Laser Tracker Measurement Technology for the Alignment, Correction, Condition Monitoring, and Refurbishment of Extrusion Presses

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ABSTRACT – Previously published methods of extrusion press alignment made use of traditional mechanics' tools such as precision levels, piano wire, micrometers, and various jigs and fixtures. Alignments were not made with the press under load, nor at operating temperature. More modern methods of measurement are desirable in order to improve accuracy and to take readings under actual operating conditions. Advances with surveying instruments began by using triangulation (intersection) with digital theodolites systems. In this paper, the latest methods using 3D Laser Tracking technology are presented. Additional benefits of this system have been identified, including: improved profile tolerances; significant production improvements; dummy block wear significantly reduced and total failures eliminated; longer container liner service life; noticeably less wear to ram and container guide-way bronze wear strips; and stem replacements minimized. Some observations are made regarding press establishment, press benchmarking, and the combined tolerances and error propagation effects for press frame alignment.

Background: Traditional Alignment Methods and Tools

Press alignment is important for smooth mechanical operation and avoidance of wear to press tooling and components. Improper alignment also affects the flow characteristics of aluminum through the ports of extrusion dies.

Traditionally, extrusion press alignment has been performed by use of mechanical tools and devices such as piano wire, precision levels, micrometers, and special jigs and fixtures. [1] Alignments are necessarily performed with the press static and cold, not at full load or typical operating temperatures. Also, today it is not easy to find mechanics with the skills to perform precision mechanical alignments.

For many press operations, alignments using these methods and tools and under these conditions are adequate for the operations and products involved. However, extruders who require greater precision (to achieve higher-grade quality product or during critical press upgrade/refurbishment), and who wish to maximize the life of press components and tooling are often in search of alignment methods that use the latest measurement technology available today.

Early Alignment with Technology:
Brief Review of Measurement Technology Using Surveying Equipment

Technology presented at the ET 2000 Seminar [2] introduced a methodology for extrusion press hghalignment using triangulation (intersection) with digital theodolites systems. This three-dimensional (3D) coordinate measurement system introduced the first published precise way to perform extrusion press alignment in true 3D geometry relationship using surveying equipment.

Modern portable 3D coordinate measurement systems directly applicable to extrusion press alignment today are:

1. Triangulation (intersection) with digital theodolites systems (now dated and less efficient)

2. Articulated Arm PCMM (Portable Coordinate Measuring Machine) uses contact probing where line-of-sight technology is unsuitable, or where there is difficult or restricted access. PCMM is unsuitable for full press alignment, but integrates well with Laser Tracker measurement.

Figure 1. Articulated Arm also known as Portable Coordinate Measuring Machine.

3. 3D Laser Tracker systems

   a. There is no doubt that 3D Laser Trackers are the most appropriate and efficient measurement systems for full press alignment and many other press refurbishment/rebuild projects requiring precision measurement.

   b. Additional technology and features such as handheld probing, scanning, and machine control products have increased the efficiency and flexibility of laser trackers in their applications.

4. There are several other portable 3D technologies that can be mentioned here to provide a more complete view. Many of these are based on laser radar scanning and photogrammetric principles using machine vision systems, high-speed cameras using integrated and structured light and automated metrology. They are more applicable in manufacturing inspection, control of mechanical parts, automated measurement applications, shop floor and production in-line assembly processes, and manufacturing multiple parts in repetitive work conditions. Data acquisition includes high-volume point clouds from scanning systems and high-resolution digital images from close-range photogrammetric systems. [3]

The focus here is Laser Tracker Measurement Technology for extrusion press alignment and the precision measurement associated with press establishment, adjustment, and the refurbishment/rebuild phases; however, comments on traditional/conventional measurement systems will also be made as appropriate.

This 3D Laser Tracker technology has been specially adapted to provide the specialist measurement service for the alignment of extrusion presses. The system and techniques provide a combined 3D inspection model by measurement of static and moving press components with the press under operational conditions (i.e., heated container, static, loaded under full extrusion pressure, and monitoring of dynamics). That means that thermal growth and load/pressure, stretch/distortion effects can also be measured, quantified, or taken into account.

Many extrusion plant managers who faithfully carried out traditional alignment methods were unable to determine the real problem until their press was measured in 3D as a full press alignment. Traditional and optical measurement processes will not pick up 3D misalignment problems such as platen skew/rotation, main ram misalignment to fixed platen, various press component concentricity issues, nor do they necessarily measure under operational conditions or during actual extrusion.

Ultimately, a Press needs to be Perfectly Aligned at and during Actual Extrusion

Note that the routine (in-house) maintenance alignment checks of the press centerline components or the tie-rod strain checks are highly dependent on the assumption that the whole press is correctly aligned (initial state of condition monitoring). Press centerline component alignment and concentricity checks including: the ram centerline (piston retracted, balanced and out positions); ram to crosshead to stem interface (stem bolster, stem clamp, stem pressure plate), and ram stem centerline must all be aligned/concentric with the press centerline. Then, the stem to container liner centerline to die stack (faces/cones) to pressure ring must be concentric and parallel.

Vertical alignments (slopes) are easily compared with machine levels. Vertical and horizontal offsets and horizontal deviations are not as simply determined with manual conventional methods. It has become more obvious that the 3D Laser Tracker alignment technique can significantly improve extrusion press efficiency, and is the superior method of correctly diagnosing and quantifying all misalignment problems. There are only a few measurement service providers worldwide that have applied 3D Laser Tracker technology specifically to extrusion press alignment. There are also some large maintenance engineering workshops and machine engineering companies with in-house laser tracker systems that they use for press alignment and precision measurement of press components when servicing the extrusion industry.

Note that measuring extrusion presses with this technology is not trivial, and requires very extensive knowledge and experience of both the measurement system and the extrusion press design and operational processes. This specialist measurement service for the alignment of extrusion presses is not something that can be readily duplicated, even if a laser tracker measurement system is available. Also, the extremely harsh conditions and environment associated with measuring an operational, especially older press, to achieve overall 3D standard errors of 0.025mm (0.001in) is near to standard system limits. Constraints include restricted, congested, and difficult access to relevant press components, worn/unclean surfaces, surrounding instability, vibration, harsh fully operational extrusion conditions, and safety.

So why and when has this 3D Laser Tracker full press alignment service been utilized? The main reason why is because there are unresolved issues with product or equipment. Product inconsistencies and changes have a variety of causes ranging from press misalignment, to component and tooling condition/wear/fatigue, to type of product, to correct procedures not being adhered to. Often, many maintenance management strategies have been exhausted and suspected misalignment must be eliminated.

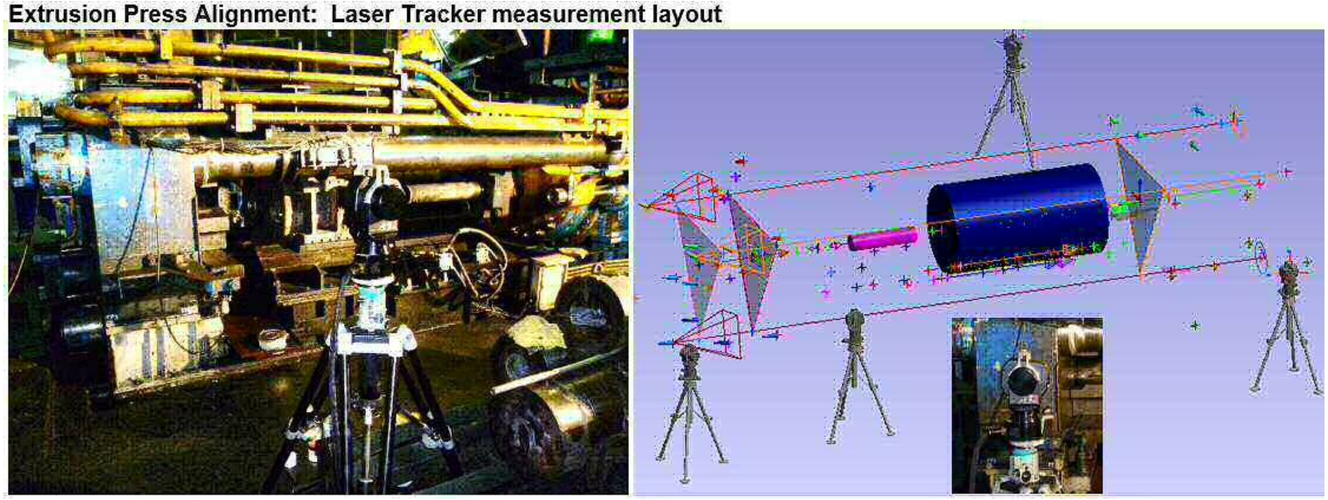
Press misalignment affects product, especially eccentric-wall tube, causing inconsistent profile and product outside tolerances. Press frame and press component alignment tolerances need to be even tighter when upgrading to achieve higher-grade quality product, and to achieve tighter product tolerance requirements. Press equipment issues are caused by wear and deteriorating press condition with an aging press; ongoing problems - extrusion plant management having a persistent history of difficulties with the press, and by press centerline tooling being well out of alignment. The geometric or dimensional aspects of an extrusion press are fundamental to proper press alignment, which is required for minimizing downtime and production wastage. Additional alignment requirements may be relevant when piercers/mandrels are involved, as they may affect the main ram alignment as well as contribute to tube wall eccentricity issues.

Three-Dimensional (3D) Laser Tracker

Figure 2. Laser Tracker and retro-reflector target.

Laser trackers have been used in the aerospace and automotive industries for over 20 years, and are now used regularly in many industrial settings where high-precision, large-scale industrial surveying is required for machine/component inspection, positioning, alignment, and dynamic monitoring. A Laser Tracker is essentially a portable co-ordinate measuring machine (CMM) that can measure large machines/components in 3D to better than 0.001in (0.025mm or 25microns). It uses a laser interferometer and/or high-precision absolute distance meter to measure distance within 10microns, and two precision angular encoders to measure the zenith and azimuth angles. The interfacing metrology software converts these polar coordinates to rectangular coordinates (X, Y, and Z).

Hand-held spherical retro-reflectors are used to measure to individual points, or to scan whole surfaces. Reproducibility of a coordinate is ±0.005mm/m (±0.005thou/in) within a 35m (115ft) sphere from a single instrument position. By measuring to reference targets, multiple instrument locations can be accurately related to enable a large or complex extrusion press to be completely measured in a single 3D coordinate system. The high-speed capabilities of the system mean that 1000 points per second can be recorded at a tracking speed of up to 4 meters per second.



(a) **(b)**

Figure 3. a) Laser tracker setup alongside the front platen of a three-column extrusion press; and **b)** All the critical components of the press are measured in a single 3D coordinate system measured from a few instrument stations around the press.

Application of 3D Laser Tracking to the Extrusion Press

A principal advantage of modern 3D laser tracker technology is the ability to establish and maintain a high degree of precision measurement with the press at actual operating conditions of temperature and no-load/extrusion-load. Typically, presses have been set up when new or after repairs and revisions, using conventional mechanical measurements that are taken without loading and at ambient temperature.

Press Benchmarking (Condition Monitoring)

On large machinery that is in service, it is usually not possible to measure and align all components in a single outage. Benchmarking of a machine with 3D laser tracker technology provides a snapshot of its dimensional and geometrical status.

A press benchmark assessment report provides an overall picture of misalignments, wear, and other operational issues. An improvement program is then developed to progressively bring the press towards ideal efficient operational geometry. Often, the remedial work and adjustments required can be carried out in a series of iterative improvement steps with conventional measuring tools during standard maintenance outages, or scheduled outages specifically for the remedial work.

Full press re-measurement after press adjustment is recommended, especially after significant iterative corrections, and after the press has bedded-in with a short period of production depending on what maintenance has been done. This provides verification of correct adjustment, identifies the net result of the incremental changes and operational changes, and re-establishes the benchmarking (initial state for condition monitoring). Once known, further improvements can be made with confidence and can be monitored with micrometers and dial gauges without having to have the press measured again for some time. Decisions to re-measure the press should be self-driven and based on repeat cycles dictated by the press's condition, its maintenance program/history, and its production characteristics. Various extruders have found full press alignment reports invaluable for progressive improvements, and have even been able to extend the repeat cycle for full press measurement from two to four years.

Benchmarking allows the end users to compare performance over time for predictive maintenance, and to compare the performance of the equipment after repair or rebuild as a condition report. Involvement of an independent extrusion press specialist (mechanical) is recommended to complement the alignment measurement, reporting, and press assessment. This provides added value to each project, with technical advice on the mechanical aspects for the various stages of professional extrusion press alignment services:

- Pre-measurement press inspection and preparation to ensure it is fit for measurement
- Press assessment to assist in interpreting the press alignment report by translating misalignments (**what** is misaligned and by **how much)** into actual press adjustments (**how** to mechanically adjust the specific press – sequence and locations of corrections and adjustment scheduling; machining, or replacement remedial work) and
- Supervision of this remedial work when necessary.

Press drawings are not essential for determining press misalignment or geometry, though a general layout may be useful for planning. Drawings are important post-measurement for the remedial/corrective phase to assess optimum adjustment locations, sequences, and procedures.

Full 3D Extrusion Press Alignment

It is recommended to do a full 3D press alignment biennially, after every major component replacement or press overhaul, after catastrophic failure/events, after traditional alignment and press has bedded-in, or when all other maintenance strategies have not resolved issues. A full 3D press alignment is generally integral to establishing a dedicated alignment program as part of maintenance management. It provides press history records for ongoing decisions on maintenance, and facilitates balanced decision making before making an investment.

Press Frame Geometry and Alignment at Establishment

The correct establishment of a press is fundamental for trouble-free operation during its full life cycle. A press not well (re)established or fully aligned may not show defects or problems for several years, but then maintenance issues will increase continuously. Most new presses are installed by the supplier using traditional alignment methods for establishment. Procedures include replicating factory pre-assembled press machined reference points/faces. Many suppliers of OEM parts are now becoming more wary of having their work checked by a third party. Understandably, new or replacement component suppliers are wishing to supply, install, and align their machinery to cover their warranties and to capture all aspects of the sale. Supplier alignment methods may be traditionally based (one- or two-dimensional), rather than modern more accurate 3D measurement technology.

The Pressure Ring. This is the replaceable interface of actual extrusion with the press frame. When it is not parallel (worn, loose, or shifted) to the face of the front platen, this is equivalent to the front platen being misaligned (even if the rest of the press frame is dimensionally correct).

The Crosshead and Container Slides and Guides. These should be straight, parallel, and symmetrically spaced about the press centerline with the correct dimensions. Horizontal and vertical alignment of angled ways/slides and uneven wear characteristics are readily located and quantified with 3D alignment.

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Figure 4. Deviations of scanned points from best-fit slide plane showing flatness and wear profile.

Press Foundations, Bedplates and Full Machine Base

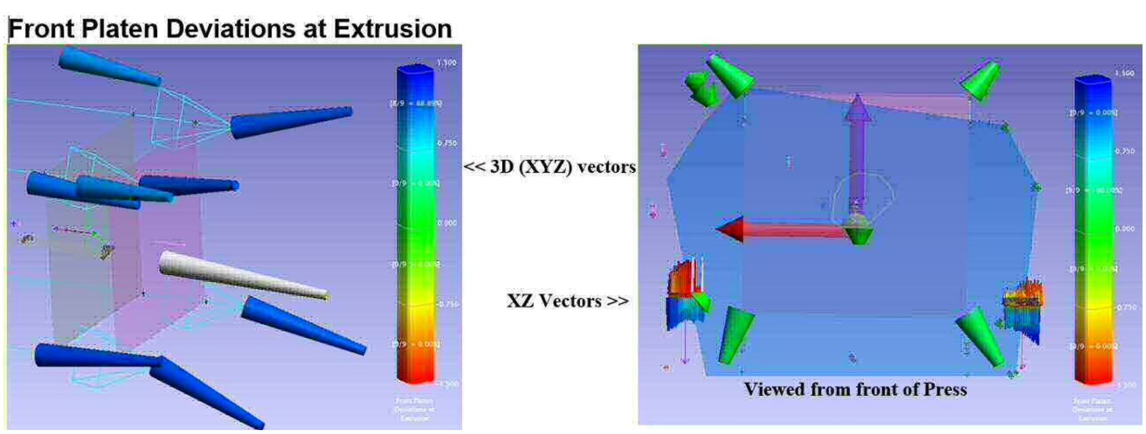
Our experience shows that the majority of beds are either fitted incorrectly at establishment or have moved and subsequently deteriorated, due to subsidence, differential settlement, damaged grout, etc.

Press foundations ideally should be a single rigid block of concrete independent of the surrounding building floor/foundations, so that any ground movement/settlement/deformation will not have a differential effect on the base bedplates, and so the press frame stays intact and aligned. Foundations may be specified by the machine vendor or manufacturer, and various design types are seen including block, box, wall/pit, framed, and even mezzanined. From a press alignment viewpoint, the full press base (whether full or partial-stepped) beneath the press frame must remain inflexible for all operational cycles and natural events throughout the press lifetime. Even if the foundation block tilts over time, the press remains aligned intact, though on a gradient. This situation is easily managed with 3D measurement systems, but will be more difficult with traditional measurement methods. The issues with a non-gravity press during routine alignment checks can simply be remedied with an appropriate wedge (longitudinal and transverse) for the machine level. Extruders often choose to reset the press to level during a major press overhaul/refurbishment.

Deflection and Dynamic Monitoring

Deflections of any part of the press frame can be measured dynamically in 3D when moving the cross head and the container, under various loads and during extrusion. These include static component foundation plates (especially during press assembly), back and front platens, pressure ring, front-insert piece, die stack, bolster, guides/ways/slides, and tie rods and their elongation.

Some presses and replacement tooling are being sourced from lower-cost countries. The platen frames of modern lighter presses cannot be assumed to be rigid bodies compared to older and larger extrusion presses, so during full press alignment measurement, they must be monitored fully (all sides of the press) during load and extrusion, to allow for distortion and differential deflection effects.

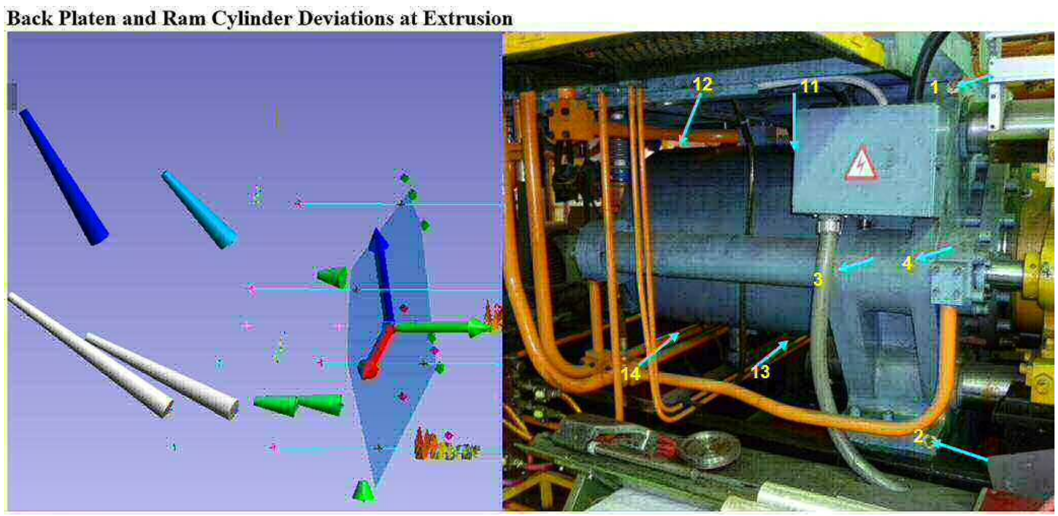


(a) (b)

Figure 5. **a)** Front platen point deviation 3D vectors from static to extrusion; and **b)** XY vectors from static to extrusion viewed from front of press.

Therefore, it is even more critical to align this type of press frame to tighter tolerances to prevent uneven deflection, and to schedule full 3D press alignment more frequently. Sensitivity to uneven tie rod elongation is amplified with the total press frame instability (base flexed with cross head movement) and a thinner, less rigid front platen.

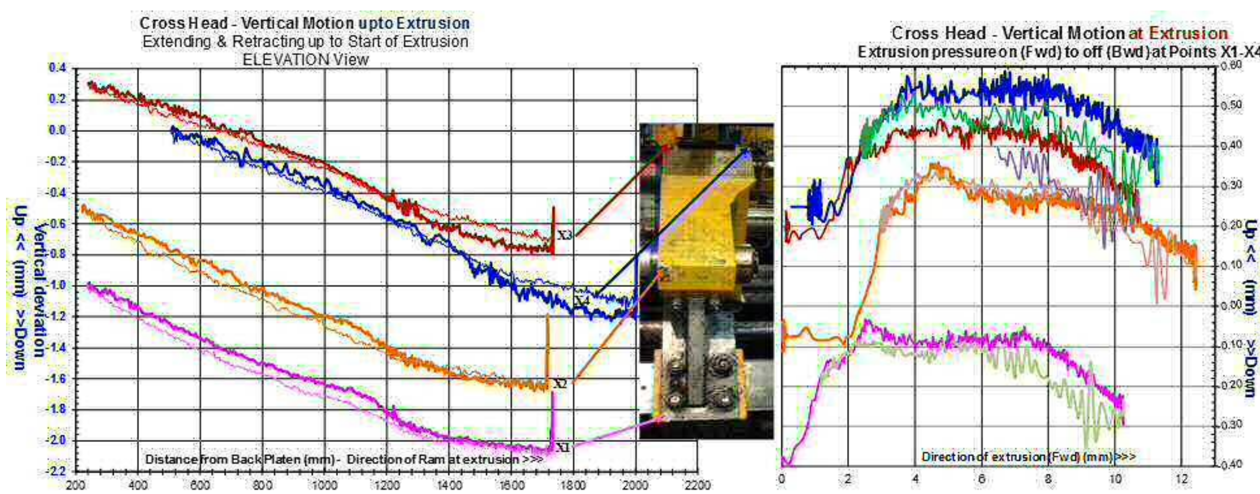
Those presses where the ram cylinder bolts into the fixed back platen housing should be monitored for independent movement of the cylinder at extrusion.



(a) **(b)**

Figure 6. **a)** Deviations at extrusion showing differential independent movement; and **b)** Monitored points on back platen and ram cylinder.

Component Monitoring. At various positions up to extrusion, and dynamic precision 3D measurement (continuous motion path profile) up to and during full extrusion, provide key diagnostic alignment information for these press centerline component combinations: ram-crosshead-stem-mandrel; and container-housing-liner.



(a) **(b)**

Figure 7. **a)** Crosshead vertical motion up to extrusion; and **b)** Crosshead vertical motion during extrusion.

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Major Component Replacement

In addition to the standard press alignment, 3D laser tracker technology also efficiently provides measurement assistance associated with:

- Main cylinder and ram replacement
- Full press dismantle and re-assembly
- Tie rod replacement, pre-tensioning and adjustment (including laminated and enclosed rods)
- Foundation leveling, re-establishment, re-grouting
- Platen and guide/way, tie rod monitoring.

During or after Press Disassembly, Re-Assembly associated with every Major Component Replacement or Press Overhaul. Metrology assistance and support with precision 3D Laser Tracker - Quality Control (QC) inspection and measurement for major revamp/overhaul/replacement tasks includes the following:

- Reverse engineer components (in-situ, in-field measurements inspection) to produce manufacturing drawings of major press components for replacement.

- QC inspection as-found component (say back platen/main cylinder housing) of existing component at press disassembly, with correlated existing/modified foundation seats or plates. Other parts of the press could also be measured during this disassembly stage.

- QC inspection of new replacement (or repaired) component at pre-installation, for conformance to dimensions and comparison with as-found. The results of prudent QC inspection can mitigate serious remedial costs and downtime for non-fitting components, such as incorrect bolt hole positions.

- Virtual (mathematical) assembly before site installation/re-assembly for accurate shim information, and to set components accurately to level and to press centerline in 3D. This means every dimensional aspect can be verified and prepared prior to physical assembly. Final/actual geometry such as matched seating is critical during assembly, to eliminate soft-foot conditions (platen stresses over a long period), and when housing feet or sole plates are not flat or level or are non-parallel.

- Accurate positioning of the back platen/main cylinder housing in real-time during press re-assembly.

- Full 3D press alignment, correct pre-tensioning and adjustment (including enclosed rods), and press benchmarking.

Notes on Leveling and Alignment Tolerances and Technology

A note on existing/traditional tools for leveling foundations, bedplates, and press components: the general specification is to level these to better than 0.04mm/m; (0.04mm/m = 0.04 thou/inch = 0.0005in/ft = gradient/slope of 8.3 arc seconds). Precision engineers' spirit levels and machine/box levels have sensitivity ranging from 5 to 8 or 10 seconds of arc for each 2mm (0.079in) bubble division. These are more suitable for localized plate flatness and level (with limited extension by straight-edge/bar transfer), and for checks on individual press components. The straightforward 180-degree end-to-end rotation of the machine level on a flat surface provides the accuracy to horizontal (gravity/zero) calibration and adjustment of the bubble vial if necessary.

High-precision electronic tilt sensors and clinometers/inclinometers achieve 0.001mm/m to 0.02mm/m (0.001 degree) single or dual axes, but most portable electronic tilt meters and protractors only achieve 0.01 degree (0.18mm/m) to 0.1 degree (1.75mm/m), and are not suitable.

Unless a press component can be assumed to be a rigid body, the 0.04mm/m (0.04thou/inch)[1] general specification ratio should be defined as ≤0.1mm (0.004in) point tolerance for foundation bedplates, machine base, ways, and any press frame or component with dimensions larger than 2.5m (8.2ft). (See note on error propagation below.)

A full press bed, for example 10m x 4m (33ft x 13ft), will require a surveyor's precise level (tilting, automatic, or digital), or a precision laser level (sweep) that can take readings (resolution) to 0.1mm or better, but preferably to 0.01mm (~0.0005in) so that individual plate level and flatness can be addressed. The level datum on these precision instruments is defined via the level vials (or the automatic compensator) that are generally accurate to 2 arc seconds (0.01mm/m). All optical instruments with rotatable lines-of-sight (LoS) used for leveling are subject to collimation error that occurs when the LoS is not truly level. Equal sight lengths will provide correct height differences, but the two-peg type test is the correct way to check and adjust the instrument to provide absolute (gravity/zero) calibration accuracy.

Individual foundation sole plates, press bedplate(s), and the faces of the matching press frame components should be flat and level with matching heights to avoid soft-foot-condition, warping, and longer-term stress loading effects. This involves setting combined base/sole plates in a single level plane or stepped height-planes for press base frames in sections, and evaluating correct shim thicknesses at each plate. The base section or overall base frame will then fit level and at the correct height relative to press centerline, with minimal distortion before and after it is fitted and grouted. If the sections of the base are not level after (re-)grouting, tie-down, and full assembly, then adjustments at individual locations may introduce soft-foot conditions. This can also affect the leveling blocks, which are machined to match the press ways and the matched seating required for major component replacement (see above).

Error Propagation and Tolerances

A note on error propagation or uncertainty analysis (overall geometric dimensioning and tolerancing): the accumulated effect of machining tolerances (especially older presses), specified tolerances for foundations, press frame, static components, and clearances (not including wear) of moving components, very quickly exceeds those for ideal press alignment; and, furthermore, tolerances may conflict with each other. Manufacturers' recommended press assembly specification tolerances may vary appreciably, especially if they are/were defined to assist a specific measuring technology or technique. Press frame specification for level, platen squareness, etc., of 0.04mm/m (0.04thou/in) when compared to that for tie-rods (±0.25mm between Tie-Rod CLs and ±0.2mm Tie-Rod lengths), the maximum allowable variation between tie-rods should be ± 0.075mm (0.003in), and could already start to conflict at distance between tie rods of ≥1.875m (6ft). It is therefore essential to measure and establish a press well within tolerance, or to compare specified tolerances with the most critical frame specification that is to be achieved.

The Laser Tracker can measure to these press components in 3D coordinates to 0.025mm (0.001in) to provide absolute dimensions, heights, level, and flatness throughout the press with corrective adjustment in real-time (virtual digital dial gauge computer screen 3D display of X, Y, and Z coordinates reducing to zero target).

Tie Rod Averages and Non-Parallelism of Tie Rods

Why are tie rod average positions at the platens seldom centered correctly? (Or, why are tie rods not usually symmetrical or parallel to the press centerline?) The press centerline at the back platen, as defined by the intersection of the ram centerline with the plane of the fixed back platen, is generally found to be ~0.6mm (0.024in) lower than the tie-rod average (analysis of many presses measured over several years), and this is considered due to the combined effect of clearance and wear of the main ram and bushings. Additionally, depending on machining tolerances, the tie-rod portholes may not have been symmetrically machined about the press centerline. The position of tie-rods within portholes of platens due to their clearances may contribute to tie-rod misalignment or non-symmetry about the press centerline. For example, if clearance is 0.015in on ϕ for the unthreaded part of the rod, [4] the rod can sit down, or to the side 0.19mm (0.008in); a worst-case accumulated effect is 0.381mm (0.015in) within and between platens. There are also cases where tie-rod nut seats at the platens were found to be spot-faced individually, not in a common plane, nor parallel. The accumulated combined effect of machining tolerances, clearance

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tolerances, positioning during press frame assembly or tie-rod replacement, and worn ram and housing cylinder bushings can easily explain this tie-rod anomaly. This can affect routine alignment checks and press alignment using piano cross-wire and optical/laser-in-centerline traditional methods. That is - the press centerline defined by the piano cross-wire will likely not match the true centers at both platens.

Preparing the Press for Measurement

Other than worn components that cannot be replaced immediately, the press is prepared by ensuring all static components are tightened, the tie-rods are correctly pre-stressed, and tooling sealing faces are clean, parallel, in good condition or where possible, new tooling installed --- stem, piercer/mandrel, container-liner, all die stack items, and pressure ring --- to obtain better accuracy of measurement. There is also the possibility of measuring used/worn out-of-spec die stack tooling to determine the differences and evaluate tooling issues. In any event, the press condition should be repeatable for moving components and reflect a fixed state from which it can be adjusted post-measurement by conventional manual methods for simple correction or real-time Laser Tracker for more complex misalignments.

Cost Savings from Full 3D Laser Tracker Press Alignment

The relative cost of a full 3D press alignment is economical, compared to cost savings after a press is correctly adjusted for optimum alignment. Benchmarking and information correlation of a variety of presses that have been measured indicate that production improvements on misaligned presses after adjustment are significant. Even presses running acceptably or well aligned by traditional standards have shown significant yield percentage gains. Generally, annual savings in the costs of disposables, not to mention maintenance down time are dramatic. *"Improper alignment is one of the causes of inconsistent die performance; it causes premature failure of fixed dummy blocks and, in extreme cases, damage or breakage to stems, containers, and tie rods."* [5]

The following cost savings can be readily evaluated by those associated with the financial aspects:

- Production improvements on some misaligned presses after adjustment were three-fold; daily throughput increased by 12 percent.
- Dummy block wear significantly reduced and total failures eliminated: replacements one to two weeks before, to eight weeks after correct alignment.
- Container liner service life: refurbishment or new replacement three to four months before, to 10 months after correct alignment.
- Ram and container bronze wear strips having noticeably less wear, negating annual machining or replacement.
- Stem replacements are also minimized.

The expensive part is fixing the press once the problem is identified.

CONCLUSIONS

Advanced Dimensional Solutions (ADS) supplies dimensional measurement and analysis services to industry using modern, three-dimensional (3D) measurement technology. Experience in providing extrusion press alignment services as a specialty for more than 18 years has been reviewed here to provide an update, beneficial information, insights to current practice, and to present the latest measurement technology available today for the alignment and major revisions of extrusion presses. Comments, recommendations, and findings for consideration for improvements have been prompted by combining the many questions, observations, and expertise from both metrologists (industrial surveyors) and the extruder specialists.

Laser Trackers are the most appropriate and efficient measurement systems for full press alignment and many other press refurbishment/rebuild projects requiring precision measurement. This modern technology is able to provide a combined 3D inspection model by measurement of static, moving, and loaded press components with the press under operational conditions. It should be employed when there are unresolved issues with the extrusion product or equipment. A properly established and aligned press, correctly pre-stressed with a well-maintained pressure ring is fundamental. Combined specified tolerances can propagate rapidly, and it is essential to measure and establish a press well within tolerance or to compare specified tolerances with the most critical frame specification that is to be achieved.

Press frame and press component alignment tolerances need to be even tighter for lighter presses, or when upgrading to achieve higher-grade quality products, and to achieve tighter product tolerance requirements.

Press benchmarking with 3D laser tracker technology provides a snapshot of its dimensional and geometrical status with details of misalignments, wear, and other operational issues. The press is optimized by applying required remedial work and adjustments in a series of iterative improvement steps during standard maintenance outages or scheduled outages, specifically for the remedial work. Full press re-measurement after press adjustment provides verification of correct adjustment, identifies the net result of the incremental changes, and re-establishes the benchmarking.

Combining the specialties of measurement and alignment with mechanical extrusion consultant provides added value to each extrusion press alignment and many other press refurbishment/rebuild projects. The cost savings resulting from full 3D Laser Tracker press alignment can be significant.

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