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five minutes. but um we ig will go through this,it's in english,so we will maybe interrupt in between.嗯，好的，那我们今天先。嗯。the mode lulus process stages it all starts with raw material we have coils of aluminum different gauges,different types of aluminum May be.t.we start the process by en coiling.t.here we see an the starting point of a car and indeed it's the coils it's winded up materials.um,which is then put onto the stamping machines,and here the pieces the different pieces are now stamped this er.is i could done according to a plan work plan depending on how many cars we want to produce,then we know how many pieces we have to produce from which type of car.er,from which type of the element of the car and finally we collect these pieces in big boxes or in bid ya,big boxes or pallets,let's say.好的，那我们先看一下啊，这个呃，这个是德国的，这个特呃在特斯拉在德国的工厂呃，它最新的这个两个工厂应该呃，一个是在德国，一个是在美国啊。然后呢？我们之前也是给大家呃上上两节课的时候有分享过啊，就是呃现在的这个新的factory planning对吧？因为我们新的工厂，它会有一些新的工艺流程，包括。呃，自动化程度等等，对吧？那我们首先在规划它之前呢？我们先来了解一下呃，现在的新的工厂，它是怎么个样子的？对吧？那它首先呢？大家可以看到前面。呃，所有的这个生产的过程就是起始于我们的这个呃呃，大家看刚才看到那个有一个地方是放了很多钢闸的钢闸，对吧？那个卷闸。那这这个呢，它这边呢，也是把这个卷闸展开以后呢进行呃切割对吧？那这个是它生产车子的第一步，有的是应该是有的是这个，这个我们德语里面叫koy就是这个卷。卷闸那呃，有的是钢的，有的应该有铜的啊，有有的有铝的等等的嗯。these two not this video,ennis h mere to has it so under the now ern vive k. this has to remarked.t.f能的v6在哪方使用？it's been blurred was to when eldon lighter blurred's in with an ED thought.游戏识别已改定。幺二五。a visor by zhou eigen ly stud in a his gal uba flashed on video had tinta gush tego NV dou has to feel first a girlfriend.blessed eyes stick and noise must cooker.马鞍的归途。a happier envied and in fuched him and fuc hes built.I'm fucked and AD klein mahon.谢谢李贝。嗯，good。旅游吧，爱丽丝的浪漫海岛吧，爱丽丝52集。嗯，这首歌。呀it's啊，这个都是它的，这个卷轴对吧？首先就是这些原材料。那这些都是铝材啊aluminum。哦哦哦。t.in addition to traditional blanking tubes,we are using laser.嗯，对，我们先就there are stamping machines，or here we have laser cutting machines who are cat cutting from the steel。the pieces right嗯呀，那我们看到首先它就是这些钢卷对吧？然后呢呃第一机器第一个做的是把这些卷卷轴先给拉开对吧拉开以后呢就？呃，进行激光的切割，那个切割成我们想要的这个大小啊，在英语里面叫blank嗯。and then with these species,we feed them to the press lines,these gigantic dyes and the press lines essentially form.the panels,you know,boom.嗯，葱鸭。so here we have the stamping. so the first point is cutting the pieces out of the out of the coil and the second step is now going through the stamping machines,giving these pieces the form.you see，round forms。we see this very good here on，on this，on this part of the video，嗯，好的，那我们可以看到啊，第一步就是打开卷轴以后先进行这个激光切割，然后呢，第二步呢，就进行。冲压冲压成呃，它想要的形状也是呃，很快速的冲压成型就压一下嗯。把30多个码给他。though instead of the visitors give tty his money here and escaped.t.呃。对呀。we are getting all of the parts necessary to make the body of the vehicle out of those gigantic machines and then all of these parts as they are finished to speak are brought to.to the body shop.so here we see that indeed er this car is in principle just only manufactured out of these pieces.here,the pieces are just collected and put together. it is of course clear that the cars which we are produced out of that.are all the same we have,we have no difference in the cars,because all the pieces put onto the pallets are then multiplied. we have sometimes car factories.where we produce different pieces for different cars，but here in the tesla factory，everything is the same嗯，那我们可以看到它这边呃，就是刚才这抽压完了以后呢？呃，它的这些组件呢？呃，就会呃，放到指定的这个存储的地方，然后呢？它这边我们可以看到它的每一个的呃呃冲压件，它或者说每个部分，对吧？它的part它都都是其实都长得一样的，因为像不好意思啊嗯，有的车厂呢，它就是每一辆车，它可能呃，因为有一些个性化定制或什么它都会有。区别，但是特斯拉他们家呢呃，基本上就是呃压的，只要比如说你这个都是门这块，那它这边基本上都是样子都是一样的OK。the role of the body centers that take all the stamping panels that we make and we bring all that together in one central location.and that's where we actually put the model of US together.we'll start,we do an underbody which is the main floor system of the car.and then from there we'll move to body sides. that's the internal reinforcement,as well as the outer skin and inside the premium area we take the body sides the underbody and the frontend of the car and we actually married it all together.so what we do here,what they do here is in principle building the white body and the white body is in principle white,because it's not painted so far,but all the pieces are now.and this you see with an impressive list or impressive ee long,long uh structure of uh.robots eras they are welding piecewise step by step and it starts with the basic of front with the underground piece.which is like the ground where all the other pieces are put on top，嗯，那我们看到啊，就是这呃，我们前面是把这个呃钢材切割成板，然后切板，以后呢又？呃，冲压成呃，我们需要的这个部分组件对吧？那呃，接下来呢，就是会把这些组件呢？呃，放到中心的这条生产线里面进行这个白参的组装对吧？呃，至于为什么叫白声，因为呃，它是现在是完全还没有呃，经过涂装对吧？那呃，这边呢？它呃，把各个的零部件都呃拼装好，然后呢？呃，这个车身的部分，然后底盘呢？也也是呃。是在另外一块流水线上拼，然后呢，它又会把呃各个不同的部分就是呃放到一起，组装到一起Mary去兼职。到一起就是OK。one of the most unique things about this body center is we actually have five different overall joining methods for the bodyshell.so here he explains how their metal pieces are combined or are connected or a rejoined,they say joined.t and they are describing them here.那就是啊，这边也是跟我们说了一下，因为它的这些金属的这个嗯，各种不同的这个部分，它有呃，怎么把它拼接起来啊，它用的这个词叫join。那它有五种不同的方法，把它给拼接起来。we use adhesive。we use self piercing，so here was a adhesive so glow。let's say用胶水粘起来。overall joining methods for the bodyshell,we use adhesive,we use self piercing rivets.we have cold metal transfer.once was fascinated，fascinated，嗯，它就是有几种哈，前面讲了三种嘛，一种是用这种专业的胶水去粘合，还有的就是用焊接，对吧？呃，另外的它还有一些冷压。嗯，resistance welding as well as a new delta spot welding system，the resistance welding and another type of welding，so they have different types of welding s which are applied here。嗯，它有它有不同的这个呃，所谓的welding就是它的这个焊接嘛，它有呃，不同的方法有热焊有冷焊。when a body leaves the body center,it's actually a full completed bodyshell ready to be prepped and painted.so what we see here is the leaving of the body shop,but the body the cars are leaving here in this er example.the not on a belt,eh? they are leaving on a,yeah,on a,on a small,uh,uh,vehicle or like like an agv or like a manual,eh?umm weld wld chair let's say wld umm wld box here,we see how.here it was too fast here we see.但是白色。对。有几日不来的。OK.when a body leaves the body center,it's actually a full completed bodyshell ready to be.ez itm and user here,we see that in we have a structure and that's not an automated system. it's very,very.呃呃，traditional lets say，嗯，好的，那我们看到啊，就是这个白参呢，它在这个body shop里面组装好了，对吧？这个车身的车体的结构。那呃，它的这个呃，我们其实在前两趟的那个课程当时也给大家分享了，就是老的这个呃，车辆的组装线啊，就是比如说是像那个宝马啊或什么的，他们以前是用传送带的。对吧，那现在呢？呃，它这边呢？就是一辆车，下面有一个呃，就是独独立的这个传送系统，但这个其实也比较老式了，因为它这个只是一个，就是带一个轮子的这么一个。这个结构，但它并不是呃一个自动的啊，因为我们现在很多的这个新的车厂都是用a GB，就是那个用自动的这个小的机器人去搬运它的，那它这边用的还是比较传统的那种。呃，这个就一辆车，带一个钢架，然后下面带几个轮子去搬运OK嗯。prepped and painted.t.this is now a traditional painting,painting process where the complete car is put like into a bath tube and her.yeah，put into this and it is coated by by by AB a thing line。let's嗯，好的，那呃，它这个白参这个组装完以后呢？它就是进进入了下一个工序，对吧？那它就是。呃，也是比较传统的一个工艺，就是呃，进行它的这个呃涂装对吧？那第一步呢？它就是要进到这个呃液体里面对吧？就像那个洗个澡一样，就是它就是。先把它静一下嗯。t have multiple pre treatment primer base,gold clear gold all of this is applied with robots that have the.t.this is with the robot sum the um,the the painting well,the painting process is several steps because they have a ground paint,a ground.这个嗯color ofc round嗯。a pretreatment and several steps until they finally get discoloured car,but what we see is this is done by roberts,because this working environment is very hard for humans to do this.and secondly,by using the robots,they can use um avery the a very low amount of paint for painting the car,so they are optimizing the consumption of paint.嗯，好的，那其实这个整个的涂装车间呢？嗯，它也是有好几道工艺的啊，除了这个呃，刚才的浸润浸进去以后呢，它肯定还要先上一个底色对吧，然后呢，再在上面。呃喷各种不同的颜色，到最后的可能还要呃外面做一个覆盖色，那呃视频里面展示的呢呃是中间的呃。一两道工序啊，但是呢呃，现在基本上它的涂装的车间呢，都是用全自动化，都是用机器人来做了。呃，这样的为什么是这样子？都是用机器人而呃，因为呢，有几个原因，第一个呢呃，我们也知道，就是油漆。这件事情对吧？包括我们以前的油漆工，它是属于这种危险工种的，因为呃，你油漆其实算是一种呃，有害的这个化学品嘛，对人体的这个呃安这个身体的。呃，安全性不太好，对吧？然后第二个呢，就是我们的机器人，它的喷涂呢呃，可以更精确，包括呢，也可以呃，相对来说更高效一些，就是呃。当时呢呃，带之前他们那个车厂，有的车厂也做过实验嘛，就是机器人喷的话呃呃，比我们这个熟练工啊，其实尤其是很吃这个工人的，这个技术的。呃，它比这个熟练工喷涂更省油漆呃，就是整的它的这个用料要更节省嗯。you get a beautiful painted body that's coming to general assembly where we have the super elegant robots we call smart,smart cart.where every card is essentially moving through the factory by itself.here we put the car on to the agvs,but this is for the third step er in the car production.or maybe the fourth step where we are doing the assembly. remember,we have the first step was just stamping the metal pieces.second step is um,the white body putting all the pieces together that they and finally wear a structure which looks a little bit like a car.served a process is then the painting with all the different coating levels and now force is the assembly嗯。好的，那我们看到啊，现在就是呃，进进到了就从它的这个油漆完以后呢，那我们就进行到了第四步，对吧？呃，那第一步呢？就是刚才先把钢板。呃，切割冲压成呃，不同的呃，部件对吧？然后第二步呢是把这些不同的部件给组装成一个白身，对吧？white shop。那这个是在body shop里面做的那呃，第三步呢？就是在呃把这个呃已经。成型的就基本上已经出了车体的样子的，这个white呃white body进行涂装对吧？涂装完了以后呢？我们可以看到呃，因为它这个就开始有不同的颜色了，对吧？因为它这边只是一个models的生产。线所以说它的车型其实都是一模一样的，这个在我们前面的那个冲压的这个里面也讲到了对吧？那所以说呢，它就是每个涂装好的车身呢，它都会有一台a GB。呃来进行运输，那它这边刚才视频里也说了，它叫什么smart呃，这个production因为它等于说是呃，不是人工去搬运，而是每台a GB它就会搬运一。一个不同呃车身的不同颜色的或者说不同，这个订单状态的车身嗯。it follows a magnetic strip and essentially the card is being assembled from inside out.er so,the agv is not very intelligent. he follows age ST the strip magnetic strip in the production and what they explain here is how to put in all the pieces into the car.and the principle is quite simple,starting from the inn est inner part to the more outside part in order to avoid conflicts in the assembly process.我们可以看到，其实汽车工业里面用的这些技术还是比较传统啊嗯嗯，大家可以呃，如果记得的话，上节课的时候我们是不是给大家看了一个现在最新的那个无人仓库的技术，对吧？那像那个就是完全可以是黑灯工厂，那像呃，这边它用的agv还是比较老式的啊，这个是几十年就是反正几十年前这边德国车厂都在用的，就是这个大型的agv，下面是用那个磁条，就是你看到那个。车车厂，它在地板上有那个一条一条黑色的那个，它那个是magnet line，就是一个磁力导线，它就是agv是根据这个磁力导线。来动的，但现在其实我们包括用AI啊，包括用各种的，其实视觉的技术就基本上就不需要呃，这个这种磁导线了，因为你磁导线其实安装成本包括。对车这个整个的车厂，其实厂房也有一定的破坏性，那OK那呃，我们接下来它的第四步就是呃。开始所谓的这个组装对吧？somebody那这个assembly也比较简单，它一般都是从内饰里面开始装，装到外面嗯。我。here we have seen the the cockpit construct eh the cockpit into eh the the the assembly of the cockpit.那我们前面是看到它的那个嗯，这个车体就是内饰的一个组装。控制板啊什么的嗯。嗯。地下地下地下醋会风吹你一根，为你等企业企业安排安排吗？t where every card is essentially moving through the factory by itself,where every card is essentially moving through the factory by itself.it follows a magnetic strip and its s like the d上的那个词条，然后。进行内部的组装，这个是this is now the part where we are in the interior going to the cockpit part，它这个实验组装的这个puppet是它里面的内饰。were utilizing automation to the fullest,we have a variety of robots,so here a lot of robots is used and they say they use the robots to the fullest.this means that they cannot do more with the robots.嗯，它前面也是说它这边就是嗯呃，都是用的这个机器人啊，然后呢呃，它其实这个组装工序也是比较简单，因为都是以这个成品了，就是所以说来说谁都可以来改。干这个活。but er we shoulder see that the robots normally are mostly used in the white body area to use the robots in the assembly area normally I ser.that's really new to go also in the assembly deeply into the robots or automation.那实际上，我们在传统的这个汽车组装的呃工艺里面就是呃它的呃，在这个白身对吧？组装白身的时候用的是比较多的这个。呃，用机器人那在后面这个啊，包括内饰啊，这些的很多都是用人工的，那特斯拉这边也是说在。这个第四步的工序里面，它也是用呃机器人这块的话，其实是比较创新的嗯。from the the teenager ones to huge one that are able to move the entire body itself.so we have here total one hundred and sixty roads。of course，全场一共有160个Robert that I am always very impressed to look at is the one that puts the seats。inside.here we see how beautiful this is,looked like where the seats are put into the into the car,because when this is done er by humans er,it is really hard work.t好的，那我们看到啊，它的这个内饰里面，它这个安装座椅，汽车座椅就是用机器人的这个。嗯，在传统的这个车厂一般呃座椅都是人安装上去的，因为内饰的部分你要去专门做这个安装的机器人，成本也是比较高的啊，那特斯拉它这边呢，就是用这个机器人来安装的。那嗯，好处呢也是在于唉，它可以减轻这个员工他的工作量，因为车座椅也比较重嘛啊，所以它这一块也是用机器人来代替。嗯，and the same rob is able to change tools more from a seat handling device to putting the windshield。this is interesting that the same robot on one side is putting in the seat and then the windshield as well,so the robots by changing the devices can be used more,more flexible.嗯，那这边也是比较有意思啊，就是同样的一台机器，它稍微进行一个呃，一些小的变更啊，就是小的这个呃，调整的话，它前面这。同样，这台机器呃，前面是在组装座椅的那呃，稍微调整一下呢，它又可以去呃安装挡风玻璃了嗯，那就同样一台机器，它可以多用。actually grabbed the windshield,put some glue around it and then put the windshield onto the car as well as do the real glass of the vehicle.t so this is put with glue into the car,the front and the back shield of the window.那这这这个机器人做什么呢？哈，就是首先呢，在呃车窗玻璃上给玻璃上胶，然后呢，它可以用于安装呃前挡风玻璃，后挡风玻璃，还有天窗。they here we have most everything we need right here in the house. we do the majority of our stamping panels,ourselves,we.nbsp. we have design engineers here at the facility,so we're very nimble and very quick at what we do.this er the idea of er tesla here is in fact that they produce every or many pieces erin in their own.yeah,ere in this own factory,but it is a very similar philosophy as the philosophy of by d.which where be also tries to produce nearly everything own.嗯，好的，那我们可以看到啊，现在这个特斯拉呢，它的理念就是说呃，这个车厂它基本上所有的这个零部件就包括从。这个白生开始对吧？它希望就是尽量多的都是在我自己的工厂里面生产的，那这个其实也有点区别于我们传统的车企，因为我们传统车企很多东西其实都外包掉的。呃，那呃，这个教授说现在包括像比亚迪啊什么的，他们嗯，也是想说哎，尽量多的能够都是自己造的。t.here they say,and this is important to get as a figure four to five days to produce the car from the raw material to the finished er product.嗯，那我们可以看到这个，这个制造效率还是比较高的啊，就是从呃原材料对吧？我下了订单以后，这个车从进我这厂，从原材料开始，一直到成品车出去，一般就只需要四到五天的时间。line,it's magnificent. it's like a piece of art.we constantly try to improve process efficiency. we want to push the boundaries of what can be done by robots versus humans.so it's a constant evolution.this is a very interesting point,which is mentioned here that there are all the factories which are built.are constantly trying to improve the processes and his comment here was they are all the time trying to figure out how a robot can help.and which part of a job or of a activity can be replaced by a robot嗯，那它这边呢？也是说了一点啊，就是这它的这个整个工厂的设计理念。就是因为我们呃之前也在说啊，包括我们的这个人机课上也好，在这个呃工厂设计课也好，因为现在现行的工厂呢，很多也是在看哎，我怎么去提高效率或我怎么去优化流程对吧？那特斯拉这边呢，它也是呃在呃尽量的就是把一些呃劳动的活，或者说是一些呃。就是尽量的把活都能够让机器人给代替掉嗯。t.we are building the future here that's how proud I feel about this,what we have seen in these last sequences here.is in principal testing environments where er,yeah,let's say the the wheel or the roundness of the wheels is tested and some other tests there are many more tests.the last fraction of the ACA production is a isa. isa is a line where several different types of tests are performed.嗯，对呀，但是不一定能把笔芯。is the future of the USA，那我们可以看到最后的这个就是一个测试的流程，对吧？就包括它测这个车运行的好不好？然后包括它的这个转速啊，等等的那呃通过测试。以后呢那呃，最后才能够出场嗯。um,what's him minus ki tn ohi n't tides by then,i chk inner er the's icy vacant slo uf mala's order,he flung UN mita vit erin fully in others.the's proclaim is yet we have no ami nut in Jimmy minut in dave d the film ze ally knitted er like him.uh,the size of the film will linger the or the size of the markets my p folio. you can't stop the ing to them for se mind on a video.呀OK。yeerso would I im max that's not h malum um um block honour is through ant hel hy iltont er seen ohmal just can't see zin ADS,can't see yeh.对吧？um,so now we show the video a ser whole video without interruption,and now you get a better er er a total impression.下一次一定要试验。呀也行嗯。yes,so we show now the complete video. it's a short video as a total video,and you get from the beginning to the end now,the production.好的，那我们呃再把这个呃视频完整的给大家放一遍啊，中间不停，大家可以来看一下，从这个从头到尾它的整个的一个生产流程。from inner to come.the happen fela gramma cked the hubby by my hoo g ladd in this video's niched'n troned and pitts iet one mitriotrand.I'm sharing the most one,yeah,uh h tag mao kay.nda does neotoma tis you muster for in a baba im,Switzerland,nim der as mitt.I know website.yaya t say AH dun rya,it was not my my my god.但是是。while he hopped in fashion,just opposed it.嗯，get seed money，yeah，yeah。nbsp the mode lulus process stages it all starts with raw material we have coils of aluminum different gauges,different types of aluminum maybe it's aluminum.needs not still呀嗯，第三路命令也一样，我们看到先从这个原材料啊，它都是用的铝材。红的绿卷。cut it into black pieces. we call them blanks in addition to traditional blanking tools we're using laser.and then with these species,we feed them to the press lines,these gigantic dies and the press lines essentially form.the panels,you know,boom.哈哈哈。六秒钟冲压一个键，速度还是比较快的，all of the parts necessary to make the body of the week。t.nbsp,the role of the body centers that take all the stamping panels that we make and we bring all that together in one central location.and that's where we actually put the model of US together.we'll start,we do an underbody which is the main floor system of the car and then from there we'll move to body sides. that's the internal reinforcement as well as the outer skin.and inside the premium area,we take the body sides the underbody and the frontend of the car and we actually married it all together.那可以看到，白生大部分都还是机器在做，有只有一小部分是在工作different overall joining methods for the bodyshell。we use adhesive. we use self piercing rivets. we have cold metal transfer.conventional resistance welding as well as a new delta spot welding system.when a body leaves the body center,it's actually a full completed bodyshell ready to be prepped and painted.t.t.you get a beautiful painted body that's coming to general assembly where we have the super elegant robots we call smart,smart cart.where every card is essentially moving through the factory by itself,it follows a magnetic strip and essentially the card is being assembled from inside out.we are utilizing automation to the fullest. we have a variety of robots from the teenager ones to huge one that are able to move the entire body itself.one of the robot that ii I'm always very impressed to look at is the one that puts the seats inside the model.t.actually grabbed the windshield,put some glue around it and then put the windshield onto the car as well as do the rear glass of the vehicle.we talk about versatility. here we have most everything we need right here in house,we do the majority of our stamping panels,ourselves.nbsp we have design engineers here at the facility,so we're very nimble and very quick at what we do currently. it takes about three to five days for modules to go from raw material all the way to being finished on the bamboo line.it's magnificent. it's like a piece of art.we constantly try to improve process efficiency. we want to push the boundaries of what can be done by robots versus humans.so it's a constant revolution.t.real building the future here，that's how proud I feel about this。好的，那我们看了一下这个整个的视频啊，就是从呃它从这个原材料对吧？到呃，整个完成呃，这个出厂对吧？好像也前面说了三到五天那呃，这个呢？也是未来的我们这些工厂的一个发展方向。yeah,we still not by common tama. yeah,I am.well,I would like to make a commenter,but based on the slides we are having here.ander with the slides are er explaining a little bit or maybe it's a better explanation of the slides.and when we go go for the slides,we see that,um,we have this,this.耶耶。你说去买还买肉，那我吃饭都还没弄成。tamazinyeahinef fica cial models,yeah.do.it's a god,so the treads in industrial production is that the the the resting time of will be always reduced.this means our production times are always shorter,becoming shorter and shorter,and this brings US to the point that the products and the.technology will be always shorter，so we try to speed up production。嗯，好的，那我们yeah，妈妈不爱听，妈妈不爱听。the number of product varieties of the materials is also um reduced and oh no,it is increased,but we try to build groups of modules and ten modules are.assembled then,the international competition requires in case of higher labor cost,more effectiveness and affectivity.and this here,in this example of the tesla,we have seen a lot of robots,more robots than ever before.eh? so this is the consequence of the higher cost of in the labor cost.er,another point is the quality and reliability becomes more important,so for the common effects it means that the testing sequence at the end of their production is becoming always larger.it is not only looking if all the components are working properly,eventually with conventional cars is that they comply with seal two emissions or fuel consumptions.and soon they are checking if the if um for the fuel,if the tanks are not,uh,are not leaking.eh? so are there a variety of? let's say quality checks also the color the paint is checked because there should be no spots on the on the skin of the color,let's say.and then environmental protection becomes more and more efficient that this is not has not been shown here and is factory very good.but in the paint and everywhere they reuse the water,they reuse resources so that the environmental protection.t is very important here,especially in the eh tesla factory,because it is in a.嗯。it is producing or the factory is established in a er protected environment er where normally no production should take place.and the delivery times will become shorter here,we have May be production time four to five days er,but this is because of the the the.the the style they produce,but in the end when you when we look into the production hours,the pure production hours,then it's even shorter because the bodies are somehow.also，somehow waiting in in cues，OK，my have na paler。好的，那我们先休息一下呃，休息五分钟再回来。