in doubt. Obviously, flatness over a considerable area must be assured in the erection of large machinery, such as paper processing equipment. Shop level techniques simply do not offer the degree of precision required.

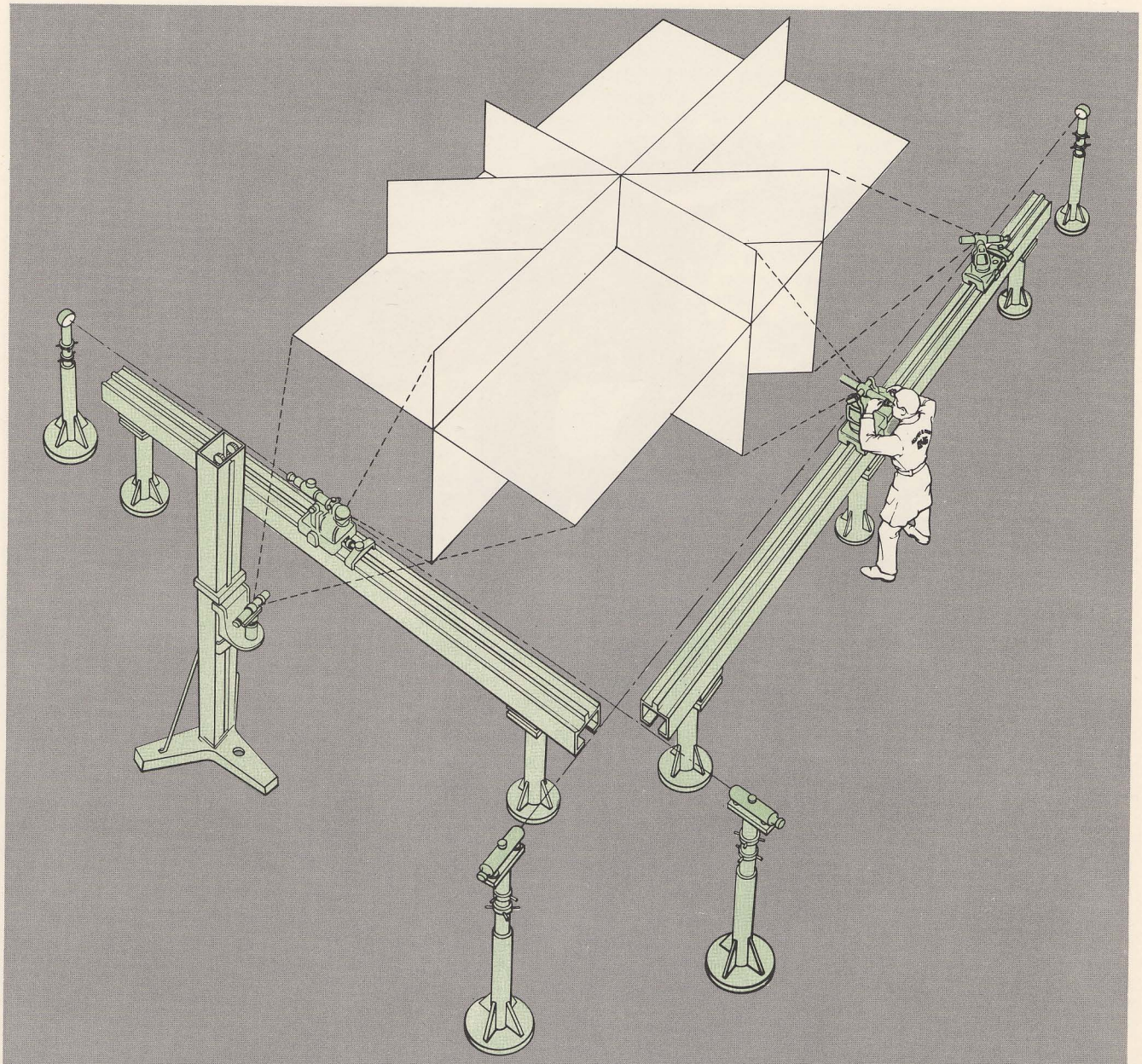
Optical metrological methods overcome these disadvantages and assure levelness to within a few thousandths of an inch, regardless of how large an area is to be covered. This high degree of levelness is accomplished by sweeping the telescope back and forth from right to left, so that the line of sight mentioned above becomes an invisible, horizontal plane of sight, giving a precise horizontal reference plane.

Is It Plumb? . . . A plumb bob may be used to establish a single vertical reference line. Of course, as vertical distances increase, the plumb bob system becomes cumbersome and inaccurate. For one thing, it takes a long time for the plumb bob to steady itself. Also, it can easily be swayed by vibration, air currents, and other disturbances which are bound to be encountered.

In the optical alignment method, a jig transit is used to erect a vertical reference plane. The degree of parallelism between this vertical plane of sight and any other surface can then be determined by measuring the offset between the two planes. As a result, measurements can be made to within .001 in., and even very large vertical areas can be made perfectly plumb.

Is It Square? . . . Perfect squareness implies that one plane forms a 90° angle with another intersecting plane. When a steel square is used to test for this condition, the results can be very misleading. Such measurements rely upon the trueness of the steel square, which can vary from square to square and with time. In addition, steel squares have a definite limit in their physical dimensions and consequently the testing of very large surfaces becomes inaccurate, slow, and cumbersome. Optical metrology overcomes all these disadvantages and offers a quick and precise method for determining squareness.

One method is to use two telescopes, each creating its own line of sight reference. One telescope carries a precision-mounted mirror on its axle; the second telescope is aimed at the mirror, so that its line of sight is reflected back on itself. Once this condition has been achieved, the two lines of sight are precisely at right angles, and the squareness of the two planes can be established with a great degree of precision.



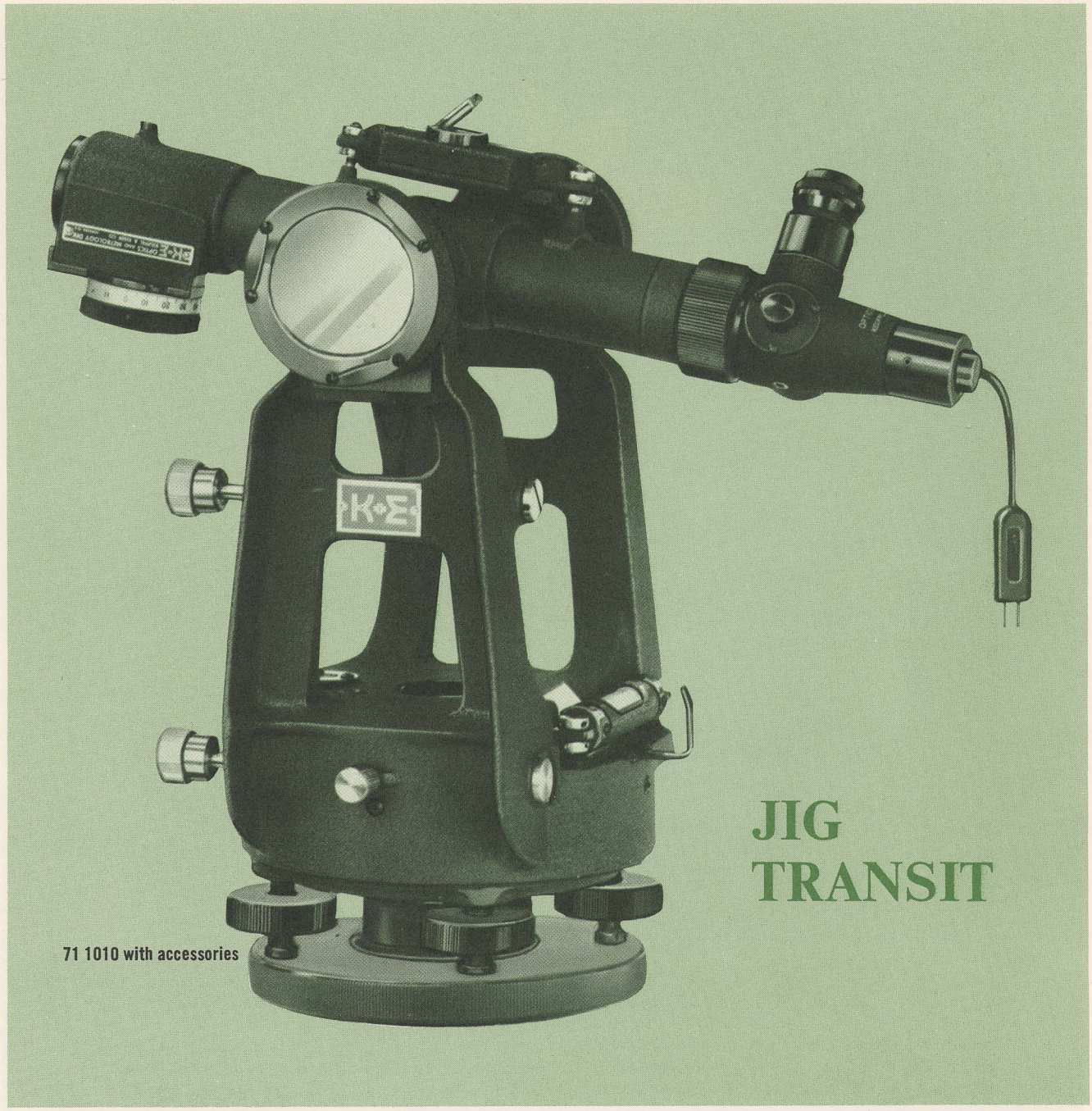
This illustration shows a typical K&E optical metrological bar and alignment setup. This layout is only one example of the numerous combinations and arrangements which are possible for accurate linear measurement and alignment. The pages which follow fully describe the K&E optical metrology and accessory line.

Optical Metrological and Alignment Equipment

K&E's complete line of optical metrological equipment and accessories includes: jig transits, alignment telescopes, levels, collimators, targets, instrument stands, metrological bars, and a wide range of supporting equipment.

The flexibility, economy, and versatility of K&E optical metrological equipment make it possible to perform the simplest as well as the most complex alignment operations.

K&E instruments set up an optical three-dimensional pattern which makes it possible to achieve highly accurate dimensional data of any point in space. Conventional mechanical measuring techniques simply cannot achieve the accuracies obtained through optical metrology.



JIG TRANSIT

71 1010 with accessories

71 1010 PARAGON® Jig Transit . . . The PARAGON Jig Transit is an exceptionally versatile instrument, specifically designed to produce the highest accuracy in optical metrological and alignment work. The transit's azimuth axle is hollow and the line of sight is centered with this axis so that it is possible to sight vertically down through the instrument base. This technique is used on a K&E optical metrological bar, or to set the instrument up over a station point.

The instrument will establish precise vertical planes and plumb lines. When equipped with a right-angle eyepiece, zenith sights or upward plumb lines can be established. Two-speed tangent screws on both the azimuth and elevation axles ease leveling and auto-collimation. The instrument comes equipped with a standard Level Vial 71 3260 attached to the telescope and a circular vial on the plate. The eyepiece is easily converted in the field for auto-collimation. The telescope focuses from 8 in. to infinity. Magnification varies automatically from 20x at 8 in. to 30x at infinity. Resolving power is 4 seconds of arc (according to the Bureau of Standards test procedure).

An all-purpose glass reticule with cross-pattern of single lines top and right, paired lines bottom and left, is employed.

71 1010 PARAGON® JIG TRANSIT

TELESCOPE: 11½ in. long, with fully achromatic K&E optical system.

MAGNIFICATION: Varies automatically from 20x at 8 in. to 30x at infinity.

FOCUSING RANGE: 8 in. to infinity.

RESOLVING POWER: 4 seconds of arc (according to the Bureau of Standards test procedure).

FIELD OF VIEW: 55 minutes at infinity, 6.4 mm at near distance.

EFFECTIVE APERTURE: 30 mm.

OPTICS: Fully coated optics used throughout.

EYEPIECE: Erecting, achromatic. Removable blank provided for auto-collimation conversion unit. Right-angle eyepiece and complete projection accessories available.

RETICULE: All-purpose, double glass, dustproof; cross-pattern with single lines top and right, paired lines bottom and left.

TELESCOPE AXLE: Bronze, with steel journals sweated on. Provided with threaded ends and stop shoulders to accommodate auto-reflection mirrors.

STANDARDS: Reinforced, ribbed, U-type bronze one-piece casting. Bearings V-type, bronze, adjustable for centering line of sight on the azimuth axis in the horizontal and vertical planes.

HEIGHT: 10¾ in. from bottom of base to center of telescope axis.

LOWER PART: Hollow azimuth axle with 1¼-in.-diam. optical clearance. Center: Cylindrical, with high-precision thrust ball bearing.

LEVELS: Telescope — Tubular vial 3½ in.; sensitivity 20 seconds per 2 mm movement. Can be alternately provided with Coincidence Level 71 3250.

Plate — Circular, sensitivity 5 minutes per 2 mm movement. Provisions for mounting Levels 71 3250 or 71 3260 parallel to telescope axle.

SCREWS: Leveling — Four, with precision-generated threads, fully enclosed to exclude dust and retain lubricant.
Clamp and Tangent — Two-speed, fine motion, for both azimuth and elevation motions.

TRIPOD PLATE: Threaded, 3½ x 8, U.S. Standard.

FINISH: Green morocco **WEIGHT:** Approximately 25 lbs.

INSTRUMENT CARRYING CASE: Polished hardwood, lock-corner with corner braces and four large rubber supports, adjusting tools, durable webbed strap.

Accessories for Jig Transit

71 1110 Optical Micrometer . . . The micrometer measures horizontal or vertical displacement from a line of sight. Its range is ±0.100 in., graduated directly to 0.001 in. The micrometer is equipped with a dustproof cover glass and a split clamp for mounting.

71 1130 Circular Auto-Reflection Mirror . . . A circular front surface mirror, 2$\frac{5}{16}$ in. in diameter, is used for establishing a plane perpendicular to a line of sight. The mirror is optically flat to within ¼ wave length of light. It can be mounted on either end of the axle of a jig transit telescope and can be adjusted to square with the axle by means of two adjusting screws.

71 1135 Rectangular Auto-Reflection Mirror . . . Similar to the circular mirror, except that this mirror is rectangular (4$\frac{13}{16}$ in. x 1$\frac{13}{16}$ in.) and can be rotated into or out of a line of sight which passes directly over the elevation axle of a jig transit telescope.

71 3250 Coincidence Level . . . This level can be used for either the plate level or the telescope level on the Jig Transit 71 1010. It can also be attached to any fixture, gauge, or machine bracket. Two $\frac{7}{32}$-in.-diam. holes, spaced 3½ in. on centers, are provided for mounting. The level vial has a sensitivity of 20 seconds per 2 mm movement.

71 3255 Coincidence Level (Reversion Type) . . . This reversion-type level is similar to the Coincidence Level 71 3250. The unit employs two optical reading systems permitting readings of the level vial with the telescope in a normal and in a 180° inverted position. The level unit can be mounted on the telescope of the Jig Transit 71 1010. The vial has a sensitivity of 20 seconds per 2 mm movement. Two $\frac{7}{32}$-in.-diam. holes, spaced 3½ in. on centers, are provided for mounting.

71 3260 Level Vial . . . This level can be used for either the plate level or the telescope level of the Jig Transit 71 1010. It can also be attached to any fixture, gauge, or machine bracket. Two $\frac{7}{32}$-in.-diam. holes, spaced 3½ in. on centers, are provided for mounting. The level vial has a sensitivity of 20 seconds of arc per 2 mm movement.

71 1140 Auto-Reflection Target . . . This target, when mounted on the objective end of the Jig Transit telescope 71 1010 or on the optical micrometer, will provide a point of reference on the line of sight for auto-reflection.

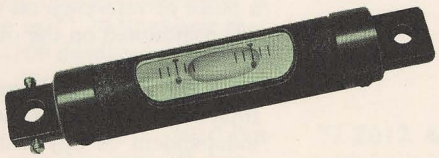
71 1145 Auto-Reflection Target (Glass Type) . . . This target has the K&E paired-line pattern on plano-parallel plate glass for attachment to the objective end of a jig transit telescope for auto-reflection.

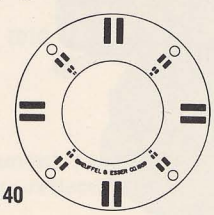
71 1211 Auto-Collimation Conversion Unit . . . The unit converts the standard Jig Transit telescope 71 1010 into an auto-collimating telescope. The unit comes complete with a light plug assembly, cord, switch, and transformer.

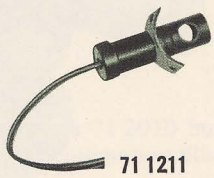
71 5511 Replacement Auto-Collimation Illumination Unit; see page 22.

71 5510 Battery Powered Auto-Collimation Illumination Unit; see page 22.

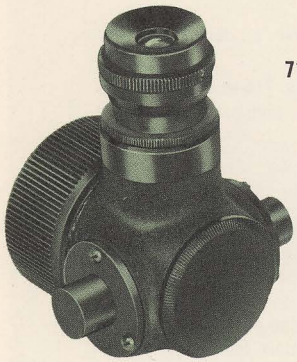

71 3250


71 3260

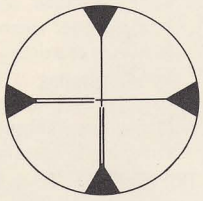

71 1140


71 1211

Optical Metrology



71 1230



71 1290

71 1230 Right-Angle Eyepiece . . . The eyepiece is used in place of the standard eyepiece of the jig transit for very low setups or when working close to walls, columns, or other obstructions. The eyepiece makes it possible to use the jig transit for zenith sights. The right-angle eyepiece maintains a fully erect image and can be rotated through 360° for sighting from any perpendicular angle.

71 1240 Combination Auto-Collimation, Projection Eyepiece . . . This combination eyepiece is interchangeable with the standard eyepiece of the K&E telescope such as 71 1010 and 71 2050. The eyepiece unit can be rearranged in the field as required to form a straight-through vision system or a right-angle system. The complete unit includes a variable output transformer for use with 110 volts AC, 50-60 cycles.

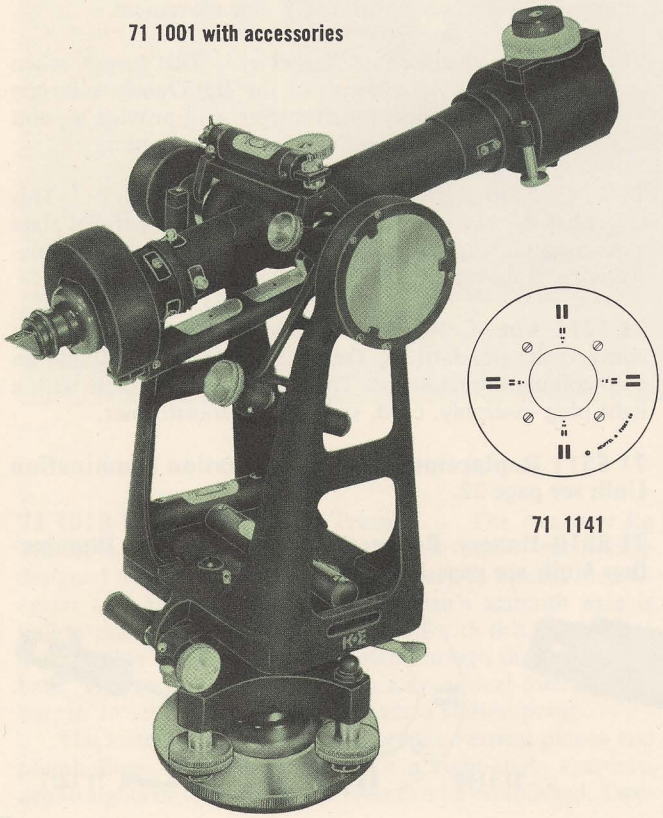
71 1260 Prismatic Eyepiece . . . The prismatic eyepiece is used in very low setups, or when working close to walls, columns, or similar obstructions. It may be rotated through 360°, giving an erect but reversed image.

71 1290 Projection Reticule . . . This double glass reticule is specifically designed for projection use. It is dustproof and has a cross-pattern with single lines top and right, paired lines bottom and left.

71 1121 Remote Control Focusing Unit . . . This remote control focusing unit for Jig Transit 71 1010 comes complete with control switch and 50 feet of electric cord. It requires 110 volts AC, 50-60 cycles.

Note: When unit is ordered separately the jig transit must be returned to factory for installation of the remote control unit.

71 1001 with accessories



71 1141

71 1001 Jig Transit . . . The jig transit will establish precise vertical planes. The 11½-in. telescope magnifies 23x with a focusing range from 3 ft. to infinity. (32x magnification is available at extra charge.) Resolving power, according to Bureau of Standards test procedure, is 4.5 seconds of arc. Field of view is 1° 10′ and effective aperture is 30 mm. Fully coated optics are used throughout and the glass reticule has single and paired crosslines.

Accessories for Jig Transit

71 1101 Optical Micrometer . . . This micrometer is similar to Micrometer 71 1110; see page 9.

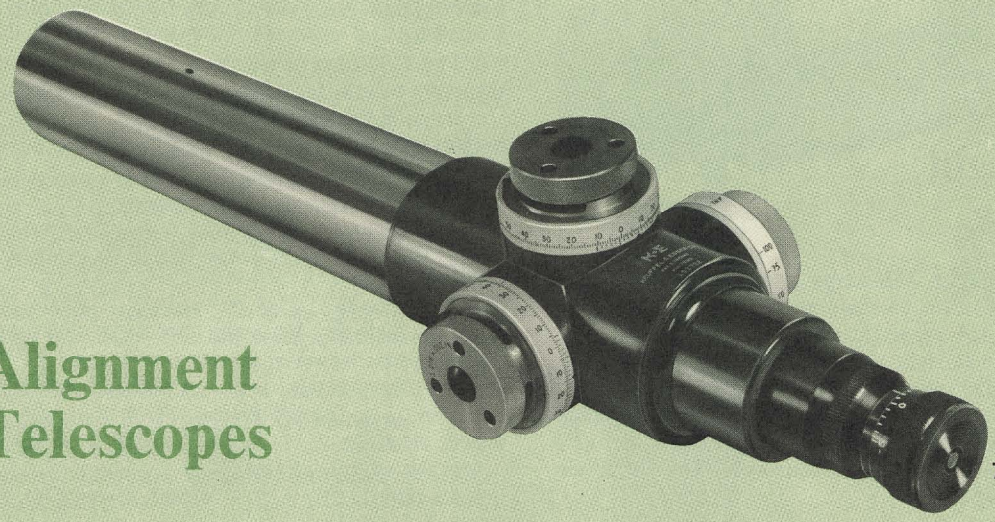
71 1130 Circular Auto-Reflection Mirror . . . Described under Jig Transit 71 1010 accessories; see page 9.

71 1135 Rectangular Auto-Reflection Mirror; see page 9.

71 1141 Auto-Reflection Target . . . The target provides a point of reference on the line of sight for auto-reflection, when mounted on the objective end of Jig Transit 71 1001.

71 3201 Striding Level . . . The striding level gives a final check on the verticality of the plane of the line of sight independent of any instrument adjustment. The level vial is adjustable and has a sensitivity of 45 seconds of arc per 2 mm movement.

Alignment Telescopes



71 2020

71 2020 Alignment Telescope . . . This telescope establishes precise reference lines of sight. Its focusing range is from zero feet to infinity. Magnification varies automatically from 4x at zero focus to 46x at infinity focus. It has an effective aperture of 42 mm. Resolving power is 3.4 seconds of arc (according to the Bureau of Standards test procedure). The image is especially bright and clear, with excellent definition; coated optics are used throughout. An all-purpose double glass reticule gives a cross-pattern with single lines top and right, paired lines bottom and left. The telescope barrel is made of through hardened stabilized tool steel with a hard chrome surface. The telescope conforms to A.I.A. specifications, including accuracy, concentricity of line of sight, and barrel diameter.

71 2021 Alignment Telescope . . . Same as 71 2020 except that it is provided with an auto-collimation eyepiece complete with illumination unit to plug in 110 volts AC, 50-60 cycles.

71 2022 Alignment Telescope . . . Same as 71 2020 but with built-in auto-reflection target and built-in auto-collimation illumination unit.

71 2020 ALIGNMENT TELESCOPE

MAGNIFICATION: Varies automatically from 4x at zero focus to 46x at infinity.

FOCUSING RANGE: Zero in. to infinity.

RESOLVING POWER: 3.4 seconds of arc (according to Bureau of Standards test procedure).

FIELD OF VIEW: 37 minutes at infinity, 42 mm at zero focus.

EFFECTIVE APERTURE: 42 mm.

OPTICS: Fully coated optics used throughout.

RETICULE: All-purpose, double glass, dustproof; cross-pattern with single lines top and right, paired lines bottom and left.

EYEPIECE: Fully erect image; diopter scale. Right-angle eyepiece and complete projection accessories available.

OPTICAL MICROMETER: Built-in horizontal and vertical optical micrometers: ±.050 in. displacement. Direct reading to .001 in. Micrometer accuracy ±.0002 in. Scale graduations are red and black colors, coded to indicate direction of displacement.

FOCUSING KNOB: Drum graduated to show focusing distance in feet.

TELESCOPE BARREL: Made of through hardened stabilized tool steel with a hard chrome surface.

BARREL DIAMETER: 2.2498 in. (+0, —.0003) (A.I.A. specification). Barrel length 9 3/16 in.

OVERALL LENGTH: 17 3/4 in. **WEIGHT:** Approx. 11 1/2 lbs.



71 2010

71 2010 Alignment Telescope . . . Specially developed in conjunction with the optical square and universal planizer for those applications where only one optical micrometer is needed. Specifications are the same as 71 2020 except that only one micrometer is used with ±.100 displacement, direct reading to .001 in.

71 2011 Alignment Telescope . . . Same as 71 2010 but with an auto-collimation eyepiece complete with illumination unit to plug in 110 volts AC, 50-60 cycles.

71 2012 Alignment Telescope . . . Same as 71 2010 but with built-in auto-reflection target and auto-collimation illumination unit.

Optical Metrology



71 2051

Line of Sight Telescopes

71 2050 Line of Sight Telescope . . . The line of sight telescope provides precise, permanent optical reference lines. It conforms to A.I.A. specifications, including accuracy, concentricity of line of sight and outside barrel. In addition, it receives all standard spherical adapters and optical squares.

The telescope is especially bright, with excellent definition. It is used as a line of sight or boresight telescope, and in optical metrological bar applications as a basic reference line of sight telescope.

71 2051 Line of Sight Telescope . . . Same as 71 2050 but eyepiece equipped with Auto-Collimation Illumination Conversion Unit 71 1211.

MAGNIFICATION: Varies automatically from 23x at 7 in. to 35x at infinity.

FOCUSING RANGE: 7 in. to infinity.

RESOLVING POWER: 3.5 seconds of arc (according to Bureau of Standards test procedure).

FIELD OF VIEW: 47 minutes at infinity; 7.4 mm at near distance.

EFFECTIVE APERTURE: 38 mm.

OPTICS: Fully coated optics used throughout.

RETICULE: All-purpose, double glass, dustproof; cross-pattern with single lines top and right, paired lines bottom and left.

EYEPIECE: Erecting, achromatic. Removable blank provided for auto-collimation conversion unit. Right-angle eyepiece and complete projection accessories available.

TELESCOPE BARREL: Made of through hardened stabilized tool steel with a hard chrome surface.

BARREL DIAMETER: 2.2498 in. (+0, —.0003) (A.I.A. specification). Ground barrel, length 9 3/16 in.

OVERALL LENGTH: 13 1/4 in. **WEIGHT:** Approx. 5 lbs. 11 oz.

71 2052 Line of Sight Telescope . . . Same as 71 2050 but with auto-collimation unit, built-in auto-reflection target, and auto-collimation illumination unit.

Accessories for Line of Sight Telescopes

71 1110 Optical Micrometer; see page 9.

71 1211 Auto-Collimation Conversion Unit; see page 9.

71 1230 Right-Angle Eyepiece; see page 10.

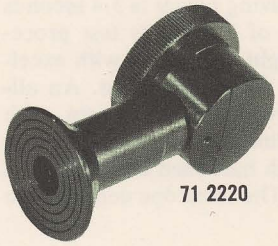
71 1290 Projection Reticule; see page 10.

Accessories for Alignment Telescopes

71 2220 Right-Angle Eyepiece Attachment . . . Mounted directly to any of the K&E alignment telescopes, the eyepiece allows these instruments to be used at floor level, against a wall or other obstruction. This eyepiece produces an erect but reversed image and can be rotated through 360° for sighting from any angle perpendicular to the line of sight.

71 2230 Right-Angle Eyepiece . . . This right-angle eyepiece is used in place of the standard eyepiece on any K&E alignment telescope. With the eyepiece, it is possible to use the telescope at floor level, against a wall or other obstruction. This eyepiece maintains an erect image and can be rotated through 360° for sighting from any angle perpendicular to the line of sight.

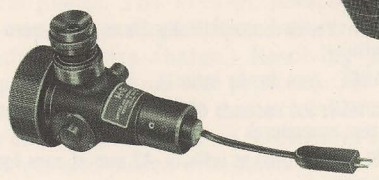
71 2240 Combination Auto-Collimation, Projection, and Right-Angle Eyepiece . . . This unit is used in place of the standard eyepiece on a K&E alignment telescope. It consists of a right-angle eyepiece plus an illumination unit which can be used either to project an image of the reticule onto a target or for auto-collimation. The unit includes the variable transformer for use with 110 volts AC, 50-60 cycles. The eyepiece unit can be rearranged in the field as required, to form a straight-through vision system or a right-angle system. For remote focusing control when using the projection unit, 71 2321, see page 13.



71 2220



71 2302



71 2240

71 2302 Angle Reading Attachment . . . This attachment fits over the objective end of a standard 71 2021 or 71 2022 telescope and converts it into an angle reading type telescope. With the angle reading attachment in place, the micrometers read directly to one second of arc over a range of 50 seconds. Magnification from 4x at zero focus to 26x at infinity. Maximum usable distance for auto-collimation, approximately 30 ft.

71 2310 Vernier for Alignment Telescope Micrometers . . . The vernier can be attached to the optical micrometers on the alignment telescope so that the micrometers can be read directly to .0001 in. or .1 second. When ordered separately, telescope must be returned to factory for vernier installation.

71 2315 Auto-Reflection Target (Slip-On Type) . . . This target, when mounted on the objective end of an alignment telescope, will provide a point of reference on the line of sight for auto-reflection.

71 2321 Remote Control Focusing Unit . . . This remote control focusing unit can easily be installed in the field, in place of the focusing knob on the K&E Alignment Telescope. The unit comes complete with control switch and 50 feet of electric cord; it uses 110 volts AC, 50-60 cycles.

71 2390 Projection Reticule . . . This reticule has been specifically designed for projection use. The pattern, which is same as 71 1290, is easily seen at a distance from the instrument, making for simple, accurate focusing.

Accessories for Both Line of Sight and Alignment Telescopes

71 5510 Battery Powered Auto-Collimation Illumination Unit; see page 22.

71 5511 Replacement Auto-Collimation Illumination Unit; for description see page 22.

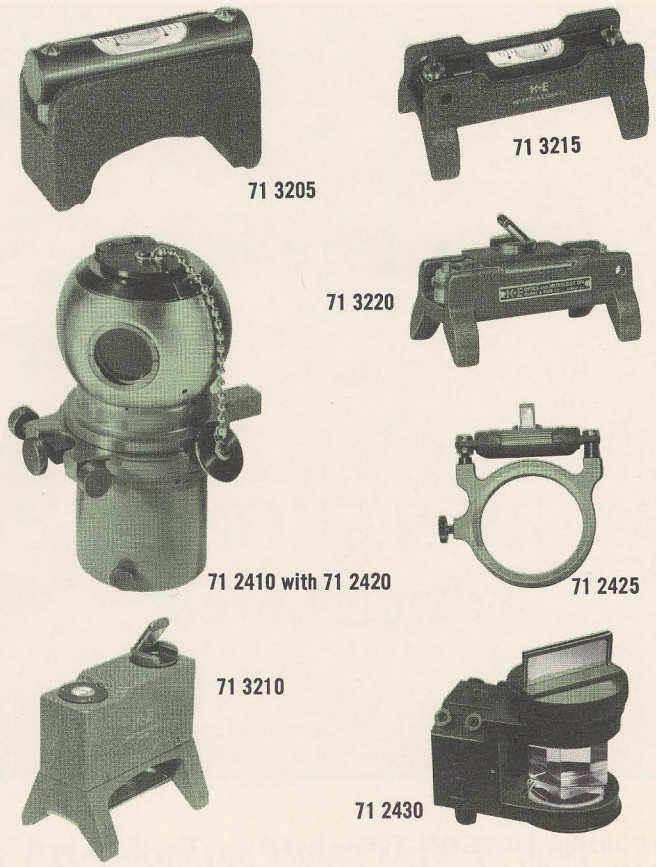
71 3205 Cross Level . . . This level establishes the reticule crosslines of the alignment telescopes and alignment collimators vertically and horizontally. The cross level is positioned by means of a stud fitting into a hole in the barrel of the instrument tube. When the level bubble is centered, the crosslines of the instrument will be vertical and horizontal. The level vial has a sensitivity of 90 seconds of arc per 2 mm movement.

71 3210 Coincidence Striding Level . . . This level is used for establishing a level line of sight with any alignment telescope or alignment collimator with a 2¼-in.-diam. ground barrel. It is placed directly on the barrel of the telescope or collimator. It has a coincidence-type level vial which is accurate to within 1 second of arc. The level can be used with an Alignment Telescope 71 2020, with or without an Optical Square 71 2410 mounted on the barrel of the telescope. A spring clip is included which prevents the striding level from accidentally falling off the barrel.

71 3215 Striding Level (Tubular Type) . . . Placed directly on the barrel, the level is used for leveling any alignment telescope or alignment collimator with a 2¼-in.-diam. ground barrel. The level vial is adjustable and has a sensitivity of 20 seconds of arc per 2 mm movement. A spring clip is included, which prevents the striding level from accidentally falling off the barrel.

71 3220 Striding Level (Coincidence Type) . . . Similar to 71 3215, but has Coincidence Level Vial 71 3250 instead of the Tubular Level 71 3260 and a modified base.

71 2410 Optical Square . . . The optical square is mounted on an alignment telescope or an alignment collimator with an outside diameter of 2.2498 in. (conforming to A.I.A. specification). It establishes a plane perpendicular to the basic line of sight at right angles to it, with an accuracy of within one second of 90°. No adjustments are needed to set the right angle. The basic line of sight can be checked while the optical square is attached to the telescope, since the square has both a front and a side aperture. The optical system is mounted in a spherical housing of 3.500 in. diam. with the vertex of the right angle at the center of the sphere.



71 2412 Double Sphere Optical Square . . . This instrument is similar to the Optical Square 71 2410, except that a second sphere is located 2.250 in. behind the sphere with the prism. With the rear sphere placed in a cup mount, the optical square can be rotated and provides a clear right-angle view through a full 360°.

71 2420 Tangent Ring for the Optical Square 71 2410 . . . The tangent ring can be mounted around the body of the Optical Square 71 2410. A tangent arm is held in a fixed position when used with Bracket 71 5170, 71 5175, or 71 5180 and provides a fine rotary adjustment of the optical square and telescope.

71 2425 Index Level for Optical Square 71 2410 . . . The level makes a right-angle line of sight through the Square 71 2410 vertical. It can also be used for indexing the right-angle line of sight when the instrument is moved to the axis of the optical square barrel and is mounted in place of the Tangent Ring 71 2420. The level vial is the same as that of the Coincidence Level 71 3250, accurate to 2 seconds of arc.

71 2430 Planing Prism . . . The planing prism is mounted on the objective end of an alignment telescope. It consists of an accurately ground rotating prism which makes it possible to sweep the line of sight through a plane containing the base line of sight. The plane through which the line of sight sweeps can be set at any attitude by rotating the alignment telescope about its precision ground barrel. The flatness of the plane established is accurate to within 2 seconds of arc.

71 5160 Plumb Aligner Bracket; see page 20.



71 3010

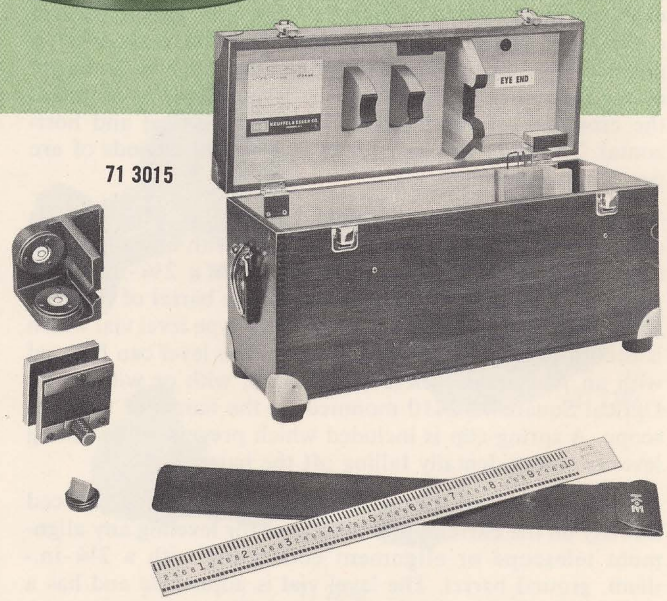
PARAGON® Tilting Levels

71 3010 PARAGON Tilting Level . . . The tilting level is specifically designed to establish a plane in space, level to 1 second of arc. When using this instrument with Optical Micrometer 71 1110 and the optical metrological scale (see page 26), displacements accurate to thousandths of an inch can be determined at distances exceeding 100 ft. from the instrument. This provides means of leveling with ease all types of machinery and equipment, such as machine tools, turbine foundations, and paper machine bed plates, to accuracies difficult to achieve by conventional mechanical methods.

The telescope incorporates a new optical design which provides a minimum focus of 4 in. and variable magnification. The straight eyepiece is interchangeable with the standard K&E right-angle auto-collimation and projection eyepieces. The tilting screw is of the new, two-speed screw design.

For rough leveling it has a circular level, sensitivity 10 minutes per 2 mm movement. For precise leveling it has a coincidence-type level with 2½x magnification, which permits leveling to within 1 second of arc.

71 3015



Four-screw leveling with the tilt (elevation) axis coincident with the azimuth axis eliminates errors due to changing the height of the instrument, which frequently occurs with the three-screw leveling instruments and those with a tilt axis not coincident with the azimuth axis.

71 3010 PARAGON TILTING LEVEL

MAGNIFICATION: Varies automatically from 20x at near distance to 30x at infinity.

FOCUSING RANGE: 4 in. to infinity.

RESOLVING POWER: 4 seconds of arc (according to the Bureau of Standards test procedure).

FIELD OF VIEW: 55 minutes at infinity, 5.2 mm at near distance.

EFFECTIVE APERTURE: 30 mm.

OPTICS: Fully coated optics used throughout.

RETICULE: All-purpose, double glass, dustproof; cross-pattern with single lines top and right, paired lines bottom and left.

EYEPIECE: Erecting, achromatic. Removable blank provided for auto-collimation conversion unit. Right-angle eyepiece and complete projection accessories available.

LEVELS: Circular Level — Sensitivity 10 minutes per 2 mm movement.

Level Vial — Sensitivity 20 seconds per 2 mm movement; coincidence reading type, permitting both ends of bubble to be observed simultaneously; magnification 2½x.

TRIPOD PLATE: Threaded, 3½ x 8, U.S. Standard.

WEIGHT: Approximately 11 lbs.

CARRYING CASE: Polished hardwood, lock-corner with corner braces and four large rubber supports; adjusting pin, center key, webbed strap.

71 3015 PARAGON® Leveling Kit . . . This kit, in a compact carrying case, provides the basic equipment required for precise optical leveling and alignment. It contains:

PARAGON Tilting Level 71 3010
Optical Micrometer 71 1110
WYTEFACE® 10-in. Optical Metrological Scale 71 6010
Right-Angle Mirror 71 3108 for level vial housing
Scale Level 71 3140
Scale Holding Magnet 71 6065
Prismatic Eyepiece 71 1260

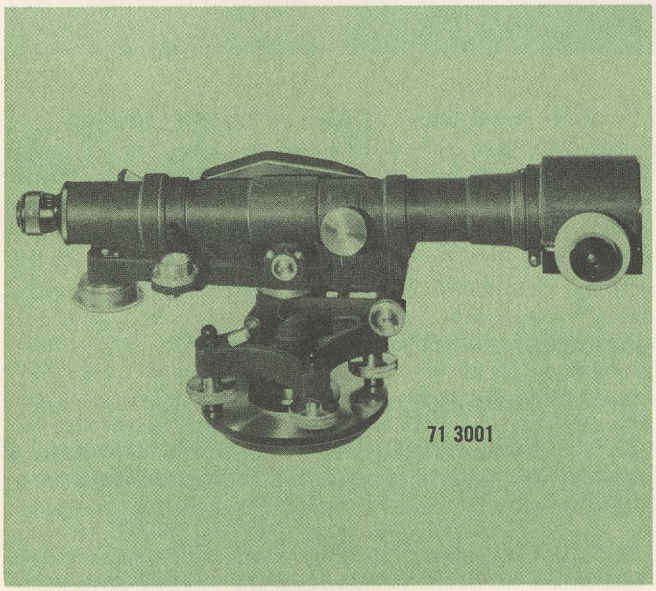
Space is provided for an extra Scale 71 6010 and Scale Holding Magnet 71 6065.

Accessories for Tilting Level 71 3010

71 3101 Optical Micrometer . . . The micrometer measures horizontal or vertical displacement from a line of sight. Its range is ±0.100 in. and it is graduated to read directly to 0.001 in. It comes equipped with dustproof cover glass and split clamp for mounting.

71 3108 Right-Angle Mirror . . . When the mirror is attached to the level housing of the PARAGON Tilting Level 71 3001, the bubble ends can be viewed from a position above the instrument.

71 3140 Auto-Reflection Target . . . Similar to the Auto-Reflection Target 71 1141 described on page 10.



71 3001 PARAGON Tilting Level . . . This instrument is similar to the PARAGON Tilting Level 71 3010. The tilting level has a fully achromatic telescope, with coated optics and erecting eyepiece. Magnification is 30x, with resolving power 4 seconds of arc.

71 3001 PARAGON TILTING LEVEL

MAGNIFICATION: 30x.
FOCUSING RANGE: 6 ft. to infinity.
RESOLVING POWER: 4 seconds of arc (according to the Bureau of Standards test procedure).
FIELD OF VIEW: 52 minutes at infinity.
EFFECTIVE APERTURE: 38 mm.
OPTICS: Fully coated optics used throughout.
RETICULE: All-purpose, double glass, dustproof; cross-pattern with single lines top and right, paired lines bottom and left.
EYEPIECE: Erecting, with resetting scale.
LEVELS: Circular level — Sensitivity 10 minutes per 2 mm movement.
Level Vial — Sensitivity 20 seconds per 2 mm movement; coincidence reading type, permitting both ends of bubble to be observed simultaneously; magnification 2½x.
TRIPOD PLATE: Threaded, 3½ x 8, U.S. Standard.
WEIGHT: Approximately 10 lbs.
CARRYING CASE: Polished hardwood, lock-corner with corner braces and four large rubber supports; adjusting pin, center key, webbed strap.

71 3005 PARAGON Leveling Kit . . . This kit, in a compact carrying case, provides the basic equipment required for precise optical leveling and alignment. It contains:

PARAGON Tilting Level 71 3001
Optical Micrometer 71 3101
WYTEFACE 10-in. Optical Metrological Scale 71 6010
Right-Angle Mirror 71 3108 for level vial housing
Scale Level 71 3270
Prismatic Eyepiece 71 1260

Space is provided for an extra Scale 71 6010 and Scale Holding Magnet 71 6065.

Accessories for Tilting Level 71 3001

71 1110 Optical Micrometer; see page 9.

71 1140 Auto-Reflection Target; see page 9.

71 1230 Right-Angle Eyepiece; see page 10.

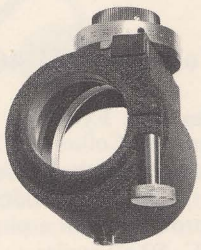
71 1211 Auto-Collimation Conversion Unit; see page 9.

71 1240 Combination Auto-Collimation, Projection Eyepiece; see page 10.

71 1290 Projection Reticule; see page 10.

71 3108 Right-Angle Mirror; see this page.

Micrometer for Surveying Instruments



71 3105 Optical Micrometer . . . For PARAGON levels. With Adapter 71 3106 and a counterweight micrometer fits PARAGON Transit 74 0020; see catalog 10.

71 3106 Adapter . . . The adapter is used with the Optical Micrometer 71 3105 to fit PARAGON Transit 74 0020.

COLLIMATORS



71 4010 Alignment Collimator . . . The alignment collimator is used to establish positions in reference to a line of sight and for checking and adjusting optical metrological and surveying instruments. It can also be used as an autocollimator when provided with Auto-Collimation Eyepiece 71 4111. The collimator barrel is machined from through hardened stabilized steel with a hard chrome surface. Ground barrel length is approximately 12 in., barrel diameter is 2.2498 in. (A.I.A. specification). The infinity target is graduated every 30 seconds with a total of 18 minutes of arc in four directions from zero. A paired-line target is centered on the collimator objective lens. Lamp Housing 71 5520, or any other target illumination conforming to A.I.A. specifications, can be screwed into the rear of the barrel.

Accessories for Collimator 71 4010

71 4111 Auto-Collimation Eyepiece . . . This eyepiece is used to convert Alignment Collimator 71 4010 to an autocollimator. The eyepiece is attached by screwing it into the end of the alignment collimator, making it a 30x infinity focus telescope. It is provided with a plug-in type illumination unit, 110 volts AC, 50-60 cycles.

71 5520 Lamp Housing; see page 22.

71 3205 Cross Level; see page 13.

71 3210 Coincidence Striding Level; see page 13.

71 3215 Striding Level; see page 13.

71 4030 Straightness of Line of Sight Collimator . . . This instrument is used in testing and adjusting all optical metrological and surveying instruments. It checks the straightness of the line of sight of any sighting telescope from minimum focus to 100 ft. The collimator contains seven reticules positioned to simulate distances of 0, 4, 10, 25, 50, 100 ft., and infinity.

Accessories for Collimator 71 4030

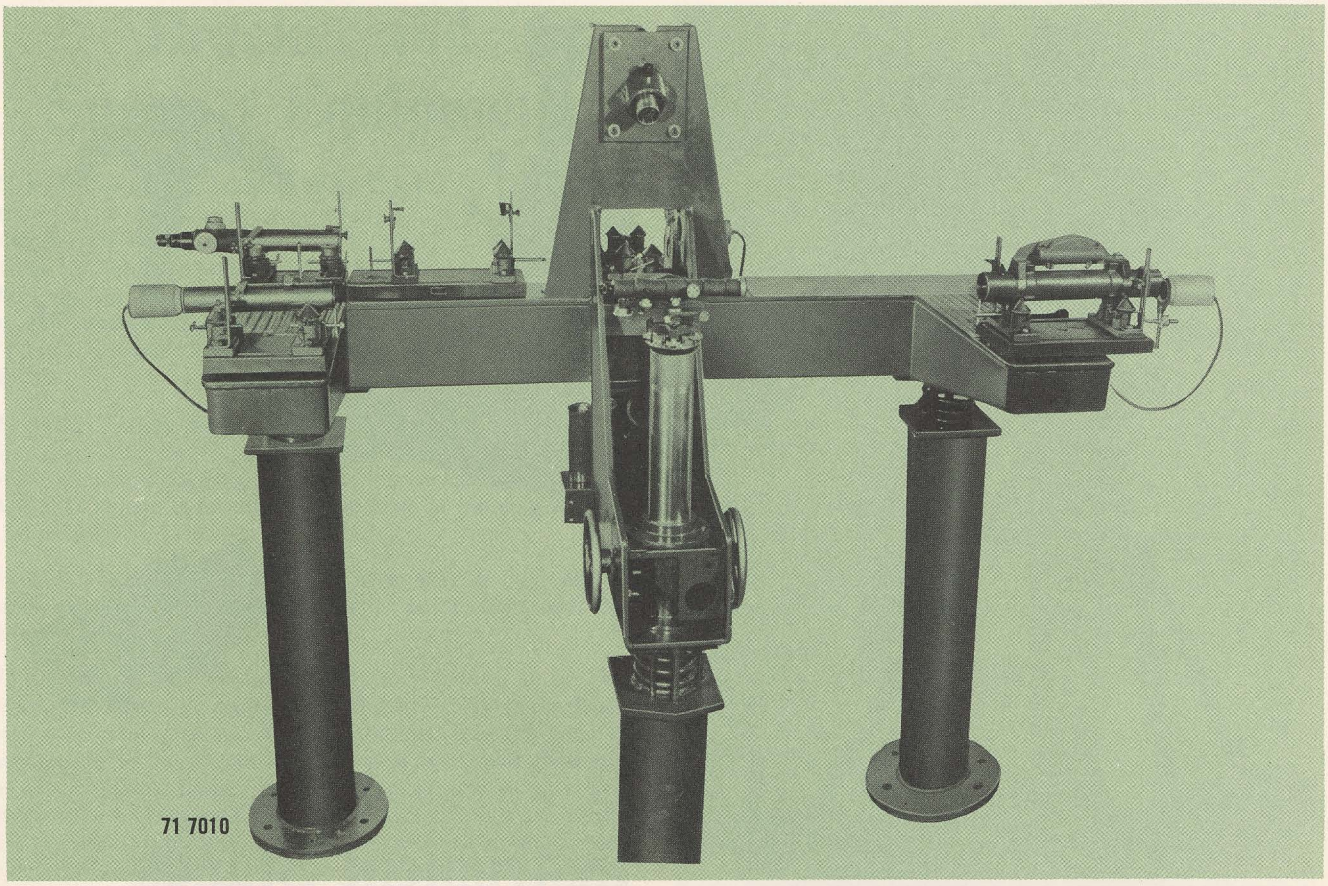
71 5520 Lamp Housing; see page 22.

71 5535 Lamp Housing Holder . . . This holder is used to position the Lamp Housing 71 5520 behind a collimator support on a Bracket 71 5192 or 71 5194.

71 3230 Coincidence Striding Level . . . The striding level establishes the Collimator 71 4030 in a level position. A coincidence-type reading system, accurate to within 1 second of arc, is used. A spring clip is included which prevents the striding level from accidentally falling off the collimator barrel.

Special Collimators

K&E can furnish special collimators to order only for testing and adjusting optical metrological and surveying instruments. These collimators can be made with various combinations of reticules positioned to simulate desired distances from zero to infinity.



Instrument Testing Equipment

71 7010 Collimator Test Stand . . . The collimator test stand facilitates making the tests and adjustments required for all optical metrological instruments, theodolites, transits, transit-type instruments, levels, etc. The entire unit measures approximately 80 in. in length and 39 in. in width. It employs welded steel construction with three-point support for maximum stability. The test section is a one-piece unit mounted on vibration dampers which virtually eliminate any vibrations that might interfere with the tests. With suitable brackets and accessories, the test stand will accommodate any instrument; see page 20 for brackets.

Accessories for Collimator Test Stand 71 7010

71 4010 Alignment Collimator; see page 16.

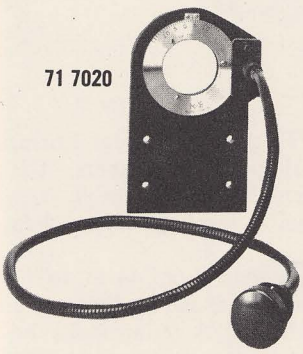
71 4030 Straightness of Line of Sight Collimator; see page 16.

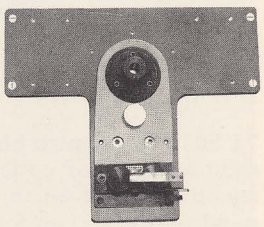
71 4111 Auto-Collimation Eyepiece; see page 16.

71 5520 Lamp Housing; see page 22.

71 5535 Lamp Housing Holder; see page 16.

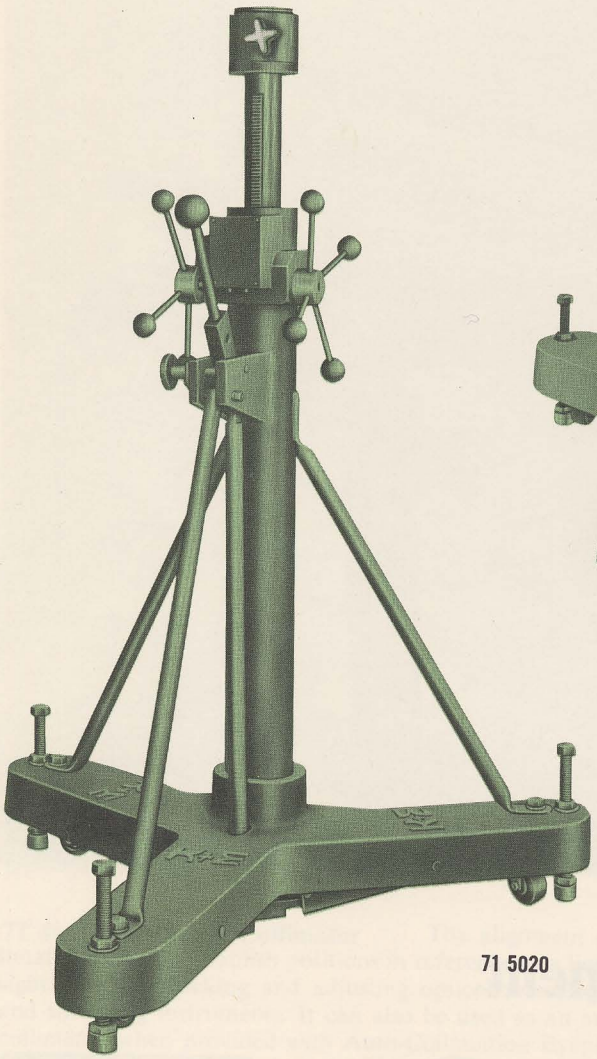
71 3230 Coincidence Striding Level for Straightness of Line of Sight Collimator 71 4030; see page 16.



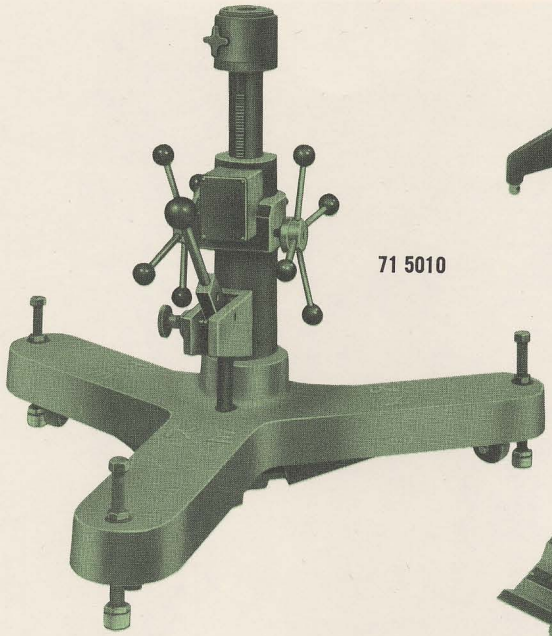


71 7020 Wedge Assembly . . . This instrument is attached to Test Stand 71 7010 for checking the right angle of optical squares and jig transits with axle mirrors. It is direct reading to 1 second of arc and can be estimated to ¼ second of arc.

71 5210 Optical Square Bracket . . . This bracket is used on the Collimator Test Stand 71 7010 for checking the right angle on optical squares. It has a 3½ x 8 mounting thread.



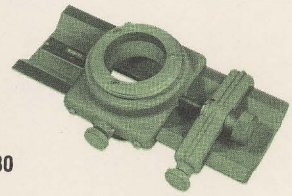
71 5020



71 5010



71 5070



71 5080

Instrument Stands

71 5020 Instrument Stand . . . This stand provides a firm, rigid support for optical metrological instruments. It is readily movable on three retractable rubber wheels. The stand rests firmly on three adjustable leveling screws when the wheels are retracted.

The height of the stand is adjustable, from 44 in. to 72 in., by a rack and pinion. The pinion shaft can be disengaged to prevent accidental change of height. A clamp locks the center column at any height and the column head can be rotated through 360°. The column has a U. S. Standard 3½ x 8 thread for attaching instruments and its center is hollow to allow downward sighting.

71 5010 Instrument Stand . . . This stand is similar to 71 5020, except that its height is adjustable from 24 in. to 35 in.

71 5005 Dog Clamp Attachment . . . Specially designed center column clamp which allows Instrument Stands 71 5020 and 71 5010 to be loaded with heavy metrological bar system while retaining complete stability.

71 5050 Extension Piece . . . This 10-in. extension piece increases the maximum height of K&E instrument stands. It is fitted with a 3½ x 8 male thread at one end and a 3½ x 8 female thread at the other end. The use of the extension piece does not affect the range of adjustment of the stands. Two or more extension pieces can be used to increase height still further.

71 5070 Trivet . . . The trivet is a special device for supporting a jig transit, transit, or level near the floor or at any position where the line of sight is low. It is very rigid in construction and is supported by removable, hardened steel points. If desired, the steel points may be removed and the trivet bolted directly to a jig or fixture. The trivet has a standard 3½ x 8 thread head; its height is 5⅝ in. and it covers a radius of 4⅞ in. Mounting hole sizes are 5/16 x 18 thread.

71 5080 Mechanical Lateral Adjuster . . . The adjuster simplifies bucking in a transit or a jig transit. It is equipped with a movable head which can be quickly positioned and clamped within a range of 4¾ in. It can be precisely adjusted by means of a fine motion lead screw. The range of fine adjustment is approximately 1¼ in. The adjuster can be mounted on any standard instrument stand, tripod, trivet, or adapter, with a standard 3½ x 8 male thread. Any instrument with a standard 3½ x 8 thread base can be mounted to it.

Bracket and Support Equipment

71 5100 Spherical Adapter (with Collet) . . . This adapter is a hardened steel sphere ground to 3½ in. diam., chrome-plated for hardness, and conforming to A.I.A. specifications It has a collet for clamping the adapter on any point along the barrel of an alignment telescope, alignment collimator, or any other tube 2¼ in. in diameter. Target Stop Ring 71 5051 is used to position a target in the center of the sphere.

71 5101 Target Stop Ring . . . The ring is used with Spherical Adapter 71 5100 to position the pattern surface of an alignment target precisely in the center of the sphere. A 2 x 24 thread is provided in the bore of the ring to hold Lamp Housing 71 5520.

71 5102 Spanner Wrench . . . This wrench tightens the tension of the Spherical Adapter 71 5100 collet and the Target Stop Ring 71 5101.

71 5103 Spherical Adapter (without Collet) . . . This adapter is a through hardened steel sphere, 3½ in. in diameter, conforming to A.I.A. specifications. It is designed to accommodate any target or tube with an outside diameter of 2¼ in. Three tapped holes with set screws are provided in the sphere to secure Lamp Housing 71 5520 or any of the 2¼-in.-diam. targets. A fourth hole, with set screw, is provided for securing the sphere to the alignment telescope or alignment collimator.

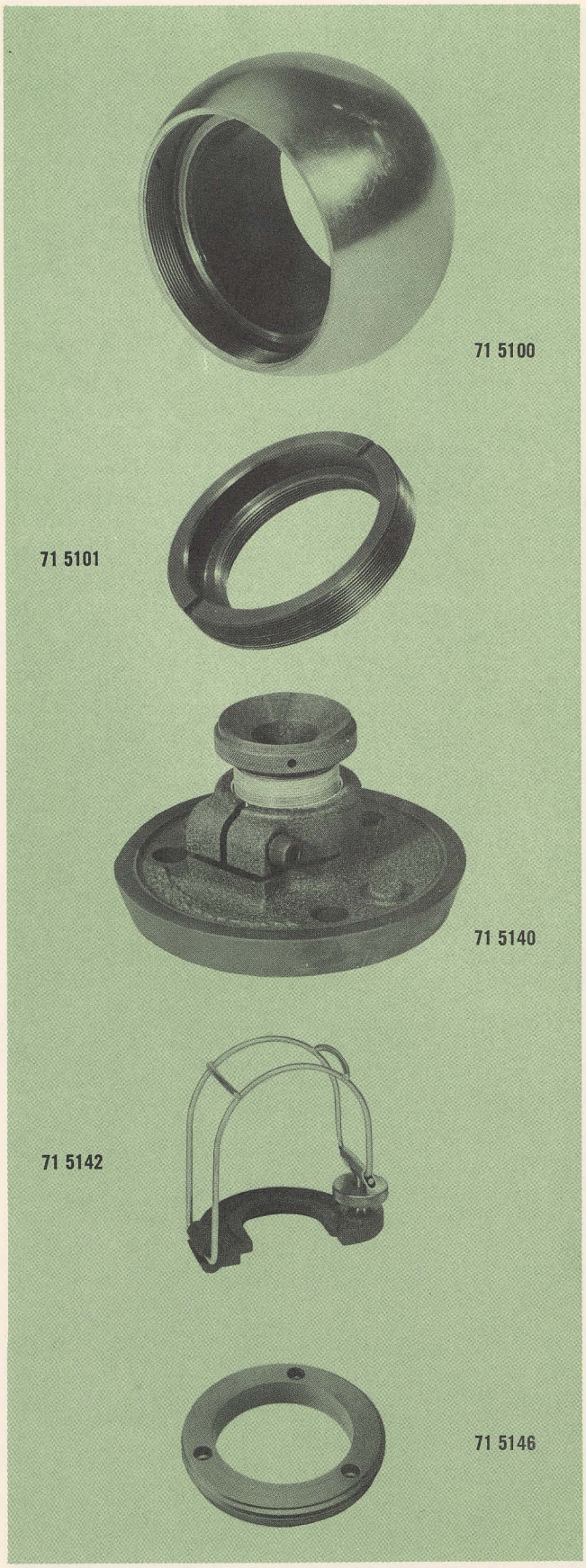
71 5140 Adjustable Cup Mount . . . This cup mount, which conforms to A.I.A. specifications, is a permanent positioning support for any 3½-in.-diam. sphere, such as Spherical Adapters 71 5100 and 71 5103, or for any telescope, collimator, or tube equipped with sphere.

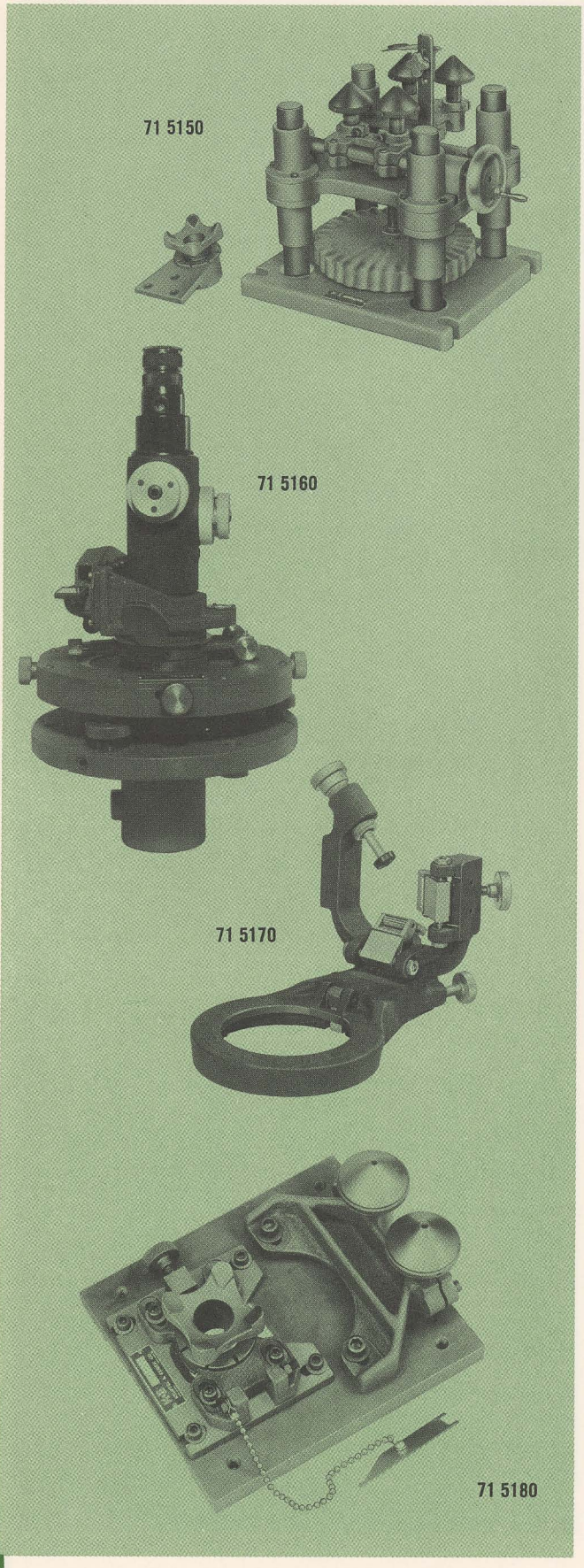
The base is cast iron with three bolt holes for mounting. The cup is adjustable in height through 1¼ in. and can be clamped in any position. Its supporting surface has three equally spaced lands for precise positioning. The vertical column of the cup mount is hollow to permit downward sighting through it.

71 5142 Clamp for Cup Mount 71 5140 . . . This clamp holds a standard 3½-in.-diam. sphere securely to the Cup Mount 71 5140 in any position. The open construction of the clamp permits measurements to be made directly to the surface of the sphere.

71 5144 Adapter with 3½ x 8 Thread . . . The adapter is used with the Adjustable Cup Mount 71 5140 or any other cup mount conforming to A.I.A. specifications. It is provided with three tapped holes 5/16 in. x 18 in. for mounting the adjustable cup mount. The adapter can be mounted on any standard instrument stand, tripod, or trivet, with a 3½ x 8 U.S. Standard male thread.

71 5146 Mounting Ring with 3½ x 8 Male Thread . . . The ring has a U.S. Standard 3½ x 8 male thread for mounting standard surveying or optical metrological instruments. It has three mounting holes for fastening the ring to any flat surface.





Bracket and Support Equipment (cont'd)

71 5150 Universal Alignment Telescope Bracket . . . This bracket supports the optical square combined with an alignment telescope, or an alignment telescope equipped with a sphere. The bracket is specifically designed to simplify the process of "bucking-in" an alignment telescope. A cup mount can be removed and a cone screw-type mount substituted. The range of vertical adjustment is 2⅜ in.

The cross slide supports the telescope and has an adjustment range of 2⅞ in. A 3½ x 8 thread is provided in the base plate for mounting the bracket to an instrument stand, such as 71 5050. The overall size of the bracket is 10 in. x 12 in. x 10 in.

71 5160 Plumb Aligner Bracket . . . This bracket is used with the alignment telescope for making precise vertical sights, either upward or downward. It consists of a clamp and level vial assembly, a bearing plate, and a leveling plate with three mounting holes permitting the complete unit to be mounted at a predetermined location. The bracket is equipped with a circular level for rough leveling, and a coincidence level reading to within 1 second of arc (.0015 in. at 25 ft.). The vertical line of sight may be displaced approximately 1¼ in. laterally in any direction. In order to maintain extremely accurate vertical sights, it is recommended that the plumb aligner bracket and the alignment telescope be purchased as a unit.

71 5170 Alignment Telescope Bracket . . . The bracket supports and provides a means for adjusting the position of alignment telescopes and alignment collimators. It can be attached to any standard cup mount, such as the Adjustable Cup Mount 71 5140. The yoke is easily repositioned on the bracket so that setups may be made with the bracket secured in a vertical, inclined, or upside-down position. With the addition of the Extension Arm 71 5175, the alignment bracket can be used with the alignment telescope and attached Optical Square 71 2410 or 71 2412.

71 5175 Extension Arm . . . The arm extends the yoke of the Alignment Telescope Bracket 71 5170 so that it will support an alignment telescope in combination with the optical square.

71 5180 Bracket for Alignment Telescope and Optical Square . . . This bracket supports an optical square combined with an alignment telescope, or an alignment telescope equipped with a sphere. The bracket consists of a steel plate with a cup assembly for supporting the square or sphere. An adjustable V-block assembly supports the telescope barrel, allowing a line of sight to be easily adjusted in the azimuth and elevation planes. The cup assembly is adjustable along the line of sight by means of a fine motion screw. This permits a downward sight through the optical square and results in precise positioning over any station.

An Adapter Plate 71 5188 can be furnished with 3½ x 8 threads for mounting the bracket to an instrument stand, such as 71 5020.

71 5188 Adapter Plate . . . This adapter plate has a 3½ x 8 thread for mounting the Bracket 71 5180 on an instrument stand.

71 5182 V-Block, Cone-Type . . . This is an adjustable cone-type V-block with the cones offset from the mounting assembly. When used in combination with another cone assembly or Adjustable Cup Mount 71 5186, the optical axis of an alignment telescope or collimator can be adjusted horizontally or vertically.

71 5184 V-Block, Shoe-Type . . . This an adjustable shoe-type V-block with the shoes offset from the mounting assembly. It is used in the same manner as 71 5182.

71 5186 Adjustable Cup Mount . . . This four-prong, hollow-center cup mount is mounted on a base plate which allows for lateral displacement of the cup mount in one direction only. This lateral motion is controlled by an adjusting screw. Some adjustment in a plane perpendicular to the adjustable plane can be obtained through the slotted mounting holes.

71 5190 Base Line Telescope Bracket . . . The bracket provides a means to adjust the optical axis of an alignment telescope horizontally or vertically. It consists of a base plate with a female threaded section on the underside and two sets of cone-type V-blocks on top. The threaded section, 3½ x 8 threads, is used for attaching to the head assembly of the instrument stand or tripod. The V-blocks, which are adjustable with the cones offset, support the telescope.

71 5192 Cone Assembly . . . This is an adjustable cone-type V-block assembly. When used in combination with another cone assembly, the optical axis of an alignment telescope or collimator can be adjusted horizontally or vertically. The T-slotted base plates are specifically designed to support this assembly.

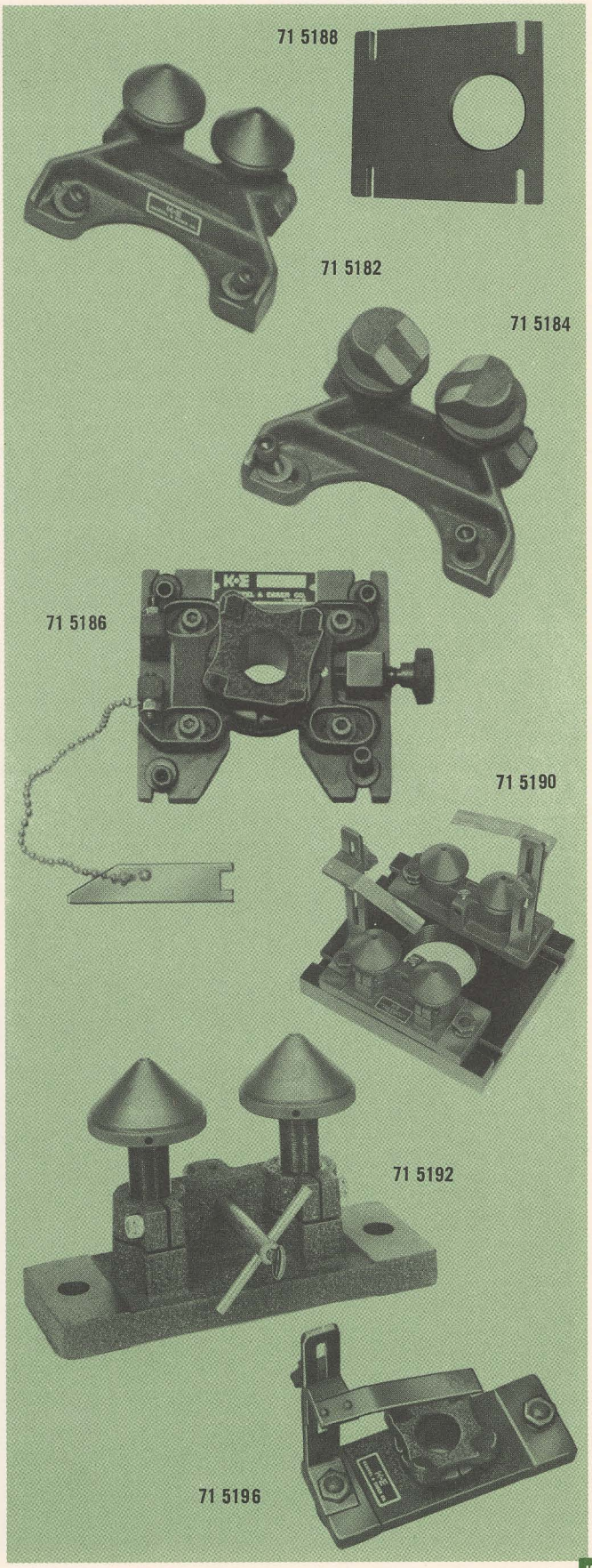
71 5194 Shoe-Type Assembly . . . Same as the Cone Assembly 71 5192, except that shoe-type adjustable V-blocks are used in place of the cones.

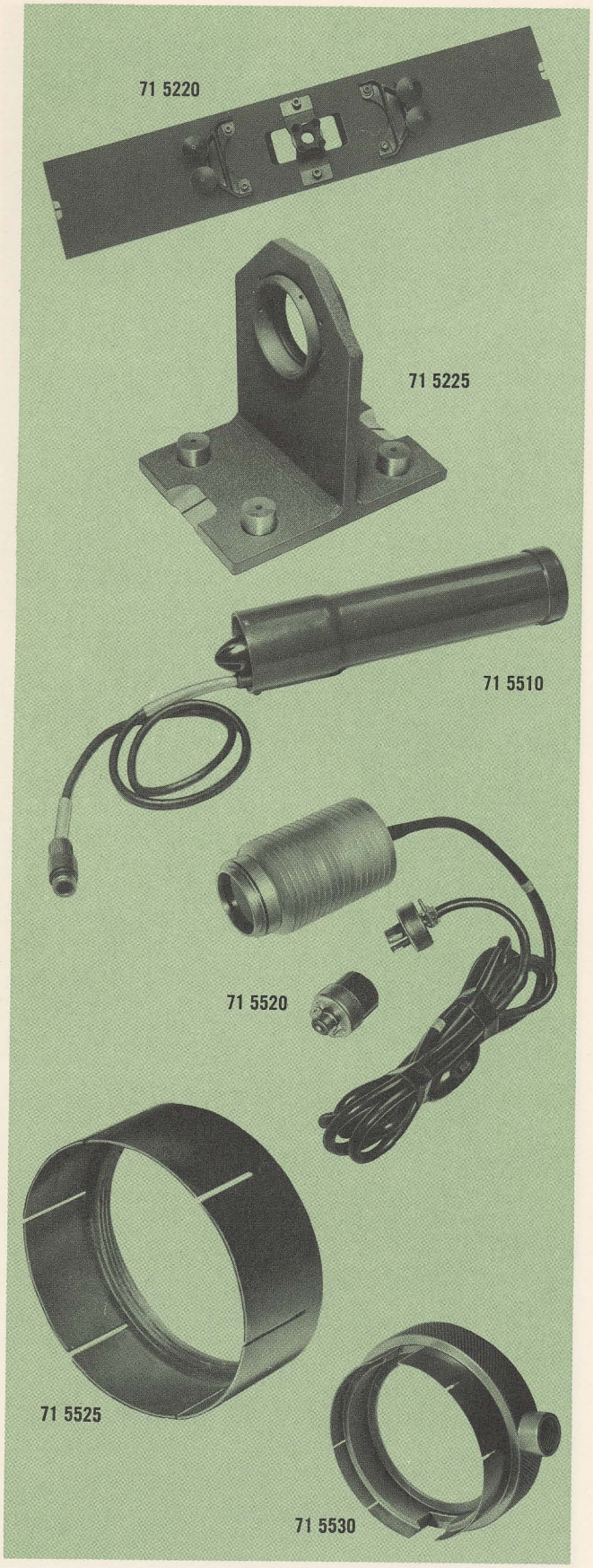
71 5196 Cup Mount Assembly . . . This assembly supports a standard 3½-in.-diam. sphere. The cup has a fast-motion height adjustment over a range of 1¼ in. and supports the sphere on four points. The vertical column of the cup mount is hollow to permit downward sighting. The T-slotted base plates are specifically designed to support this assembly.

71 5201 T-Slotted Base Plate . . . This 10 in. long base has two parallel T-slots. The plate is provided with three counter-bored holes for mounting on Test Stand 71 7010. It can also be used as an instrument bracket, independently of 71 7010. Cone Assembly 71 5192, Shoe-Type Assembly 71 5194, and Cup Mount Assembly 71 5196 units may be used on this plate.

71 5204 T-Slotted Base Plate . . . Same as 71 5201 but 14 in. long.

71 5208 T-Slotted Base Plate . . . Same as 71 5201 but 18 in. long.





Bracket and Support Equipment (cont'd)

71 5220 Scribe-Line Bracket . . . This bracket is specially designed for laying out crosslines or for transferring station points from one line of bed plates to the opposite set of bed plates in the erection of paper machines or similar large machinery. It is used with an alignment telescope and optical square.

71 5225 Scribe-Line Bracket for Target . . . This bracket is used with Scribe-Line Bracket 71 5220 and provides a support for a target directly over the scribe line on the base plate. The telescope on the Bracket 71 5220 can then be aligned to the target on the Bracket 71 5225.

Illumination Units

71 5510 Battery Powered Auto-Collimation Illumination Unit . . . The illumination unit is used on auto-collimating telescopes in place of the standard illumination unit. It provides illumination for the Target Illuminator 71 5530. Power is supplied by two 1.5-volt flashlight batteries (size D). A battery case, rheostat switch, 6 feet of electric cord, and bulb are included.

71 5511 Replacement Auto-Collimation Illumination Unit . . . The Auto-Collimation Unit consists of a transformer, cord, switch, and light plug assembly. It is designed for 110 volts AC, 50-60 cycles, and may be used with all auto-collimation illumination attachments.

71 5520 Lamp Housing . . . The lamp housing provides illumination for the reticule pattern of an alignment collimator or any transparent target positioned in a spherical adapter such as 71 5100 or 71 5103. The lamp is rated at 15 watts and requires 110 volts AC.

71 5525 Adapter Ring . . . The adapter positions the Lamp Housing 71 5520 in a 2½-in. smooth bore.

71 5530 Target Illuminator . . . The target illuminator illuminates glass or nylon targets when positioned in Spherical Adapters 71 5100 or 71 5103 and Target Holders 71 6410 or 71 6450. The unit comes complete with Battery Powered Auto-Collimation Illumination Unit 71 5510.

71 5535 Lamp Housing Holder . . . The holder positions Lamp Housing 71 5520 behind a collimator supported on Bracket 71 5192 or 71 5194.

Target Holding and Centering Equipment

71 6410 Adjustable Target Holder for Large Bores . . . This device holds a target, such as 71 6110 or 71 6180 in any bore from 16 in. to 68½ in. in diameter. The target holder is supported by three telescopic legs. Three sets of legs are supplied for use in bores of diameters from 16 in. to 23½ in., 23½ in. to 38½ in., and 38½ in. to 68½ in., respectively. The legs can be clamped at any position within their range. To center the target in the bore, an Indicator Holder 71 6420 with Dial Indicator 71 6428 must be attached to the target holder.

Accessories for Adjustable Target Holder for Large Bores 71 6410

71 6415 Legs . . . For use in bores of diameters from 65 in. to 121 in.

71 6420 Indicator Holder . . . For use with 71 6410.

71 6425 Extension Rod . . . For 71 6420, for use in bores of diameters from 67 in. to 121 in.

71 6428 Dial Indicator . . . For use with 71 6420.

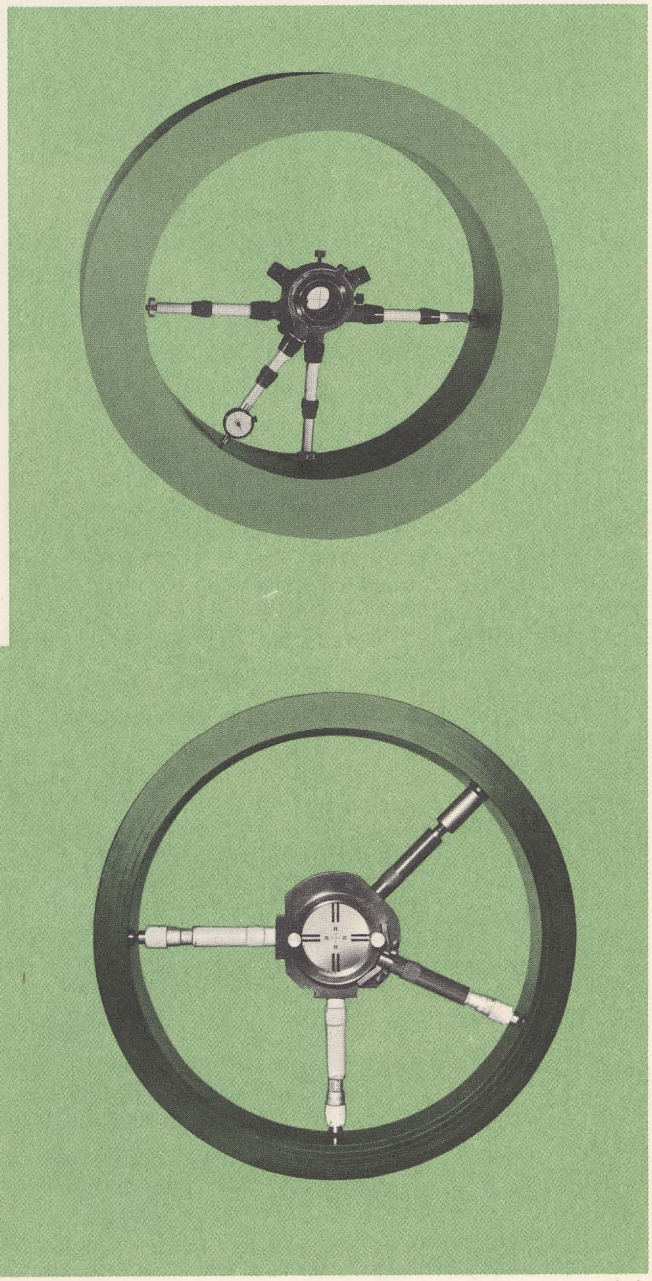
71 6440 Scale Holder for Bore Profiling . . . This accessory attaches to Adjustable Target Holder 71 6410 to hold WYTEFACE® Optical Metrological Scales for establishing the mechanical center of bores in rough castings.

WYTEFACE Optical Metrological Scales for Scale Holder 71 6440

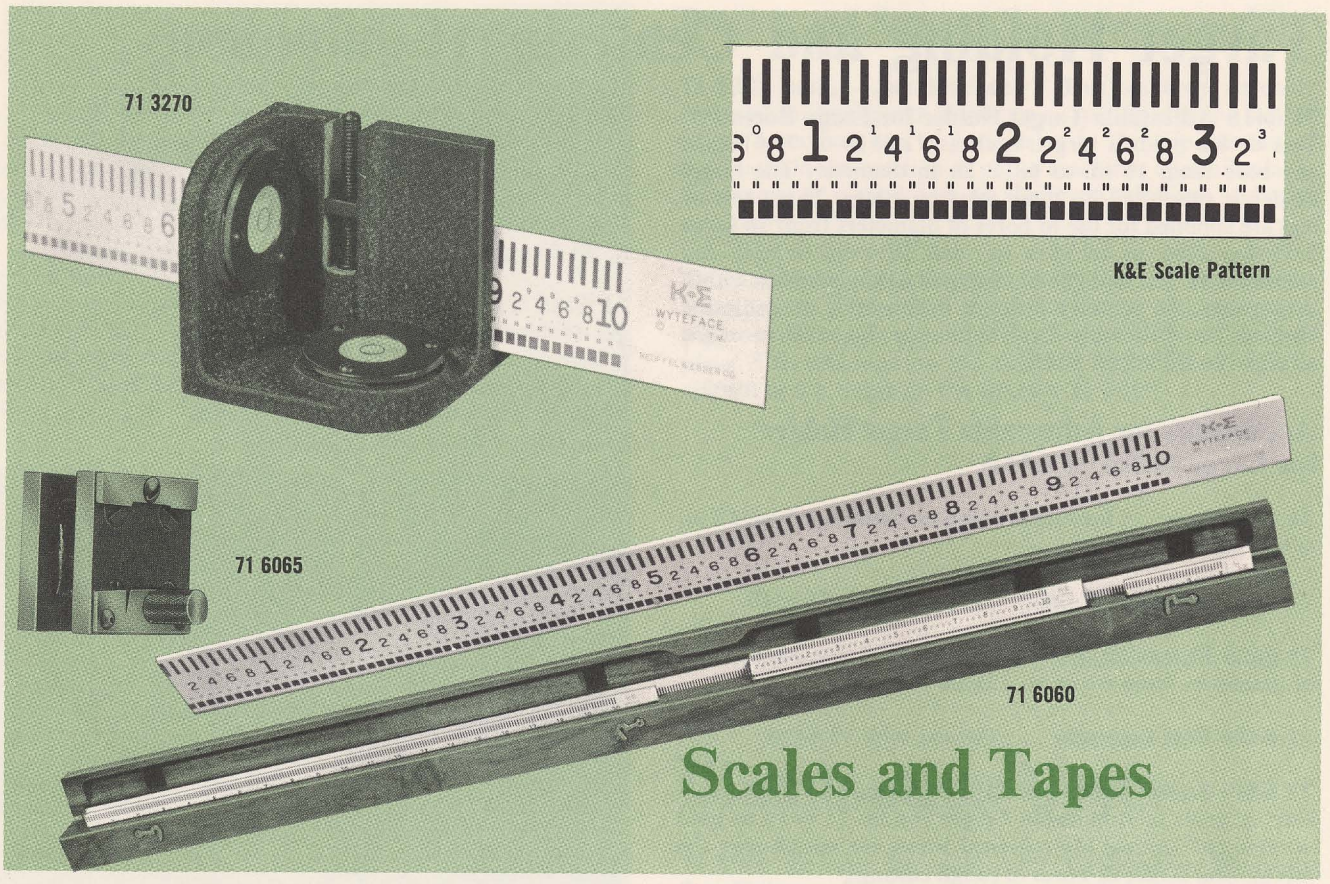
	Length
71 6012	10 in.
71 6022	20 in.
71 6042	40 in.

71 6450 Adjustable Target Holder for Small Bores . . . This device holds a target in any bore from 5½ in. diam. to 21½ in. diam. The target holder is supported by two micrometer stick legs and one spring loaded plunger leg. The kit comes complete with a set of legs and extensions to fit all diameters between 5½ in. and 21½ in.

71 6455 Target Centering Device for Adjustable Target Holder for Small Bores 71 6450 . . . This device is a micrometer stick with a V-type adapter on one end, and is used to center the target mounted on the Target Holder 71 6450. The set consists of all adapters necessary to fit bores from 5 in. to 21½ in. diam.



Optical Metrology



WYTEFACE® Optical Metrological Scales . . . These scales are made of hardened tool steel with a white matte surface. The paired-line graduations are black to provide maximum contrast. The center of the space between each pair of lines represents .100 in. and is accurately located to within ±.001 in. (at 68°F) from the zero end of the scale. Four pairs of lines, each with a different separation, are provided at each .100 in. for different lengths of sights, as follows:

Separation in Inches	Sight Distances in Feet
0.004	Up to 7
0.010	7 to 20
0.025	20 to 50
0.060	50 to 130

The 3-, 10-, and 20-in. scales are graduated throughout their length. The 40-in. scale has the first 19½ in. blank and the last 20½ in. graduated. Graduations are numbered at each inch and subnumbered at each .200 inch.

Inch numbers are repeated between every subnumber for easier reading.

Scale Length	
71 6003	3 in.
71 6010	10 in.
71 6020	20 in.
71 6040	40 in.

71 6060 Empty Mahogany Box . . . for set of 4 scales.

71 6065 Scale Holding Magnet . . . The magnet holds 3-, 10-, and 20-in. optical metrological scales at right angles to the finished surface of any magnetic metal. Overall size 2 in. x 2 in. x 1 in.

71 3270 Scale Level . . . This level sets optical metrological scales vertically or horizontally. It can be attached to any steel scale, up to ⅛ in. in thickness, and between 1 in. and 1½ in. in width. Both of the vials have a sensitivity of 10 minutes of arc per 2 mm movement.

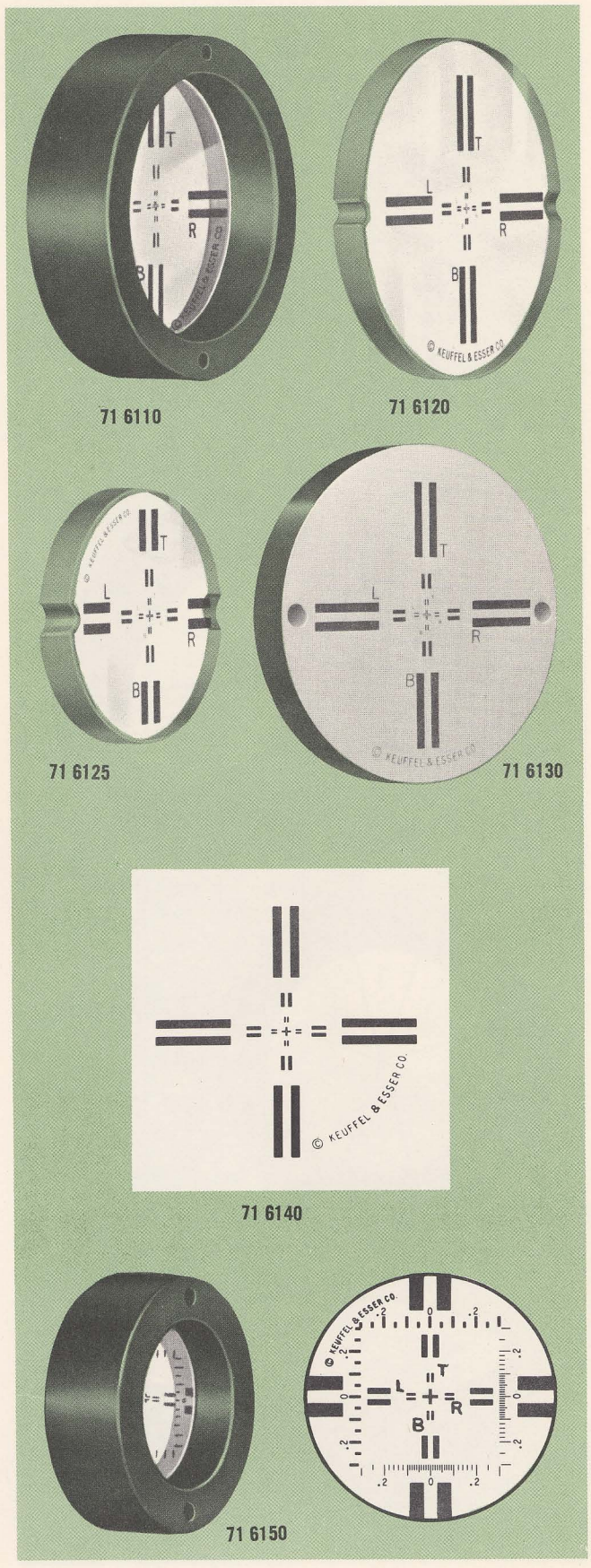
WYTEFACE Optical Metrological Tapes . . . The optical metrological tapes are used to establish precise station positions along a line of sight. They are ⅜ in. wide and .008 in. thick, divided and numbered every 10 in. throughout their length. At 68°F (20°C), no graduation will vary more than .005 in. from its true position, and a 10-in. length will not vary more than .003 in. A report is included with each tape, comparing its graduations with those of the K&E master tape which has been certified by the National Bureau of Standards. The following tapes are available:

	Tape Length
71 6092	20 ft.
71 6094	50 ft.
71 6096	100 ft.

On special order, tapes can be furnished in any length up to 300 ft. When ordering, specify length desired and product number 71 6090.

71 6080 Optical Metrological Tape Tension Weight . . . This weight provides the proper tension for optical metrological tapes and has a clamp for attaching it to the tape.

Targets and Mirrors



71 6110 Glass Alignment Target . . . This paired-line glass target is mounted in a hardened and ground stabilized steel ring 2.2498 in. (+0, —.0005) diam. x ½ in. thick. It is centered within .0005 in. with respect to the outside diameter of the ring. It will fit into any of the standard spherical adapters, such as 71 5100 and 71 5103, conforming to A.I.A. specifications.

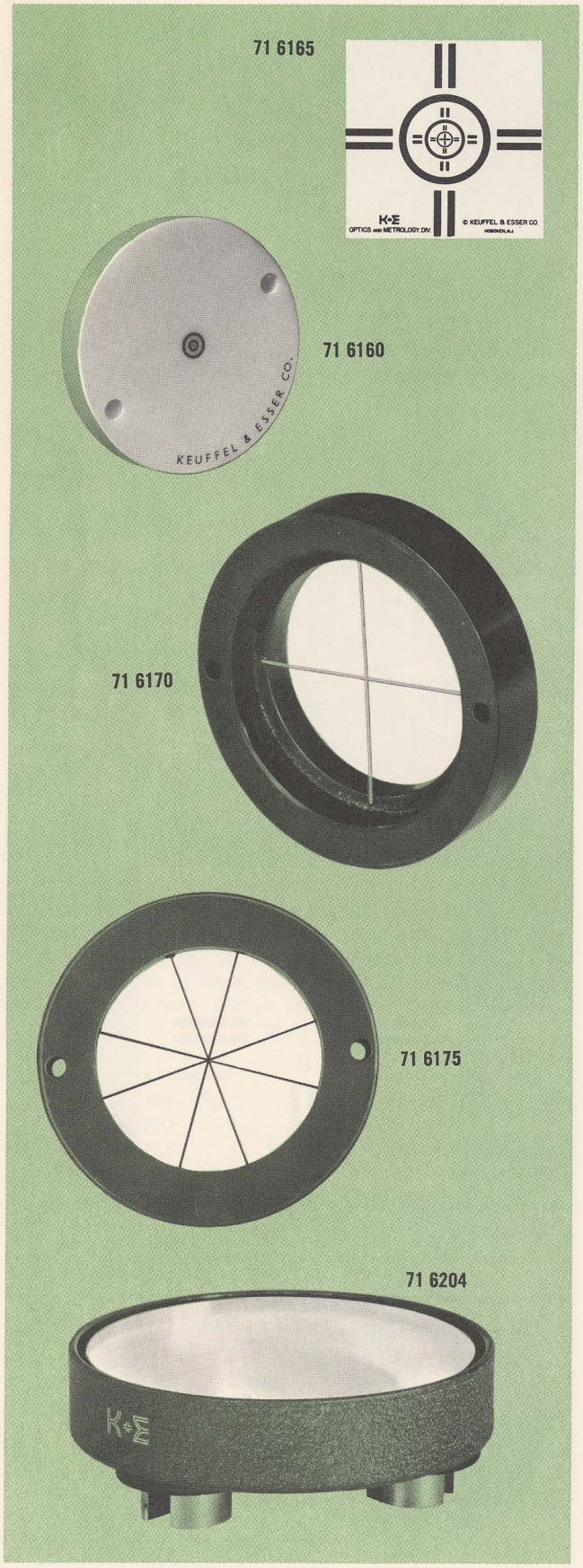
71 6120 Glass Alignment Target . . . Same as 71 6110 but unmounted and ¼ in. thick. The paired-line pattern is centered within .0005 in. with respect to the outside diameter. The target will fit into any standard spherical adapter, such as 71 5100 and 71 5103, conforming to A.I.A. specifications.

71 6125 Glass Alignment Target . . . This unmounted paired-line glass target is 1.4990 in. (—0, +.0005) diam. x ¼ in. thick. Its paired-line pattern is centered within .0005 in. with respect to the outside diameter.

71 6130 Aluminum Alignment Target (Disc-Type) . . . This target has a paired-line target pattern like 71 6110 but is printed on a 2.2498 in. (+0, —.001) diam. disc of aluminum, ⅜ in. thick.

71 6140 Alignment Target (Plastic Film) . . . This target has a paired-line target pattern like 71 6110 but is printed on a 2½-in. square piece of white plastic film. This target can be cemented to machine components for alignment reference.

71 6150 Glass Displacement Target . . . This paired-line glass target, with horizontal and vertical displacement scales, is mounted in a hardened and ground stabilized steel ring 1.4990 in. (—0, +.0005) diam. x ½ in. thick. It is centered within .0005 in. with respect to the outside diameter of the ring. The displacement scales are graduated up to .300 in. each side of zero, the large divisions reading .050 in., the smaller, .010 in.



Targets and Mirrors (cont'd)

71 6160 Plastic Alignment Target . . . This 2.2498 in. (+0, −.001) diam. x .340 in. thick target consists of a bull's-eye-type target pattern impressed on a milk white translucent plastic disc. The target pattern consists of a center dot .010 in. diam., an inside circle .096 in. diam., and an outside circle .119 in. diam.

71 6165 Adhesive Alignment Target . . . This target has a standard paired-line alignment target pattern, 1½ in. square, with additional bull's-eye pattern. The target can be cemented to any flat or curved surface for alignment reference, for example: walls, machine beds, missile casings, fixtures, etc. The target has an anodized aluminum foil face. It meets abrasion, temperature, weather, and salt spray requirements of MIL specifications. It employs an adhesive back with peel-off release liner which peels off clean and fast with no distortion of target face.

71 6170 Open Alignment Target . . . This target is used when a target is required at several positions along a line of sight. Because it is an open target, it is possible to sight directly through it without distortion. Its nylon-monofilament crosslines are mounted in a hardened and ground stabilized steel ring 2.2498 in. (+0, −.0005) diam. x ½ in. thick. They are centered within .001 in. with respect to the outside diameter of the ring. The target will fit into any standard spherical adapter conforming to A.I.A. specifications, such as 71 5100 and 71 5103.

71 6175 V-Pattern Open Alignment Target . . . This target is similar to the Open Alignment Target 71 6170 except that it has a double V-pattern of nylon monofilament.

71 6202 Magnet Back Mirror . . . A magnet back mirror is used to check the perpendicularity of any flat surface to a line of sight by means of auto-reflection or auto-collimation. The mirror has a circular front surface 2½ in. diam. Its reflecting surface is flat to within ¼ wave length of light. A single magnet is cemented to the back of the mirror. Its contact surface is ground parallel to the mirror surface within 3 seconds of arc.

71 6204 Magnet Back Mirror . . . Used for the same purpose as 71 6202, the mirror provides a much larger field of view and allows auto-reflection and auto-collimation to be established more quickly at greater distance. It is a circular front surface mirror, 4 in. diam. Its reflection surface is flat to within ¼ wave length of light. Three magnetic feet are cemented to the back of the mirror. Their contact surfaces are ground parallel to the mirror surface to within 3 seconds of arc.

Targets and Mirrors (cont'd)

71 6230 Auto-Reflection Angle Mirror . . . This mirror reflects a line or sight at any horizontal angle up to approximately 160°. It is used in combination with any telescope equipped with an auto-reflection or for auto-collimation.

The instrument consists of the base of an engineer's transit with a front surface mirror accurately positioned in place of the conventional standards and telescope. The mirror is optically flat to within ¼ wave length of light. Its reflecting surface coincides exactly with the line of the azimuth axis of the instrument. A crossline on the mirror surface indicates the center of the azimuth axis.

The instrument has a standard 3½ x 8 thread base. Its azimuth circle reads direct to 30 minutes and is double numbered 0-360 and 360-0. A double direct vernier reads to 60 seconds or can be set to 30 seconds. Instruments reading to 20 seconds can be furnished on special order.

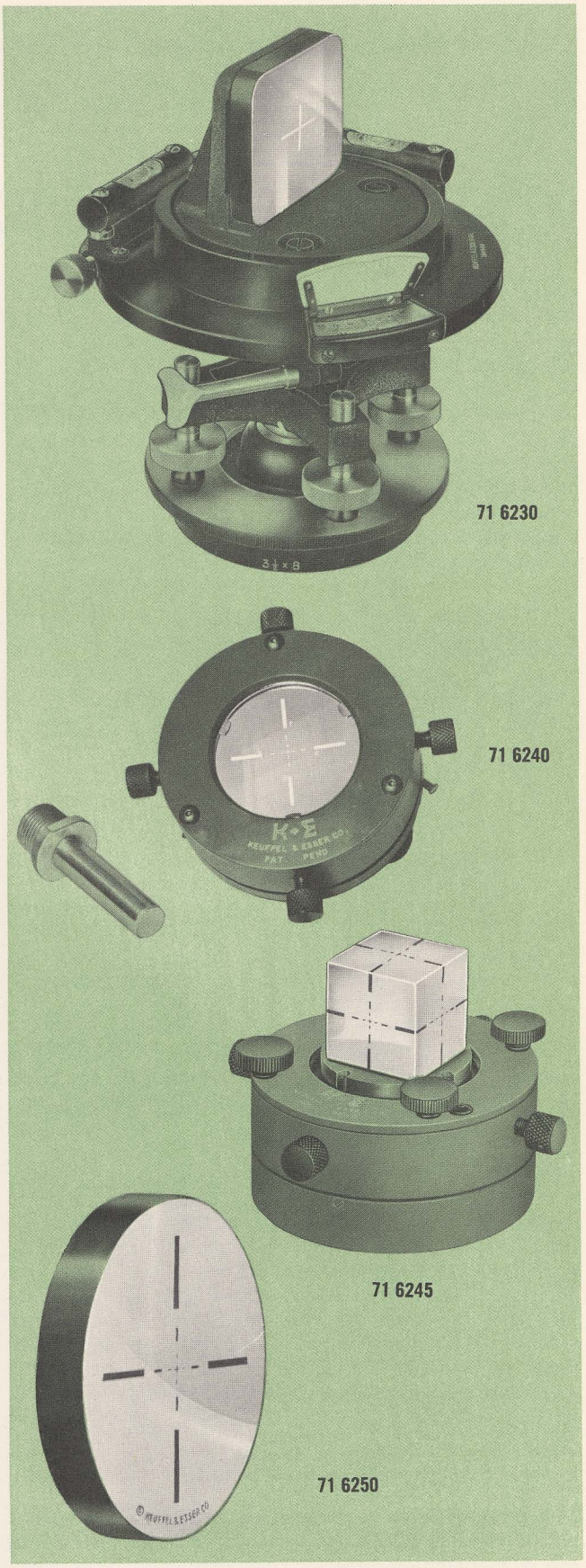
71 6240 Adjustable Spindle Mirror Target . . . This instrument establishes the axis of rotation of machine tool spindles, pumps, compressors, motors, radar tracking devices, marine propeller shafts, and many other rotating machine elements. By establishing the axis of rotation, the alignment of one rotating element to another can be made to a high degree of precision. The instrument consists of an optically flat front surface mirror target supported in an adjustable mount capable of shifting or tilting the mirror for adjustment. The instrument can be mounted either by means of its three rear surface magnets or by means of its removable arbor.

Overall dimensions are 4⅞ in. diam. x 3¾ in. deep (without arbor). The device has a fine motion target shifting range of 3/16 in. and the mirror tilting range is 1½°. Arbor is ½ in. in diameter and 2 in. long. The lines are opaque matte finish and disperse the light. They appear black when illuminated with collimated light perpendicular to the surface, and white when illuminated from the side.

71 6245 Adjustable Cube Mirror Target . . . This instrument is similar to the Adjustable Spindle Mirror Target 71 6240. The unit consists of a glass cube with mirror targets on five sides. The cube is mounted on an adjustable steel plate and can be shifted and tilted. The adjustable cube mirror target can be mounted either by means of its three rear surface magnets or by means of its removable arbor. Its overall dimensions are 4⅞ in. diam. x 3¾ in. deep (without arbor). Fine motion target shifting range is 3/16 in. and the mirror tilting range is 1½°. The arbor is ½ in. in diameter and 2 in. long. The cube is 1⅜ in. and all face-to-face angles are 90° within 3 seconds of arc.

71 6250 Mirror Target . . . This 2¼-in.-diam. glass mirror target is used to check the perpendicularity of a part by auto-reflection or auto-collimation and also to position the part on the line of sight. The target is unmounted and can be fitted directly into the part to be positioned, or into any standard sphere such as 71 5100 or 71 5103.

The target has a front surface mirror flat to within ¼ wave length of light. It is ¼ in. thick, 2.2498 in. (+0, −.0005) diam.



METROLOGICAL BAR SYSTEMS

Linear distance measurements to accuracies of .001 in. are a common problem, not only in the field of aircraft and missile metrology, but also in the manufacture and inspection of machine tools, atomic reactors, and other precision assemblies. The methods of making such measurements have involved to an increasingly greater extent the use of the "Metrological Bar." K&E Metrological Bar Systems provide industry with a simple, versatile, economical means of achieving the desired degree of precision in measuring linear distances ranging from a fraction of an inch to one hundred feet and more. K&E offers both horizontal and vertical metrological bar systems.

Horizontal Metrological Bar System

The horizontal metrological bar system basically consists of:

1 . . . Track supporting a jig-bored index bar having precision drilled bushings spaced every 10 in.

2 . . . Carriage carrying an optical instrument, such as the jig transit or alignment telescope with optical square. This carriage traverses the instrument along the track.

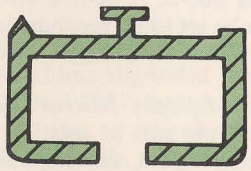
Instrument may be positioned over linear stations by sighting onto a precision 10-in. scale which is indexed to the drilled bushings of the index bar.

Plane of sight containing this station is then established perpendicular to an optical base or reference line which is separated from, but parallel to, the metrological bar itself. This perpendicularity is established by collimation or autocollimation to the base line telescope.

Track . . . The track is the carriage guide assembly along which the carriage traverses the instrument. The track also supports the index bar. The profile of the top section of the track consists of a 10 in. wide flat plate with a V-rail guide on one side, a raised flat rail on the other side, and a raised T-section down the center. The tracks are one-piece aluminum alloy extrusions and available in standard lengths of 10-, 15-, 20-, and 30-ft. continuous lengths. Sections can be joined to form metrological bars of any desired length. The K&E Metrological Bar System offers two track cross sections:



1. Flat Track, consisting of the top profile only. This track offers advantages over the box track in some instances. It can be mounted on different kinds of support beam members, such as I-beam, single and double channel, and tubing with channel welded on top. The track can also be mounted directly to any flat surface, such as a building floor or a ship deck, where overhead room is a problem. Since the flat track can be mounted on many different types of support members, no electrical wiring system is supplied.



2. Box Track, a one-piece aluminum alloy extrusion consisting of an integral support beam and track. It can be mounted directly on fixed support posts or on adjustable mobile support stands. The K&E box track is supplied with a 6-volt electrical wiring system complete with a 6-volt transformer and Hubbell twist lock outlet every 5 ft.

Flat Track	Box Track	Length
71 5600	71 5610	10 ft.
71 5601	71 5611	15 ft.
71 5602	71 5612	20 ft.
71 5603	71 5613	30 ft.

71 5620 Index Bar . . . This is a 1¼ in. x ½ in. rectangular jig-bored steel bar 10 ft. long. Jig-bored holes with highest grade 7/16-in.-diam. drilled bushings are located precisely at 10-in. intervals. The index bar is fastened to the top of the T-shaped center of the track with provisions for expansion and contraction. The end design is such that successive sections can easily be joined together.

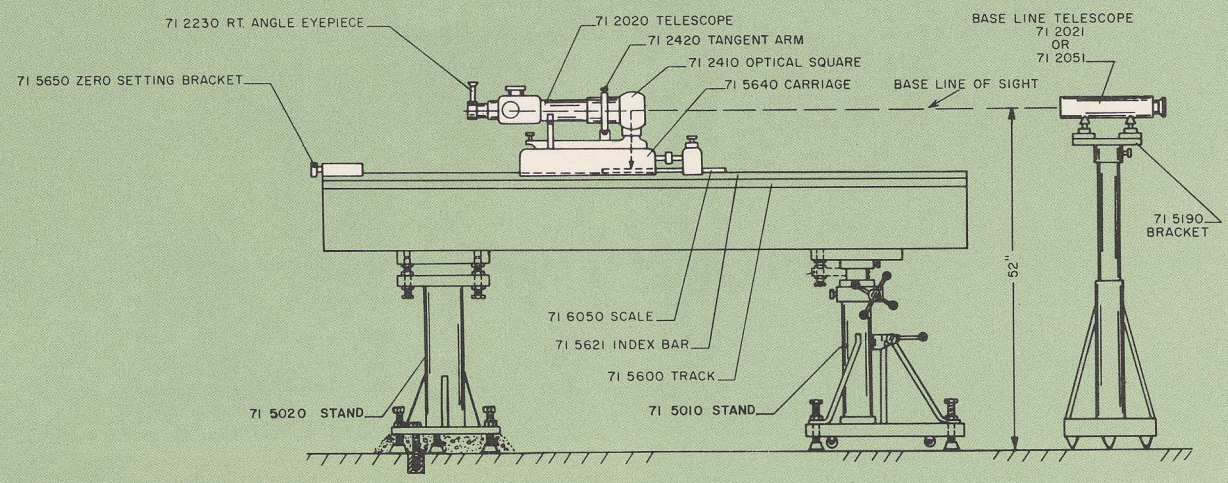
Other materials to match coefficients of expansion of parts being measured can be supplied on special order.

71 5621 Index Bar . . . Same as 71 5620 but 5 ft. long.

71 5650 Index Bar Zero Setting Bracket . . . The bracket is used to initially align the index bar with a fixed reference point or zero station of the working piece, if required. The bracket consists of a base casting with a "Push-Pull" type adjusting screw arrangement and an L-shaped lever arm. The bracket is clamped to the track on one end of the metrological bar and the L-shaped lever arm to the end of the index bar.

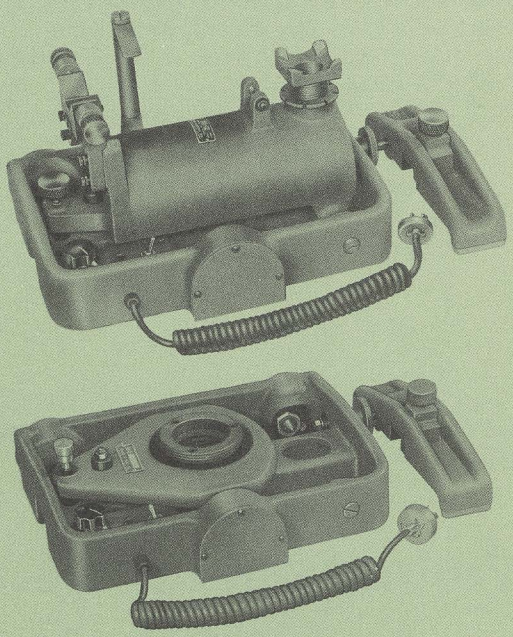
71 5655 Spacing Gauge . . . The gauge is used to join successive index bar sections. It is a rectangular steel bar provided with two dowel pins very precisely spaced 10 in. apart, which insures the proper spacing between the two holes on either side of the joint.

Horizontal Metrological Bar System using Alignment Telescope with Optical Square.



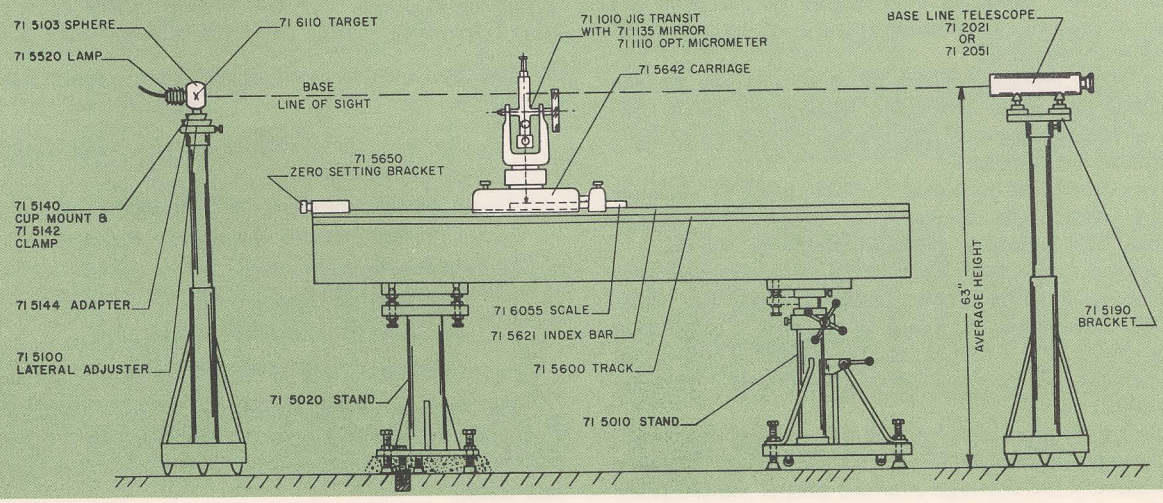
71 5640 Carriage for Alignment Telescope with Optical Square . . . The carriage consists of a base casting with an instrument tilting plate which straddles the metrological bar scale. The tilting plate pivots the instrument about the intersection of the line of sight and the top surface of the scale. The carriage rides on two V-type rollers and a plain roller. The V-type rollers are guided by the V-rail on one side and the plain roller rides on the raised flat rail on the other side of the track. A clamp bracket is provided to lock the unit quickly to the T-shaped center of the track. By means of a fine motion lead screw the carriage can be precisely adjusted and located over the desired station. The range of the fine adjustment is approximately ¾ in.

A 6-volt electrical system is built into the carriage to provide illumination for the metrological bar scale. A rheostat is used to give proper illumination for projection and auto-collimation. This is especially useful when the K&E combination projection, auto-collimation eye piece is attached to the telescope supported by the carriage.

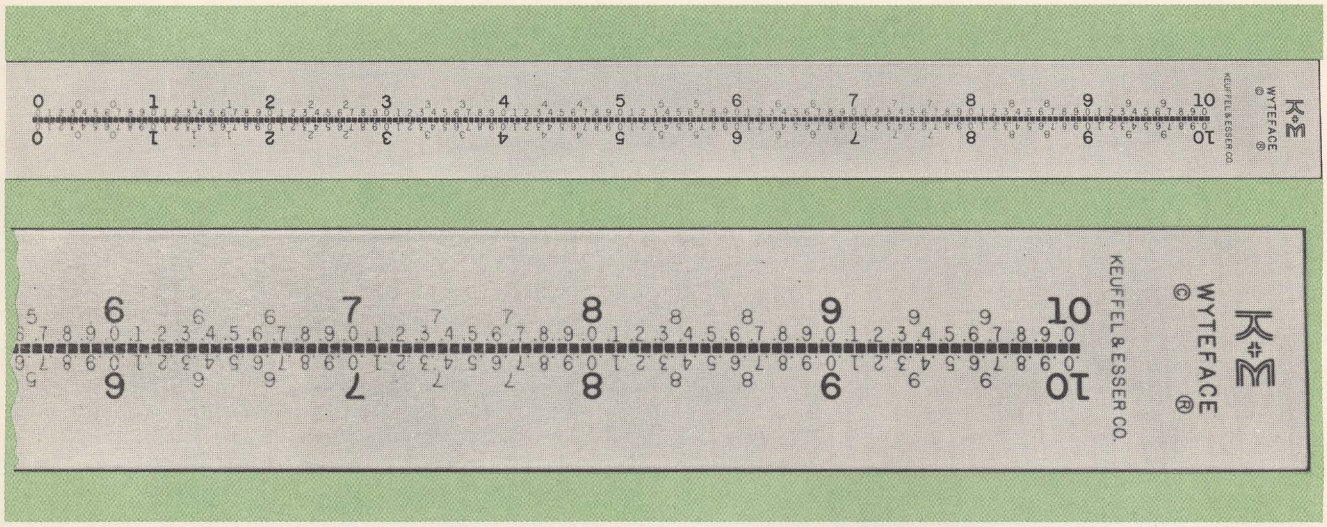


71 5642 Carriage for Jig Transit . . . Same as 71 5640 but with fittings to hold the Jig Transit 71 1010.

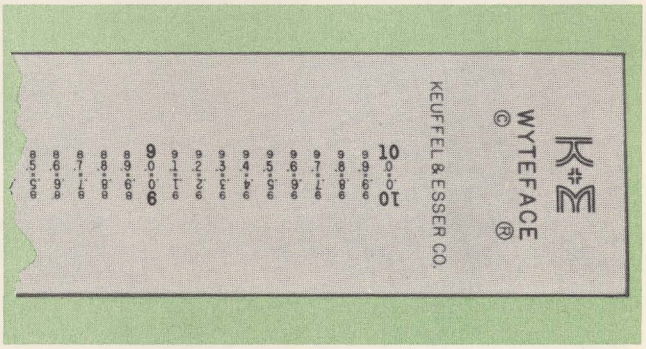
Horizontal Metrological Bar System using Jig Transit.



Optical Metrology



71 6050 WYTEFACE® Metrological Bar Scale for Alignment Telescope with Optical Square . . . WYTEFACE Metrological Bar Scale is made of tool steel with a white surface. The paired-line graduations are black to provide maximum contrast. The center of the space between each pair of lines represents .050 in. Each graduation is accurately located to within .001 in. (68° F) from the zero end of the scale. Two sets of numbers are provided so that the scale face reads from either side of the metrological bar. The scale has two dowel pins, spaced 10 in. apart; the zero graduation of the scale pattern is centered to the first pin.



71 6055 WYTEFACE Metrological Bar Scale for Jig Transit . . . Same as 71 6050 but center of the space between each pair of lines represents .100 in.

Vertical Metrological Bar System

The K&E vertical metrological bar makes it possible to measure vertical linear distances to a degree of precision not previously obtainable. The unique features of the K&E vertical metrological bar are:

The vertical station position is read optically on the metrological bar scale from the instrument itself. No mechanical linkage between instrument, carriage, and scale reading system is required.

The PARAGON® Tilting Level 71 3010, a highly accurate tilting level specifically designed for use on the vertical metrological bar, is used to establish horizontal planes.

The optical micrometer attached to the instrument provides means for making precise readings. When the tilting plate in the micrometer is tilted by turning a graduated drum, the line of sight is moved parallel to itself. The amount of displacement can be read directly to .001 in. and estimated to .0001 in.

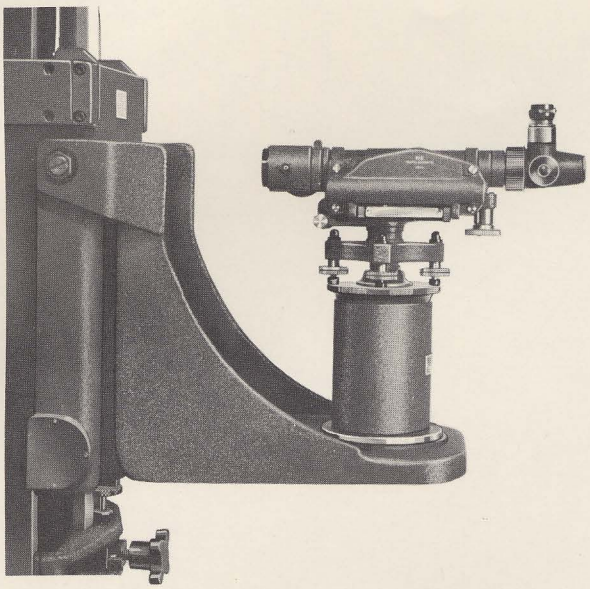
The design features built into the K&E vertical metrological bar carriage assure fast and easy station settings. No time is lost in moving the carriage over the proper station point while at the same time trying to maintain the instrument in a horizontal plane. The K&E system incorporates two distinct operations, neither of which influences the other.

The K&E vertical metrological bar is furnished complete with:

1 . . . Tribrach base with retractable casters and leveling screws
2 . . . Vertical box track with circular level vial
3 . . . Counterbalanced carriage
4 . . . Master index bar
5 . . . Zero setting bracket
6 . . . WYTEFACE® metrological bar scale
7 . . . Extension piece (used with tilting level only)

The vertical metrological bar is also equipped with a 6-volt electrical wiring system complete with a 6-volt transformer, 12 feet of cord and Hubbel twist lock outlets on the box track.





71 5670 Vertical Metrological Bar System . . . Complete system, length 10 ft.

71 5675 Vertical Metrological Bar System . . . Complete system, length 15 ft.

71 5625 Index Bar . . . The master index bar for the vertical metrological bar is essentially the same as the one for the horizontal metrological bar. In addition, Alnico magnets are provided to hold the metrological bar scale to the index bar. Length 10 ft.

71 5626 Index Bar . . . Same as 71 5625 but 5 ft. long.

71 5646 Carriage . . . The carriage for the vertical metrological bar consists of a base casting, a tilting bracket, and a clamp bracket.

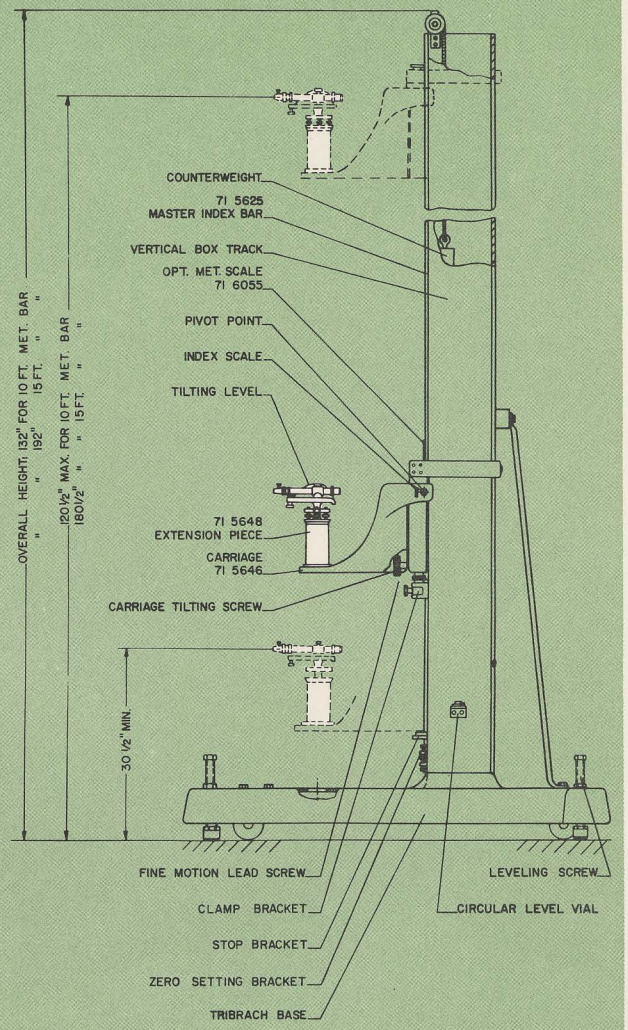
The carriage is counterbalanced with a weight suspended from two steel cables. The base casting rides on two V-type rollers and a plain roller on a standard metrological bar track. It is held to the track by spring loaded braces to assure firm contact with the V-type rails.

The tilting bracket which straddles the metrological bar scale is pivoted about an axis that intersects the top surface of the metrological bar scale. A glass index scale mounted on top of the base bracket is permanently lined up with this pivot axis. Therefore, when the sight level is aimed at the glass index scale, the line of sight intersects the tilting bracket pivot axis. This means that the subsequent leveling accomplished by tilting the bracket about the pivot axis does not disturb the scale setting.

A clamp bracket is provided to lock the carriage quickly to the T-shaped center rail of the track. By means of a fine motion lead screw, the carriage can be precisely located over the desired station point.

A 6-volt electrical system is built into the carriage to provide illumination for the metrological bar scale. A rheostat gives proper illumination for projecting and auto-collimating when the K&E combination auto-collimation projection eyepiece is attached to the telescope.

Vertical Metrological Bar System.



71 5648 Extension Piece . . . The extension piece is used on the carriage in conjunction with the PARAGON® Tilting Level 71 3010 in order to bring the line of sight of the level to the height of the pivot point axis. With the K&E Jig Transit 71 1010 on the vertical metrological bar this extension piece is not needed.

71 5660 Vertical Box Track . . . The track is the carriage guide along which the carriage traverses the instrument. It also supports the index bar. The track is a one-piece aluminum extrusion consisting of an integral support beam and track and is mounted on the Tribrach base which has retractable casters and leveling screws. The track comes with a circular level vial for accurate setting. Length 10 ft.

71 5665 Vertical Box Track . . . Same as 71 5660 but length is 15 ft.

K+E CATALOG 9

OPTICAL METROLOGY

price list

EFFECTIVE AUGUST 27, 1962

SPECIAL NOTICE

General Notice . . . Many items in this Price List are identified by Keuffel & Esser Co. Trade Marks . . . Items sold by Keuffel & Esser Co. are subject to discontinuance and price change without notice. All orders are subject to acceptance at the Company's Office in Hoboken, N. J. or a Keuffel & Esser Branch. Title passes to the buyer upon delivery of goods to the Carrier.

Ownership of Goods in Transit . . . The Consignor's responsibility for delivery or damage of goods ceases when title passes to the Consignee, and, therefore, Consignor's responsibility ceases as soon as the goods are delivered to the Carrier. Thereafter, responsibility for non-delivery, damage, and payment for goods resides in the Consignee . . . Claims against the Carrier must be made by the Consignee within time limits specified by the Carrier. The fact that notice has been given to the Carrier that the goods have not been delivered and that a request has been made to trace them, does not serve to extend the period within which claims for damage or loss may be made. When requested, we will furnish the necessary documents for making these claims. Shipments will be made without declaration of value unless Customer requests otherwise. Parcel Post shipments are insured for invoice price only, unless Customer requests otherwise. The Customer will be charged for the cost of any insurance. All prices are FOB shipping point unless other terms are specifically agreed upon.

Limits of Liability . . . Keuffel & Esser Co. maintains the highest standards in the manufacture of its goods, and any goods found to be defective in material or workmanship will be repaired or, at our option, replaced, for the original purchase within ninety (90) days after original purchase. No other warranty or guarantee, express or implied, shall be applicable to these goods. Since the usage to which the goods may be put is beyond the control of Keuffel & Esser Co., we assume no responsibility for any inconvenience, loss, or direct or consequential damage, arising from the possession or use of the goods.

K+E

KEUFFEL & ESSER CO. NEW YORK • HOBOKEN, N.J.

PHILADELPHIA • DETROIT • CHICAGO • MILWAUKEE • ST. LOUIS • DALLAS • DENVER

SAN FRANCISCO • LOS ANGELES • SEATTLE • ANCHORAGE • TORONTO • MONTREAL

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CONSUMER PRICES – OPTICAL METROLOGY

- This Price List relates to shipments from Hoboken, N. J. and all K&E Branches in U. S. A., except Alaska. For South East Alaska, prices are F.O.B. Seattle, Washington—for our Branch in Anchorage, add 10% to prices shown.
- Quantity prices are available where applicable.
- Products are listed numerically by new product number.
- When ordering, be sure to specify quantity, *New* product number, size and other information that may be needed to complete the description of the product.
- Old to New Product Number listing follows this price list.

JIG TRANSITS & ACCESSORIES

	Each
71 1001	$550.00
71 1010	975.00
71 1101	175.00
71 1110	180.00
71 1121	220.00
71 1130	90.00
71 1135	160.00
71 1140	50.00
71 1141	50.00
71 1145	110.00
71 1211	75.00
71 1230	230.00
71 1240	290.00
71 1260	21.00
71 1290	60.00

ALIGNMENT TELESCOPES

71 2010	1350.00
71 2011	1400.00
71 2012	1450.00
71 2020	1750.00
71 2021	1800.00
71 2022	1850.00

LINE OF SIGHT TELESCOPES

71 2050	600.00
71 2051	675.00
71 2052	725.00

TELESCOPE ACCESSORIES

71 2220	150.00
71 2230	230.00
71 2240	290.00
*71 2302	185.00
71 2310	35.00
71 2315	50.00
*71 2321	190.00
71 2390	50.00
71 2410	980.00
71 2412	1350.00
71 2420	97.00
71 2425	250.00
72 2430	1350.00

TILTING LEVELS

71 3001	500.00
71 3005	$800.00
71 3010	575.00
71 3015	875.00
71 3101	180.00
71 3105	175.00
71 3106	15.00
71 3108	7.00
71 3140	50.00

LEVELS

71 3201	33.00
71 3205	30.00
71 3210	400.00
71 3215	140.00
71 3220	225.00
71 3230	275.00
71 3250	100.00
71 3255	150.00
71 3260	17.00
71 3270	31.00
71 3280	225.00

COLLIMATORS

71 4010	500.00
71 4030	1250.00
71 4111	300.00

INSTRUMENT STANDS

71 5005	24.00
‡71 5010	490.00
‡71 5020	490.00
‡71 5050	40.00
71 5070	40.00
71 5080	75.00

BRACKET & SUPPORT EQUIPMENT

71 5100	110.00
71 5101	10.00
71 5102	12.00
71 5103	40.00
71 5140	15.00
71 5142	15.00
71 5144	15.00
71 5146	10.00
71 5150	675.00
*71 5160	2200.00
71 5170	200.00
71 5175	30.00
71 5180	375.00
71 5182	90.00

	Each
71 5184	$100.00
71 5186	220.00
71 5188	55.00
71 5190	250.00
71 5192	90.00
71 5194	100.00
71 5196	70.00
71 5201	90.00
71 5204	110.00
71 5208	145.00
71 5210	580.00
71 5220	610.00
71 5225	350.00

ILLUMINATION UNITS

71 5510	35.00
71 5511	50.00
71 5520	50.00
71 5525	10.00
71 5530	75.00
71 5535	40.00

METROLOGICAL BAR SYSTEMS

‡71 5600	200.00
‡71 5601	300.00
‡71 5602	400.00
‡71 5603	600.00
‡71 5610	360.00
‡71 5611	495.00
‡71 5612	600.00
‡71 5613	840.00
‡71 5620	300.00
‡71 5621	105.00
‡71 5625	360.00
‡71 5626	190.00
71 5640	400.00
71 5642	400.00
71 5646	750.00
71 5648	40.00
71 5650	45.00
71 5655	85.00
71 5660	700.00
71 5665	950.00
71 5670	2500.00
71 5675	2750.00

SCALES & TAPES

71 6003	36.00
71 6010	42.00

	Each
71 6012	$ 66.00
71 6020	48.00
71 6022	78.00
71 6040	66.00
71 6042	114.00
71 6050	70.00
71 6055	70.00
71 6060	25.00
71 6065	19.00
71 6080	90.00
71 6090	Special
*71 6092	235.00
*71 6094	330.00
*71 6096	525.00

TARGETS & MIRRORS

71 6110	50.00
71 6120	30.00
71 6125	25.00
71 6130	25.00
71 6140	2.00
71 6150	40.00
71 6160	15.00

	Per 100
71 6165	25.00

	Each
71 6170	50.00
71 6175	60.00
71 6202	75.00
71 6204	90.00
71 6230	600.00
71 6240	400.00
71 6245	1350.00
71 6250	65.00

TARGET HOLDING EQUIPMENT

71 6410	450.00
71 6415	58.00
71 6420	150.00
71 6425	20.00
71 6428	21.00
71 6440	150.00
71 6450	340.00
71 6455	100.00

COLLIMATOR TEST STAND

*‡71 7010	3900.00
71 7020	550.00

*To order only

‡F.O.B. Hoboken, N. J.

PRDOUCT NUMBERS

OLD TO NEW

For your convenience, *Old* product numbers are listed in numerical order, followed by the *New* product number. If an Old product number is not listed, the item has been discontinued.

When ordering, use the New Product Number

OLD	NEW
9092-1	71 1001
9092-1A	71 1010
AR9092-2A	71 2302
C9092-2	71 2021
CN9092-2	71 2022
9092-2	71 2020
CN9092-2B	71 2012
C9092-2B	71 2011
9092-2B	71 2010
9092-2V	71 2310
9092-3	71 3001
9092-3A	71 3010
9092-4	71 4010
9092-4½	71 4111
9092-5	71 3105
9092-5A	71 3106
N9092-7	71 3101
9092-9	71 1101
9092-9A	71 1110
9092-11	71 5520
9092-11A	71 5525
9092-11B	71 5510
9092-11C	71 5530
9092-11H	71 5535
9092-11R	71 5511
N9092-12	71 2230
9092-12	71 2220
9092-12A	71 1230
9092-13	71 6230
9092-14	71 2410
9092-14B	71 2412
9092-14L	71 2425
9092-14T	71 2420
9092-15	71 2430
9092-16	71 5160
9092-20	71 5020
9092-20A	71 5005
9092-20E	71 5050
9092-20½	71 5010
9092-21	71 7010
9092-22	71 3005
9092-22A	71 3015
9092-30	71 4030
9092-49LG	71 2390
9092-49MG	71 1290
CN9092-53A	71 2052
C9092-53A	71 2051
9092-53A	71 2050
9099-8	71 3108
9099-11A	71 1130
9099-11RA	71 1135
9099-13B	71 3210
9099-13C	71 3215
9099-13D	71 3201
9099-13E	71 3230
9099-13F	71 3205
9099-13G	71 3270
9099-13H	71 3280
9099-13J	71 3250
9099-13JR	71 3255
9099-13K	71 3260
9099-13M	71 3220
9099-15	71 2315
9099-16	71 1141
9099-16A	71 1140
9099-16B	71 1145
9099-17	71 3140
9099-20A	71 1211
9099-21D	71 2240
9099-21C	71 1240
9099-21R	71 2321
9099-21RA	71 1121
N9099-28	71 6003
N9099-30	71 6010
N9099-32	71 6020
N9099-34	71 6040
9099-35	71 6060
9099-36	71 6065
9099-37	71 6080
9099-39	71 6090
9099-39-240	71 6092
9099-39-600	71 6094
9099-39-1200	71 6096
9099-40	71 6110
9099-40AD	71 6130
9099-40S	71 6140
9099-40U	71 6120
9099-40½U	71 6125
9099-41	71 6150
9099-42	71 6170
9099-42V	71 6175
9099-43P	71 6160
9099-43S	71 6165
9099-46A	71 1260
9099-50	71 5100
9099-51	71 5101
9099-52	71 5102
9099-53	71 5103
9099-54	71 5140
9099-54A	71 5144
9099-54½	71 5142
9099-56A	71 5210
9099-56B	71 5220
9099-56C	71 5225
9099-57	71 5170
9099-57½	71 5175
9099-58	71 5180
9099-58A	71 5188
9099-58B	71 5182
9099-58C	71 5186
9099-58G	71 5146
9099-58S	71 5184
9099-59-10P	71 5201
9099-59-14P	71 5204
9099-59-18P	71 5208
9099-59B	71 5192
9099-59C	71 5196
9099-59S	71 5194
9099-61-2	71 6202
9099-61-4	71 6204
9099-64	71 6240
9099-64B	71 6245
9099-65	71 6250
9099-70	71 5070
N9099-71	71 5080
9099-72	71 5150
9099-80	71 6410
9099-80R	71 6415
9099-81	71 6450
9099-81M	71 6455
9099-83	71 6420
9099-83A	71 6428
9099-83R	71 6425
N9099-86-30	71 6012
N9099-86-32	71 6022
N9099-86-34	71 6042
9099-86	71 6440
9099-87R	71 7020
9099-100BT — 10 ft.	71 5610
9099-100BT — 15 ft.	71 5611
9099-100BT — 20 ft.	71 5612
9099-100BT — 30 ft.	71 5613
9099-100FT — 10 ft.	71 5600
9099-100FT — 15 ft.	71 5601
9099-100FT — 20 ft.	71 5602
9099-100FT — 30 ft.	71 5603
9099-101-5 — 5 ft.	71 5621
9099-101 — 10 ft.	71 5620
9099-101V — 5 ft.	71 5626
9099-101V — 10 ft.	71 5625
9099-102	71 5650
9099-103	71 6050
9099-103A	71 6055
9099-104	71 5640
9099-104A	71 5642
9099-104E	71 5648
9099-104V	71 5646
9099-105	71 5655
9099-106 — 10 ft.	71 5660
9099-106 — 15 ft.	71 5665
9099-115	71 5190



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OPTICAL METROLOGY
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