Optomechanix

Optoelectronics 2017 in Shenzhen report

Best Ideas we Learned in China

China's Watch Factories: Counterfeit vs Authentic

China's Fast Paste progress in Optomechanics

Building a Laser Michelson Interferometer

Iran's First Watch Factory

Oct-Dec 2017

Technical journal of OMiD, Opto-Mechanical Institute of Design

The Grea China Wall, 22,000 Km in lengh, one of the most visited sites in China draws crowds.

Contents

OSA The Optical Society | 100 Since 1916

Member of OSA
Optical Society of America

OMD Opto Mechanical Institute of Design

SPIE.

Member of SPIE
The international Society for Optical Engineering

This issue Dedicated to:

Rostam Moharami, is an Iranian pioneer watchmaker who graduated from Academy of Watchmaking in Bienne Switzerland, in 1975 . He sold his house to purchase the most up to date watchmaking machinary to bring back with him to his homeland, and established National Watchmaking Industries in 1982. He made Zimak brand which stands for: “Elegant Wristware of Ancient Persia”.

We have a full story article on his small watchmaking factory. Mr. Moharami rightfully calls the techniques of watchmaking as: “Skills of Micromechanics”. Political views don’t really matter. At the end of day, when people look at the world in their own honest way, there are nothing but wonderous people trying out various ways of life. I hope this art will evolve, and Islamic designs would enter the fine art of watchmaking.

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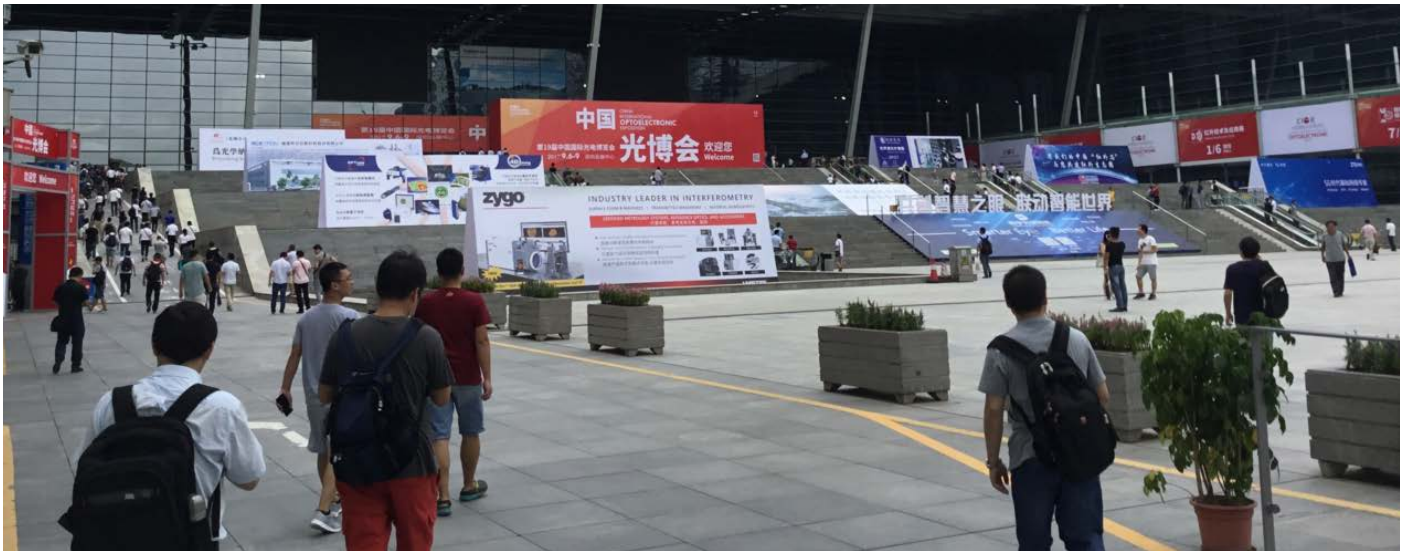
Optomechanix is a quarterly journal of Opto-Mechanical Institute of Design (OMiD), with technical articles for practical, hands-on audience. If you would like to contribute your work, we highly encourage articles with an illustrative approach. We travel around the globe to bring you up-to-date information in the field of Optics, Optomechancis, and Micromechanics.

Cover page photo: Leica M5, the most sophisticated optomx ever copied by Chinese, and a counterfeit IWC watch.
Inside page photo: China’s great wall: Great efforts of a rich past, drive a nation’s current efforts.

Attending Shenzhen Optoelectronics Show 2017

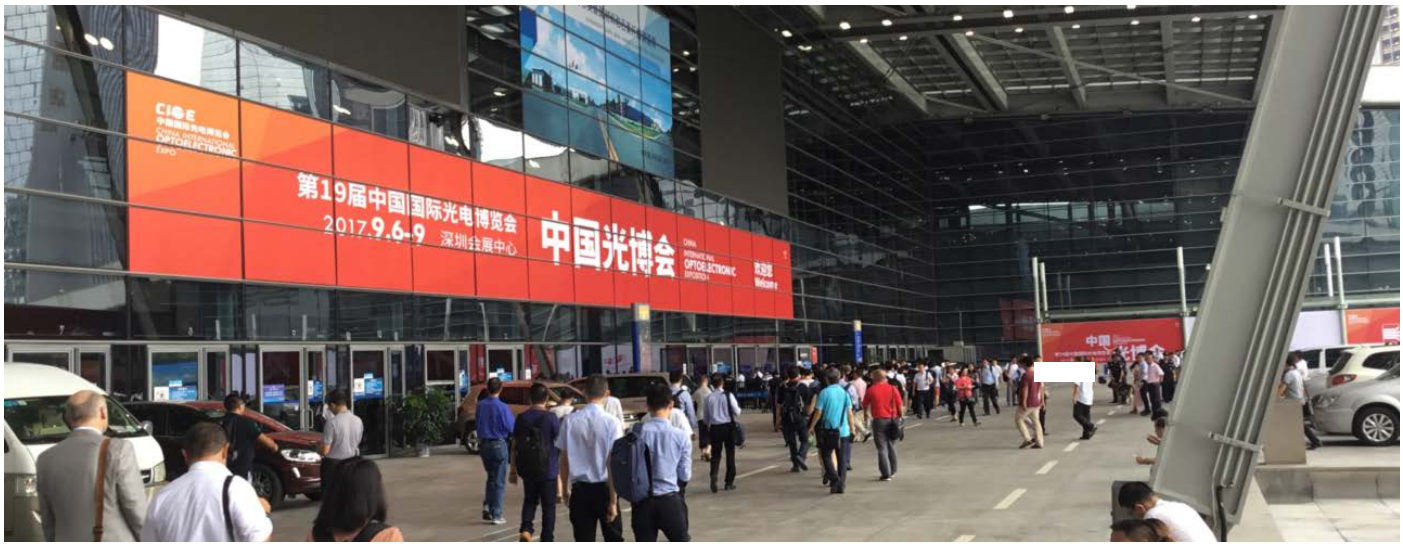
The Opto-Elecronics show Sep 6-9, 2017 held in Shenzhen was an internaional show, but it was in most part Chinese companies. There were a good number of foreign companies from Europe, and America but unfortunately the visitor guide was completely written in Chinese. Upon arriving in China, Shenzhen transportaion provided an easy access to the show. Chinese subway was so easy to follow, and they did have English names. Even the show statistics you'd receive in a follow up email was completely Chinese. So it's my guess that the total number of attendees was 57,348 and

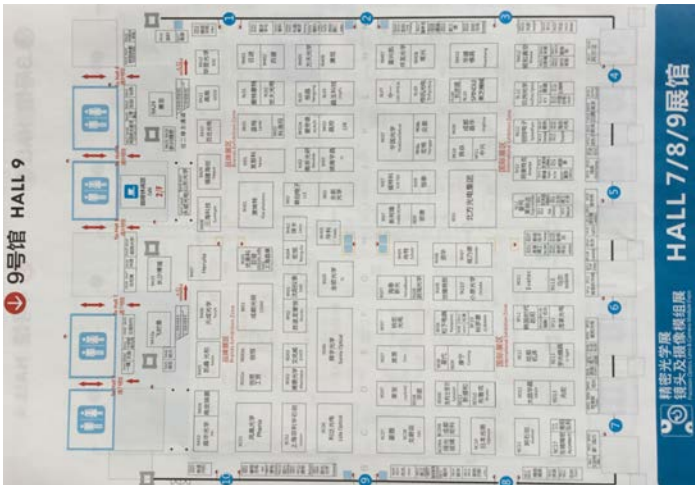


1,668 exhibitors, 3,653 optoelectronic brands from 67 countries, thanks to Google translate. Speaking of Google, very few people know this search engine won't work in China. So the most shocking welcome gift you'll receive is your notebook or phone will connect to the internet, and nothing would work. One reason is many of our mobile devices are set to use Google as its default search engine, and when you would type anything in the address bar, it will just stay blank, and nothing would show on your screen. It would take a while to set the search engine in your ipad or laptop to Yahoo so you could do an inernet search. Some of the websies to reserve tickets or to book a hotel room might also not work. So you'll later learn to download VPN to access them. Then a translation ap so you could ask directions, and hear back what they are saying is a must have. Other than this, China is a very friendly, and fun country to visit.

China is a well mannered country with friendly people, and they highly value tourism. Restaurans won't acceptt tips, and some hotel bell boys won't accept money for carrying your luggage. This a great behavoral acheivement, I think, because of how the media has always portayed China, it will surprise you how their culture has evolved. The world is moving forward in its culure, and it's different from what you'd see on TV. I consider China a great succes in how they receive foreigners, and how they have evolved culturally. If English language was better spoken in the streets, China would have been a heaven for visitors.

The second method of transportaion is cab drivers who have escaped this value system. Cab drivers are an ecception in most countries because they could meet you right at the airport, and they can take your cash without you knowing the





The Visior guide was all in Chinese, with companies' names written in English in an almost unreadble font size. Even Thorlabs' ad used few English words. My impression was this wasn't fully prepared to be an internaional show. Foreign visitors were so welcomed at the booths, but they simply couldn't find their way around the show.

real price. The hird method of transportation is bicycles, and elecric motors that are easilly rentable via an ap on your mobile phone. If you stay one week in China, and you don't use them you'll feel left out. They are a great way to reduce pollution, and keep everyone in shape. I wish many other countries would utilize this to reduce their pollution.

Another barrior you'd notice everywhere in China is long metal fences. You'll find them around buildings, dividing street lanes, and all around shopping malls. They would certainly make you a better planner before starting your journey from say, an ATM machine back to your hotel. It would make no sense why at the end of a fence, there is no way to exit, and you'll have to walk all the way back to be able to get out. My guess is it's a type of populaion conrol when it gets really crowded a times.

Ali Afshari
CEO, OMiD

#1

If your hotel is near #3 (blue) youl'd switch to #1 (red), and get off on Convention Center, announced in English.

Easiest metro system to follow: Switch to #1, and get off on Convention Cener, announced in English.

The train path is clearly indicated on the trains, and the name of the station is clearly announced.

If you decide to take a taxi, just pay by the meter. Don't fall for taxi drivers who'd throw unknown prices at you.

Exhibition floor

The exhibiton Guide was all writen in Chinese, and if you looked very close, you'd find the companies' names written in small print in alphabetical order. When you arrived at the booh, the English names were more visible. Many of the Chinese booths lacked any personel who spoke English. I thought right there that a translator app would be a must have in China. Some atttendees walked around with an interpreter. This is something that didn't make much sense, why someone in a technical field wouldn't speak English, but these were slaes people that were mostly hired to sell in China, and many of them didn't do foreign trade. This is why the show was an excellent opportunity for international buyers to walk in a booth, and with the aid of an entterpreter, get to be their rep in their own country.

The badge sysem was very efficient. It would have been faster if you remembered your pre-registration number.

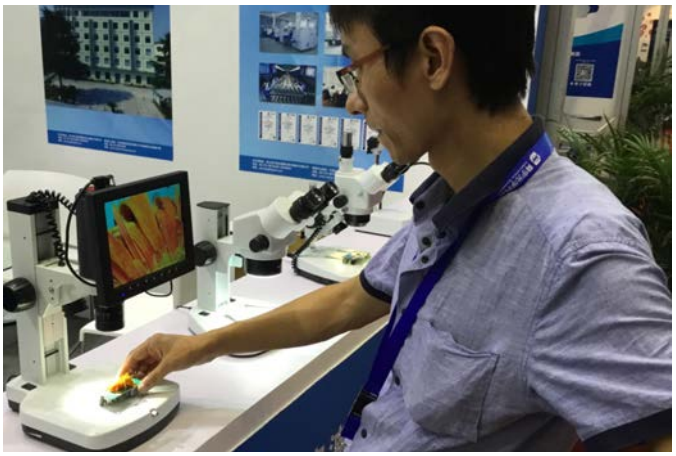
The lines were reasonably short, and there were blue T-shirt attendants guiding you where to go.

Chinese binoculars (left) are much more affordable than the world's famous brands Leica or Zeiss, with reasonable optical performance, and sturdy optomechanics. An infrared camera (right) reveals the inner structure of an LED lamp.

In general, I was impressed with the product variety, and quality level of most products at the show. This was a reasonably big show, with around 50 optomechanical related exhibitors. These companies included catalog houses who sold manual or motorized stages, and optics lab mounts and accessories, microscope, and binoculars manufacturers, optical test equipment manufacturers, and companies that made complete lens assemblies, and objectives.

China's cheap labor cost has gone up drastically during past decade, and many companies are moving their production to neighboring countries like Vietnam. During their economic boom, China learned the know to raise their quality level to world standards, and many small companies emerged to produce and market their own line of products as were seen at the show. Fisheye lenses are now being produced for the cinematography market, and more complex optomechanical components were on display this year that would normaly be expected out of Japan.

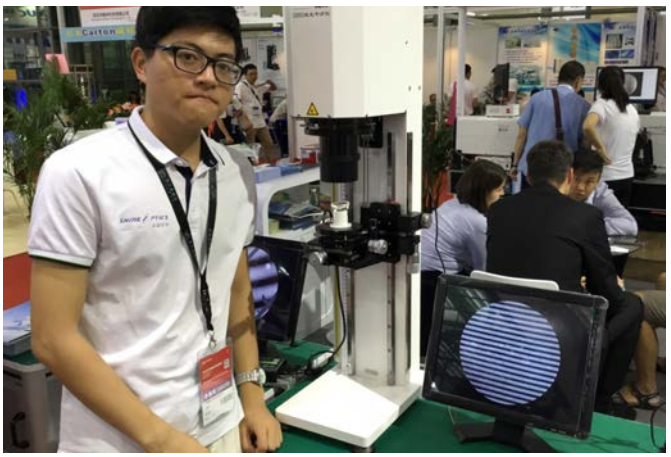
Various motorized stages were similar in design to that of German manufacturers but not as compact as Micos.



Built-in monitor microscope or video magnifier were a popular attraction for microsopy displays.

Stereo zoom microscopes built by this firm has an added design features for easier handling.

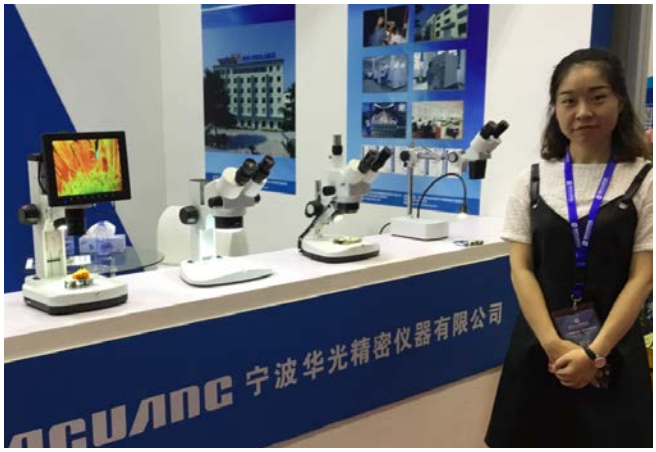
New line of optical test equipment for testing MTF, and back focal length, spherometry, and surface ruffness.

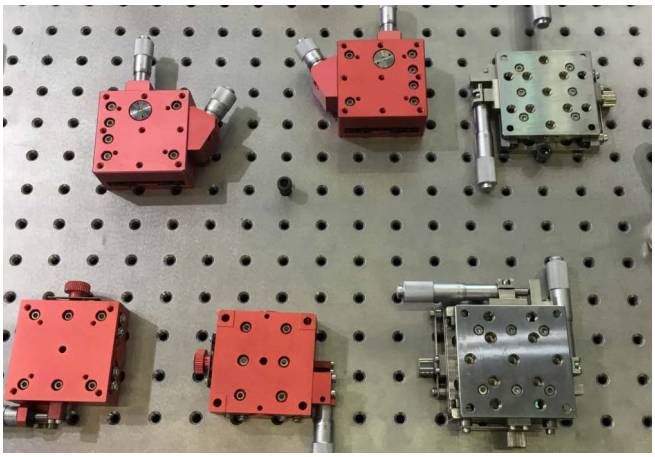


High quality fisheye lenses for the cinematography market (left) on display, with an image circle that can fill the full frame sensor format. A surface profiler interferometer (right) suitable for quick lens testing was reasinably well made.

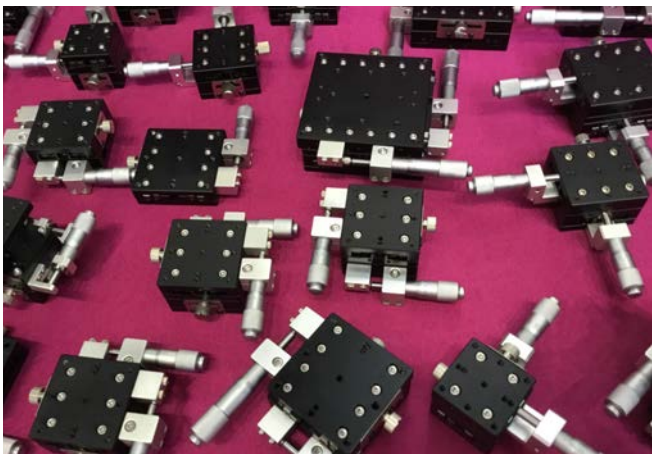
In addition to the rapid growth in LED flat panel displays, the most popular consumner product at the show were binoculars, and microscopes, which happen to be the largest quantity in optiomechanics exports out of China.. These are challenging instruments to design because the end users are ordinary people without much knowledge of optics. For years, Chinese made microscopes were less than desirable in optomechanical quality. Today, china is producing microscopes for the Big Four. These high quality customers has moved China ahead of the game as you'll see in the following articles covering China's enormous economic success.

Some of the mechanical sages made in China lack adequate precision, and know how. The engineering side is not too critical of tolerances. The Thorlabs cage system copied by copmany on the right, would need a few improvenments in their optomechanical precision. Rods in the cage system require exact bore centration which this system lacks.





Colorful stages are found in new Chinese factories that are private owned. The burocracy in government owned companies does not allow new products to emerge. You could see new microscope designes that are up-to date in their design when you visit independent, sole perpriotorship fast paste companies that are better in following trends.



Mechanical sages, and parts made in Shenzhen, and Beijing are displayed a the show. There are top qualiy manufacurers as well as a few low grade work. China still has the repuaion of making parts per cusomer's order rather than their own set standards. I saw a good example of it when examining threaded bores at end of rods: The treaded bores were so much off cenered that you wouldn' find a German company ever leting such part go out their door.

The book Reading Generation in China

My wife and I were so surprised to see children's enthusiasm inside bookstores to read books. This is something we haven't seen visiting other countries. China is investing heavily in printing children's books. This is so unusual because these books can only be sold inside China mainland. The quality of the children's books are amazing both in print, and translation detail. Parents are encouraging their children to read. We saw this in every bookstore we visited. China is going to have a great future by this popular discipline. If you consider how much children in similar age spend on their mobile phone in other parts of the world, and how this can influence their ability to study school text books in future, this is a great promise for China's future.

What do children like to read? They like comic books... So here are so many of them in China book stores that you might only find them collecor's booksores in oher countries. The graphic reproduction quality is fantastic.

There are bookshelves, and bookshelves of books in on any subject you are looking for but only in Chinese.

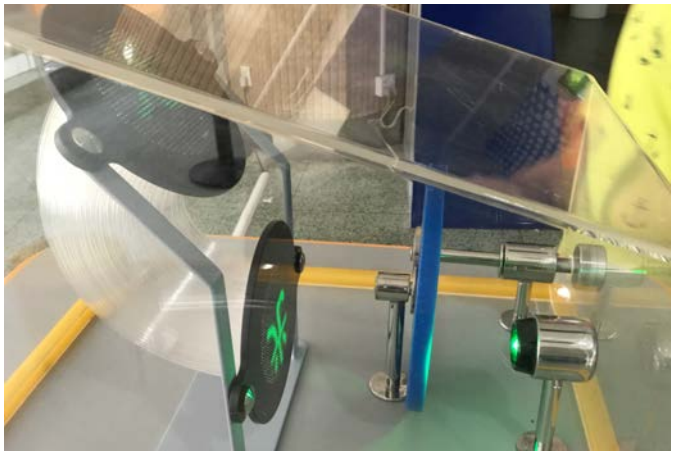
We found only one law breaker, looking a his cell phone! The rest of the children have better concentration.

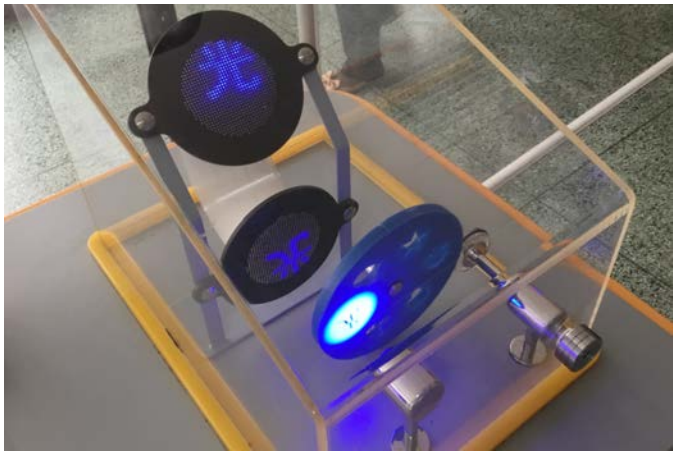
Children's books were so well illusraed, and prined on high quality paper. There were, of course so many copies of works from oher countries. We had seen books copied by other nations before but in China, they were as good as he original.

Shenzhen Science Museum

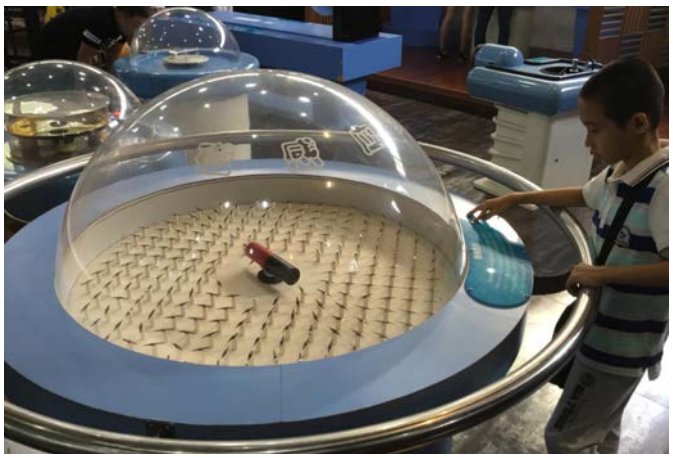
We also visited Shenzhen's science museum, and saw the same number of children learning science. Science museums for children are popular around the world, and I have visited many of them. In china, children seemed to have better concentration in playing with science toys, and they seemed to be more serious. There were less number of children running around pushing buttons. Science experiments seemed to be very basic, and cleverly designed to get the child's attention without flashy electronics. The height of the experiments were designed for children of age 6 and above, that are prepared to be more engaged with the demonstration, and be able to follow it through. Parents seemed to be a big part in children's participation, and they showed equal interest.

A chemistry experiment demonstraion at Shenzhen science museum draws a crowd around this enthusiastic teacher holding a red glass of chemical. Everyone is listening to see what's inside, and how the experiment is going to turn out.





The light guide experiment utilizes a coherent fiber bundle to transfer the image. There is an image wheel that rotates by a knob on the right to change several projection targets that go through the fiber bundel to form an image.



Powerful magnet at center attracts compass needles along its similar poles. China currently has a monoply in super magnets. The audio speaker (right) produces longitudinal sound waves, visible via the floating pellets inside glass tube.

A child learns how to put a simple puzzle together (left). A hand operated water screw pump in the shape of a drill, rolls water upward (right). I have seen these made of wood before, but this one uses steel drum, and it's much easier to learn.

A child learns math by playing with an aligator toy at the science museum (left). Two dimensional objects hanging from the celing (right) produce 3 dimensional shadows on the wall to teach children how they could draw 3D objects on paper.

For a time that most countries are cutting educational funds for schools, China seems to be doing the opposite.

Made In China Counterfeit Industries

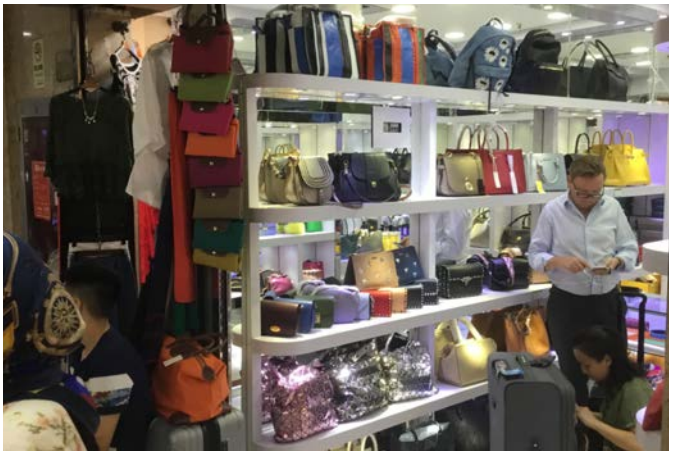
Every nation is good at producing their traditional local handcrafts. Swiss are good at watchmaking, Germans in producing high quality optical Instruments, Persia is good at making rugs, and India, and China rank high in producing silk, and stone carvings. Why are countries pushing so hard to preserve these local crafts?

People of the world are very good at producing what they are passionate about. There is a strong bond between culture, and its handcrafts. China is good at manufacturing high quantity products. When it comes to other nations' crafts, they could copy watches, but only to mimic its shape, and carvings at a glance. By close examination, the details are missing in a copy versus the real authentic watch. The mechanics are also not there. If you ever wind a German made A Lang & Sohne watch, you could feel the big difference. The efforts in perfecting a product that have been carried from heart to hert in a nation can not be reproduced by those who try to copy it.

Historically, China has made copies of Leicas, and Swiss watches. I don't think there is any nation in the world that wouldn't want to be able to do that. What makes it questionable is why are they putting the original name brand on it? When the Swiss make watches, they spend whatever time it takes to achieve the level of quality they are culturally accustomed to. This is called passion, and this is how all original crafts stay preserved in their country of origin. It's a common mistake people make when they see Chinese made copies of a product. China simply can not reproduce the same quality. Passion always prevails, but People do lose their original product when they start losing faith on it.

I saw the same feelings when visiting a stone handcraft factory in Shenzhen. Our guide was a very pleasant, sensitive man, and showed us how each piece was being hand-made by the workers. He was upset why some visitors weren't respectful of those hand made Chinese crafts. He said the stones we carve are tied to our ancient culture, and people don't want to pay for the time that is spent on making them because they say it's made in China! It was ironic to see even Chinese are having a hard time preserving their historical hand crafted artifacts because of "made in China" branding.

We examine the details of a replica watch (left): The Chinese copies are only made to look authentic, but machine made Chinese Geneva Stripes are easily spotted as opposed to more refined Code de Geneva lines (right) in Swiss Watches.



At a well known shopping center in Shenzhen, near Hong Kong border, brand names are sold at a fraction of their original price. It is not hard to see the quality isn't there but you could buy a fake Rolex for $50, and a fake Gucci for a lot less.

After China's industrial revolution in 1979, the country grew enormously in private business, and enjoyed over 10 percent growth in export sales each year for almost four decades. There are now 3,000 watch factories in Shenzhen alone, and they would all make watches per order. The usual turnaround is around 60 days to receive the first prototype of a new watch. These factories strive on made to order watches, and China has become the primary source for fashion watches.

China's production quality was divided in three categories: Cheap, fair, and good, with a huge difference in price. The cheapest products are sent to 3rd world countries. Importers with dishonest business ethics are to blame for this who ask for the cheapest possible cost, and Chinese manufacturers are good at saying yes to such demands. When I visited Chinese bookstores in Shenzhen, and Beijing, I saw their best quality products were being sold there. China's copying of name brands is yet another side of this manufacturing power house that is able to produce look-a-like products at a cheap price for many name brand fans who can't afford the real cost of their favorite brand names.

The real Gucci bag sells for $1,500 a few blocks away. The real authentic brand feels, and handles so different. It is worth the money for someone who appreciates the quality. Made is China seems more fair than anyone might think.

Which one is a fake Rolex, and which is real? I was amused when I entered a Rolex shop, and the salesman was warning me about fake Rolexes, and he casualy said: "By the way, this is a fake one". Genuine Rolex movement is shown on right.

Public destruction of 7,000 fake Rolex watches (leftt) in 2010. This theatrical performance in front of the press was arranged between concerned watchmakers, working in tandem with custom officials. Right, inside Longio watch factory.

The real art of Chinese Watchmaking

Now that I have discussed the counterfeit industry in China, I would also like to discuss the genuine watch factories in China that are trying to make their own mark. Two such factories are Longio, and Beijing Watch factory. What these watchmaking factories are trying to do is to provide something the current watchmaking culture is not set up to do as their European counterparts. By producing fake watches for so many years, the passion for real watchmaking has emerged in China, and is changing the mass produced Chinese culture to a more authentic hand made mechanical wonder. You could still find high volume production habits present in hand made watches, the most apparent one being the CNC decoration patterns instead of refined Code de Geneva lines that are applied by hand one at a time in Europe.

When passion adds to manufacturing, the work shop starts to look like the masters. In Beijing Watch factory, more serious watches are being made than just copies. The $80,000 “Wu Ji” watch (right) are sought after by many watch collectors.

In a Tourbillion watch, the Pallet Wheel, the Pallet, and the Balance are all mounted on a rotating carriage. The pallet wheel (which rotates like the second hand) is engaged to a stationary gear (right) that causes the entire carriage to rotate.

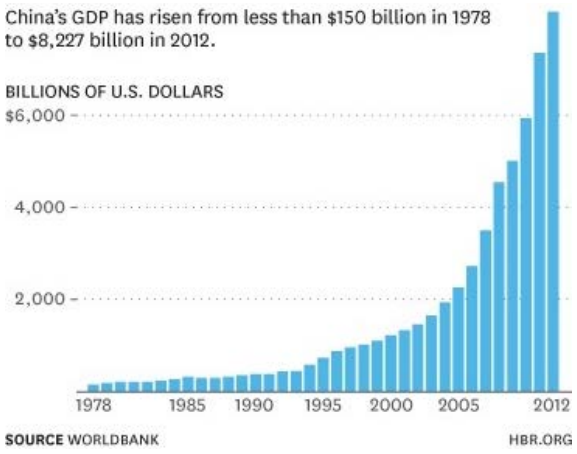
If you like micromechanics, “Wu Ji” (Infinite Universe) axial tourbiliion made by Beijing Watch factory (left) would intrigue you. This newcomer is not as impressive as the $400,000 Gyro Tourbillion reverso made by Jaegar La Coultre (right).

China's fast Paced progress in Optomechanics

Following their 1949 revolution to establish People's Republic of China, Mao's misguided vison of "Great Leap Forward" struggled for three decades for survival but it eventually failed. It wasn't until 1977 when ideas of Deng Xiaoping espoused by Zhou Enali for modernization began moving China forward by empowering economic decision makers at the expense of communist party officials. By 1979 country had fully recovered from stagnation of "The Cultural Revolution". Chinese had already began coping of Leica camera, which was the most prolific brand of the time, and even copied Leica M5. This camera was one of the most sophisticated instruments of its time with built-in light meter, and interchangeable lenses. Today, those hand made cameras are sought after by many collectors, and are much higher in price than the real Leica M5 found on eBay. Other European products they copied were machine tools. I happen to own two of those

Segull optical company copied the prestigeous Leica M5 (named Red Flag, left) in early 1960's. The real M5 (right) still is a marvel of engineering, and complexity. Such bold moves prepared China to shift from High quality to high quantity.

A factory floor in China producing parts. Many of the machines to make watches, camera bodies, and microscopes are not at all sophisticated as in Europe. Few assembly floors are modrenized like the electronics board assembly, opposite page.



Huge container cargos heading towards US, Asia, and the rest of the world contains high volume quantities of optomechanical, and micromechanical instruments. China had enjoyed over 10% growth in their export sales since 1979.

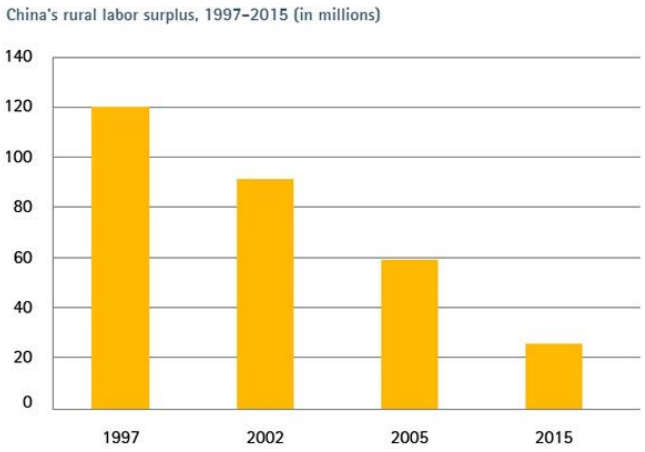
machines from that era, and they are beautifully crafted. Microscopes, binoculars, and telescopes were other favorite instruments that were being copied in China. Basically, China didn't spend money developing. They copied already made instruments with inferior quality. China was always interested in focusing on quantity than quality. Historically, Japan started the same way but they took a different path, focusing on producing products with higher quality at a higher cost.

Visiting a watchmaking factory in China, you'd hear production numbers in the range of 300,000 per month on just a single order. Toys inside kids meals at Mac Donald's, and Burger King are all made in China with quantities of 450,000 or more. The factory, and assembly floor in Chinese watchmaking factories are so different from their European counterparts. China assembly rooms are more like a sewing factory, with low cost hand operated stands to press crystal onto the watches, non-ergonomic assembly benches, and chairs. The intricate watch hands are pushed in with a $5 hand held rod rather than a Bergeon press costing $1,800 each. There are many skilled workers who lack higher discipline.

I heard an interesting story about how one Chinese factory assembled a medium sized order of watches: The finishing steps to assemble the watch was done on the cargo ship. Their logic was the workers would work more efficiently if they did the assembly onboard the ship. This is because if someone's uncle died, or his mother got sick, they'll still show up to work because they are in the ship, and they can't go anywhere!

High volume production is China's specialty. Unfortunately, in micromechanics, just copying won't work at all if you don't know the tolerances. China got away with this by relying on customers for specification. I remember back in 1995, a Chinese factory had Mitutoyo micrometer copies on their table top display at Laser Munich. They looked terrible, both in surface finish, and design proportions. Next year, they were made to look almost the same. I bought one sample for testing, and soon found the anvil tip had an eccentric motion, and I don't know if they ever fixed it. But what about Europe?

The way it works in Germany is they have an apprentice program called the Dual System. After a new employee is hired at say, Carl Zeiss, and starts his/her work, they are sent to this training school 2 out of 5 days per week. German government, and Carl Zeiss both will pay for the training, and for a precision engineer, it would last 3 1/2 years. During this apprentice program, they learn how to do things very professionally with their hands. Those who will work with CNC



The handwork on Chinese made watches is amazing. A watch uses very fine pieces to fit together in a very small package. How they do it is driven by China's business economy. Everythign in China is business oriented even during tourism trips.

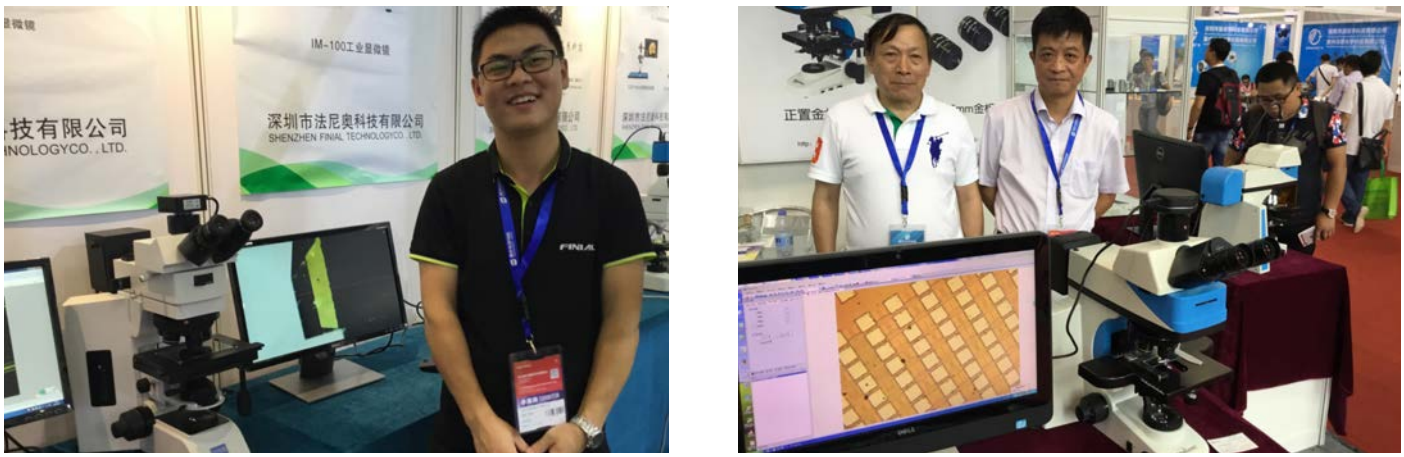
Non-ergonomic chairs used in China factories (left) is not fair to the employees. Basically, the low cost is at the expence of diccomfort for employees. For high tech assmblies, and because of customer visits, work ergonomics has improved.

machines, would file the metal they'll be machining for six months. This rigorous filing, and filing teaches them about the material they will be working with. This is how world class quality manufacturing is achieved in Germany.

In China, handwork would cost a lot less, and that's where many low cost products are sent to be made. No matter how fast a modern machine can machine parts, it's cost would increase the overhead rate of the shop. The cost of a small European live tooling CNC machine made by Emco or Index is around $100-350,000. Higher end machines like Hardinge, and Nakamura would go as high as $650-800,000. The monthly payment to pay for these machines determines the overhead cost of the shop. In US, the average running cost of a machine shop is $65 at its best, and around $85 for shops with high end machines, whereas in countries like China, it's $25-40. This is because parts are produced by older generation machines costing around $15-20,000, and the rest of the work is completed by cheap labor but this wasn't by choice. Technological development has advanced gradually in factories, and outdated equipment continue to be used.

Microscopes: Leica DM6000B is made by Leica Instrumnets LTD, Shaghai, Olympus CX31 is made in Philipines, Nikon E100 is made by Novel Optics in NanJing, and Zeiss Primo series (right) are made by Motic Group in Xiamen plant.

The hardinge machine on display at Shenzhen show reveals micron repeatability, and concentricity. Why automated machines like this haven't yet replaced low cost workers in China, and Vietnam? The answer lies in the total overhead cost.



A copy of OLympus BX2 microscope (left), high performance microscopes (right) are made by manufacturers not very well known to the west. The marketing company who sells in Europe or in US puts their name brand on the products.

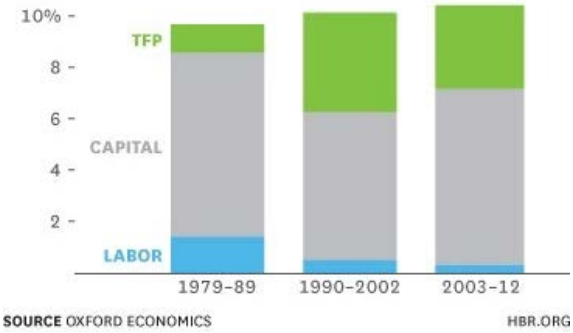
To stay competitive, all the big four microscope manufacturers rely on plants in China or Philippines to build many of their models. Technically, Chinese microscopes have always had the sticky grease problem that caused the sample, and focusing stages' knobs to be too stiff to turn in winter, or too loose in summer. This problem still exists in their current low cost microscopes. A typical price break down of a Chinese made microscope sold in US is as follows: It would cost $100 to build it, $70 overhead, and $130 for profit. It is imported to US for $300 by a major distributor, and by the time it reaches a catalog house like Edmund optics, it is marked as high as $1,600. In this cycle, everyone involved gets their share.

China has gained the know-how to offer a wide range of low cost biological microscopes. These microscopes have built-in cameras (see below) that would hook directly to a computer for image capture at 1/20 th of the cost of Olympus. Of course, the Olympus version would be twice as tall, and four times as heavy. The educational market demands cheaper microscopes in a compact size. Yes, it still uses peanut butter-like grease inside the microscope stages but it has otherwise very good functionality. Cheaper sells, and the world keeps consuming the "Made in China" label. When it's time to publish the images taken with the cheaper microscopes though, it is soon realized that image quality through a Zeiss, Leica, Nikon, and Olympus can not be achieved through inferior optics. Although all these companies might manufacture some of their high end models in Asian plants, the optics side is still made in Europe, or Japan.

Conclusion

Just like Japan, China took the bold path of copying quality products in the past, but after the 1979 economic boom, they gained the know-how by keeping up with higher requirements set by their customers. In most part, Chinese manufacturers still rely on older generation machines, and lower worker's compensation rights to reduce their overhead costs. Today's cost effective formula to produce world class quality is to produce the less critical parts such as mechanical stage, and main body casting, and illumination portion in Asian plants while allocating the more critical components such as high end objectives, and critical optical coatings, and assemblies to plants in Europe, and Japan. In today's competitive playground, it still takes discipline, and passion to produce high end products. Discipline, and passion can not be achieved with poorly trained workers, and cheap tools. It takes time, persistence, and proper apprenticeship to crate highly skilled habits in a factory floor to excel in product quality. It would then take good pay, and worker benefits to keep it running.

A Chinese student microsocpe at Kashan University (left) with built-in CMOS camera, and USB computer interface. We added one of Olympus objectives (right) to achieve much higher optical clarity, and contrast, but with much added cost.



Capital has been the major driver in China's growth over the last three decades, not labor or productibity increase (as measured by total Factor Productivity (TFP), the ratio of output to inputs)

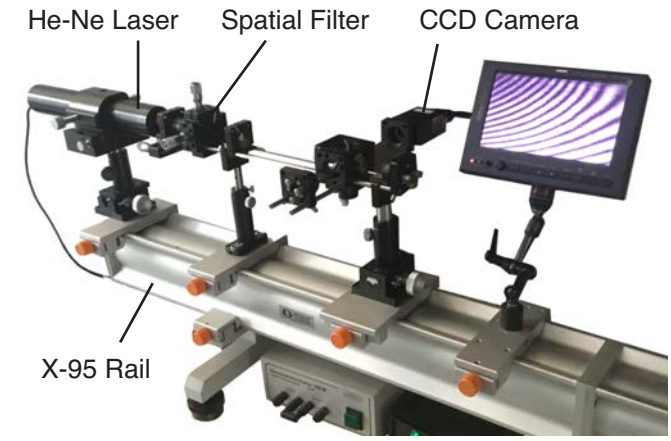
Higher tolerance fabrication of optomechanics requires more expensive machines with an overhead cost of $85 per hour. The Hrdringe collet mount above is built right into the spindle to deliver better than 1 Micron parts concentricity.

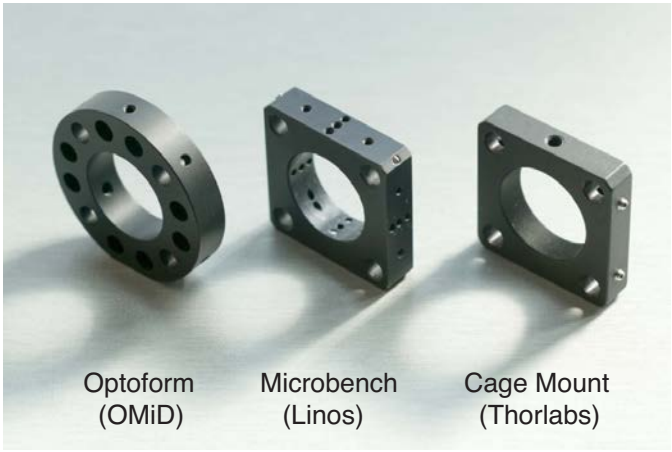
Building a Michelson Interferometer: Form vs Function

By Ali Afshari

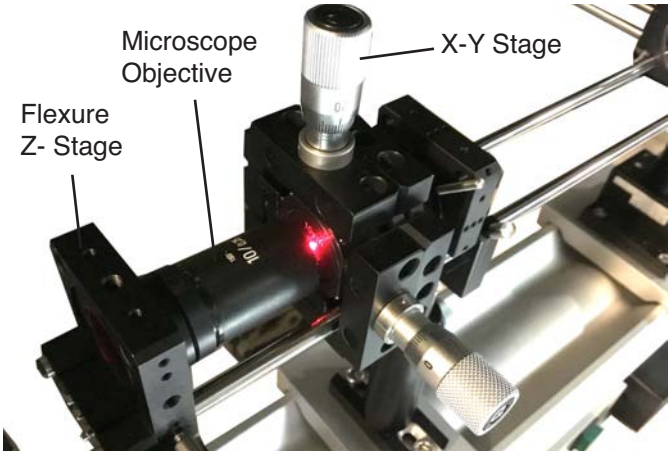
In the last issue, I described how an iPhone microscope can be constructed, and in this issue, we will examine building a Michelson interferometer with Microbench system. To begin with, to build an interferometer, we'd need a clean laser source, so a spetial filter would definitely be where to start. The X-Y stage in Thorlabs is different from Microbench system in that it does not allow passing of rods through the stage. This scheme demands threaded bores on end of rods, which Microbench rods lack. In spite of its 30 year old design, I still prefer Microbench X-Y stage in comparison with Thorlabs, and Optoform. I am the designer of Optoform, so why do I still have so high regards for prior art?

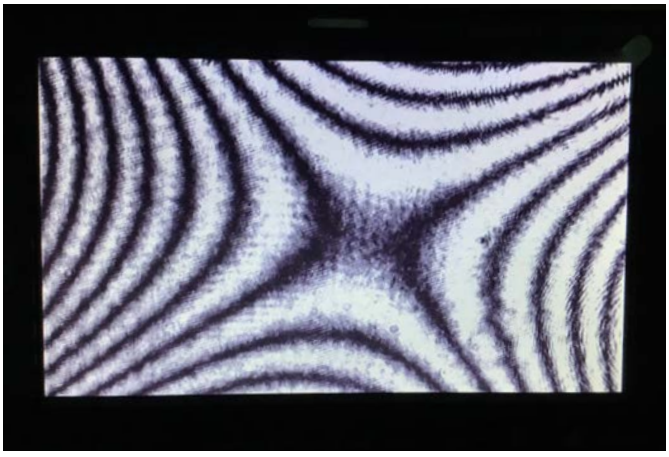
Microbench is our role model in high quality manufacturing. We like to maximize the benefit to our customers, and we compare ourselves with the best. Microbench is truly a precision system, and quality engineering in Germany doesn't end with design. It is world class quality in manufacturing. Thorlabs' success doesn't bother us. We prefer quality over sales. To build an interferometer, for example, high rigidity is essential, and the cage system from Thorlabs simply isn't good enough. The cage system utilizes the edge of screws to secure the rods while Microbench, and Optoform utilize direct force from the face of set screws to secure the rods. In this scheme, the force is big enough to deform the precision bores, and to lock-in the rods not at just two points but by inner half circumference of the bores. Rods in Microbench, and Optoform won't wobble. Newport's cumbersome rod clamping design is good in function. This is what separates form, from function. Thorlabs copied the form from Microbench but they cut costs at the expense of its higher stability. Newport design has much better stability but lacks the versatility of Microbench's simple form.





In our stability study, we utilized Microbench X-Y stage, and the Z (flexure) focusing stage (originally Designed by Thorlabs) to see how easy it is to focus the objective to the pinhole, and achieve a flat wavefront through a collimating lens.





The results were not very satisfactory: The focusing of microscope objective wasn't really easy, and at times it seemed useless. The focus would still jump with even four rods. The laser beam kept falling off the pinhole during adjustments.

The First Iranian Watch Factory

By Ali Afshari

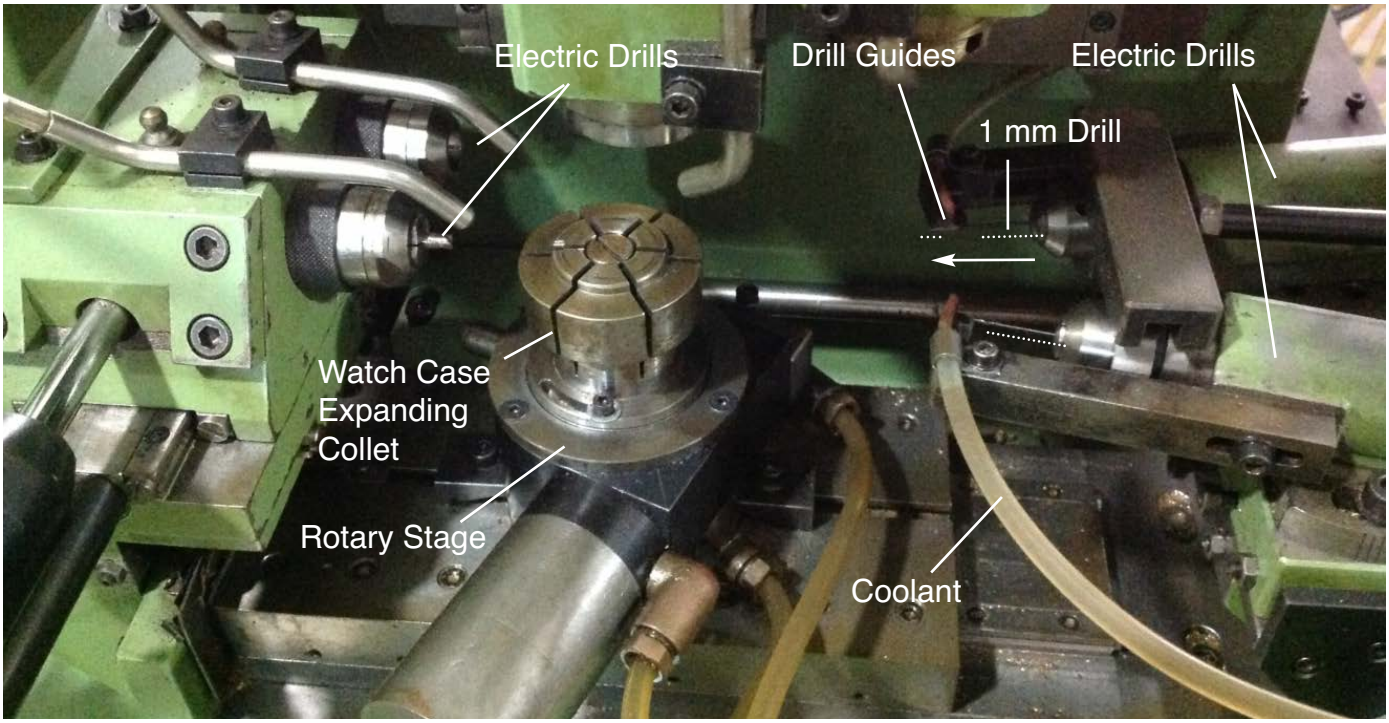
The story of an astute individual who went to Switzerland to study watchmaking, and decided to bring back watchmaking machines to produce watches in Iran is a bold move. Rostam Moharami is such a determined individual whom after going through his apprenticeship with the best watchmakers of his time, he fell in love with watchmaking, and decided to carry the torch. He sold everything he owned in Swiss Franks to raise money to purchase the machines. He then loaded them on trucks to transport them to Iran. Upon arrival on Swiss border, he was stopped there because the destination tag read “Islamic Republic of Iran”!

He couldn’t convince Swedish border control so he went back to his school to get a letter from his school principal that these were watchmaking machines for the sole purpose of making watches. While he reached the Iranian border, he had equal trouble getting them through until he arrived at an industrial park in the city of Gazvin west of capital city Tehran. It had taken him two and a half months to transport the machines, and took him another year to start using them.

The factory was officially opened by minister of Industry Mr. Nematzadeh, who spent two hours at the factory watching the entire process of watchmaking. There were 25 female employees trained to run the 50 machines with a capacity to produce 2000 watches per day. He named his brand “Zimak”. This is the Persian abbreviation for: “Elegant Wrist ware of Ancient Persia”. Like many visionary technocrats, Zimak factory went through many obstacles to survive but the biggest shock was 2 1/2 tons of Chinese made watches

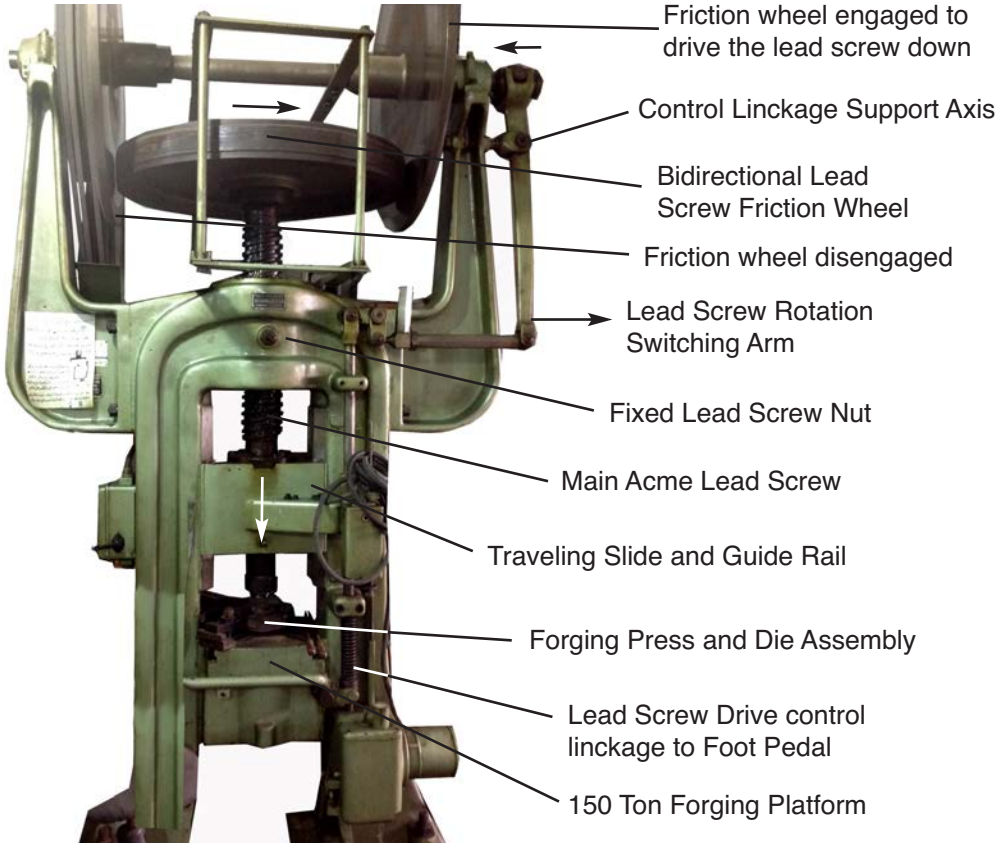
Rostam Moharami visiting OMiD museum in 2015

With Rostam Moharami, who received watchmaking recognition award at Tehran Watch Show, Feb 2017.



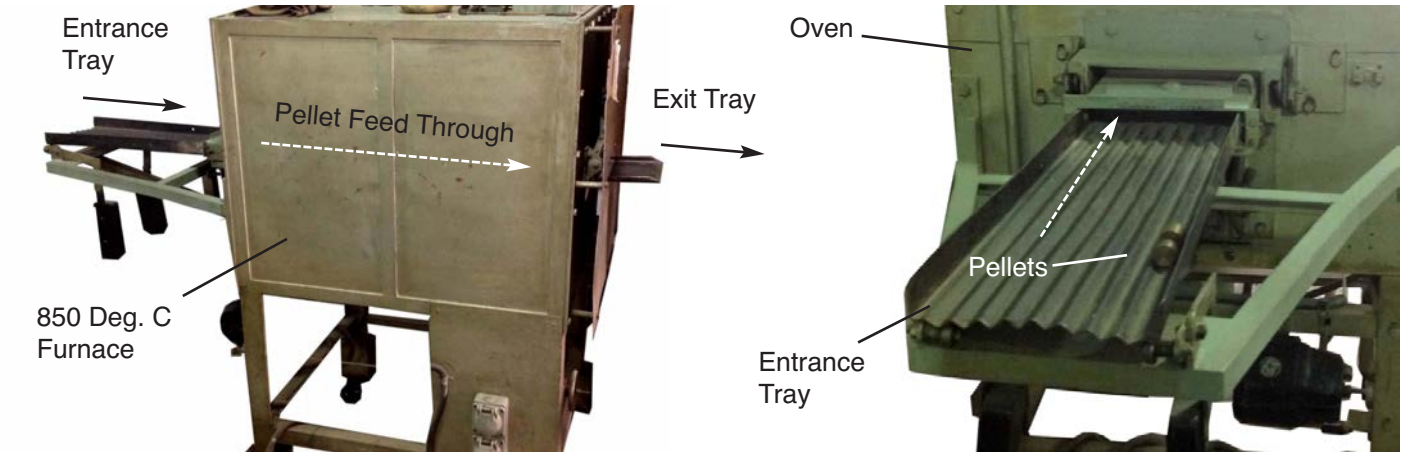
Pneumatic multi drill Swiss machine to make side holes in watch cases at Zemak watch factory. The 1 mm blind holes (above) are made from inside the strap lugs. This takes place at a slant angle with super long drills for clearance. Swiss ingenuity uses drill guids close to the drill tip for precicse drilling.

The Forging Machine

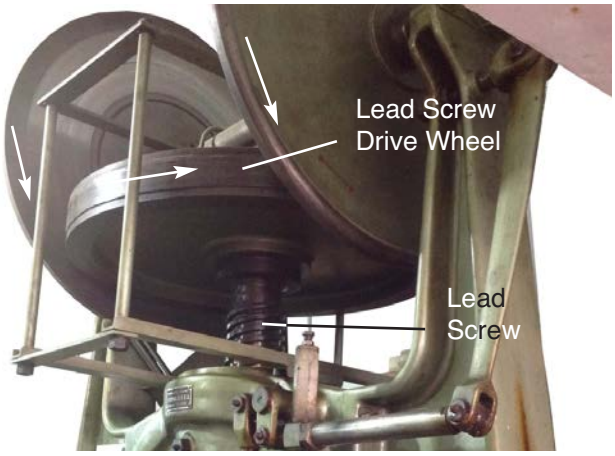


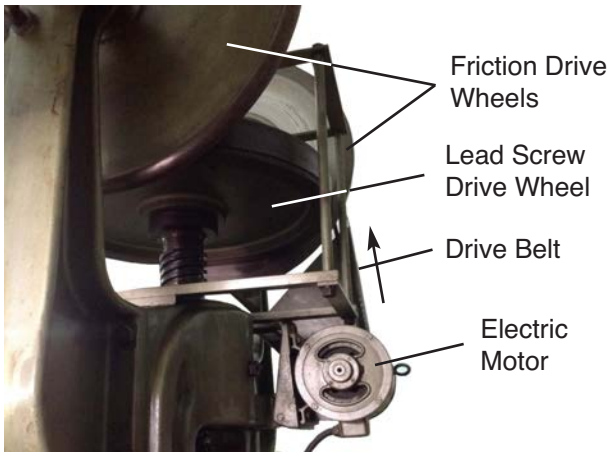
Osterwaldersa 150 ton forging machine has an interesting design using a simple lead screw like the first printing press machines. While the machine is turned on, the two friction wheels on top are in constant rotation. When the foot pedal is pressed down, the two wheels move to the left, and the friction wheel at the end of Lead Screw is engaged to drive the press down (left), hence forging the part.

When the foot pedal is released, the linckage to the friction wheels moves them to the right, turing the Lead Screw in opposite direction, thus moving the press up.



Before the pellets are placed on the forging press, they are heated up by a furnace that works like a conveyer belt (above). The pellets go through an intake tray, go through the furnace to reach 850 degrees C, and exit through the other end.

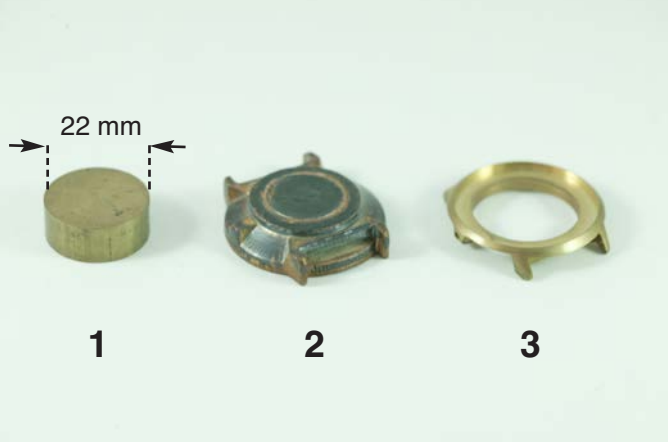


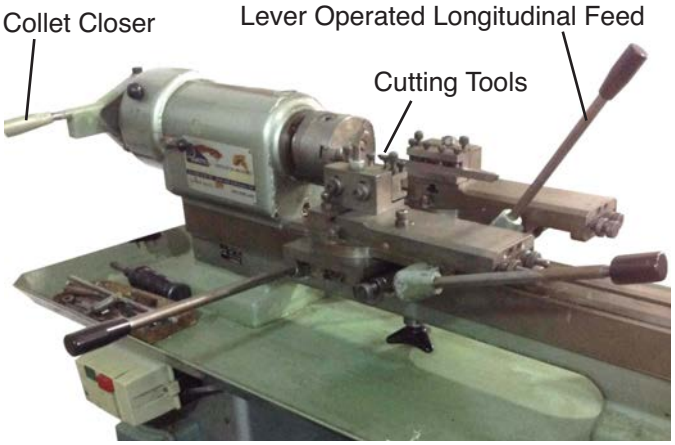


Osterwaldersa 150 ton forging machine works with two friction wheels that rotate in parallel with each other (left). The rotation of main lead screw depends on which friction wheel is engaged with the Lead Screw drive wheel (left). The friction wheels are connected together by a central shaft, and belt driven by an electric motor (right).

that entered Iran between 2010-13. The price of a basic watch that we'll discuss here is around $65, compared to a similar watch made in China that would only cost $25. He ended up laying off all his employees. Zimak factory is still kept open for special orders, like an order of 250 watches he received from the office of foreign minister, Javad Zarif.

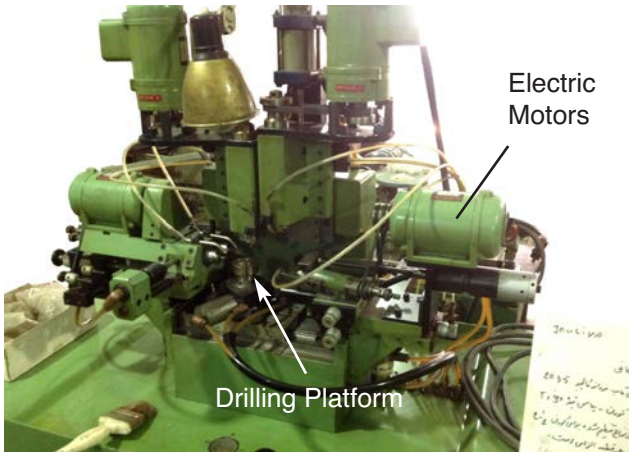
I will go over how each and every part is made at the shop floor, and hope to upload its video on YouTube. The first step is a huge forging machine next to a furnace. Below, 22 mm Dia. by 9 mm long Bronz pellets are fed into the furnace, and like a conveyor belt, the pellets exit the furnace at a 850 Deg. C temperature. The pellets are transferred to the forging machine (opposite page) with a long forceps, and the foot pedal is pressed to operate the machine. After a huge impact (150 Tons), a watch case is forged into shape. There are various dies to make different styles of men and ladies watches. The forged piece is machined by a lever operated lathe to make a nice finished part. This piece goes to another





First three steps of making the watch case: Pellets are fed through a furnace to 850 Degrees C (1), and formed in the 150 ton forging machine (2), and the forged blank is machined to its basic figure (3) via a lever operated lathe (right).

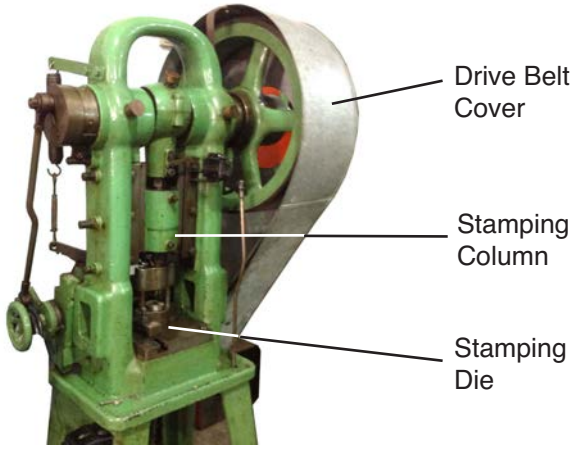
These Swiss designed machines are setup to do specific tasks on the watch case, and the operations performed are to, i.e., thread the back of the case (left) for installing the rear cap, or do other machining operations on the case (right).

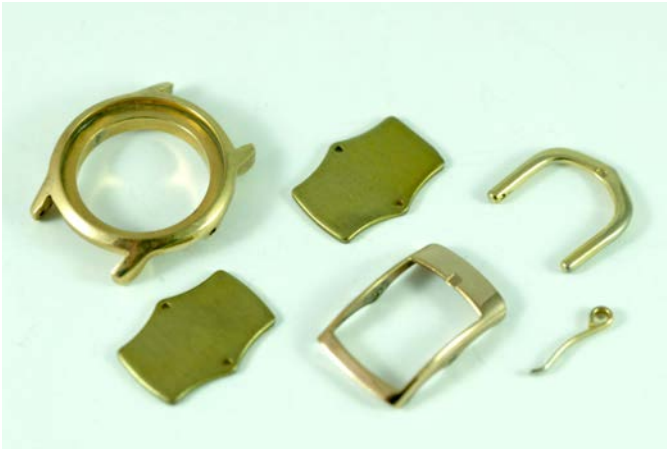


Pneumatic drilling machine (above) fabricates all the side holes on a watch case before it goes to polishing. An experienced opereator can perform all operations without looking at the control panel push bottons (for more details see Page 21)

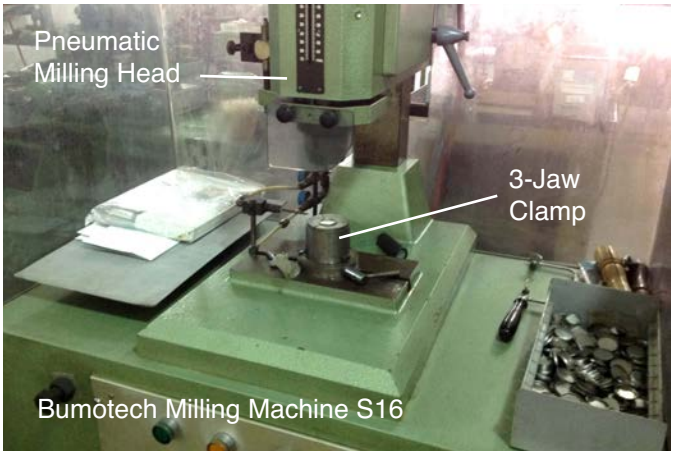
machine that drills the four strap holes, and the center stem hole. The watch case then goes through rigorous polishing, and it may need additional operations whether the back plate is threaded or friction fit type. All the operations are done by separate stand alone machines, so they can be trained to an operator to do just one task very professionally. The job tasks are switched between employees so they will learn every step in watchmaking.

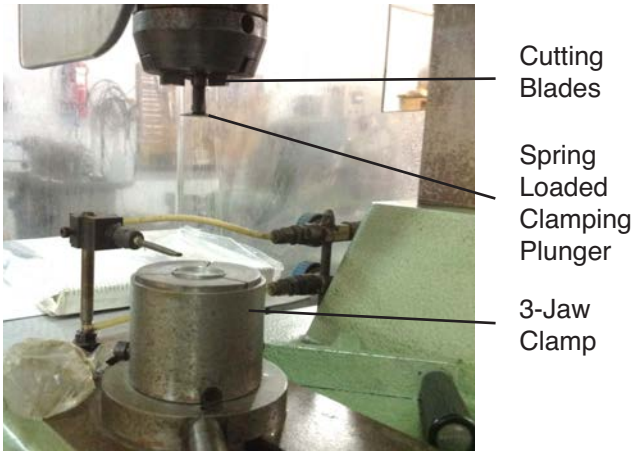
To make the rear cap, there are punch machines that will cut stainless sheet metal to size, and then punched again in a die it to form a cup. The cup is then machined to size by a foot operated pneumatic machine that will face off the excess metal to give it an exact height. This sounds too easy to require a separate machine but it's not. The last operation is the polishing operation where the back side of the rear cap is usually polished with a fine pattern of concentric rings.



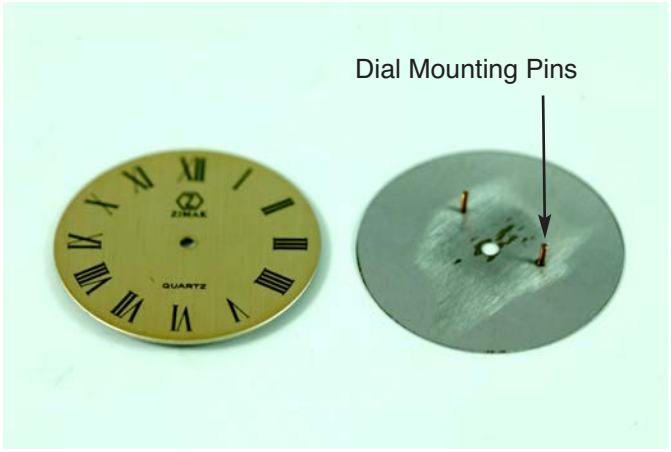


Stamping machines fabricate different parts of the watch (right). Left, the drive belt rotates a large pully to transfer the stamping force. There is a specific stamping machine to make the rear cap of the watch from stamped out metal discs.



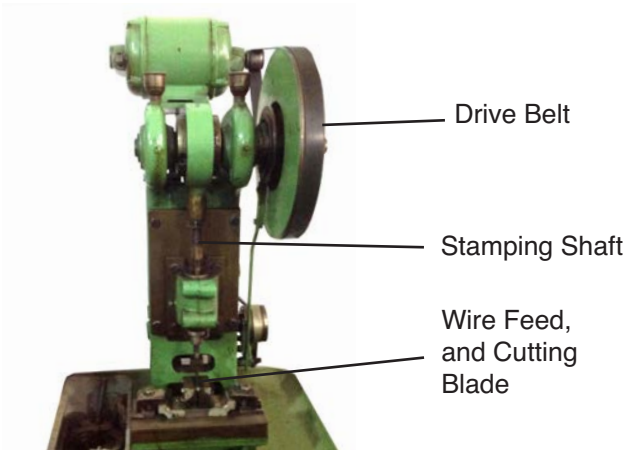


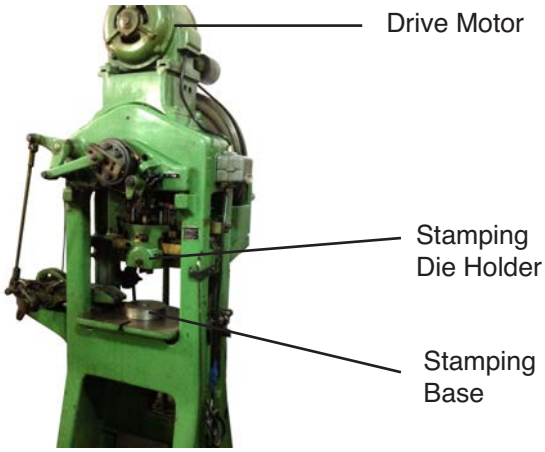
After the rear cap is formed to its shape, it is transfered to a specialized mill to machine off its excess edges. The adjustable depth hydraulic mill above, pushes the rear cap down while approaching it (right) so it won't fall off the 3-jaw vice.



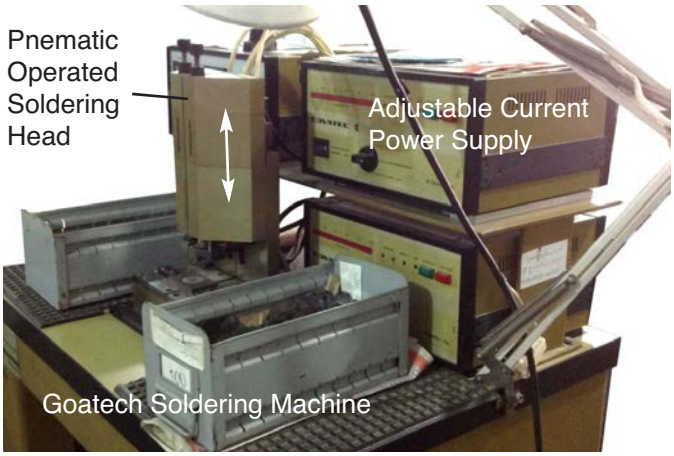
The blank rear cap is deburred, and polished with abrasive paper while it's spinning. The watch dial (right) is the most visible part of a watch. The first operation is to solder two legs on back of the dial for mounting onto the watch movement.

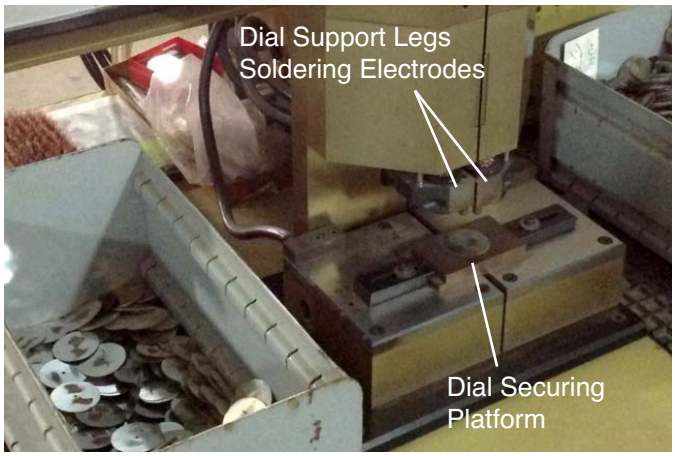
To make the watch dial, Mr. Moharami had to find out how to make it for himself because no one was willing to teach him the know how. At the back of the face, there are two short copper legs that are soldered. These are cut in a cutting machine that he devised, and they are fed into an automatic soldering machine that precisely solders a pair with precise location accuracy on the back of the watch dial. The watch dial is made of Tin that is painted, and baked in an oven. They are then rubber stamped with the desired pattern using a special stamping machine (see next page). The stamping medium is like a soft boiled egg that is placed on an ink pad and is pushed onto the dial face for precise concentricity. The dial is baked one last time in the oven for maximum durability. Various other watch parts are manufactured to complete the wrist band (opposite page) by similar punch machines to cut, and form from steel, and brass sheet metal. Zimak has the capability to protect parts with many types of metal coatings.



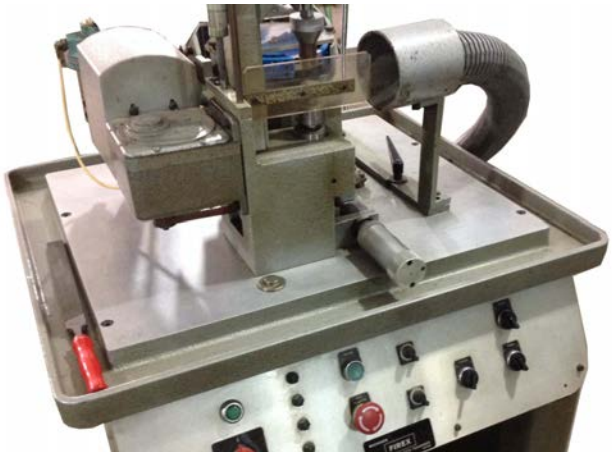


Stamping machines stamp the dial face (right), and dial mounting stems (left). Mounting stems are cut from copper wire at exact lengths, with straight sharp ends before they could be soldered to back of dial face, made of Tin.





Electrode soldering machine precisely solders two mounting legs at exact distance on the back of the dial for its mounting onto the watch movement. The dial face is made of Tin, and the mounting legs are brass. The joint is extremely sturdy.

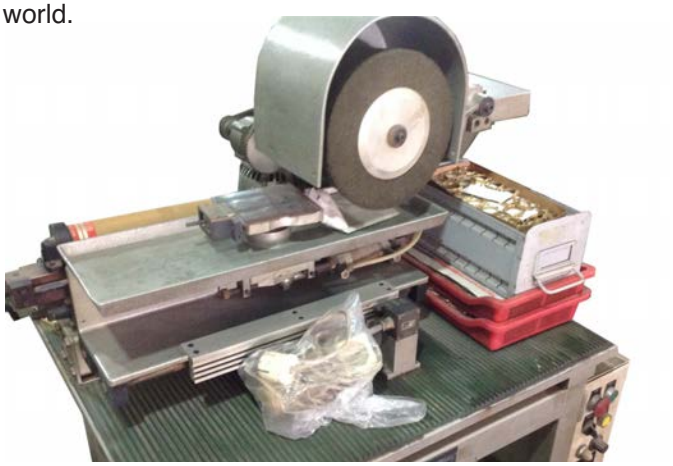


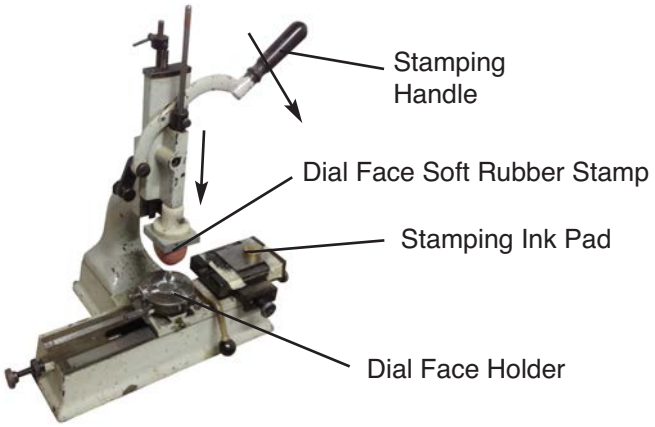
Firex Dial
Polishing
Machines

Watch dials are custom designed for customers. Firex polishing machines (above) polish the watch dial by generating concentric micro patterns on its face, The dial is then painted or dipped into a solution for a thin Silver or Gold coating.

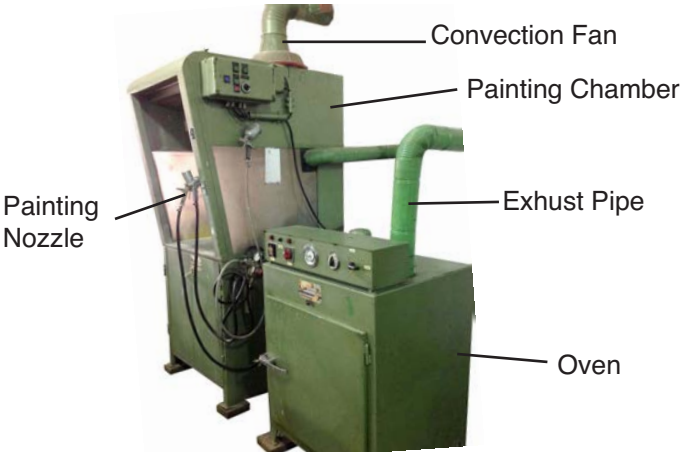
The final assembly, and water proof testing are done in a dust free room. Zimak watches are built with the same standards learned from Swiss factories. Although many high end watch makers make their own movements, most watch factories do not make everything that goes into their watches. Fabricating the movement is the specialty of factories like ETA. The art of watchmaking, as Rostam Moharami recalls one of his professors, Emil Golay once told him during his school years, “It’s the work of someone who is either in love or someone crazy.” Rostam Moharami says: “I was both!”.

This year, when the Swiss were attending the Tehran watchmaking show, they met Moharami, and he showed them his diploma, signed by his teacher Emil Golay, and FH certified (Federation of Swiss Watch Industry). They had heard about the famous watchmaker, and were so surprised to see one of his students has been making watches on this side of the world.





Firex polishing machine (left), and dial stamping machine (right) are utilized to design, and fabricate custom dials. Watch dials are mounted in series on the carrier below the polisher (left), thus a variety of uniform patterns can be acheived.

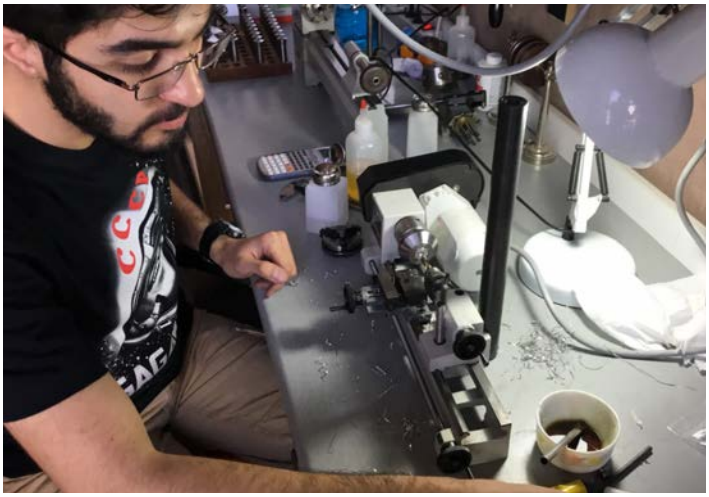


Watch dials are spray painted in an Painting Chamber 100-200 at a time, and baked in an oven (right) for a hard coating. You can’t clean watch hands because of their thin Rhodium coating, but watch dials may be clened with soft solvents.

Zemax watch parts before assembly (left). The watch movement is imported from Switzerland. Although wrist watch movements have been built in Iran, none of them have reached production, but clocks have been in prodcution for years.

I am regularly invited to speak to university students, and It's so rewarding to connect with the Iranian youth. I always invite everyone to visit the museum. While there is strong desire among students to make things, they are constantly held back by their parents to focus on their school work. The outcome is plenty of graduates with untrained hands.

OMiD has opened its doors to the youth to get the hands-on experience they won't learn at school. Museums have this-magical affect on students to become self motivated in science. Iranian students are so devoted to get their degrees. When I was in their age, I couldn't control myself when I was working on my projects at home, and I would push aside my school work. That's why I always got bad grades, and barely made it through school. In contrast, I have shown these students the most exciting projects but right in the middle, they went right back to do their homework. I find that very empowering, and wonder how someone in their shoes knows how to do that. This reminds me of my brother's teacher that he said he would take the entire class to a topless bar. Right before the dancers were ready to take their top off, he would ask them to leave! My brother was a great architect, and passed away a few years ago. I learned many insights from him about design. I am glad I came back here to spend my time with the youth. All the country's budget is absorbed by prospering construction advocates who could only understand bricks. I don't think the youth would have much voice here. I am looking for the one rare individual who would take over my shop.



Navid Asadi is a physics student currently working on his 3D printer project. He is using Unimat 3 lathe, and mill to build all the intricate parts. Unimat 3 is a 30 year old Austrian machine. I met the original designer of Unimat 3, and asked him why they had to discontinue making this fabulous machine? He said after making detailed market study in the 90's they found the majority of youngsters were more interested in computer games than making anything with their hands!

A steam engine is being built from an old Unimat kit. Various parts have been diecast out of Aluminium, and they need to be machined to their finished form to construct the engine.The steam engine kit includes all the hardware, and blue prints so students could learn both machining techniques, and how to read engineering drawigs. This kit was originally sold in Unimat catalog, and it's over 35 years old.

Events Calendar

January 2017

Photonics West

US, San Francisco 01/30-02/01

February

Photonics Russia

Russia, 2/27-3/02

March

Photonics China / OFC

Shanghai, 3/14-16 /San Diego 03/13-15

April

May

CLEO

US, San Jose Convention 5/16-18

June

Laser Munich

Munich, Germany 6/26-29

July

Inustrial Export Russia

Yekateringburg, 07/10-12

August

Photonics San Diego

US, San Diego 8/6-10

China Optoelectronic Expo

China, Shenzhen 8/6-9

September

Photonics India

India, Deli 9/14-16

October

November

Medica Trade Fair

Germany, Dusseldorf 11/13-16

December