What Does It Take to be An Automotive Fastener Supplier?

胜任汽车扣件供应商的必要条件

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When I was first asked to write an editorial on the topic of automotive fasteners and related quality requirements, I accepted. Once I started, I quickly found that I had to solicit some guidance from other experts in the automotive fastener supply chain. I found there is not a simple recipe or list of requirements that can be "checked off" in order to supply fasteners to the automotive industry. In fact there isn't even a defined "measurement system" as is found for aerospace or commercial fasteners. What I did find were (3) very important elements that when applied correctly, will result in a firm's ability to supply the automotive industry. These are:

- ISO/TS 16949 Registration
- Zero Defect Policy commitment
- Ability to perform automated sorting/inspection process on "critical" part features

First and foremost, a supplier has to be registered to ISO/TS 16949 quality management system based on ISO 9001 but having several additional requirements as it relates to automotive production components. A quality management system is the foundation of how orders are accepted, processed, inspected, and ultimately shipped to the end user. ISO/TS 16949 has specific requirements outlining a process known as PPAP (Production Part Approval Process). It is this process that sets ISO/TS 16949 apart from other ISO quality managements system with its emphasis on the entire manufacturing process. There are five levels of PPAP, which are outlined by AIAG (Automotive Industry Action Group). The basic elements for a PPAP are as follows:

- Design records
- Engineering change documents
- Customer engineering approval
- Design FMEA
- Process flow diagrams
- Process FMEA
- Control plan
- MSA
- Dimensional analysis
- Material performance results
- Initial process studies
- Qualified laboratory documentation
- ARR
- Sample product
- Master sample
- Checking aids
- Records of compliance
- PSW

Requirements for all fastener measurements are the same. This simply means that length is length, pitch diameter is pitch diameter, and so forth. The important part is to know what your customer's requirements are, which are deeply ingrained in any ISO quality system defined by contract review. Automotive plants have to rely on coordinating thousands of parts coming together at just the right time in order to

当我受邀撰写有关汽车扣件与品质相关规范的专文时，起笔的当下，我很快发现必须向其他汽车扣件供应链中的专家征询意见。我发现并没有所谓的规范清单可让业者参考，以衡量自身是否能供应产品给汽车产业。事实上，与航太用扣件或商用扣件不同的是，汽车用扣件的供应并没有绝对的量测准则。但在此仍可归纳出三项非常重要的条件，若这些条件运用得宜，将有助于供应方企业持续且稳定地提供扣件产品给汽车产业。这三项条件分别是：

1.ISO/TS 16949 认证登录。

2.产品零缺陷管理保证。

3.有能力可为关键性零件执行自动化筛选与检测程序。

首先最重要的是，汽车扣件供应商必须在拥有ISO 9001认证基础上登记ISO/TS 16949品质管理制度认证，当然若牵涉到汽车产制零件，则还会有几项附加条件。品质管理制度是接单、处理订单、审核订单、出货给终端用户时必要的基础平台。ISO/TS 16949与一般的ISO品质管理制度不同之处在于，ISO/TS 16949针对PPAP(生产件批准程序)列出了特定要求，特别重视整体产制程序。PPAP共有五个层级，由汽车工业行动小组(AIAG)列出每个层级的特定要求。PPAP的基本构成如下：

- 设计纪录 。
- 工程变更文件。
- 客户工程批准。
- 设计失效模式及效应分析。
- 生产流程图。
- 过程失效模式及效应分析。
- 控制计画。
- 测量系统分析。
- 尺寸分析。
- 材料性能结果。
- 初始过程能力研究。
- 合格实验室文件。
- 外观批准报告书。
- 生产件样品。
- 标准样品。
- 检查辅具文件。
- 客户规定要求之合格纪录。
- 部品提出保证书。

所有扣件量测的规制要求都一样，这代表长度、螺纹节径等等的规制都是制定好的。重要的是去了解顾客要求的项目内容是什么，这些都深藏在合约列载的ISO品质体制要求里。汽车制造厂必须配合正确的时机调度上千个涌入厂内的零配件，才能有效率地为生产线进料，这其中有一小部分包括组装汽车用的扣件。读者们应该不难想像，或甚至听过业界闻之色变的「产线暂停」或「退单纠纷」，这些都是因为出现不良品导致的结果，而且付出的金钱代价相当大！因此汽车制造商遏止这个问题采用的其中一个做法是，要求供应商达成「零不良品」的目标。虽然实际上并非硬性要求达到绝对100%的效果(也就是PPM = 0)，但会希望供应商尽量遵循合约要求，并采用统计制程控制 (SPC) 以试着达成目标。

制程能力指数(CPK)是一种数字指标，以显示您的制程是否能有效率地产制符合要求的零配件。想像一下，假设要将几颗球连续投进16英吋的圆环内，圆环的尺寸代表产品可达的

effectively feed the production line. A small portion of that coordination is the fasteners that hold the vehicles together. I' m sure you can imagine or have heard horror stories of "line down" and charge backs because of a defective part. That costs money! One of the ways automobile manufacturers try to combat this is to demand a "zero defect" policy from their suppliers. That does not necessarily mean 100% perfection with a PPM = 0, but does point back to contract review and the use of SPC (Statistical Process Control) to try and meet that demand.

CPK is a Process Capability Index, which is simply a number that represents the effectiveness of your process in achieving conforming parts. Consider trying to throw a series of balls through a 16 inch round hoop. The hoop size represents the product limits, and the sizes of the balls which vary from a 16 inch diameter playground ball to a 2 inch diameter golf ball, represent your production process. Of course it will be easier to throw the golf ball through the hoop, but that represents a very defined process and a higher CPK value. The lower the CPK value, the more variation you have in your process, and the harder it is to keep it centered as to not go beyond the product limits. The "tighter" your process becomes, the less centered on nominal product size you need to be. Automotive customers demand certain CPK levels. Achieving "Zero Defects" means that you have met your customers CPK value.

Lastly, to even consider being part of the automotive supply chain, you must be willing to perform various automated sorting operations. This is typically done on critical features, where 100% automated sorting is done. For instance, the head height of a hex bolt might be the critical feature to assure effective tightening. You' ve already met your CPK values for all features (including head height) on the fastener, but you know that a head height is considered "critical" because if the head height is too high it will interrupt production by clogging screw feeding equipment in final assembly. Based on your customer's target CPK value, you realize there may be a small percentage of parts present in the production lot that are out of tolerance on head height. This will be a feature that you will either sort for in-house or send out for an automated sorting/inspection process before shipping the product. Automated sorting/inspection can be performed on a number or more "critical" features at a time depending on the type of inspection equipment used.

There is no difference in the quality requirements for supplying U.S., European, or Asian automobile producers. All look at quality in the same extremely stringent manner, which is both demanding and unforgiving. It is my suggestion to anyone that is trying to supply the automotive market to follow the above general guidelines, which can be broken down further into more specific details.

- Have a complete understanding of the part requirements.
- Perform machine capability studies, gage R&R studies, and make sure you have a good gage calibration program.
- Have procedures in place to inspect and optimize your raw material usage.
- Making sure your perishable tooling are properly designed and as resistant to wear as possible.
- Have well-defined machine set up procedures are important because many non-conforming parts are generated when tooling is changed.
- Make sure you are monitoring the production process using well-planned SPC methods to assure adherence to the required CPK performance.
- Have automatic sorting/inspection equipment suitable for removing parts with non-conforming "critical" features effectively at high production rates.

Supplying the automotive market is not a task to be taken lightly. It involves dedication, commitment, and the ability to adapt to the changing market. It starts with solid internal operational discipline, thorough documentation, unwavering commitment to consistently high quality standards, and a never-ending adherence to the process of continuous improvement throughout the entire organization.

最大尺寸，而投入的球代表您的制程，其范围可小至2英吋的高尔夫球，大到16英吋的垒球。当然，要将高尔夫投进圆环还会容易许多，但这也代表您的制程必须非常精确，且制程能力指数必须更高。反之，制程能力指数越低，制成的可变空间就越多，但也较难将产品维持在中心点以免超过尺寸极限。制程越是「紧绷」，对产品公称尺寸需付的心力相对较低。汽车制造商通常会要求特定的CPK等级，当您能达成「零不良率」，也就代表您已达到顾客指定的CPK值。

最后要注意的是，在考虑是否成为汽车扣件供应商之前，您必须能接受执行多种自动化筛选作业，尤其是能自行针对扣件关键性能进行筛选过滤，因此要能做到100%自动化筛选。举例来说，六角螺栓的头部高度是确保紧固效果的关键。即使产品的所有特性（包括头部高度）已达成CPK值，但您仍须了解，头部高度之所以是「关键」，是因为在最终组装阶段，头部若是过高就会阻塞给料设备。基于顾客指定的CPK目标值，您发现在产线中可能出现了小部分头高超过容许值的零配件，而在出货之前，您就必须透过厂内或委外筛选过滤出这些缺陷零配件。自动化筛选检测程序可用于数项或多项关键特性，所需花费的时间则依使用的检测设备而定。

欧美亚汽车制造商对供应商采用的品质要求并没有不同，各国都对供应的产品品质采用极严谨的要求，且相当强制，也不容许偏差。我建议想供应汽车市场的厂商遵守上述通用原则，甚至可细分为下列七项细则：

- 须完全了解车厂对零配件的要求。
- 须检测您的机械产制能力以及量测之重复性与再现性，确认拥有良好的测量仪器之校准程序。
- 须拥有检查并优化原料使用方式的程序。
- 确认您的可耗工模具设计优良且抗磨耗度越高越好。
- 须有明确制定的机械安装程序，以避免更换工模具后出现不符顾客要求的产品。
- 确认您采用SPC监控制程，确保达到顾客要求的CPK值。
- 须拥有自动化筛选检测设备以在大量生产状况下过滤不符合特性要求的扣件。

决定是否成为汽车扣件供应商之前，您必须慎重且再三熟虑。您必须完全投入、达成承诺、有能力跟着市场随机应变。一切从严格的厂内操作纪律开始，包括做数据的文件纪录、持续承诺一致的高品质标准、一路直到整体企业架构的不断革新。