



Industrial Engineering is concerned with the analysis, design, improvement, installation and management of integrated systems of human resources, data, finances, materials, equipment, and energy as safely as possible with minimum impact on the environment, delivered within a holistic methodology.

INDUSTRIAL ENGINEERS MAKE IT HAPPEN BETTER

The three key objectives of the IIEA are:-

- 1. TO UNDERTAKE AN ACTIVE AND VARIED PROGRAM FOR MEMBERS**
- 2. TO PROMOTE AND ENHANCE THE TRAINING OF INDUSTRIAL ENGINEERS**
- 3. TO PROMOTE AND CAMPAIGN FOR INDUSTRIAL ENGINEERING OPPORTUNITIES WITHIN INDUSTRY**

NEWSLETTER 9

[From the President](#)

[Standing for Federal Council](#)

[Divisions](#)

[IIEA Member Expose](#)

[Did You Know](#)

[Future of IE in Australia](#)

[Love Your Constraints](#)

[Quick Lock Pin Assembly Improvements](#)



FROM THE PRESIDENT

- Our event schedule has been varied and very interesting.
 - Three divisions have undertaken successful events(Queensland, WA and SA)
 - We are continuing with the Future of Work Series with 2 events scheduled for June.
 - The IIEA besides endeavouring to collaborate with College of Leadership and Management(CLM) and now as well with the WA Sub branch of the Royal Aeronautical Society(RAeS)
 - The IIEA is underway with promoting Industrial Engineering with industry in WA.
 - Hopefully this will be extended to other divisions shortly.
 - If any members have industry contacts where IE may be of assistance, please contact me.
 - The 2021 AGM at this time is scheduled for Saturday 11th September(9th October alt) At this stage whether it's a F2F(face to face)/Hybrid meeting or Webinar, will be determined. The undertaking of a F2F event is still being determined depending on Covid19 situation. With ongoing lockdowns , it looks like it will be an Online AGM similar to 2020.
 - The voting and queries etc during the AGM will be using SLIDO/MENTI via mobile phones.
 - The membership director is continually in contact with members and has been liaising with potential employers.
 - The IIEA is working with a career and recruitment agency.
 - The IIEA is actively working with Curtin University and University of Melbourne in developing their IE degree courses as well as participating on their Industry Advisory Councils
 - Please don't forget to renew your subscription.
 - The Operational Research Society of India, Bangalore Chapter has contacted the IIEA re presenting papers at their December International Conference on Business Analytics and Intelligence
 - **HAVE YOU FILLED IN THE MEMBER SURVEY. Please complete by 14th July.**
-



STANDING FOR FEDERAL COUNCIL

The IIEA is always looking for innovative members to play an active part in the running of the organisation.

There is also a need for succession planning to allow a transformation for continual improvement.

I, as Federal President, am asking full members to consider standing for the position of FEDERAL COUNCILLOR.

The position as a federal councillor requires:

- Attending quarterly council meetings
- Input into various decisions between meetings
- Participating in various tasks as required
- Being an active member attending events regularly
- Time of about 1 to 2 hours per week on average as required
- The position is for 2 years and can lead to other positions within the council (secretary, treasurer, vice president, president) with the benefit of the experience.

Please could you consider this appeal. Nomination forms/brief CV together with position descriptions will be sent out before end of July.

DIVISIONS

Queensland-Damian Kennedy (FIIEA), Michael Morrow (MIIEA)-Program Director

The Queensland Division of the IIEA held a very successful Webinar on the 26th March, presented by long time IIEA QLD member Brian Lawrence and facilitated by new IIEA Federal Council QLD member, Michael Morrow. The webinar titled, "Virtual Plant Inspections Pilot Project" was well attended by a good number of on-line (Zoom) attendees.

The presentation featured a pilot project being undertaken by CS Energy into remote sensing of critical equipment located in very remote geographical areas. The presentation featured the 'Real Wear' system which allows anybody, fitted out with a special helmet, to facilitate examination of equipment under the direct supervision of asset engineers located off-site at CS Energy Headquarters. Through the in-built wifi capabilities of the system, asset engineers can command the helmet sensors to zoom in on particular features of the equipment being examined and to send back real-time data and other information. Voice activated capabilities enable 'take picture' and 'zoom in' instructions to be immediately followed by the equipment. Future developments of the system including infrared capabilities, acoustic pick-up and longer than current 3-hour battery life were also outlined. Overall, it was a very informative and well-presented presentation.

Further to the above, the QLD Division has also been liaising with the Advance Robotics Manufacturing (ARM) Hub to hold a webinar this week, in conjunction with CLM QLD. Unfortunately, due to an event already being held by ARM this week, this webinar has necessarily been postponed to a later date (new date to be confirmed).

Upcoming events include Everhard Industries Case study of an industrial engineering in August and a Lean Manufacturing -highlighting lean manufacturing concepts and tools in November.

NSW-Prabhu Ramdos(MIIEA)-A Webinar is planned for July.

Victoria-Abdul Mazid(MIIEA)-A webinar presented by Boeing is planned for September.

SA-Graham Eagles(MIIEA)-An excellent webinar entitled 'Love Your Constraints' by Lewis Trigger was delivered during May.

Critical Chain Project management workshop is planned for September to be presented by Lewis Trigger in conjunction with UniSA.

The SA Division is also working closely with new and existing members.

WA-for Bob Watson(FIIEA)/David Karr(CPEng, FIIEA)

- The WA division has a very busy schedule of events for the next few months.
- The **Future of Work-Workplace Trends Seminar-2** by Dr Giverny De Boeck-Curtin University with 25 attendees was successfully undertaken. The workshop highlighted the importance of IE's need to consider focusing on the **human** aspect, when implementing changes in the workplace.
- 14th July- **Practical Application of Operational Excellence in Aerospace Industry** -Francis Hiew
- 27th July- FOW3-Maximising human capital utilising Automation by Rowan Fenn of Rise-X
- August- **Optimum Airline Flight Operations**-Graham Hartree
- It is hoped that with the probable Online AGM that a local F2F AGM meetup can be undertaken

International-Sam Ghraith(MIIEA)

The following report highlights some news from our international counterparts, conscious of the fact with the rise of COVID most engagements and activities have stalled.

South East Asia and particularly the middle east have continued to see a demand for Industrial Engineering which is reflected in their current job markets and education offerings.

Sri-lanka

- Since last year March with the rise of Covid our Sri-Lankan Colleagues could not organize or engage in any activity on IE. It has been difficult to get the members to work on the chapter. Administration has been lacking , the plan is to wait till the country lock-down measures is relaxed and then get our office bearers elected and chapter registered.
- Request by Godfrey
- When it comes to membership, can you suggest a concessional membership fee for overseas,(Sri Lanka), due to high exchange rate.
- Also we could recommend people with acceptable IE qualifications to apply so that it will be mutually beneficial for applicants as well as the IIEA.
- The procedure given to us by the IMS UK. Also IMS allowed a life membership by paying double the annual fee at once.
- This method also got significant funds at once to the institute where they built financial stability by eliminating most of their administrative cost.
- Please send how to sign up process if any IE person wants to get membership at IIEA is it possible and what is the process.

Singapore

- No news / update for this report

UAE

- My contacts in UAE have not responded mainly due to COVID and work commitments.
- Education sector is following a hybrid model but have strict guidelines with all courses online only.
- At Sharjah University The Department of Industrial Engineering and Engineering Management has around 450 students enrolled in the BSc program and has seen considerable interest in PHD programs.
- With Australian university and education providers also entering this market in the last 10 years, interest and demand is expected to remain at the very least the same.

In my discussions, a lack of service and value-add by Australian sector coupled with almost no 'pure' Industrial Engineering demand or jobs is contributing to lack of interest in IIEA activities. Australian IE jobs are rare, but can be found indirectly via complimentary skills and tag lines of Continuous improvement, process specialist, LEAN, 6Sigma etc... this is the opposite overseas. I speculate that Australian market may be a reflection of the future state of these other markets but regardless opportunity still remains.

FUTURE OF INDUSTRIAL ENGINEERING IN AUSTRALIA-

By David Karr (CP Eng, FIEA) 30-06-21



Industrial Engineering (IE) has been on the Australian scene since 1959. Membership has peaked at over 1000 in the 1980's. However today although in a growth mode, the IIEA membership is hovering below 100.

IE in Australia (as opposed to other developed or developing economies) has not been in the forefront of engineering.

With the introduction of IE degrees at Curtin University (WA), and University of Melbourne, there will be a steady stream of graduate IE's. Hence the IIEA has embarked on a program of promoting IE in industry. Hopefully ALL our members will promote this excellent and needed profession. There are reference materials on the web (<http://iie.com.au/about/industrial-engineers/>).

The IIEA has embarked on publishing regular newsletters quarterly (refer <http://iie.com.au/resources/journals/>), having regular events refer (<http://iie.com.au/events/>)

Our membership is growing. The IIEA welcomes our new members Alex Castellanos Delgado, Louise O'Grady, Kristine Roble, Mohammed Taha, Guilherme Totorella

The relationship with Engineers Australia (EA) is growing, especially with EA promoting IE events. There is still a need for a review of the MoU in order to tie up a few details.

The AGM is coming up in September (possibly October). At this stage it will most probably be Online due to COVID issues, the safety of our members and the possible financial risks due to a last minute cancellation.

We will be eliciting input from our members by utilising Slido and Menti during the AGM.

Finally for the first time ever, the IIEA has sent out a Members Survey. Please complete by 14th July.

https://docs.google.com/forms/d/1O_AeHonO7aHXOxiyXaR1u3RtpUHbASyOdZ49jrZu-rc/viewform?edit_requested=true#responses

IE is well placed to enhance the operations of organisations. Be it in data analytics, change management, lean/agile, autonomisation, circular economy etc etc.

I wish the best of luck to you all and Stay Safe.

LOVE YOUR CONSTRAINTS - Lewis Trigger



Recently the IIEA had the pleasure of co-hosting a Webinar together with the University of S.A, entitled "Love Your Constraints". The webinar was brilliantly presented by an acclaimed Industrial Engineer expert, Lewis Trigger, whose expertise is in the Theory of Constraints (TOC).

The message that came through loud and clear was a complete turn about how we normally relate to Constraints. Most managers hate constraints and bottlenecks. After all constraints and bottlenecks cause delays, don't they? Lewis Trigger presents a complete turnaround, showing managers to value their constraints by leveraging them - to look after them, to protect them from nasty surprises, and so enable managers to deliver consistently better results from the resources you already have. After all Constraints and bottlenecks are what ultimately controls the output of your business.



Lewis conveyed the central themes of what he terms "Constraint Innovation", through a personal story during his officer training for the Israeli Air Force. The story revolves around a desert training exercise in which the "Constraint" is the slowest trooper by the name "Herbie". All of the Constraint Innovation fundamentals are employed in the story, showing how we "leverage" Herbie and achieve the desired outcome. Herbie's story is the story of every system,

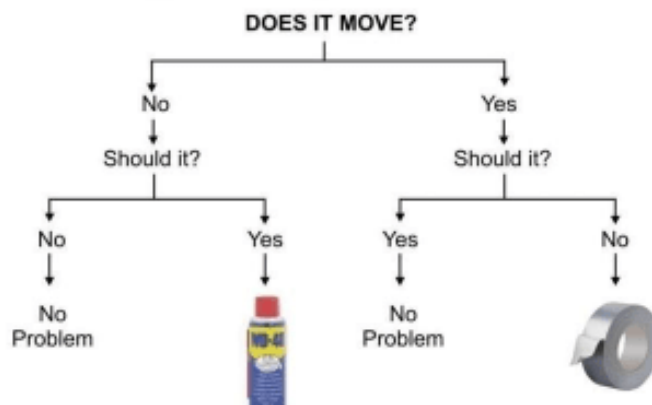
where ultimately the outcomes of all organizations are dictated by how we manage our Constraints, our "Herbies".

To hear Lewis, click on the following link <https://youtu.be/ukf2pj-sLNE>

Special thanks to Lewis Trigger as well as to Graham Eagles, President of our S.A. chapter for organizing this thought-provoking event, together with Ross Morris, Director of "Strategic Partnerships", the executive training branch of the University of S.A.

Lewis will be facilitating an online workshop later in the year via the University, whose details can be found in the following link. <https://www.unisa.edu.au/connect/executive-education/programs/process-constraint-management/>

Engineering Flowchart



IIEA Member Exposé

Alan du Mée(Retired)(HND,MSc,MBA,MIEA,FAICD,FAIM)



Alan is of French and Scottish descent and was born in Mauritius

He studied the Honours Degree transfer course and then the MSc in Industrial Engineering at Cranfield University in England in 1972, so I am an old fella!

This was followed up with an MBA in Finance and Strategic Planning from the Graduate School of Business at the University of Cape Town in South Africa in 1979.

With his Undergrad in Mechanical and Production Engineering from a TAFE in London after a technical Apprenticeship in an English factory, this rounded out a broad range of technical skills. These skills were then applied in a developing career, from England, Mauritius, South Africa, Zimbabwe, Australia, USA, with assignments in China, Malaysia, Indonesia, Brazil (including Argentina and Bolivia for a specific project.) Thailand. I have worked for BHP, Anglo American, the Queensland Government in the Energy business as CFO of the Queensland Electricity Commission and CEO of Tarong Energy, then Glencore Coal working on Carbon Capture and Storage since 2009.

He has learnt the following:

- A broad range of skills gives you choice in your career.
- Working with people you trust ethically and technically makes work easy and enjoyable.
- The Industrial Engineering skills incorporate innovation and technical integration, a common language almost anywhere.
- The common ground around almost all cultures across our fascinating and diverse world is a sense of humour. People everywhere would rather laugh than cry. Personal pride should not get in the way.
- In business enterprises, technical skills and technology (engineering and finance) cross cultural boundaries and allow people from many backgrounds to find common ground and achieve outstanding goals.
- The Industrial Engineering disciplines provide a unique basis for achieving these outcomes.

It is hoped that this short personal history is found insightful and motivating.

Alan du Mée, Managing Director
A Solid Foundation ® Pty Ltd.
counsel for Boards, CEOs and Senior Managers

Rob Murphy(Retired)(MIEEA)



Rob Murphy retired on April 1st 2021 following nearly 50 years as an Industrial Engineering practitioner. His achievements include the development of a LEAN based environmental system (cLean) that was adopted globally and saw him awarded the Armstrong World Industries (AWI) Chairman's Award for business excellence in 2006. The cLean methodology saw the four Australian manufacturing divisions provide 10% of global EBIT while only contributing 5% of global revenue. AWI's Australian manufacturing was also recognised by Keep Australia Beautiful, won the Save Water and Greenhouse Challenge awards, and were inducted into the Victorian Manufacturers Hall of Fame.

Rob served as the Victorian Chapter President and represented the Institute on the Victorian Board of Engineers. He was a Federal committee member and served as senior vice president.

History

Rob started his professional life as a cadet on Cardiff Docks UK. "I have always felt fortunate to have been trained at that time and in that place" says Rob, "I spent supervised time in the: stores, machine shop, plate shops, welding bays, forge, template loft and drawing office, and within procurement and planning. It was a thorough grounding across all business activities that has served me well". Arriving in Australia in March 1983 Rob initially designed production layouts and jigs as part of a design team introducing forestry equipment. He then was engaged by Siddons Industries (Sidchrome) and introduced CNC technology, ran a drawing office and provided oversight on their bonus system. Another move to Alfa Laval involved plant layout design, the introduction of CNC equipment and robotics. Rob finally settled with AWI (formerly Armstrong Nylex) in 1993 and progressed from Engineer, through to General Manager Manufacturing with cost responsibility for Australian operations, profit responsibility for Africa, and technical support and guidance for Indian and Chinese manufacturing. Along the journey Rob gained his Masters' degree in Manufacturing, became a LEAN practitioner, and a Six Sigma Champion. The last eight years of his working life saw Rob as a Business Adviser working with the Federal Governments Entrepreneurs' Program providing holistic advice to manufacturing SME's. While retired Rob currently provides part-time coaching and mentoring to SME's through the Victorian Governments Business Resilience Program, and is a registered coach and mentor with the Federal Governments Boosting Female Founders initiative. In these roles, and to meet his wish to pass on knowledge, Rob has developed a number of 'How to Do It Yourself' resources that he provides freely to any clients. These include a complete LEAN (VSM) deployment manual and a simplified strategic planning course. Rob now happily retired, lives in Gisborne with his wife Wendy, and looks forward to the more sedate challenges to come.



Did you know.....

Windows 10



CTRL + BKSP. Holding down the backspace button to delete multiple letters at once is such a waste of time. ...

Web



CTRL + L to highlight the address bar. You can immediately begin typing to go to a new website.



QUICK LOCK PIN ASSEMBLY IMPROVEMENTS

By Prabhu Subbiah Ramdoss(MIEA)

PART 2

Contents

2.7a Conceptual visibility, Issues and constraints	1
2.7b Conceptual Design Evolution.....	2
2.7c Mechanical Design Engineering application.....	3
2.7d Cutting tool design based on the machining process.....	4
2.7e Geometry and Dimensioning the cutting tool.....	5
2.7f Fixture design, Process capability and Cutting Tool Life study.....	5
2.7g New Inspection methods:.....	6
2.7h Destructive testing and Customer Specification.....	7
2.8 The tasks delegated and how it was accomplished;	8
2.9 Any particular technical difficulties/problems faced and how it was solved ;.....	8
2.10 Strategies devised including any original or creative design work:	8
d) Summary.....	9
2.11 My view of the overall project.....	9
2.12 How the project fared in meeting the goals/requirements;.....	9

2.7 How engineering knowledge and skills applied;

2.7a Conceptual visibility, Issues and constraints

As a mechanical engineer, picking up concepts while seeing any mechanisms and realizing it once the right application is found. This particular knowledge and skills will always help to design and developing new things. When inventing new things conceptually, It will be so excited to see how my conception is being converted to reality.

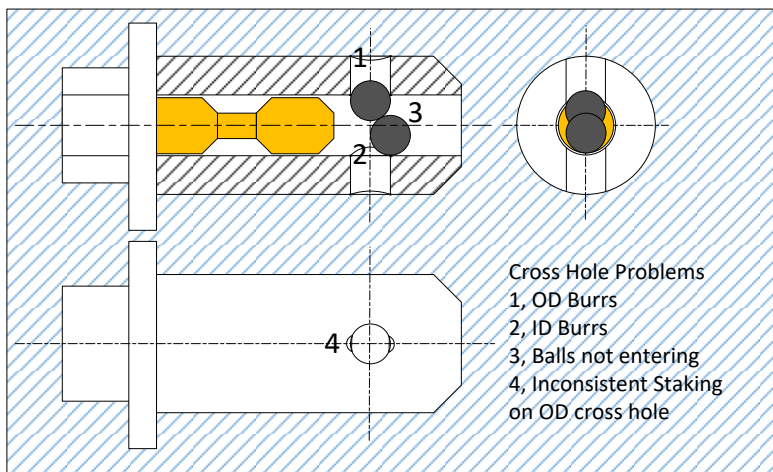
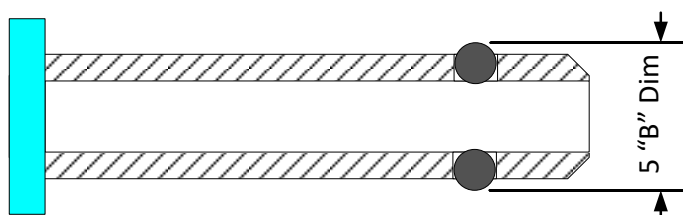


Fig - 4 Cross Hole issues of Pin

2.7b Conceptual Design Evolution

STEP 1

Fig - 5 MAX B Dimension



Collected Pin Body Component Dimensional Details and focused on unknown feature.

- Outer diameter – 0.2470" to 0.2485"
- Inner diameter – 0.140" to 0.150"
- Cross hole diameter – 0.094" to 0.096"
- Ball GR100 diameter – 0.09370" to 0.09375"
- "B" Dimension – 0.306" to 0.316"
- Stake depth - unknown – "Big?" (measured by the amount of pound force used)

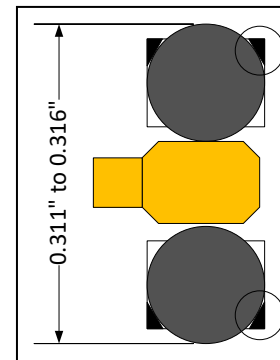
STEP 2

Concept Required:

- To have a positive stop, for missing balls on Pin OD cross holes.
- Positive stop can vary B dim between 0.311" to 0.316"
- Spindle Diameter tolerance is 0.005" can use B dim between 0.306" to 0.311"
- Need to get away from the Unknown feature.

STEP 3

- Positive stop in a form of a cone has been created on cross hole as shown in the black transparent circles.
- Introducing this positive stop, we can eliminate staking regular Pins.
- The Cross Hole stake depth - unknown – "Big ?" has removed from Pins.
- This Positive ball retention cone also eliminates the OD burr.
- It is achieved by circular and helical interpolation using a programming with the conical form end mill key way

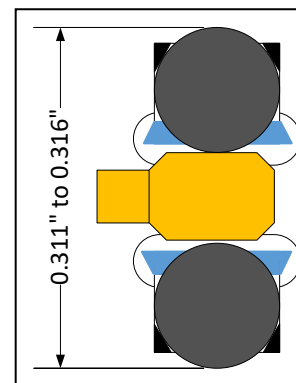


the Pin OD
process from
been
burr.
CNC
cutter.

Fig - 6 With cone

STEP 4

- Bottom chamfer as shown in the ovals has been
- By doing this Bottom chamfer the ID burrs in the Pin has been removed.
- Now there is a clear passage for the ball bearings to cross holes.
- This can be achieved by circular and helical interpolation using CNC programming with the conical form end mill cutter.



introduced.
ID cross holes
enter the
interpolation
key way

Fig - 7 With ID & OD cone

PBR Concept is great, but need to find the Cone Angle through study and investigation of possibility of the design.

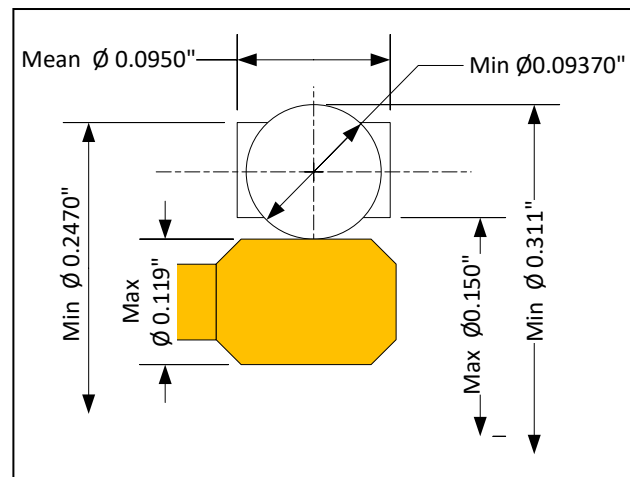
2.7c Mechanical Design Engineering application

The following conditions, geometry dimensioning and tolerance determine the Positive Ball Retention cone angle.

S.no	Feature	Max	Min	Critical Condition	Considered
1	Pin outer diameter	0.2485"	0.2470"	Min	0.2470"
2	Pin inner diameter	0.150"	0.140"	Max	0.150"
3	Pin cross hole diameter	0.0960"	0.0940"	Mean	0.095"
4	Ball bearing diameter	0.09375"	0.09370"	Min	0.09370"
5	B – Dimension	0.316"	0.311"	Min	0.311"
6	Spindle diameter	0.119"	0.116"	Max	0.119"

Construct the Geometry using AutoCAD,

- Draw all elements with its critical dimensions as shown.
- The critical diameter ball contact should be above its equator and contact point should be below the critical outer diameter to have PBR



point
cone
Pin
cone.

- 8 Critical Dimension

Fig

Refer Fig - 1 1/4" Oversize ball PBR Geometry

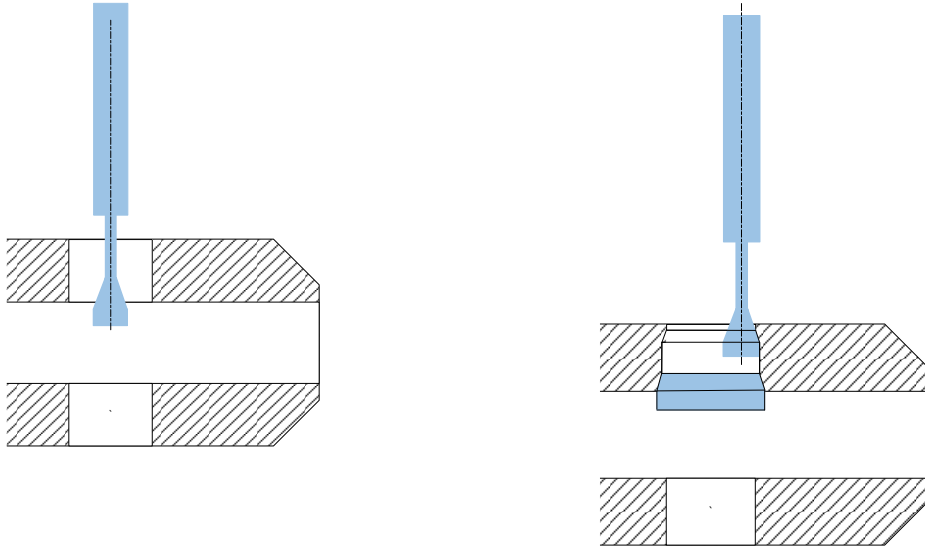
- Draw a horizontal line to the left of length 0.001" from the ball bearing extreme point on the X axis and cut the ball diameter above the equator on the first quadrant to get the ball contact point.
- A tangent line drawn through the contact point to touch the Y axis and repeat the same on the second quadrant.
- The tangent lines shall cut the cross hole diameter to form a conical profile as shown in black triangles in the above construction.
- Now it measures the included angle is 24°,
The linear dimensions,
Center of ball bearing to the contact point - A is 0.009",
Pin outer diameter to the contact point - B is 0.011" and
Pin center to the contact point - C is 0.118".
Now the contact point is well within the specifications as stated above.
- The above geometry with critical boundary conditions confirms that if this conical profile can able to machine then the ball bearings will have a positive ball retention feature, will eliminate the missing balls issues and is better than inconsistent staking process.

2.7d Cutting tool design based on the machining process

A cutting tool is required to make the above constructed cone in the Pin cross holes. The tool should follow the path as shown below.

Cutting Tool generated two conical profiles - Top cone is PBR feature with no OD burr & Bottom cone is to remove ID burr

Fig - 9 Cutting Tool Entry in the cross hole



2.7e Geometry and Dimensioning the cutting tool.

Refer fig -2

- Overall length - 2"
- Neck diameter – $0.050'' \pm 0.001''$
- Cutting edge diameter – $0.065'' \pm 0.001''$
- Straight Cutting edge length – $0.030'' \pm 0.001''$
- Cone length – $0.066'' \pm 0.001''$
- Cutting base to neck length – $0.250'' \pm 0.001''$
- Cone angle - $24^\circ \pm 1^\circ$

This cutting tool geometry profile can be able to make two cones and sizing with no burrs left inside for easy ball bearing entering the cross holes.

In old process we used straight reamers for sizing after drilling the cross holes.

Failure Mode Effective Analysis FMEA was done to identify the key risk element that affects the formation of the cone profile on the cross hole. Developed Form cutting tool inspection methods and procedures to its tolerance to validate the retention profile, which ensures product safety feature while lifting heavy objects.

Enquired and made these cutting tools with Harvey and Fullerton tools. As the diameter of the tools is too small, needs higher surface footage to cut the profile. The best suited material is Solid carbide with Tin Aluminum Coating.

2.7f Fixture design, Process capability and Cutting Tool Life study

Work holding fixtures were made to hold 12 pc in a run, based on the available table space with 6 pins facing each other. When I run the machine, the first 6 pins will have the first cross hole and the second 6 pins will have the second cross hole. CNC programs were made to follow the path as explained in above layout. Once the CNC program has been proved, the next step is to study the cutting tool life to estimate the number of holes can be made per cutting tool.

Set aggressive cutting parameters for the cutting tool to break initially and then dropped down to optimal parameters. Both tool life and process capability study performed together to reduce the project time frame.

Based on experience, drafted a sample plan to make 1000 pc order. The life of the tool was initially expected to 400 to 500 pcs. The results were shown above in the previous section. Each sample represents every sixth pc of a run. All the samples were collected in an order to see how the Max B Dimension is varying and also to see how the cutting tool is behaving in the process.

Initially I started with Max B- Dimension, after machining some pins, I have witnessed the Max B Dimensions were dropping. Analyzed it was due to tool wear happened in the process. Then I did Z correction to make the Max B Dimension to the same as started. I repeated the same till the tool is not cutting the metal. I made 3 Z corrections for making 600 pins before I change the tool. Then I completed the balance pins with new tool.

2.7g New Inspection methods:

For Variable feature – Max B Dimension



Picture - 3 Measuring Max B Dimension

- Inserted the balls in to cross holes of the pin.
- Designed a ball nose plunger and adopted to a load meter of capacity 100 Lbs.

Picture - 2 Inspection set up

- Pushed the balls against the PBR profile using the plunger and maintained the load 11 to 13 Lbs. for each pin to get its Max B dimension.
- Used a pitch Micrometer - 0.00005" resolution to get Max B dimensions as shown.
- Inspected all the pins and got the dimensions and used Minitab to check the process normality

and Process Capability **Refer Graph 2 & 3**

For Attribute features

1, Cross hole diameter measure through ID of pin.

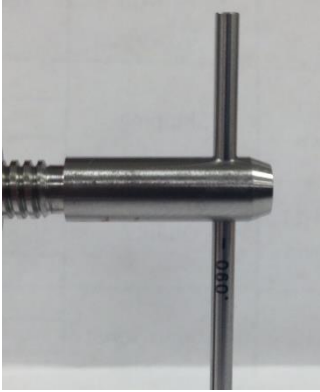
There are no standard instruments available to get the cross hole diameter after the top cone has been machined due to its inaccessibility. Developed a new break through tooth brush form gauge as shown below. It has a sizing cylinder made on stem diameter which is lower than the internal diameter of the pin. It can enter through the nose of the pin and get inserted in to the cross holes to check its size. These gauges were made with increments of 0.001" on the sizing cylinder diameter.



Picture – 4 Tooth Brush form Gauge

These gauges can answer Yes or No type. The stem and Leaf Plot display shows 157 cross holes has 0.096" and 45 cross hole has 0.097". These cross hole sizes 0.096" and 0.097" can allow the ball bearings to enter freely during the assembly.

2, OD Cross hole diameter of the pin (Cone minor diameter).



Used regular Pin gauges to check the OD cross hole of the pin.

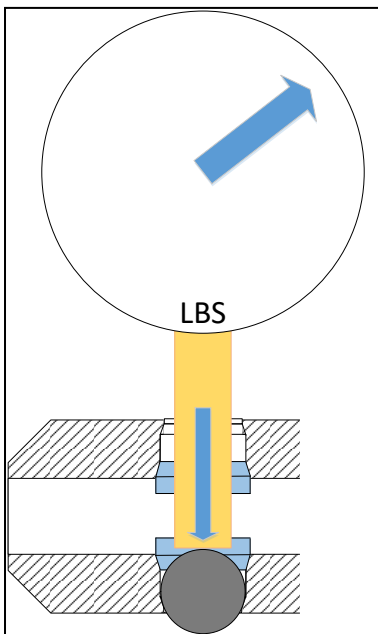
126 Holes are with 0.090" and 76 Holes are with 0.091"

This confirms that the contact point circle diameter is 0.093" is on the cone formed in the pin cross hole.

Now, PBR is realized.

Picture – 5 pin gauge

2.7h Destructive testing and Customer Specification



Cross hole Ball push out destructive testing was carried out per NAS 1332 Specification. The push out values should be at least 10 lbs. for 3/16", 15 lbs. for up to 3/8" pins and 30 lbs up to 1" Pins. Ball push out test performed for the PBR feature. Insert the ball in to the cross hole, insert the hardened pin from the top hole and apply load on the pin and measure the load when the ball is popping out.

S.no	Pin	Push out Values lbs		
		NAS 1332	Stake	PBR
1	1/4"	15	20	45
2	3/8"	15	35	175
3	1/2"	30	45	600

This PBR feature shown superior results than NAS 1332 specification and stake design, the ball will not get missed after the pin assembly.

Fig - 10 Push out Testing

The high ball pushes out values has provided opportunity for a higher Max B dimensions by increasing its tolerance range. This ensures additional product safety while lifting heavy objects.

2.8 The tasks delegated and how it was accomplished;

Initially it was started as an improvement project with the Warner Swasey multi spindle machine leads to "The Other way of manufacturing Quick release Pins". Mapped the overall project process layout and solved the important issues as stated above in the background of this project. The fourth and fifth one was totally a new conceptual thing. Eliminating the cross hole issues and staking process from the regular pin's, implementing the new concept PBR for addressing missing ball issues and make them a reality is one of the benchmark conceptual reality project, that was accomplished.

This huge task was achieved by taking positive steps applying Mechanical and Industrial engineering knowledge and conceptual skills gained through earlier work experience by asking right questions at each difficult situation. Solid works and AutoCAD skills helped to spec out the concept in a visual and dimensional format by eliminating the unknowns in the processes. Team work thought process begins with the team members and higher ups in the organization and gained their support to move forward to make the concept a reality. Designed and developed the concept, tools, gauges, inspection methods and identified the product variables and attributes. Once the destructive test has proved

that PBR concept is working and is the best than the current staking process. True objective was achieved when we presented the concept to our premium customer and reinstated their satisfaction on the products.

2.9 Any particular technical difficulties/problems faced and how it was solved ;

When it was planning to machine the PBR cross holes in the pins, it was not knowing that how to measure the ID cross hole diameter. There was no standard instrument is available to check the diameter at the machine due to it accessibility. We were trying using the correct ball size bearings in to the holes, but it was not the right method to measure the ID cross hole diameter. Questions were raised in the meeting that how measuring this diameter can be achieved.

Applied thought process, which resulted a new form gauge that can enter through the nose side of the pin. The tooth brush form gauge as shown in the previous section under inspection. The form gauge was presented to the Team with the PBR Pin samples everybody was so satisfied. This custom tooth brush form gauge has solved the problem of not having a standard gauge and can measure the product attribute feature.

2.10 Strategies devised including any original or creative design work:

- History data collection from ERP system and Quality portal to see how bad the Quick Release Pin cross hole issues are affecting the business.
- Performed close observation at each process of manufacturing pin.
- Prepared the project details and shared with all its metrics to the higher ups, to start the project and as the project getting progressed, immediately sharing the details on regular intervals with the team members.
- Studied and Reviewed the geometrical dimensioning and tolerance requirements stated in the products (stake design). Documented the tolerance range for each dimension and captured the critical boundary conditions. Asked the right questions to the features that doesn't get answered, which is a huge variable that always lead to inconsistency in the products.
- Resulted a new creative design using solid works and AutoCAD,that led to the introduction of the new concept Positive ball retention – PBR. A new premium product line in the Pin Family.
- Constructed geometry of the new PBR concept for 20 different pins with critical boundary conditions and arrived its cone angle.
- Design the cutting tools with its dimensional constraints and purchased the cutting tools from the suppliers.
- Creatively designed the tooth brush gauges with it accessibility constraints to check an important attribute “ID cross hole diameter”

d) Summary

2.11 My view of the overall project

In over all this Positive Ball Retention PBR is a high level project for the conceptual reality. Design and developing the complete new concept, its tools, gauges, process development, new inspection methods, identifying the attributes and variables in the component manufacturing is a remarkable challenge. Always so thankful to all the team members in this project who physically worked, actively participated and helped in achieving this new conception. Again this PBR project has eliminated the current cross hole issues and regained the customer confidence with products. Now, this PBR is a new product line in the Pin Family.

2.12 How the project fared in meeting the goals/requirements;

The project has truly met the goal that was defined in the objective. This project has proved the conceptual reality with all its parameters. I have presented the details, that how the concepts came to reality, supported with all the documentary evidences such as test results, process capability results, cutting tools designs, development of new inspection systems and new custom gauges. I have proven the product being supplied to the truck company for their engine block assembly section. The conceptual reality got presented to the customer who rejected the pins for missing balls issue a year ago, this concept regained the confidence and also supported with new business for this premium pins.