

Digital Electronic

BENCHMARK GAUGES

For Effective Hot Alignment
of Turbomachinery



ACCULIGN, INC.

PLEASE NOTE OUR NEW ADDRESS

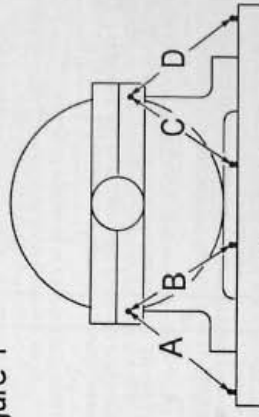
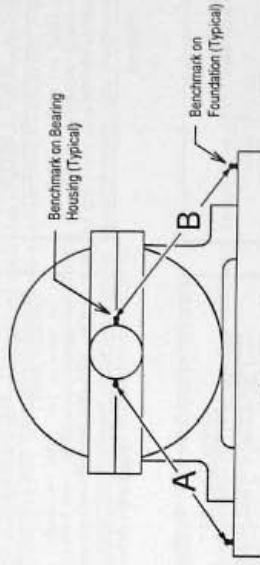
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ON-LINE MONITORING OF COUPLING ALIGNMENT

PROPER ALIGNMENT OF TURBOMACHINERY HAS LONG BEEN RECOGNIZED AS A PREREQUISITE TO SAFE, TROUBLE-FREE OPERATION. BENCHMARK GAUGES PROVIDE A SIMPLE, RELIABLE, AND EFFECTIVE MEANS OF OBTAINING ON-LINE DATA FOR MONITORING COUPLING ALIGNMENT.

Benchmark gauges offer a simple, reliable, and effective means of securing hot alignment data for turbomachinery trains by accurately measuring the movement of the machines relative to the machine foundation. With the Acculign system, benchmarks are permanently attached to the foundation and to the machines at or near each bearing location. When the machines are aligned in the cold condition, benchmark gauges are used to measure the distance between pairs of benchmarks. These measurements are recorded, as are the angles at which the measurements are taken. When the machines are brought on line and attain normal operating temperature, the distances between benchmark pairs are again measured and recorded. Vertical and horizontal movements of the machines can then be calculated from the recorded data, as can actual running alignment of the equipment. A PC program is provided for these calculations.



Where bearing housings are readily-accessible, benchmarks are typically placed as shown in Figure 1. Where bearing housings are not readily-accessible, benchmarks may be placed as shown in Figure 2. In either case, all benchmarks at a given bearing location lie in a plane normal to the shaft centerline.

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PARTIAL LIST OF USERS OF ACCULIGN EQUIPMENT

A-C Compressor Corp.	Cooper Energy Services	Dresser-Rand	Rubicon
Air Products & Chemicals	Con Edison of New York	Jacksonville Electric	Ruston Gas Turbines
Alberta Natural Gas	Cummins Engine Co.	Kawasaki Heavy Ind.	San Diego Gas & Electric
ALCOA	David Brown Pumps	Lagoven, SA	Santa Fe Pacific PL
American Cyanamid	Delaval Canada	Los Angeles County	Seminole Pipelines
Amoco Chemicals	Detroit Edison	Lubrizon Corporation	Shell Oil
Amoco Oil	Delta Refining	Lufkin Industries	Shell Chemical
Aramco Services	Diamond Shamrock	Lyondell Petroleum	Shell E&P
ARCO Alaska	Dow Chemical	Mannesmann-DeMag	Shell Pipeline
ARCO Chemical	Dow Chemical Canada	M.A.N./GHH	Siemens Energy Corp.
ARCO Polymers	Delaval Stork	Mather & Platt Ltd.	Siemens-Allis
ASEA	Dresser Pump Division	Mid-America Pipeline	Solar Turbines
Atlantic Richfield	Dresser-Rand	Mitsubishi Heavy Ind.	Sohto Alaska Petroleum
Atlas Powder	Dresser-Rand Canada	Mobil Chemical Co.	Sohio Chemicals
Baltimore Gas & Electric	E. I. DuPont	Mobil Oil	So. Carolina Elec & Gas
Bechtel International	Elliott Company	Monsanto	So. California Edison
Bechtel Construction	Elliott Turbomachinery	National Almirante	Star Enterprises
Bechtel Canada	Esso Resources Canada	New Brunswick Electric	Stewart & Stevenson
Bingham International	Esso Petroleum Limited	New Zealand Refining	Sulzer Bingham Pumps
Borg-Warner AC	Exxon Chemical USA	Northern Natural Gas	Sulzer Pumps Ltd.
Bp Chemicals	Florida Power & Light	Northeast Chemicals	Sun Refining & Marketing
Brown & Root	Frick Corporation	Northeast Utilities	Syncrude Canada
BWIP International	General Electric	Panhandle Eastern	Tenneco
Byron-Jackson	General Electric Canada	Petroperu S.A.	Texaco
Carrier Corporation	Georgia Pacific	Philadelphia Gear	Texaco Canada
Celanese Chemical	Goulds Pumps	Phillips Petroleum	Toshiba International
Celanese Canada	Gulf Canada Limited	Phillips Petroleum	Trunkline Gas
C. F. Braun	Hoechst Celanese	Public Svc of N.H.	Turbodyne
Chevron, U.S.A.	Huntsman Chemical Co.	PPG Industries	Union Carbide Linde
Citgo Petroleum	Hydro Agri Trinidad	Qatar Fertilizer	Union Pump Canada
C-H (Canada)	ICI Americas	Quantum Chemical Corp.	Weir Pumps
Columbia Gulf Trans.	IMO-Deival	Rayonier Canada	Westech Gear
Columbia Nitrogen	Imperial Oil Enterprises	Rohm & Haas	Westinghouse Canada
Connecticut L&P	Ingersoll-Dresser Pumps	Rotoflow Corporation	Westinghouse Electric
Consumers Power	Iowa Electric Company		Yemen E&P
Coppus/Murray			York International

GENERAL PROCEDURE

Permanently attach benchmarks to the equipment and to the foundation at or near each bearing location. Recommendations for placement of benchmarks are furnished with benchmark gauge sets. After installing the benchmarks, align the equipment in the normal manner and record final alignment readings. Using the benchmark gauge, measure and record the distance between each pair of benchmarks (A and B in Fig. 1 on Page 1, or A, B, C, and D in Fig. 2). Also measure and record the angles at which the readings are taken. Angles are measured using the inclinometer furnished with the benchmark gauge set.

When the equipment is brought on line and reaches normal operating temperature, again take and record benchmark gauge readings at each location. Any movement of the machines from the initial (cold) to the final (hot) condition will be reflected in changes of benchmark gauge readings. By using PC programs furnished with each benchmark gauge set, the following information can be obtained without stopping the equipment for a "hot check":

- Vertical and horizontal movements at each benchmark location (Fig. 3 or 4 on facing page).
- Alignment of the machines in the running condition (Fig. 5 or 6 on the facing page).
- Shim changes and horizontal movements required to improve alignment, if desired (Fig. 5 or 6).

Sketches for required calculations are provided as reusable plastic laminates. PC programs for these calculations are furnished on a 3-1/2" floppy diskette which may be used with any IBM (or compatible) PC using an MS-DOS operating system. Machine movements can also be determined graphically, if desired.

Photographs of typical benchmark gauge installations are shown on Pages 4 and 5 of this brochure. Photograph 6 shows the inclinometer being used to determine the angle at which the measurements are taken, in determining axial deflection of diaphragm-type couplings.

ADVANTAGES OF THE ACCULIGN SYSTEM

Since their introduction in 1971, Acculign benchmark gauges have gained wide acceptance by industrial users by offering the following advantages:

- The technique is simple, reliable, easily-understood, and requires no special technical skills.
- Vertical and horizontal movements of the machines are obtained with equal ease.
- The stainless steel benchmarks are permanent and easily maintainable for long-term monitoring. Once the benchmarks are mounted, setup time for hot checks, or re-checks, is minimal.
- Data-taking is a one-man operation.
- The tools are simple, reliable, and require minimal calibration.
- Since benchmarks are easily mounted by field personnel, the system is equally applicable to existing equipment and to new installations. Factory or shop modifications to equipment are not required.
- The method is adaptable to cramped quarters. There is sufficient flexibility in the choice of benchmark locations such that interference with piping, instrumentation, or other equipment is seldom a major problem.
- Easily-used PC programs make data reduction quick, simple, and accurate.
- Benchmark gauges are by far the most cost-effective means of obtaining reliable hot alignment data.

An additional advantage of the Acculign system is the ability to reverse the normal procedure to obtain alignment data for equipment already in operation. Benchmarks can be applied to a machine while it is in operation (using proper safety precautions, of course), and reference measurements taken and recorded. Then when the machine is taken off line, another set of measurements are taken, along with simultaneous coupling alignment checks. From this data, it can be determined whether or not alignment corrections need to be made. A specific shutdown for alignment checks is often eliminated by this procedure.

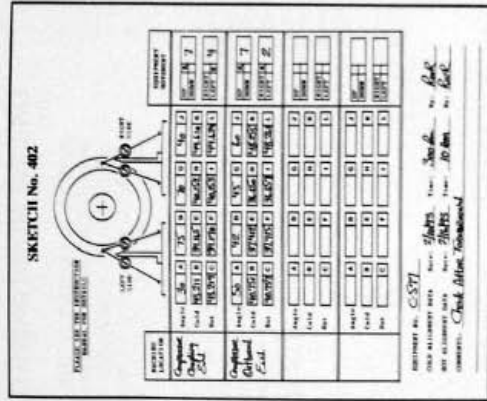


Figure 4

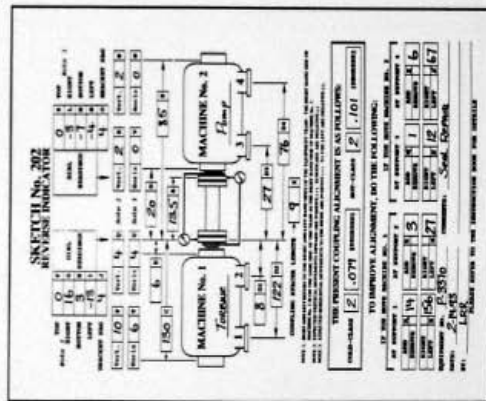


Figure 6

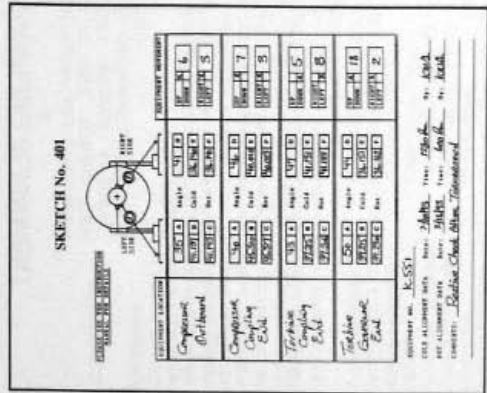


Figure 3

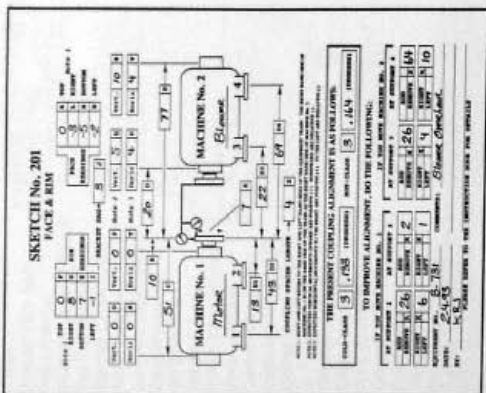
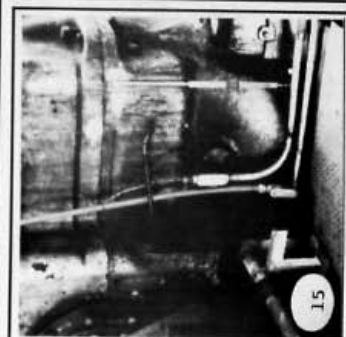
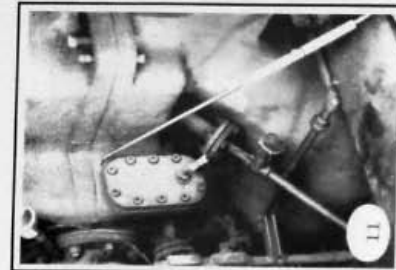
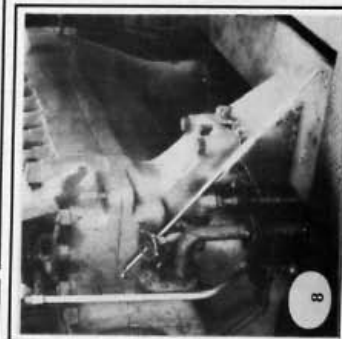
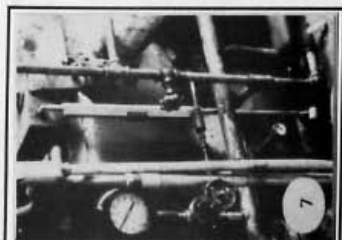
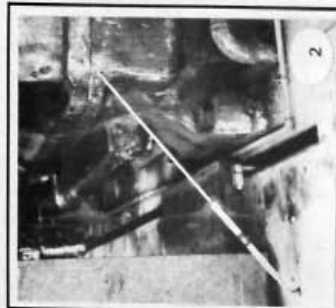
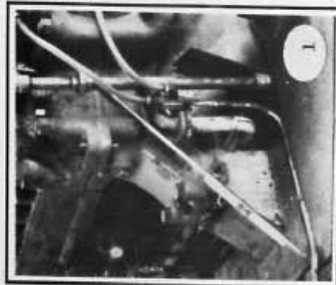
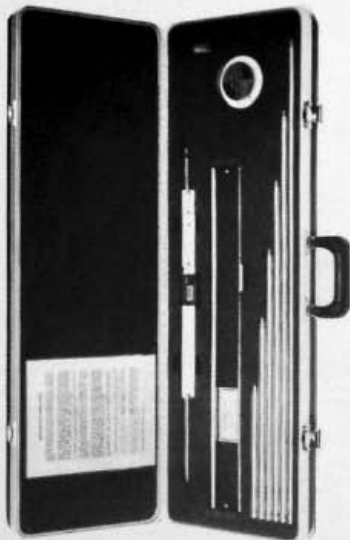


Figure 5





ITEM 1 -- BASIC BENCHMARK GAUGE SET (ITEM 1M FOR METRIC UNITS)

Benchmark gauges are specifically designed for conducting on-line checks of turbomachinery alignment. The basic benchmark gauge set consists of a telescoping column with an electronic digital readout, six extensions, a 25" (625mm) standard, and an inclinometer. The digital readout uses a single 1.5 volt size SR44 battery (type and size commonly used in electronic calculators and cameras). Expected battery life is 2 years. A spare battery is furnished.

The benchmark gauge itself is spring-loaded with spherical seats at either end to match the spherical benchmarks that are mounted on the equipment. The gauge is self-supporting when placed between pairs of benchmarks. The range of the benchmark gauge, without extensions, is 25" to 30" (625mm to 750mm).

The six extensions give the tool a total range of 25" to 60" (625mm to 1500mm) in increments of 0.001" (0.01mm). The standard and the extensions are constructed of Invar. The low coefficient of thermal expansion of this material greatly reduces measurement errors resulting from thermal expansion of the tool itself. The standard and the extensions are manufactured to an overall accuracy of 0.001" (0.025mm) in length.

Exposed portions of the tool, including spherical seats, are stainless steel. The gauge set is packaged in a durable ABS plastic case. Overall dimensions 38" x 14" x 5" (965mm x 355mm x 127mm), weight 28 pounds (13kg).

ITEM 2 -- EXTENSION SET (ITEM 2M FOR METRIC UNITS)

Set of 4 extensions for Item 1 covering a measurement range of 60" to 80" (1500mm to 2000mm). Furnished in a tubular plastic case. 16 pounds (7 kg).

ITEM 3 -- EXTENSION SET (ITEM 3M FOR METRIC UNITS)

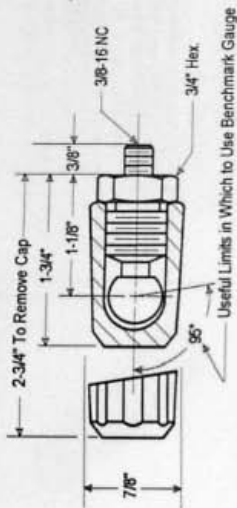
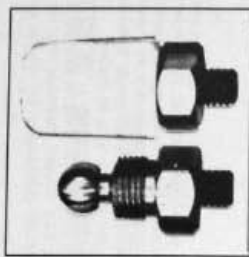
Set of 4 extensions for Item 1 covering a measurement range of 80" to 100" (2000mm to 2500mm). Furnished in a tubular plastic case. 20 pounds (9 kg).

ITEM 5 -- SHORT RANGE BENCHMARK GAUGE SET (ITEM 5M FOR METRIC UNITS)

For conducting hot alignment checks on smaller equipment. Same construction as Item 1, but with a reduced measurement range. The range of the benchmark gauge is 13" to 16" (325mm to 400mm). The six extensions give the tool a total range of 13" to 34" (325mm to 850mm). Case dimensions 24" x 14" x 5" (610mm x 355mm x 127mm). 20 pounds (9 kg).

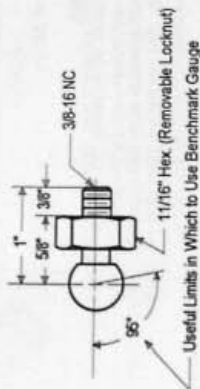
ITEM 6 -- EXTENSION SET (ITEM 6M FOR METRIC UNITS)

Set of 6 extensions for Item 5 covering a measurement range of 34" to 52" (850mm to 1300mm). Furnished in a tubular plastic case. 20 pounds (9 kg).



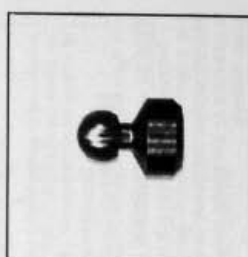
ITEM 10 -- COVERED BENCHMARK

This covered benchmark is recommended for general turbomachinery work. It is of one-piece construction of type 18-8 stainless steel. It is furnished with a 3/8-16 NC carbon steel stud for mounting directly into a tapped hole. Alternatively, the stud may be removed for mounting directly on a 3/8-16 NC male thread, or the base of the benchmark may be welded directly to the equipment. If threaded fasteners are used, it is recommended that the assembly be epoxied in place to avoid inadvertent movement. The protective cover is made of molded Delrin® plastic, which offers good mechanical properties and excellent corrosion resistance. To mount this benchmark in concrete, use Item 20 (Page 8). Properly mounted, this protected, stainless steel benchmark affords alignment reference for the life of the equipment.



ITEM 13 -- THREADED BENCHMARK

This simple benchmark is useful for a wide range of non-critical applications which do not require the long term protection afforded with Item 10. It is of one-piece construction of 18-8 stainless steel, and is screwed into a lapped hole and secured with a locknut. The stainless steel locknut is furnished.



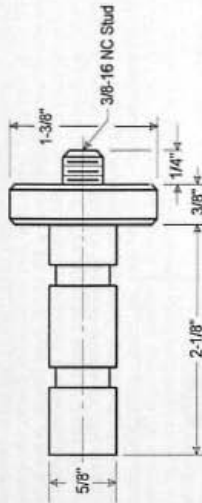
ITEM 14 -- WELD-ON BENCHMARK

Similar to Item 13, but with a flat, non-threaded base. Weld directly to the equipment. Same 95° useful limits as other benchmarks. Base is 3/4" diameter. Base to centerline of the ball is 3/4".



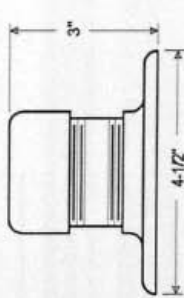
ITEM 15 -- MASONRY BENCHMARK

Similar to item 13, but with a 9/16" diameter base which can be epoxied directly into a 5/8" diameter by 1-1/4" deep hole. Especially useful for non-critical applications requiring placement of benchmarks in concrete. One-piece construction of Type 18-8 stainless steel. Same 95° useful limits as other benchmarks. Dimension from base to centerline of ball is 1-3/4".



ITEM 20 -- BENCHMARK MOUNT

This item provides an excellent means of mounting the covered benchmark (item 10) to concrete or masonry structures or foundations. The unit includes a concrete anchor, 3/8-16 NC stud, and a heavy mounting washer. This mount is installed in a 5/8" diameter by 2-1/4" deep hole. Epoxy cement may be applied at assembly to enhance mechanical integrity. The benchmark (item 10) is not included.



Mounts with Four Concrete Anchors (Furnished). Dimensions are Approximate.

ITEM 21 -- BENCHMARK PROTECTOR

Recommended for use with items 10 and 20 where placement of the benchmark must be in a location where it is subject to mechanical damage. It is made of galvanized pipe fittings, and comes complete with four concrete anchors and screws for mounting. Anchors require holes 1/2" diameter by 1-1/4" deep. The benchmark is accessible by unscrewing the cap and pipe nipple. The floor flange need not be removed to take benchmark gauge readings.

ITEM 32 -- ACCESSORY KIT

This accessory kit provides an assortment of essential items for placing benchmarks on almost any turbomachinery train. It was developed specifically to fit the needs of field service personnel who use benchmark gauges at various locations. It is equally useful as a starter kit for first-time users of benchmark gauges. The assortment is packaged in a steel tool box, and contains the following items:

ITEM	DESCRIPTION	NUMBER OF PIECES
10	Covered Benchmark	72
20	Benchmark Mounts	20
40	5/16" Drills	4
41	3/8-16 NC Plug Taps	4
42	3/8-16 NC Bottoming Taps	4
43	Tap T-Handle	2
44	5/8" Masonry Drills	2

Kits containing various combinations of accessories can be furnished upon request. Price of the kit is dependent upon the contents.

ITEM 40 -- 5/16" High Speed Drill (Tap drill for 3/8-16 NC taps)

ITEM 41 -- 3/8-16 NC Plug Tap (For mounting benchmarks)

ITEM 42 -- 3/8-16 NC Bottoming Tap (For mounting benchmarks)

ITEM 43 -- T-Handle for 3/8-16 NC Tap

ITEM 44 -- 5/8" Carbide-Tipped Masonry Drill (For mounting items 15 and 20)

ITEM 45 -- 1/2" Carbide-Tipped Masonry Drill (For mounting item 21)

IMPORTANT NOTICE TO PURCHASER

Acculign products carry a limited warranty for a period of one year from date of purchase. Warranties do not apply to products that have been damaged by accident or misuse, or as a result of service or modifications other than through Acculign, Inc. In all cases, packaging, shipping, and reimportation arrangements and charges are the responsibility of, and to the account of the user.

Products are sold on the basis of specifications applicable at the time of manufacture, and there is no obligation to update products once sold. Products out of warranty will be serviced on a line and materials basis.

Seller's and manufacturer's only obligation shall be to replace such quantity of the product proved to be defective. Neither seller nor manufacturer shall be liable for any injury, loss, or damage, direct or consequential, arising out of the use of or inability to use the product. Before using, the user shall determine the suitability of the product for his intended use and user assumes all risk of liability whatsoever in connection therewith.

Due to the rapidly-changing nature of the electronics industry, no warranties or claims are made as to the length of time for which any electronic product or component can be obtained, serviced, or repaired.

The foregoing may not be altered except by an arrangement signed by officers of seller and manufacturer.

THANK YOU FOR CONSIDERING ACCULIGN PRODUCTS