



## GLOBAL SUPPLIER QUALITY MANUAL

Note - additional language versions available at:  
[www.IngersollRand.com](http://www.IngersollRand.com) > Products and Services >  
Doing Business With Us > For Suppliers



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**Introduction, General Information and Pre-Selection Expectations**

## Supplier Acknowledgement and Acceptance of GSQM

**Purpose:** To provide an explanation of the Supplier Acknowledgement & Acceptance Form and submission procedure.

**Documents:**



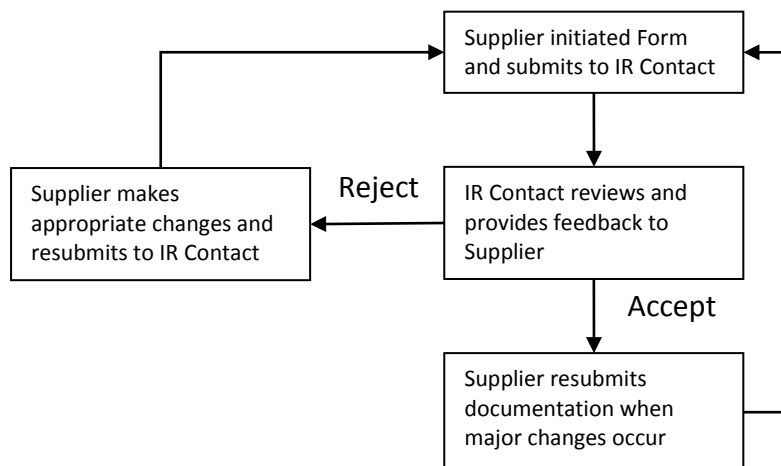
QMOD-0010.02

**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand

**Explanation:** The Supplier Acknowledgement & Acceptance form has been designed to document the supplier's acknowledgement and receipt of Ingersoll Rand's Global Supplier Quality Manual.

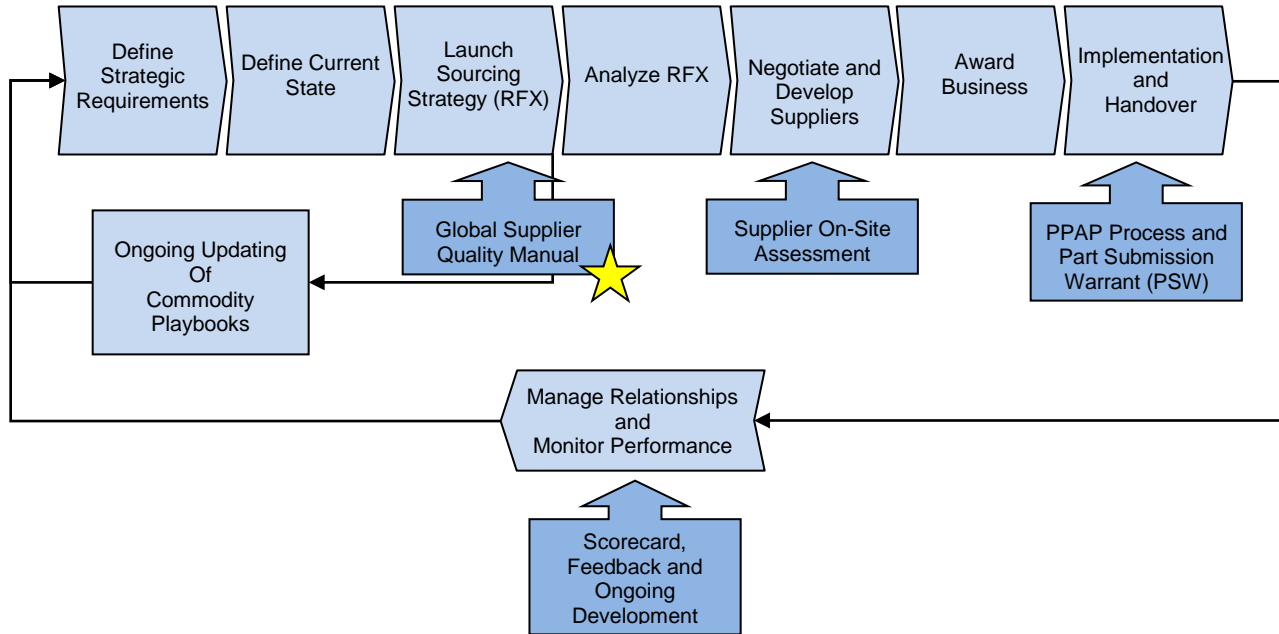
**Supplier Responsibilities:** It is critical that Suppliers become fully knowledgeable of the GSQM content so that they understand how, when, and why submissions and documentation are provided to IR. We ask that the appropriate Leaders within your organization review the manual and take the appropriate actions to become fully compliant. If you have any questions contact the IR Supply Chain and/or Supplier Quality Departments.

**Process Flow:**



## Introduction to SQ Manual

**Purpose:** This manual provides quality guidelines for Ingersoll Rand Suppliers to meet or exceed in order to supply direct parts, raw materials, service parts and sourced products purchased by Ingersoll Rand.



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand

**Explanation:** 1. Supplier Quality Expectations:

Ingersoll Rand is committed to producing quality, reliable and cost effective products that are shipped on time, provide customer value, and conform to national and international requirements. Ingersoll Rand and its Customers demand and expect defect free products and services and we recognize the importance of its Suppliers in providing Ingersoll Rand with quality parts and raw materials on time so that those Customer's expectations can be met.

2. Communication Expectations:

It is critical that Suppliers become fully knowledgeable of the GSQM content so that they understand how, when, and why submissions and documentation are provided to IR. We ask that the appropriate managers within your organization review the manual. If you have any questions contact the IR Purchasing or Supplier Quality Departments.

IR strives for effective and positive relationships with its Suppliers. Suppliers are encouraged to contact their assigned Supplier Quality Engineer (SQE), Strategic Sourcing Team (SST), Center Of Excellence (COE) Leader, or local Buyers whenever clarification is needed about the GSQM or if the Supplier foresees some problem in being able to meet the commitments of the system. Early

effective communication can help resolve issues before they become a problem.

All information, forms, materials or the like which are submitted by Supplier to IR in Supplier's compliance with the IR GSQM shall be the property of IR.

**Supplier  
Responsibilities:**

IR suppliers are required to:

1. Provide products and services that meet 100% of the following specifications: Engineering and/or material specifications and any industry standards not explicitly identified in these specifications
2. Contact IR Sourcing when they do not understand a requirement or the requirement is unclear.
3. Demonstrate compliance to the following: Design requirements, including critical, significant and other dimensions, process control and capability requirements,
4. Maintain a quality control system that acts in a timely and accurate manner with defined timeframes for record retention.
5. Provide expertise and resources to perform effective root cause analysis.
6. Obtain written approval from IR prior to making any changes to products, or processes including moving products from one facility to another.
7. Notify IR of any and all situations that may negatively impact the product's form, fit, function and/or appearance.

## Introduction, General Information and Pre-Selection Expectations

### Ingersoll Rand Facilities, Addresses, and Contact Numbers

#### Climate Solutions

Location	Address	Telephone Numbers
Arecibo, PR	PO BOX 144060, Arecibo, PR 00614-4060	787 878 1691
Asia Sourcing Team	1/F Raffles City, No.268 XiZang Road Central, Shanghai	+86 21 53599566
Barcelona, Spain	Sant Josep 140-142, Poligono Industrial El Pla, 08980 Sant Feliu de Llobregat Barcelona Spain	34 93 685 77 00
Charlotte	4500 Morris Field Drive; Charlotte, NC 28208	704-398-4600
Ciales, PR	KM 11.1, Stte Road 149, Ciales, PR 00638	787 871 3300
Clarksville	2701 Wilma Rudolph Blvd; Clarksville, TN 37040	931-645-6471
Columbia	400 Killin Road; Columbia, SC 29203	803-714-2800
Curitiba, Brazil	Av dos Pinheirais, 565 - Estacao	+55-41-3641-4444
Epinal	1, rue des Ameriques, B.P.6; F-88191 Golbey Cedex, France	33-32931-7300
Forsyth	165 Industrial Park Road; Forsyth, GA 31029	478-994-4293
Ft. Smith AS	9900 Aire Circle Dr.; Ft. Smith, AR 72916	479-648-7402
Galway, Ireland	Monivea Road, Mervue, Galway, Ireland	353 91 751 231
Global Parts	3600 Pammel Creek Rd; LaCrosse, WI 54601	608-787-2000
Global Products Sourcing (GPS)	2701 Wilma Rudolph Blvd; Clarksville, TN 37040	931-645-6471
Gloversville, NY	140 East State Street, Gloversville, NY 12078	518 725 0644
Hastings, NE	1800 Centennial Avenue PO Box 862, Hastings, NE 68901	402 463 6751
LaCrosse	3600 Pammel Creek Rd; LaCrosse, WI 54601	608-787-2000
Lexington	1515 Mercer Road; Lexington KY 40511	859-259-2500
Louisville, GA	1430 Highway 24E, Louisville, GA 30434	478 625 7241
Lynn Haven	200 Aberdeen Loop; Panama City, FL 32405	850-271-6030
Macon	7610 Industrial Highway; Macon, GA 31206	478-781-6495
Malaysia Trane	2047 Lorong Perusahaan 10 13600 Perai Malaysia	+4 390 7073
Minneapolis, MN	314 West 90th Street, Minneapolis, MN 55420	952 887 2200
Piscataway	One Centennial Ave; Piscataway, NJ 08855	732-980-6000
Pueblo	101 William White Blvd; Pueblo, CO 81001	719-585-3800
Rushville	1300 N. Benjamin; Rushville, IN 46173	765-932-7200
Shanghai Trane	10/11F Raffles City No. 268 Xi Zang Road Central Shanghai 200001, PRC	021-5359 9566-278
Shannon, Ireland	50-52 Industrial Estate, Shannon Co., Clare Ireland	353 61 470300
Shenzhen, China	No. 5 District, Che Gong Miao Industrial Zone, Shenzhen, Guangdong Province China 518040	86 755 838 99 801
St. Louis	20 Corporate Woods Dr; Bridgeton, MO 63044	314-301-6000
Suzhou, China	2A&2B&2C, Suchun Industrial Square 428 Xinglong Street, Suzhou Industrial Park, PR China	86 512 6283 6628
Taicang Trane	No.8 Zheng He East Road, Taicang, Jiangsu, China PRC	+86 512 53585200
Thailand Factory	35 Mu 8 Poochao, Poochaosamingprai Road, Samrong Tai, Phapradaeng, Samutprakarn, Thailand,	+66 2 3841142
Waco	182 Cotton Belt Parkway; McGregor, TX 76657	254-299-6300
Zhongshan Trane	Haojiang Road, Torch Development Zone, Zhongshan, Guangdong, China PRC	+86-760-8288541

## Introduction, General Information and Pre-Selection Expectations

### Industrial Technologies

Location	Address	Telephone Numbers
Davidson, NC	800-D Beaty Street, Davidson, NC 28036	704-896-4000
Augusta, GA	4125 Washington Road, Evans, GA 30809	706-863-3000
Athens, PA	101 North Main Street, Athens, PA 18801	[1] 570 888-7777
Campbellsville, KY	101 Industrial Drive, Campbellsville, KY 42718	[1] 270 465-3511
Changzhou, China	190 Chenfeng Road, Jintan City, Jiangsu, 213200 China	[86] 519 239 1888
Davidson, NC	800-D Beaty Street, Davidson, NC 28036	[1] 704 896-4500
Detroit, MI	2955 Stephenson Highway, Madison Heights, MI 48071	[1] 248 398-6200
Douai, France	529 Avenue Roger Salengro, 59450 Sin le Noble, Douai, France	[33] 3.27.93.08.08
Guilin, China	Chaoyang Rd, Qimasham, Guilin, Guangxi, 541004 China	[86] 773 581 0124
Mocksville, NC	501 Sanford Avenue, PO Box 868, Mocksville, NC 27028	[1] 336 751-3561
Naroda, India	22/29 G.I.D.C. Estate, Naroda, Ahmedabad 382 330 India	[91] 79 2820323
Nanjing, China	88, Jiang Dong Nan Road, Nanjing 210012 China	[86] 25-661-8877
GHH-Rand Schraubenkompressoren GmbH	Steinbrinkstr 1, 46145 Oberhausen, Germany	[49] +49 208 699 4000
Pavlovo, Russia	Pavlovo ul. Chapaeva, 43 Nizhegorodskaya Oblast, 606130 Russia	[7] 83171 61486
Sahibabad, India	37-A, Site-4, Sahibabad Industrial Area, Ghaziabad 201-010 India	[91] (0120) 2895116 ~ 126
Seattle, WA	2724 Sixth Avenue South, Seattle, WA 98134	[1] 206-624-0466
Shanghai, China	468 Wenjing Road, Minhang Shanghai, 200245 China	[86] 21 6430 2631
Southern Pines, NC	1725 US Hwy 1 North, Southern Pines, NC 28387	[1] 910 692-8700
Unicov, Czech Republic	Ingersoll-Rand CZ s.r.o. Sumperska 1345 Unicov 783 91, Czech Republic	[420] 585 093 111
Vignate, Italy	Strada Provinciale Cassanese, 108/110, Milano 20060, Italy	[39] 02950561

### Security Technologies

Location	Address	Telephone Numbers
Carmel, IN	11819 N. Pennsylvania St., Carmel, IN 46032	317-810-3700
Briargate Business Center	2315 Briargate Parkway, Ste 700, Colorado Springs, CO 80920	(719) 388-7300
Ives	50 Ives Place, New Haven, CT 06511	(203) 772-4837
Jamboree Business Center	1915 Jamboree Drive, Colorado Springs, CO 80920	(719) 264-5300
Kryptonite	437 Turnpike Street, Canton, MA 02021	(781) 828-6655
Locknetics - Forestville	575 Birch Road, Bristol, CT 06010	(860) 584-9158
Olathe	2119 E Kansas City Rd, Olathe, KS 66061	(913) 393-8700
Otay Mesa	9655 Siempre Viva Rd., Ste 3, San Diego, CA 92154	(619) 671-9339
Princeton (LCN)	121 West Railroad Avenue, Princeton, IL 61356	(815) 875-3311
Recognition Systems (RSI)	1520 Dell Avenue, Campbell, Ca 95008	(866) 861-2480
Schlage Security Plant	3899 Hancock Expressway, Security, CO 80911	(719) 390-5071
Security Technology HQ	11819 N Pennsylvania St, Carmel, IN 46032	(317) 810-3700
Steelcraft - Cincinnati	9017 Blue Ash Road, Cincinnati, OH 45242	(800) 930-8585
Steelcraft - Suwannee	2700 Crestridge Court, Suwannee, GA 30024	(770) 921-9410
Von Duprin	2720 Tobey Drive, Indianapolis, IN 46219	(317) 429-2100

## Introduction, General Information and Pre-Selection Expectations

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### Residential Solutions

Location	Address	Telephone Numbers
El Sauzal	Carretera Libre Tecate-Ensenada, Km 104 #963, El Sauzal de Rodriguez, Ensenada, B.C., CP 22760 Mexico	[52] (646) 177 4782
Ensenada	Km. 115 Carretera Transpeninsular 4580-4; Col.Carlos Pacheco Ensenada, 22890 Mexico	[52] (646) 177 4782
Tecate	Calle Los Olivos #698, Tecate B.C., Mexico	[52] (665) 40622
Tijuana	La Encantada Industrial # 24050 Parque Industrial Florido, Tijuana B.C. 22860	(52) 6656540622
Ft. Smith BU	4811 S. Zero Street; Ft. Smith, AR 72903	479-646-5511
Monterrey, Mexico	Avenida Nafta #750, Parque Industrial Stiva Aeuropuerta, Apodaca, NL, Mexico 66600	011-52-81-8145-0180
Sourced Products	6200 Troup Highway; Tyler, TX 75707	903-581-3200
Trenton	2231 E. State Street; Trenton, NJ 08619	609-587-3400

### Other

Description	Location	Address	Telephone Numbers
Ingersoll Rand (China) Industrial Equipment Manufacturing Co., Ltd	Suzhou Wujiang, China	2333# Pang Jin Road, Economic Development Zone Wujiang, Jiangsu, China, 215200	[86] 512 6363 6888
Ingersoll Rand Equipment Manufacturing Czech Republic s.r.o.	Czech Republic	Havirska ul., 280 59 Kolin Czech Republic	420 321 757 111
Ingersoll Rand Asia Pacific	Shanghai, China	Tower B, City Center of Shanghai, 100 Zun Yi Road, Shanghai 200051 P.R. China	[86] 21 2208 1288

### Safety and Security guidelines when visiting Ingersoll Rand Manufacturing Sites

- Purpose:** Ingersoll Rand is committed to maintaining a safe and secure environment at all sites and expects all visiting Suppliers to fully comply with Company, state, and federal guidelines regarding safety, environmental and legal issues.
- Scope:** Applies to all Suppliers and Supplier's support personnel who visit Ingersoll Rand manufacturing sites.
- Explanation:**
1. Supplier Responsibilities:
    - A. All Suppliers and Supplier's support personnel are required to abide by the guidelines as put forth in this policy. If there are any questions about specific safety and security requirements, the Ingersoll Rand host and/or Safety, Health, and Environment department should be contacted for clarification before the visit.
    - B. Information received, learned or observed by a Supplier in a visit to a Ingersoll Rand manufacturing location shall be maintained in confidence by the Supplier and shall be used only for the benefit of Ingersoll Rand.
  2. General Guidelines:
    - A. All Suppliers and Supplier's support personnel are required to bring the appropriate safety equipment with them when they visit Ingersoll Rand sites. Please notify your Ingersoll Rand Contact to determine the appropriate minimum safety equipment requirements prior to your scheduled visit.
      - i. Safety glasses with side shields are required in the manufacturing areas although not in the office areas.
      - ii. Steel-toed safety shoes are required in the manufacturing areas, suppliers should bring their own steel toed safety shoes if they have them. Special shoe covers are available in the Security Office for those who do not have their own shoes.
      - iii. Protective equipment such as gloves, protective coverings for the arms and/or body, hard hats, and/or ear plugs may be required at these sites depending on the nature of the Supplier's visit. The host location will provide this level of personal protective equipment if required. All safety equipment required by state and federal regulations and any Ingersoll Rand requirements will be the minimum safety compliance for Suppliers visiting any sites.
      - iv. Any visitors who will be going into manufacturing areas must wear appropriate clothing. Examples of articles that might be inappropriate are scarves, ties, jewelry. Shorts or skirts that expose skin and open shoes are prohibited. Socks must be worn with safety shoes.
      - v. No cameras or recording devices are allowed in Ingersoll Rand facilities without the approval by visiting Department Manager
    - B. All visitors must be accompanied by Ingersoll Rand associates through the length of their tour unless specific areas are indicated by the Ingersoll Rand host. Visitors must stay within the marked aisle ways.
    - C. Ingersoll Rand sites are production facilities with a variety of machinery and forklifts/overhead cranes being used. Please be alert to your surroundings and yield to traffic.
    - D. Ingersoll Rand sites have a variety of emergency plans to properly manage fires

and tornadoes. Should the alarm system go off during your visit listen carefully to the instructions of your host and other Ingersoll Rand personnel and go with them to the appropriate staging area they indicate.

E. Accident and Injury Reporting:

- i. In the event of an accident or injury, the Ingersoll Rand host should be made immediately aware of the issue as well as the Safety, Health, and Environment Department. Should the issue occur on either 2nd or 3rd shift contact the Safety, Health, and Environment Department. If there is no immediate response contact the Security Department for the facility you are visiting.
- ii. Suppliers and Supplier's support personnel must be covered under their own worker's compensation insurance. Proof of coverage may be requested during visits to Ingersoll Rand facilities.

F. First Aid and Emergency Medical Services:

- i. Some Ingersoll Rand facilities maintain Nurse's Stations at each facility; others have first aid rooms and/or first aid responders. Basic first-aid, such as bandages, can be obtained at these stations or through these individuals.
- ii. In the event of an emergency beyond basic first-aid, Ingersoll Rand will assist in arranging medical transportation to outside medical facilities as needed.

## Introduction, General Information and Pre-Selection Expectations

### GSQM Revision History

Revision Date	Revision #	Approver	Requested Changes	Description of the change
1/2/07	0	B.Cook/C.Knowles	Original	Original GSQM Issue Date by Chuck Knowles (931)648-5239 Trane
3/28/07	1	C.Knowles	SQEs	Eliminated error messages and macros
11/17/08	1a	C.Knowles	Legal	Changed name from Trane to IR and added other sector logos
3/10/09	2	GSCC	Mike Rebilas	Updated forms to AIAG format and improved wording
9/3/09	3	M. Rebilas	M. Rebilas	Updated plant addresses, OSA macros.
11/13/09	4	M. Rebilas	M. Rebilas	Added "Sustainability" content to OSA.
3/1/10	5	M. Rebilas	SQ&D Team	Updated PQR form content & signature block. Added Software Change Request content to English version only.
4/1/11	6	C.Knowles	SQ&D Team	Change File Format from for Excel 2007 compliance. Completely Revamped Section B to align with AIAG PPAP. Replace "Part Qualification Requirements" tab with "Production Part Approval". Delete Tabs for SVPP and NCI. Merge CCT (TK and Hussmann) with TCS (Trane Commercial) into Climate Solutions. Change Trane Residential to Residential Solutions. Rearranged Worksheet tabs to separate Procedures from Forms.
5/18/11	6a	C.Knowles	SQ&D Team	Repaired file to maintain Excel 2003 compatibility. Added Requested By date to PSW. Renamed Titles on PSW PPAP Checklist. Added PPAP Checklist section to PSW Procedure. Fixed Table of Contents Section D numbering. Revised Q81 of On Site Assessment. Added Appearance Approval Form to PPAP Procedure. Included PPAP procedure references to Ingersoll Rand BOS procedures. Deleted OSA questions 66 and 67, which were redundant to questions 78 and 79. Added instructions into "On Site Assessment (OSA)" to address Microsoft Excel Macro Security issues.
7/6/11	6b	C.Knowles	SQ&D Team	Reformatted GSQM to PDF document. Fixed OSA scoring to allow Interim Approval for 85%-99% Score on Mandatory Questions.
8/12/11	7	C. Knowles	SQ&D Team	Added Management of Company Owned Asset Procedure Replaced "Climate Solutions quality engineering" with "Ingersoll Rand ACR" in "Production Part Approval Process (PPAP)"
9/1/11	7a	C. Knowles	SQ&D Team	Fixed typo on PFMEA/DFMEA procedures: "7 - High; Repeated

## Introduction, General Information and Pre-Selection Expectations

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				Failure; FR 1 in 100". Fixed broken hyperlinks to Capacity Demonstration Review Forms and Appearance Approval Forms. Removed Hussmann facilities
4/23/12	7b	C. Knowles	SQ&D Team	Modified OSA procedure and form to allow for conditional approval with 70% Overall, 85% Mandatory

### Glossary of Terms

Item	Definition
5-S	Sort, Straighten, Shine, Standardize, Sustain: Part of Lean Manufacturing methodology (Workplace Organization)
ANOVA	Analysis of Variance: calculation procedure to allocate the amount of variation in a process and determine if it is significant or is caused by random noise.
ANSI	American National Standards Institute
Appearance Item	A product characteristic that is visible once the product is completed
APQP	Advanced Product Quality Planning
Basic Function Analysis	Analysis of a feature or characteristic which is the primary reason for the existence of an item, from the user's point of view; the purpose or performance feature which must be attained if an item is to work or perform.
C/A	Corrective Action: Action to eliminate the cause of a detected nonconformity.
CAD	Computer-Aided Design/Drafting
CA/PA	Corrective Action/Preventive Action
CAE	Computer-Aided Engineering
Capability Studies (Cpk & Ppk)	Capability Study- a graphical or statistical tool that visually or mathematically compares actual process performance to the performance standards established by the customer. Indicators include Cpk, Cp, Ppk, Pp.
CAM	Computer-Aided Manufacturing
CF's (Critical Feature)	Are part characteristics identified on Ingersoll Rand's drawings and/or material specifications that significantly affect performance, fit, function or workability on the finished good, and therefore require application of statistical measures for capability assessment and/or 100% control.
Component Drawing	The Engineering controlled documentation used as part of the contractual information that defines the Engineering dimensional and other requirements. The drawing may be in electronic or hard copy form. An electronic 3-dimensional model may be considered a drawing or part of a drawing documentation.
Component Part	Generally a single part or simple assembly that has a specific purpose in a subsystem, system, or product. A linkage rod or pre-assembled linkage rod assembly would be an example of a component part
Component Subsystem	Generally an assembly of two or more components that provides partial functionality needed to perform a defined product function. An actuator and linkage would be an example of a component subsystem.
Component System	Generally and assembly of two or more components that provides the complete functionality needed to perform a defined product function. A chiller control system including controller, sensors, actuators, and interconnecting wiring would be an example of a complete system.
Containment Plan	A plan developed to make sure that components used on products meet the Design Sigma quality level. An example may be "100% inspection of the critical parameters"
Control Plan	A written description of the system used for controlling production parts or bulk materials and the processes used in their manufacture. They are written by suppliers to address the important characteristics and engineering requirements of the product.
Correlation Analysis	Correlation is the degree or extent of the relationship between two variables.
Cost of Quality	The cost associated with the quality of a work product. Includes four categories: Appraisal, Prevention, Internal Failure, and External Failure costs.
Cycle Time	The rate or time that process takes to complete a product.
CTO (Critical to Quality)	Any characteristic identified on a drawing or specification where significant variation may affect fit, form or function. These characteristics are typically identified on a drawing by a black diamond
DFA	Design for Assembly
DFM	Design for Manufacture

## Introduction, General Information and Pre-Selection Expectations

Item	Definition
Design FMEA	Design Failure Mode and Effects Analysis is an activity to assess and prioritize the risk of failure of a product design component, subsystem, or system in achieving product performance, reliability, or safety goals and develop mitigation plans for the critical few. Output will include corrective actions to mistake-proof the design or take other measures to ensure the design function will be met. Results from the DFMEA are used to identify the component failure modes that have causes that need to be addressed in the Validation Plan.
Design Review of Test Results	Meeting held to review the results of the validation tests that were done for the PQR. Attendees typically include technical experts as appropriate to render conclusions from the testing done to confirm the component's ability to meet performance and reliability CFs
Design Sigma	Normalized design variability measured in units of standard deviation. Sometimes measured as a z score where $z=x/S$ , $x$ = a deviation score and $S$ = the standard deviation of the distribution in which $x$ occurs. A low design sigma represents a high variability in the distribution. Our near term Design sigma goal is 4 or greater. The rollup of the CFs to the Design Sigma provides an opportunity of tradeoffs between various CF design/process choices to result in the highest design sigma at the lowest overall cost.
DOE	Design of Experiments: a structured, organized method for determining the relationship between factors (Xs) affecting a process and the output of that process (Y).
EHS	Environmental Health and Safety. EHS documentation includes MSDS sheets and other documentation as defined by the Ingersoll Rand Safety organization
Early Launch Containment (ELC)	Early Launch Containment is intended to guarantee the quality level of early shipments during the ramp-up phase. It can also be deployed during supplier process and / or design changes.
FAST diagram	Function Analysis System Technique: tool/diagram used in value analysis and value engineering projects.
Feasibility Review	The evaluation and documentation of capability to meet customer requirements prior to production or acceptance of a contract.
FMEA	Failure Mode Effects Analysis: procedure and tools that help to identify every possible failure mode of a process or product, to determine its effect on other sub-items and on the required function of the product or process.
FIFO	First In First Out, using raw materials or products on the basis of oldest to newest.
First Article Inspection Worksheet	A worksheet that is used to record the component parameters actually measured on a component part sample and compare against the drawing or specification requirements.
FPY	First Pass Yield: the number of good units produced divided by the number of total units going into the process.
Functional Test	A test to measure the component or component system ability to perform to the required functional requirements. Functional tests may include performance in a defined operating range and/or in a defined operating environment range, or a system or sub-system test to confirm capability for its intended function.
Gage R&R	GR&R- Gauge Repeatability & Reproducibility: a statistical tool that measures the amount of variation in the measurement system arising from the measurement device and the people taking the measurement.
GD&T	GD&T- Geometric Dimensioning and Tolerancing
Hypothesis Testing	Hypothesis Testing- the process of using statistical analysis to determine if the observed differences between two or more samples are due to random chance (null hypothesis) or to true differences in the samples (alternate hypothesis).
Indirect Materials	Materials that do not become part of the final product or product packaging.
Interaction Analysis	An interaction occurs when the response achieved by one factor depends on the level of the other factor. On interaction plot, when lines are not parallel, there's an interaction.

## Introduction, General Information and Pre-Selection Expectations

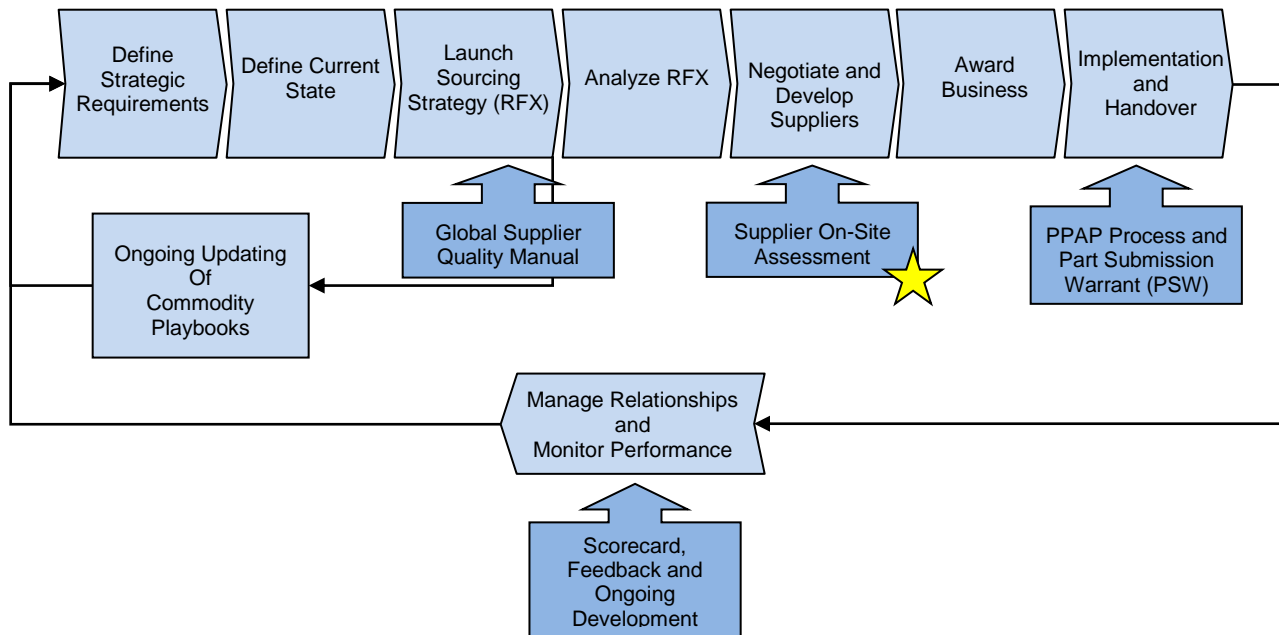
Item	Definition
ISO/IEC 17025	General Requirements for the Competence of Calibration and Testing Laboratories
Key Characteristics	See Critical Features
Lean Manufacturing	Initiative focused on eliminating all waste in manufacturing processes.
Life Test	A test to measure the component's ability to perform without failure usually conducted with accelerated cyclic stresses induced in a controlled environment.
Life Cycle Cost Analysis	The development and analysis of all significant costs of ownership of an item, system or facility over a specified length of time. Used in VA/VE activities.
Mechanical Certifications	Certifications to a standard of mechanical properties using industry standard testing procedures that includes such characteristics as tensile strength, yield strength, hardness or impact resistance.
Mixed Model Production	Produce a high variety of product through the same value stream, based on the customer's requirements.
MSA	Measurement System Analysis: an experimental and mathematical method of determining how much the variation within the measurement process contributes to overall process variability.
MSDS	Material Safety Data Sheet
NIST	National Institute of Standards and Technology
NPD	New Product Development
Pareto Analysis	Analysis of data using the "Pareto Principle" or 80/20 rule. Used to aid in identifying the "vital few" factors which are responsible for most problems.
P/A	Preventive Action: actions taken to prevent a problem from occurring.
PPAP Record	The PPAP Documentation and other records used to document, qualify and approve the component and the manufacturing processes. Any changes to the design or processes during or after the PPAP is completed must be reviewed and approved to ensure design sigma is maintained.
PCBA	A Completed Printed Circuit Board Assembly
Predictive Maintenance	Use of equipment maintenance records to focus attention on key failures that lead to equipment unavailability and downtime.
PM	Preventive Maintenance
Pre-Production Product Prototypes	Consists of any product, product system, sub-system or component prototypes that will be used to apply the component to a Ingersoll Rand product in Ingersoll Rand production. This can include concept prototypes, design verification prototypes, and Ingersoll Rand manufacturing process prototypes.
Process Flow Diagram	Method for displaying processes that illustrates how a product or transaction is processed. Also known as Process Mapping.
Process FMEA	Process Failure Mode and Effects Analysis is an activity to assess and prioritize the risk of failure of a product design component, subsystem, or system's manufacturing process in achieving product performance, reliability, or safety goals and develop mitigation plans for the critical few. Scope typically includes shipping and packaging as well as chemicals, coatings, and magnetized parts and EHS considerations.
Production Lot Run Trials	Components made on production tooling for a selected volume of Ingersoll Rand production units. These trials are typically conducted to generate statistical data to confirm capability.
Pull System	The flow of resources in a production process by replacing only what has been consumed.
Purchase Specification	The Engineering controlled documentation used as part of the contractual information that defines Engineering requirements for a component or component family. Typically these contain detailed requirements that may include testing & standards, performance, agency, or other requirements.
QFD	Quality Function Deployment: a structured methodology and mathematical tool used to identify and quantify customers' requirements and translate them into key critical parameters.

## Introduction, General Information and Pre-Selection Expectations

Item	Definition
Release	Documentation release is done to achieve a specific goal: 1. Production documentation release is done to support production of the product. 2. Engineering sample documentation release is done to support build of samples for evaluation or support of system prototype build. 3. Concept documentation release is done to support concept evaluation, system level design reviews, supplier budgetary/estimate quotes, etc. 4. Production Tooling documentation release is done to support production preparations of critical tooling, and may not include final production information. 5. For an existing component, at the start of an NCI the documentation package could very well be at the production release stage, reflecting the maturity of design activity and completeness of requirements. This might be very typical of a fabricated part. For new designs or development work in process, any of the other release actions are possible. Use of the term "release" signifies reviewed and approved significant documentation technical content to meet a specific goal.
RTY	Roll Throughput Yield: the probability that a single unit can pass through a series of process steps free of defects.
SIPOC	Suppliers, Inputs, Process, Outputs, Customers. Used to evaluate and analyze elements of a process. Obtain inputs from suppliers, add value through your process, and provide an output that meets or exceeds your customer's requirements.
Six Sigma	A systematic methodology that utilizes information (management by facts) and statistical analysis to measure and improve a company's operational performance, practices and systems by identifying and preventing 'defects' in manufacturing and ser
SPC	Statistical Process Control: the application of statistical methods to identify and control the special cause of variation in a process.
Subsystem Level Functional Test	See Functional Test
Special Characteristics	See Critical Features
System Level Functional Test	See Functional Test
Supplier Process Audit	This is the plan to document the processes and validate the measurement systems for components with CFs. This plan will be used to assure each CF has a plan for control and that the measurement systems to be used have been validated. The documented PQP record will be used by the Supply Management Organization for supplier audits after the NCI is closed.
Takt Time	The demand rate, or the maximum time per unit allowed to produce a product in order to meet demand. For production process to be successful, cycle time must be less than TAKT time.
Team / Process Charter	Document or sheet that clearly scopes and identifies the purpose of a Quality improvement project. Items specified include background case, purpose, team members, scope and timeline.
Validation Plan	The plan that defines the responsibilities and actions required to qualify and validate the component supplied to meet the design intent CFs and other requirements at the defined quality level
Value Stream Mapping	Value stream mapping is a paper and pencil tool that helps you to see and understand the flow of material and information as a product or service makes its way through the value stream to aid in waste elimination.
VA/VE	Value Analysis/Value Engineering: the systematic use of techniques which identify the required function of an item, establish a value for those functions and provide the functions at the lowest overall cost.

## Supplier On-Site Assessment (OSA)

**Purpose:** To assess supplier's quality management system and related business processes, in order to determine viability as a supplier to Ingersoll Rand.



**Documents:**



QMOD-0001.01

**Scope:**

Applies to Suppliers of production parts, raw materials, service parts, and sourced products when deemed necessary by the responsible Ingersoll Rand division.

**Explanation:**

The OSA, along with commercial and technical assessment, is part of Ingersoll Rand's supplier approval process and should be applied in the following situations

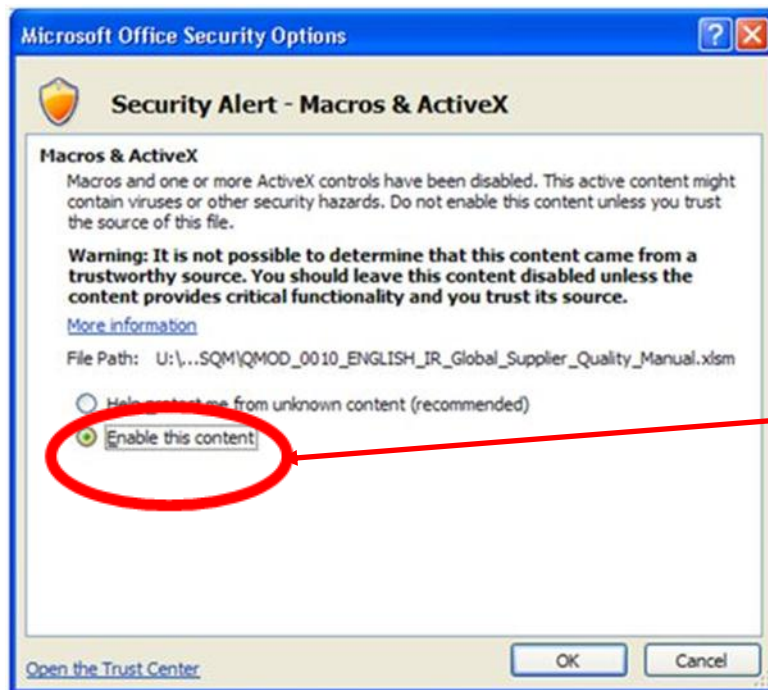
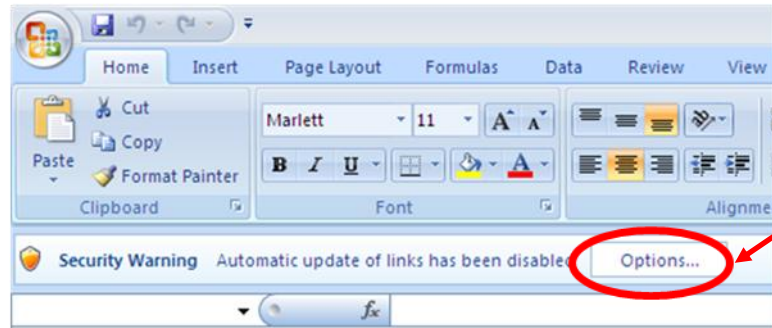
- Before any business is awarded to a new supplier to IR
- Whenever there is a significant change in an approved supplier's operations, such as plant relocation or change of ownership.
- Periodically, as determined by IR, in order to ensure continuation of supplier's quality management systems

Also, OSA may be completed for a currently approved supplier as a prerequisite for other Production Part Approval Process (PPAP) activities, especially where the design or manufacturing process of the new components is significantly different than earlier approved components.

Note: The OSA serves a different purpose than the Supplier Process Audit (SPA). SPA is part of Ingersoll Rand's Production Part Approval Process (PPAP) and is used to evaluate a particular manufacturing process in preparation for mass production. OSA is used to evaluate a supplier's quality systems and is an integral part of the IR supplier approval process.

## Introduction, General Information and Pre-Selection Expectations

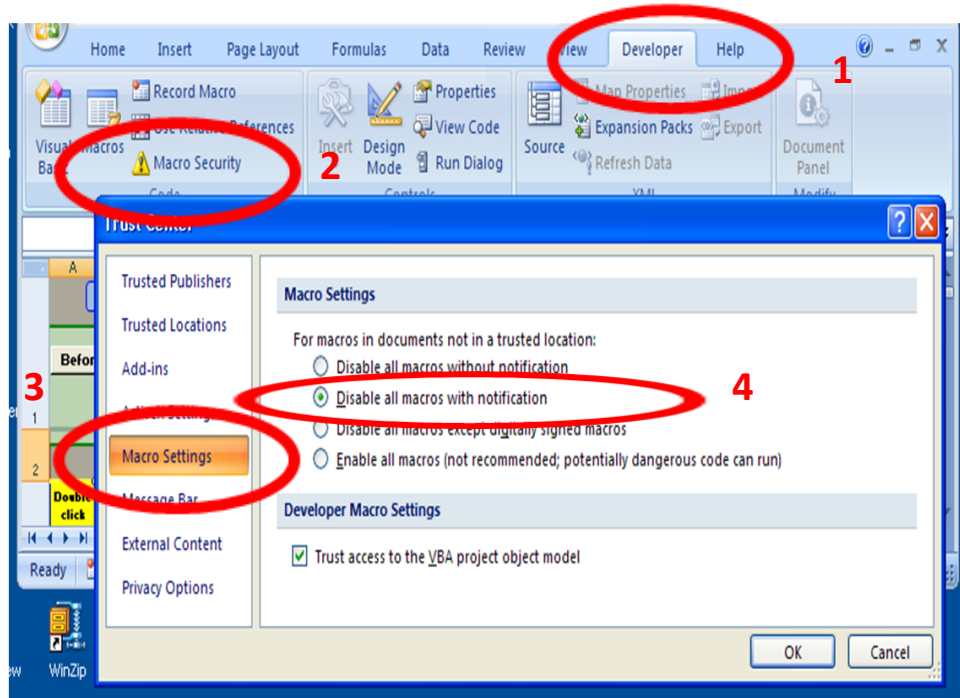
**Instructions:** In order to properly use the OSA Form, Macro Security must be enabled for the Excel Workbook. If you are using Microsoft Excel 2007 (or later) and see the following dialog box, then you must enable Macro Security.



## Introduction, General Information and Pre-Selection Expectations

If you do not see the "Security Warning" listed above, you need to change the Macro Settings by following the instructions listed below.

1. Click on "Developer"
2. Click on "Macro Security"
3. Click on "Macro Settings"
4. Click on "Disable all macros with notification"



### Supplier Responsibilities:

1. New Suppliers must submit the requested commercial and technical documentation to Ingersoll Rand Sourcing, and IR Sourcing must approve before an OSA is completed.
2. The "Assessment" form can be printed in advance and completed by assessment team member(s) during the course of the assessment, or sent to the supplier for self-assessment prior to the onsite visit.
3. The Supplier must be prepared to address and show evidence of all items contained in the OSA.
4. Ingersoll Rand will conduct the OSA and representatives from the Supply Chain, Engineering, Materials and Quality departments may attend and may have additional audit items.
5. The OSA will consist of the following items:
  - A. BEFORE items per OSA document - addressed prior to viewing shop floor operations
  - B. DURING items per OSA document - addressed on shop floor.
  - C. AFTER items per OSA document - addressed after viewing shop floor operations
6. Ingersoll Rand will issue a report to the Supplier summarizing the results of the visit. The report will include observations by the assessor(s).
7. The Supplier is responsible for responding to the assessment and observations and where applicable identifying countermeasures to be taken.

## Introduction, General Information and Pre-Selection Expectations

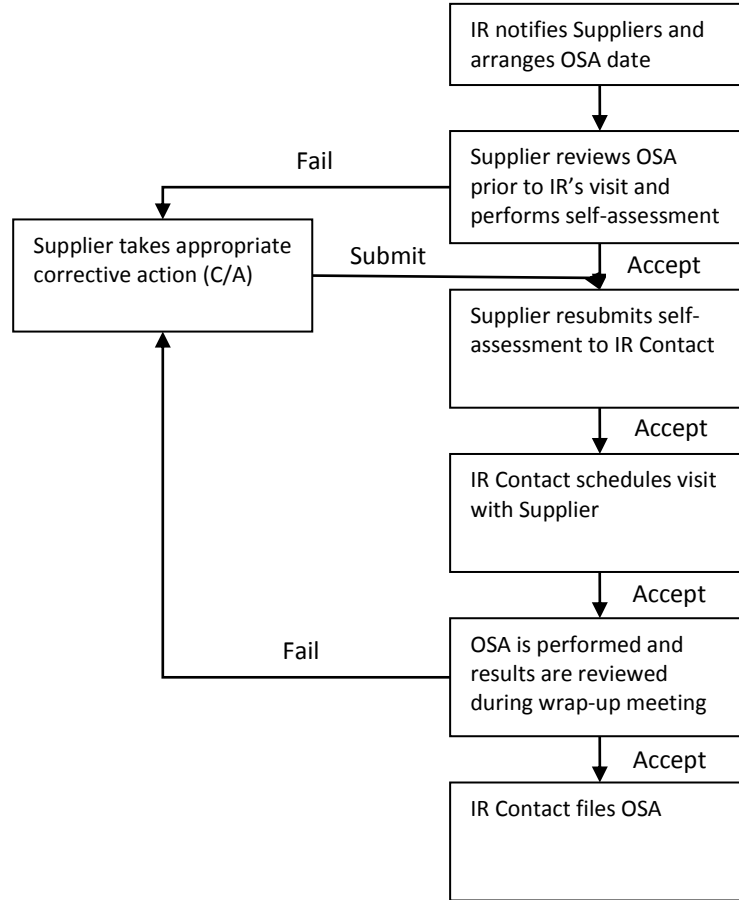
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- OSA Scoring:**
1. "Partial" or "Full" credit should be denoted by an "x" in the appropriate field. Fields should be left blank to reflect "Zero" credit.
  2. "Partial" credit should be granted when a process or aspect of performance is not systematically implemented & demonstrated across site operations. Examples include:
    - A. FMEA's in place for a limited number of processes, product lines or cells (note: a partial rating would apply even if IR product would benefit from the limited deployment),
    - B. Uneven application of gage control across facility,
    - C. Quality performance measured only for specific customers,
    - D. Newly-implemented with little evidence of effectiveness.
  3. Approximately 1/3 of total questions are identified as mandatory KEY questions.
    - A. Supplier must score 100% on all mandatory KEY questions.
    - B. If deficiencies are found suppliers will have 30 days to submit a plan as agreed upon between IR and supplier.

- Approval:**
1. A supplier is approved at 100% scoring on all mandatory KEY questions, and 85% on all questions

- Conditional Approval:**
2. A supplier is conditionally approved at 85% scoring on the mandatory questions, and 70% scoring on all questions.
    - a. The supplier has 30 days to submit a plan agreed upon between IR and the supplier to resolve the deficiencies.
    - b. If the supplier does not achieve an approved plan within 30 days, the supplier is no longer conditionally approved for business and is re-categorized as a non-approved supplier to IR.
  3. At any time a supplier in the conditionally approved stage can lose this status due to poor quality performance.
  4. In order for the supplier to be fully approved, the supplier must score 100% on the mandatory questions within 6 months of the audit.
  5. At the end of the 6 month period if the supplier has not addressed all of the deficiencies to IR's satisfaction, the supplier will be re-classified to a non-approved supplier status which subjects the supplier to potential loss of business with IR.

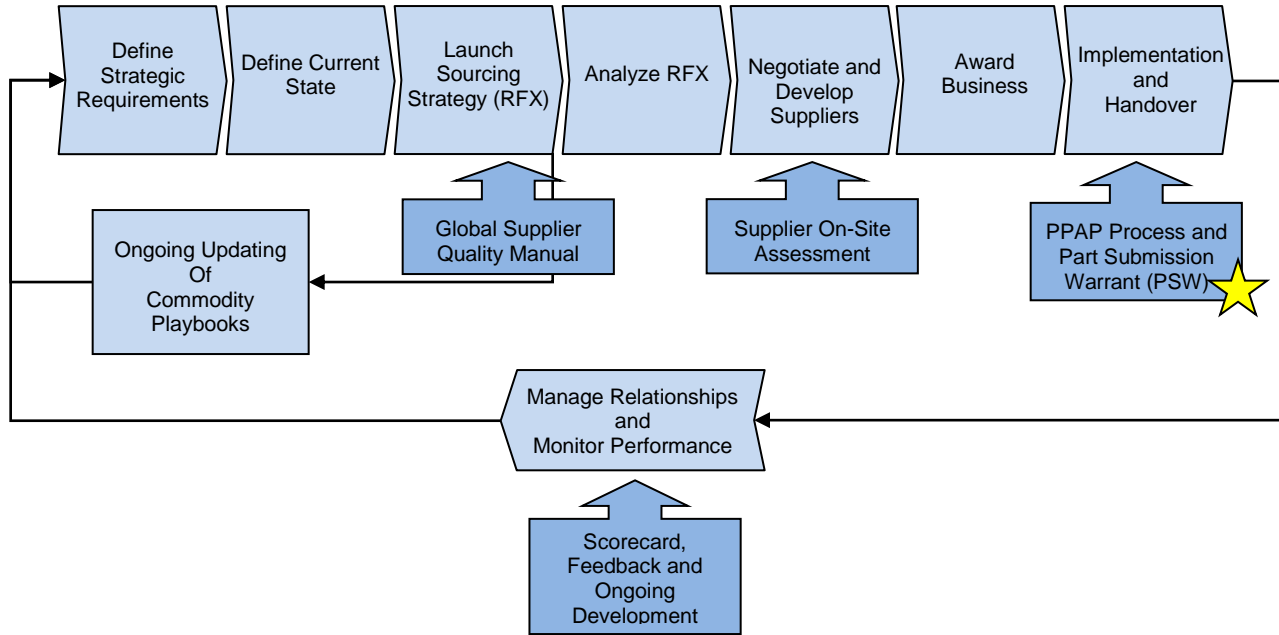
## Process Flow:



**Pre-Launch Activities and Expectations**

## Production Part Approval Process (PPAP)

**Purpose:** To define the process, responsibilities and deliverables for introducing new or revised components to Ingersoll Rand. To help Suppliers successfully achieve or increase the quality of the product design as components are developed or changed.



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand for:

1. all Ingersoll Rand businesses, operations and functions
2. all types of supplied parts regardless of complexity, criticality or cost

and applies to:

1. all new part purchases
2. all qualified supplier changes (initiated by Process/Design Change Request)

**Explanation:** Ingersoll Rand follows the AIAG Production Part Approval Process (PPAP) 4th Edition for validation of all purchased material required for production applications. This PPAP procedure is necessary to understand and comply with submission requirements.

**Ingersoll Rand Responsibilities:** Each Ingersoll Rand facility must designate an Authorized Customer Representative (ACR) for each PPAP. The ACR will typically initiate contact with the supplier to discuss PPAP submission requirements. The PPAP submission requirements will be formally communicated via the PPAP Part Submission Warrant (PSW).

**Supplier Responsibilities:** It is expected that suppliers will obtain the PPAP manual and will understand the contents therein in conjunction with the exceptions listed below. PPAP submissions are to be submitted to the Ingersoll Rand Authorized Customer Representative (ACR) designated on the PPAP Part Submission Warrant (PSW). All products with unique part numbers require secure approval prior to supplying production quantities of product.

Where the ACR is unknown the supplier must contact the Ingersoll Rand purchasing agent for information. In all cases it is incumbent on the supplier to ensure the designated ACR is able to represent all of the Ingersoll Rand facilities the PPAP component is used. Multiple PPAP documents may be necessary to qualify a component for multiple facilities.

A PSW signed by the authorized customer representative and returned to the supplier is evidence of PPAP approval.

**Exceptions to AIAG Production Part Approval Process (4th Edition) <sup>1</sup>:**

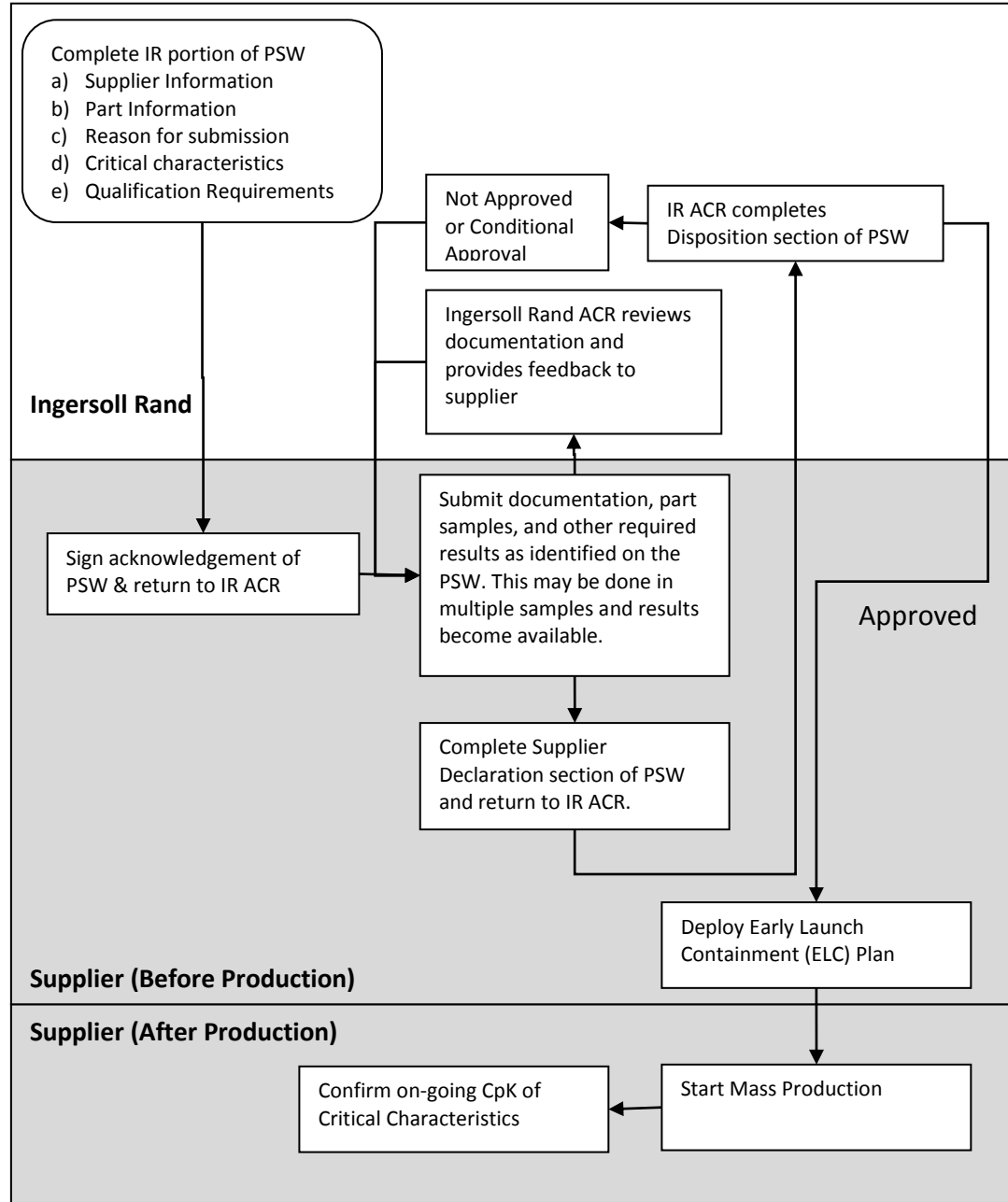
1. Significant Production Run (PPAP Section 2.1).
  - a. A minimum of 50 consecutive parts is required.
  - b. The IR Authorized Customer Representative (ACR), in conjunction with input from the supplier, may adjust the required number of consecutive parts.
2. PPAP Requirements (PPAP section 2.2)
  - a. Always consult your IR Authorized Customer Representative (ACR) to determine which items or records will apply to a particular PPAP
3. Reporting of Part Material Composition (PPAP section 2.2.1.1)
  - a. International Materials Data System (IMDS) is not currently used by Ingersoll Rand, Climate Solutions.
4. Marking of Polymeric Parts (PPAP section 2.2.1.2)
  - a. This section does not apply.
  - b. Marking is done per the design record.
5. PPAP sections 2.2.4 through 2.2.8
  - a. See the Global Supplier Quality Manual for available forms
6. Dimensional Results (PPAP section 2.2.9)
  - a. Master samples are not required.
7. Master Sample (PPAP section 2.2.15)
  - a. Master samples are not required.
8. Part Weight (Mass) (PPAP section 2.2.18.1)
  - a. Part weight is not required.
9. Critical Features / Key Characteristics
  - a. Ingersoll Rand may classify Critical Characteristics as Critical Features (CF), Key Characteristics, Safety Characteristics, or Critical to Quality (CTQ) Characteristics.
10. Submission Levels (PPAP section 4.1)
  - a. The default submission level is Level 3. The authorized customer representative is responsible for identifying the appropriate level PPAP. The following table provides information only on what generally will dictate the level of PPAP.
11. The supporting documents required in the PPAP process must be stored and controlled.

## Pre-Launch Activities and Expectations

PPAP Level	PPAP Level Description
<b>Level 1</b>	<p><b>PSW only (and Appearance Approval Report, when requested).</b> Typically Applied to: Supplier initiated changes to a part that do not affect form, fit or function of that part, off the shelf components</p>
<b>Level 2</b>	<p><b>PSW with product samples and limited supporting data.</b> Applied to: Off the shelf components or a similar part qualified with a level 3 PSW.</p>
<b>Level 3</b>	<p><b>PSW with product samples and complete supporting data. Default Climate Solutions Submission Level.</b> Applied to: Supplier-initiated changes that affect form, fit or function, parts that have special characteristics, new suppliers to Ingersoll Rand, new components. <b>Must submit Early Launch Containment (ELC) plan.</b></p>
<b>Level 4</b>	<p><b>PSW and other requirements as defined by the customer.</b> This level is reserved for special applications only.</p>
<b>Level 5</b>	<p><b>PSW with product samples and complete supporting data reviewed at the supplier's manufacturing location.</b> Applied to: On-site review, as requested by the Ingersoll Rand ACR. <b>Must submit Early Launch Containment (ELC) plan.</b></p>

### PPAP Submission Levels Description

**Process Flow:**

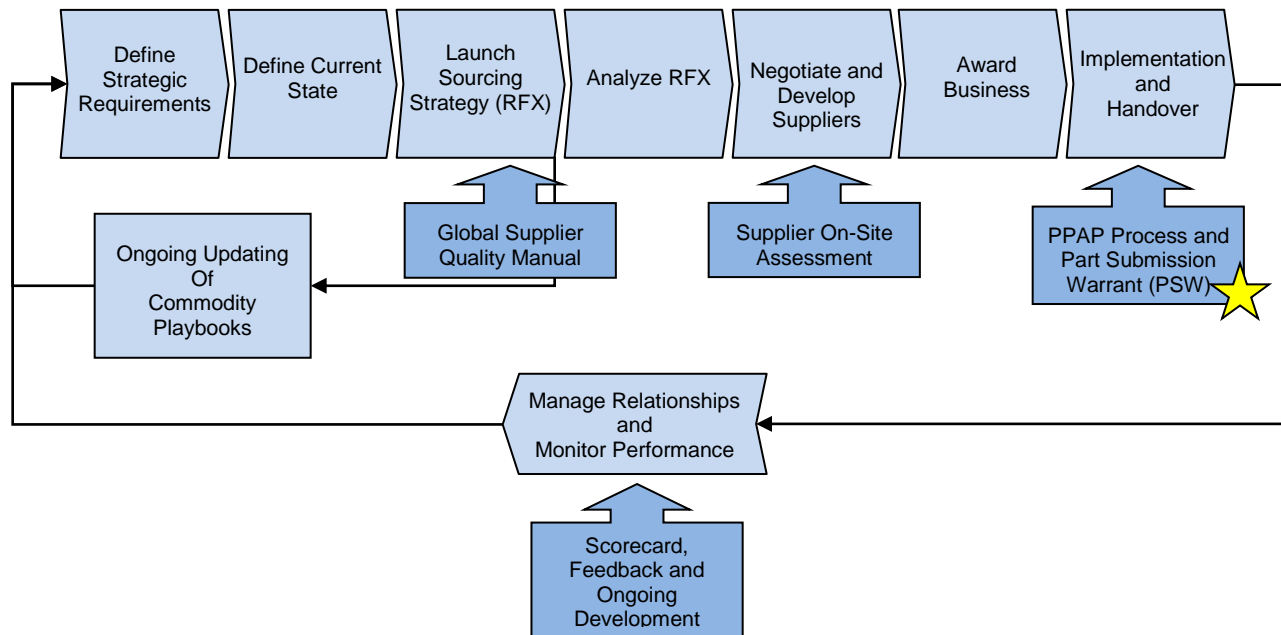


**References:**

1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

## PPAP Requirements Element 1: Design Record

**Purpose:** To document the design that is being approved by this PPAP submission.



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Design Record requirement is indicated on the PPAP Part Submission Warrant (PSW).

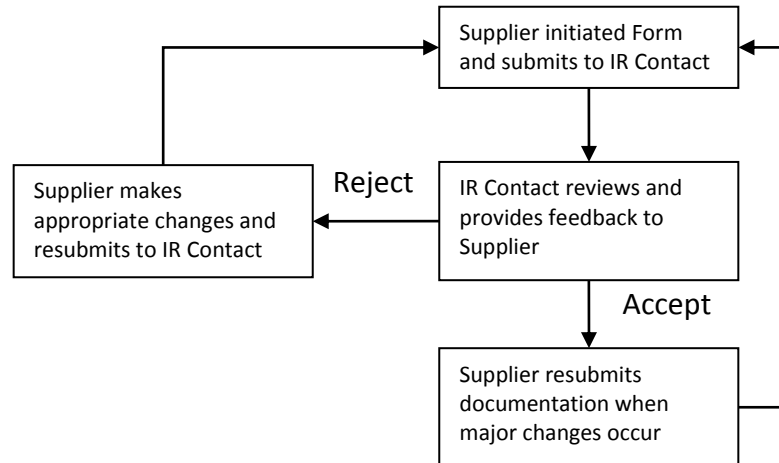
**Explanation:** The purpose of the Design Record PPAP requirement is to ensure all appropriate Drawing and Specifications have been provided to the supplier and are current.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall the Design Record requirement be performed?
    - a. Submission is required for Level 2, Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
    - b. If the components/details are proprietary, please contact the ACR for guidance.
  2. How should the Design Record requirement be completed?
    - a. The Design Record consists of:
      - i. Drawings
      - ii. Purchase Order
      - iii. Specifications referenced (directly or indirectly) on either the Drawings or the Purchase Order
    - b. A copy (electronic or paper) of each element of the design record shall be submitted with the PSW.
    - c. For parts where an Ingersoll Rand Drawing or Specification is not defined, i.e. catalog parts, the design record may consist only of a functional specification or a

- reference to a recognized industry standard.
- d. Any exceptions shall be approved by the IR ACR.

**Process Flow:**

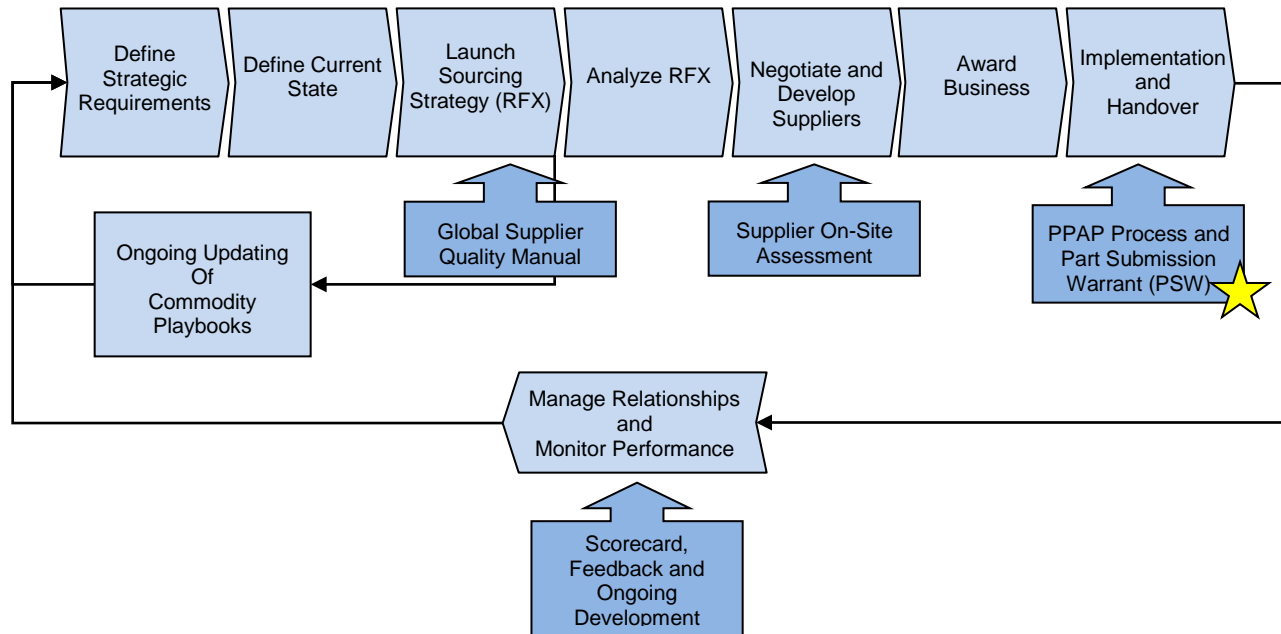


**References:**

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 2: Engineering Change Documents

**Purpose:** To document any authorized engineering changes that have not yet been incorporated in the Design Record, but have been incorporated into the product to be approved by this PPAP submission.



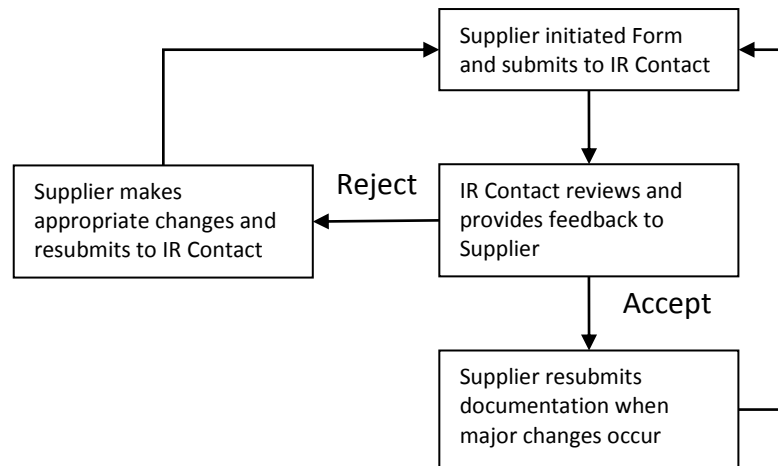
**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Engineering Change Document requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:** The purpose of the Engineering Change Documents PPAP requirement is to ensure any Ingersoll Rand authorized engineering changes to the Design Record are properly documented and accounted for during the PPAP submission process.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall the Engineering Change Document requirement be performed?
    - a. Submission is required for Level 2, Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
  2. How should the Engineering Change Document procedure be performed?
    - a. Copies of any Ingersoll Rand communication that instruct the supplier to deviate from the design record shall be included with the PPAP PSW.

### Process Flow:

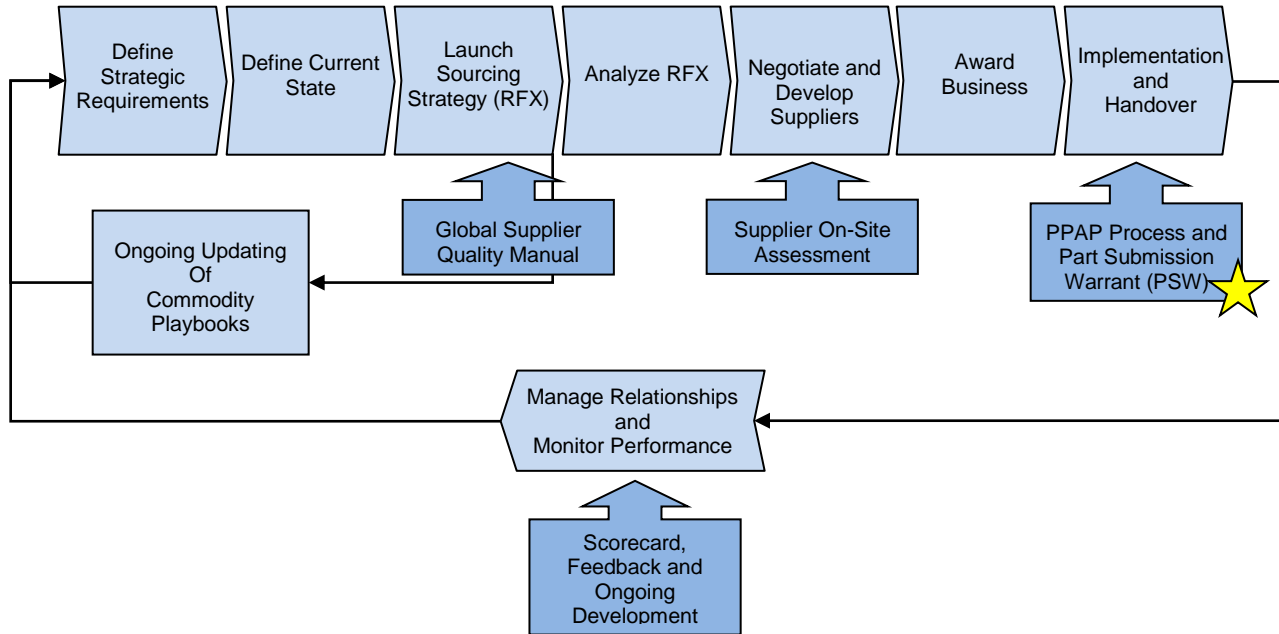


### References:

1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

## PPAP Requirements Element 3: Ingersoll Rand Engineering Approval

**Purpose:** To document that Ingersoll Rand engineering has approved the design for parts that are being submitted for production approval.



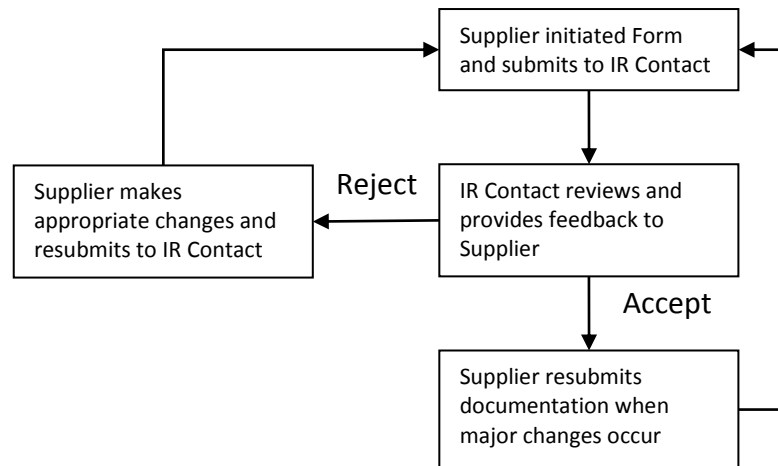
**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Ingersoll Rand Engineering Approval requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:** The purpose of the Ingersoll Rand Engineering Approval PPAP requirement is to ensure that, when specified by Ingersoll Rand, any formal Ingersoll Rand Engineering Approvals have been received and properly documented during the PPAP submission process.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall the Ingersoll Rand Engineering Approval requirement be performed?
    - a. Submission is required for Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
  2. How should the Ingersoll Rand Engineering Approval procedure be performed?
    - a. All Engineering Approval requirements shall be communicated on the Design Record or on the PSW.
    - b. Copies of any Ingersoll Rand communication that indicate Engineering Approval for each applicable requirement shall be included with the PPAP PSW.

### Process Flow:

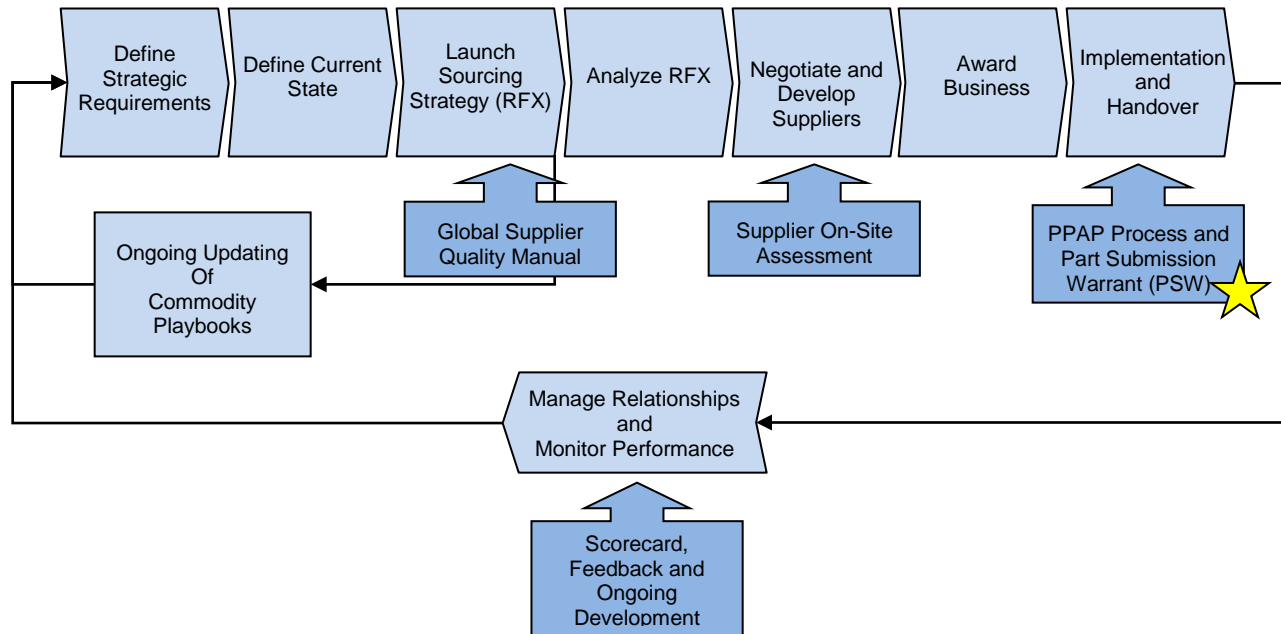


### References:

1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 4: Design FMEA

**Purpose:** To predict the potential failure of the product design, evaluate the effects of those failures, and then identify actions to reduce the risk before the design is released to manufacturing.



**Documents:**



QMOD-0002.02

**Scope:**

Applies to all IR Suppliers of production parts, raw materials, service parts, and sourced products who control the design of their product.

(If the supplier does not design their product (such as a build-to-customer-print supplier), then the supplier is not required to develop a DFMEA.)

**Explanation:**

A DFMEA should be conducted as part of the design development activity so actions can be taken before the final design is released to manufacturing. It is a disciplined review and analysis of a new or revised product. This exercise is conducted to anticipate, evaluate, and resolve potential design and application problems. A DFMEA is a living document and should be reviewed and updated as new failure modes are discovered.

A DFMEA is used to identify potential weak areas in the manufacturability, reliability, serviceability, and application of the product design. Cross-functional teams with subject matter experts should be organized to study the design for possible failure modes, effects of failures, and potential causes. Countermeasures must be provided for failure modes with high Risk Priority Numbers (RPN). Also, regardless of the resultant RPN, special attention must be given when Severity is high.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup>, *Advanced Product Quality*

*Planning and Control Plan (APQP)*<sup>2</sup>, and *Potential Failure Mode and Effects Analysis, (PFMEA)*<sup>3</sup> reference manuals for guidance on completing this procedure.

### Supplier

#### Responsibilities:

1. When shall the DFMEA requirement be performed?
  - a. Submission is required for their design-controlled product during a Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
2. Who shall complete the DFMEA requirement?
  - a. This requirement shall be performed by the Supplier's Design Engineering Organization.
3. How should the DFMEA requirement be completed?
  - a. Create and submit a DFMEA if the supplier has design control of the part
  - b. Treat the DFMEA as a "living document" and maintain it throughout the life of the product.
  - c. The DFMEA is an assessment of the adequacy of the Design Record in defining a product that will meet Product Requirements. The purpose is to uncover deficiencies in the design specifications, validation and verification.
  - d. Typical DFMEA Failures can be caused by:
    - i. Unclear specifications,
    - ii. Inadequate knowledge of environmental conditions,
    - iii. Insufficient Analysis, Modeling and Simulation,
    - iv. Poor Design,
    - v. Insufficient Testing,
    - vi. Not designing for process requirements.
  - e. Typical DFMEA Controls include:
    - i. Controlled Documents– Drawing Features and Engineering Specifications,
    - ii. Prevention - Analysis, Simulation and Modeling,
    - iii. Detection - Prototype Testing, Design Verification Testing, Reliability Testing.
  - f. The DFMEA should be updated and revised prior to any Engineering Changes. Determine and document if the change creates any new failure mode or impacts the severity, occurrence, or detection of the current failure modes.
  - g. Show continuous improvement to reduce top RPNs.
  - h. Supplier must address and identify all Ingersoll Rand Special Characteristics (Key Characteristics, Critical Features, and Critical to Quality (CTQ) items) on the DFMEA.
  - i. Retain and control the DFMEA's for Ingersoll Rand products.
  - j. If the supplier deems the DFMEA a proprietary document, then the submission requirement may be substituted with a document review between the customer and supplier representatives.
4. DFMEA rankings<sup>4</sup>
  - a. Unless other specified by the ACR, the Design FMEA shall be ranked as follows:

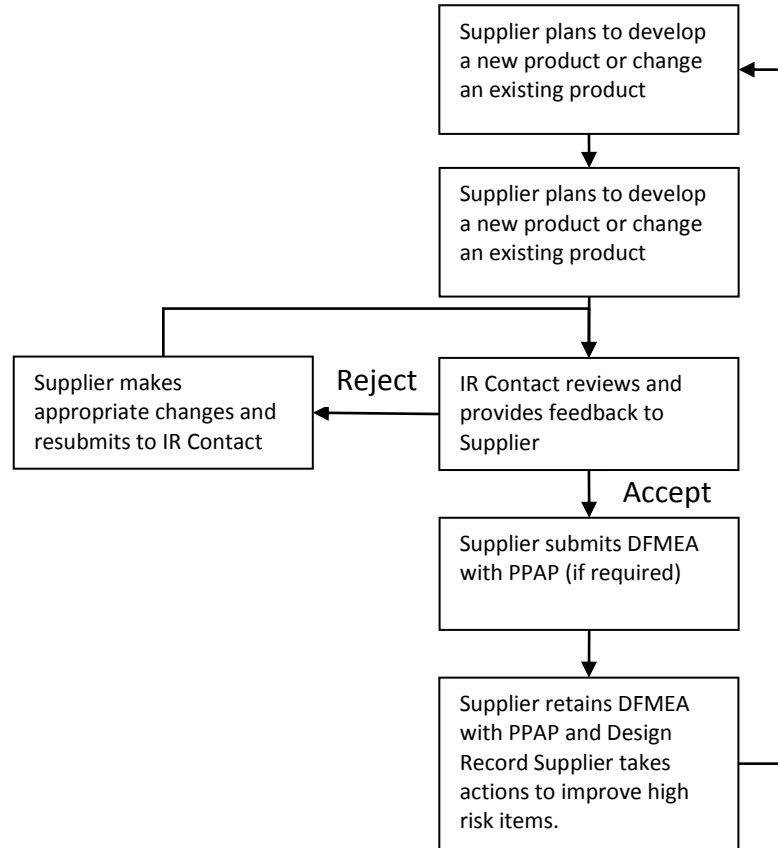
## Pre-Launch Activities and Expectations

**RPN Action Levels:**

RPN ACTION LEVELS <sup>4</sup>		
	CRITICALITY: SEVERITY & OCCURRENCE	
RISK PRIORITY NUMBER (RPN)	SEVERITY RATING LESS THAN 8 OR OCCURRENCE RATING LESS THAN 5	SEVERITY RATING 8 OR HIGHER IN COMBINATION WITH AN OCCURRENCE RATING OF 5 OR HIGHER
RPN < 100	NO ACTION REQUIRED	CORRECTIVE ACTION REQUIRED
RPN 100 - 180	TEAM TO DISCUSS WHETHER CORRECTIVE ACTION IS REQUIRED	CORRECTIVE ACTION REQUIRED
RPN > 180	CORRECTIVE ACTION REQUIRED	CORRECTIVE ACTION REQUIRED

SEVERITY	OCCURRENCE	DETECTION
10 - Hazardous without warning	10 - Very High; Failure almost inevitable; FR>1 in 10	10 - Absolute Uncertainty
9 - Hazardous with warning	9 - Very High; Failure almost inevitable; FR 1 in 20	9 - Very Remote
8 - Very High	8 - High; Repeated Failure; FR 1 in 50	8 - Remote
7 - High	7 - High; Repeated Failure; FR 1 in 100	7 - Very Low
6 - Moderate	6 - Moderate; Occasional Failures; FR 1 in 200	6 - Low
5 - Low	5 - Moderate; Occasional Failures; FR 1 in 500	5 - Moderate
4 - Very Low	4 - Moderate; Occasional Failures; FR 1 in 1,000	4 - Moderately High
3 - Minor	3 - Low; Relatively Few Failures; FR 1 in 2,000	3 - High
2 - Very Minor	2 - Low; Relatively Few Failures; FR 1 in 10,000	2 - Very High
1 - None	1 - Remote; Failure is Unlikely; FR 1 in 100,000	1 - Almost Certain

### Process Flow:

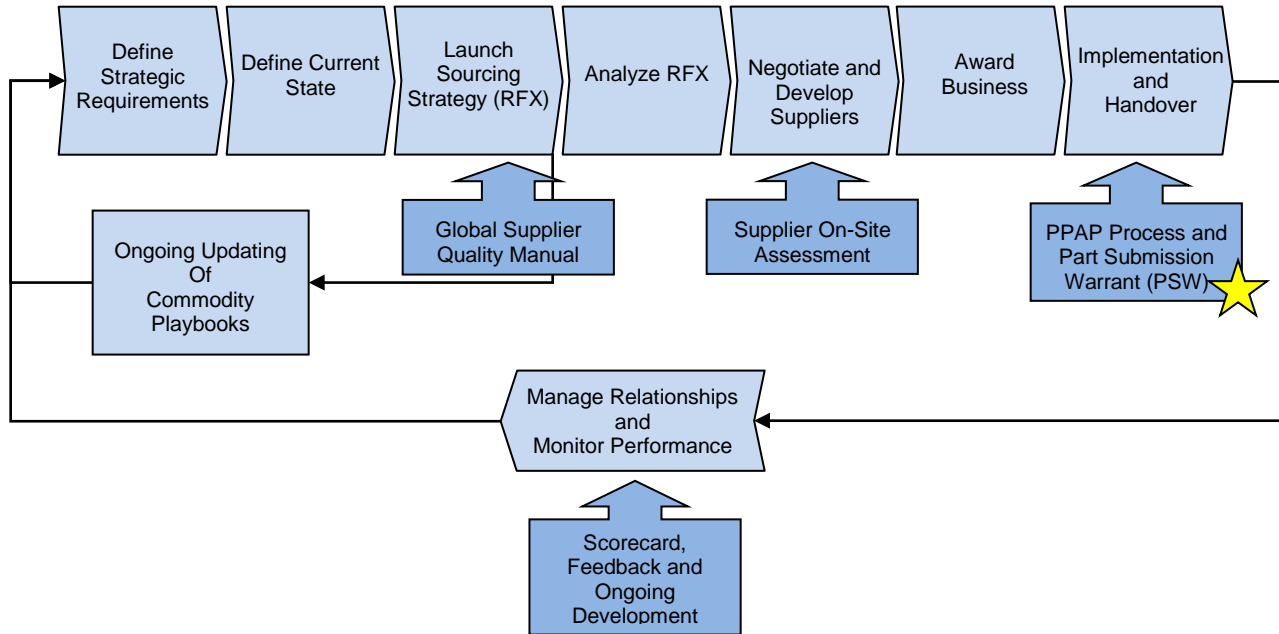


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.
- 2) Automotive Industry Action Group (AIAG) (2008). Advanced Product Quality Planning and Control Plan (APQP), 2nd edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.
- 3) Potential Failure Mode and Effects Analysis, PFMEA, 4th Edition, June 2008. ISBN: 978-1-60534-136-1. [www.aiag.org](http://www.aiag.org)
- 4) Supplier Reliability, Trane ES 5201001, Rev. A, 2007.

### PPAP Requirements Element 5: Process Flow Diagram / Map (MAP)

**Purpose:** To clearly describe the production process and the flow of product through each step of the manufacturing process.



**Documents:**



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Process Flow Diagrams requirement is indicated on the PPAP Part Submission Warrant (PSW).

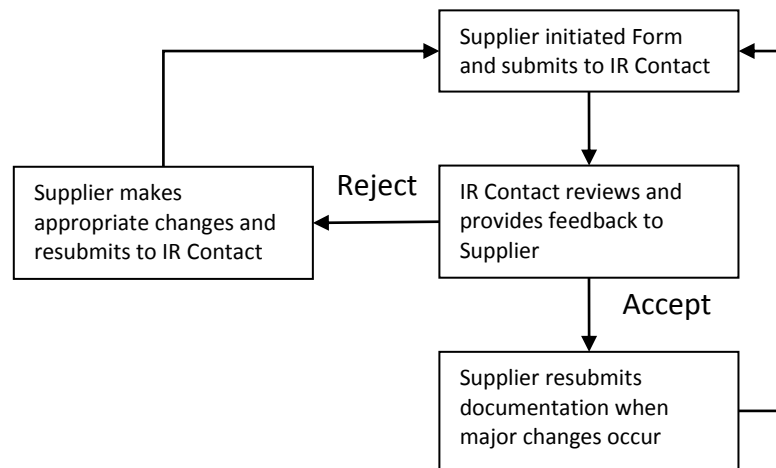
**Explanation:** The purpose of the Process Flow Diagrams requirement is to ensure that, when specified by Ingersoll Rand, the supplier's process meets Ingersoll Rand's needs, requirements and expectations and is properly documented during the PPAP submission process.

The Process Flow chart is a schematic representation of the current or proposed process flow. It can be used to analyze sources of variations of machines, materials, methods, and manpower from the beginning to end of a manufacturing or assembly process. It is used to emphasize the impact of sources of variation on the process. The flow chart helps to analyze the total process rather than individual steps in the process. The flow chart assists with conducting the FMEA and designing the Control Plan.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> and *Advanced Product Quality Planning and Control Plan (APQP)*<sup>2</sup> reference manuals for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall a Process Flow Diagram be completed?
    - a. Submission is required for Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
    - b. Supplier shall review and update their Process Flow Diagrams for all PPAP submission levels.
  2. How should the Process Flow Diagrams procedure be performed?
    - a. Supplier must treat Process Flow Diagram as a "living document" and maintain it throughout the life of the product.

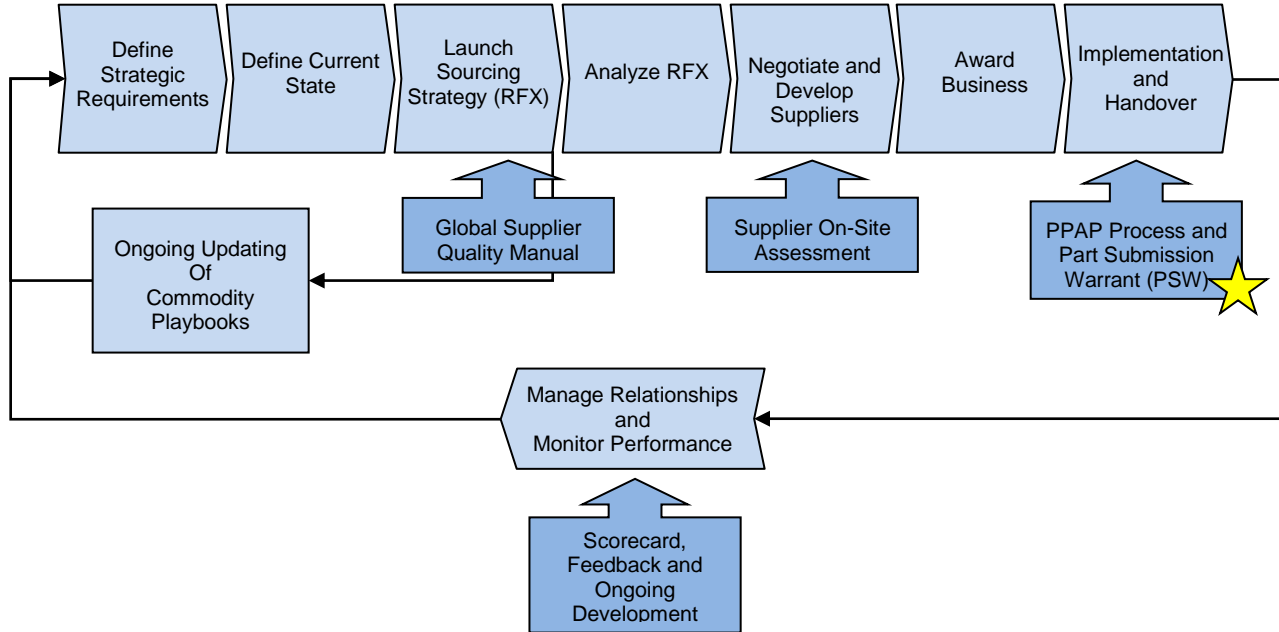
**Process Flow:**



- References:**
- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.
  - 2) Automotive Industry Action Group (AIAG) (2008). Advanced Product Quality Planning and Control Plan (APQP), 2nd edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

## PPAP Requirements Element 6: Process FMEA

**Purpose:** To predict the potential failure in the manufacturing process of a product, evaluate the effects of those failures, and then identify actions to reduce the risk.



**Documents:**



QMOD-0002.03

**Scope:**

Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand.

**Explanation:**

A PFMEA should be conducted during product quality planning and before beginning production. It is a disciplined review and analysis of a new/revised process and is conducted to anticipate, resolve, or monitor potential process problems. A PFMEA is a living document and should be reviewed and updated as new failure modes are discovered.

A PFMEA is used to identify potential weak areas in the manufacturing and assembling process. Cross-functional teams should be organized to study each step of the process for possible failure modes, effects of failures, and potential causes. Countermeasures must be provided for failure modes with high Risk Priority Numbers (RPN). Also, regardless of the resultant RPN, special attention must be given when Severity is high.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> and *Advanced Product Quality Planning and Control Plan (APQP)*<sup>2</sup>, and *Potential Failure Mode and Effects Analysis, (PFMEA)*<sup>3</sup> reference manuals for guidance on completing this procedure.

**Supplier  
Responsibilities**  
:

1. When shall the PFMEA requirement be performed?
  - a. Submission is required for Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
2. Who shall complete the PFMEA requirement?
  - a. This requirement shall be performed by the Supplier's Quality Assurance Organization.
3. How should the PFMEA requirement be completed?
  - a. Create and submit a PFMEA for each process involved
  - b. Treat the PFMEA as a "living document" and maintain it throughout the life of the product. The supplier's Process Flow Diagram, Process FMEA and Control Plan should be aligned.
  - c. Assume that the design is capable and focus on process capability and control.
  - d. The PFMEA should be updated and revised whenever a potential change to the production process is being considered, such as during an Engineering Change, Process Change, or corrective action to a quality problem.
  - e. Show continuous improvement to reduce top RPNs.
  - f. Supplier must address and identify all Ingersoll Rand Special Characteristics (Key Characteristics, Critical Features, and Critical to Quality (CTQ) items) on the PFMEA.
  - g. Retain and control the PFMEAs for Ingersoll Rand products.
  - h. If the supplier deems the PFMEA a proprietary document, then the submission requirement may be substituted with a document review between the customer and supplier representatives.
4. PFMEA rankings <sup>4</sup>
  - a. Unless other specified by the ACR, the Process FMEA shall be ranked as follows:

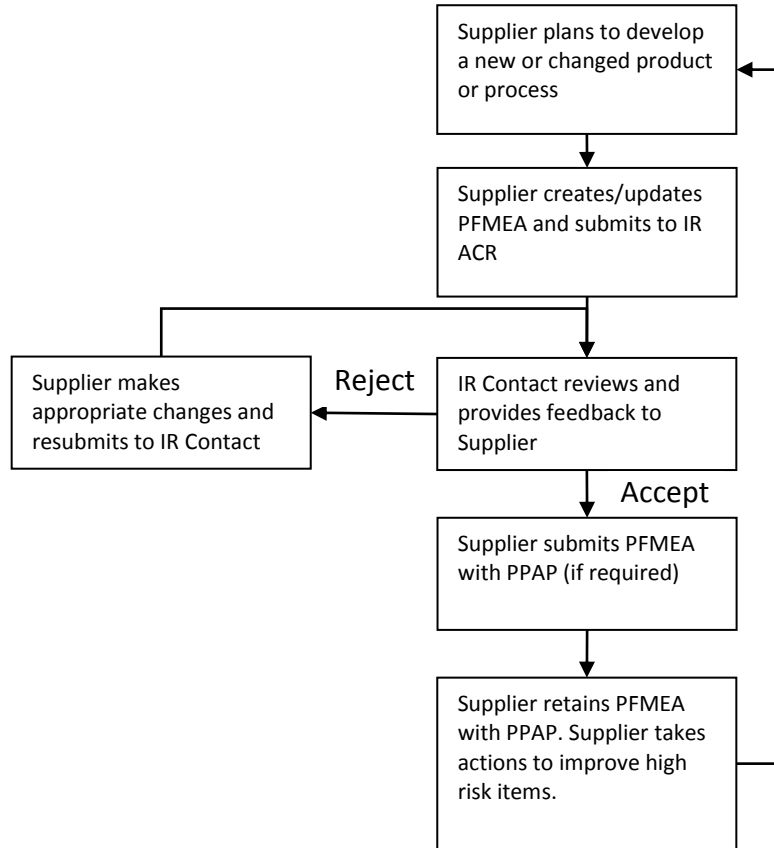
## Pre-Launch Activities and Expectations

**RPN Action Levels:**

RPN ACTION LEVELS <sup>4</sup>		
RISK PRIORITY NUMBER (RPN)	CRITICALITY: SEVERITY & OCCURRENCE	
		SEVERITY RATING LESS THAN 8 OR OCCURRENCE RATING LESS THAN 5
RPN < 100	NO ACTION REQUIRED	CORRECTIVE ACTION REQUIRED
RPN 100 - 180	TEAM TO DISCUSS WHETHER CORRECTIVE ACTION IS REQUIRED	CORRECTIVE ACTION REQUIRED
RPN > 180	CORRECTIVE ACTION REQUIRED	CORRECTIVE ACTION REQUIRED

SEVERITY	OCCURRENCE	DETECTION
10 - Hazardous without warning	10 - Very High; Failure almost inevitable; FR>1 in 10	10 - Absolute Uncertainty
9 - Hazardous with warning	9 - Very High; Failure almost inevitable; FR 1 in 20	9 - Very Remote
8 - Very High	8 - High; Repeated Failure; FR 1 in 50	8 - Remote
7 - High	7 - High; Repeated Failure; FR 1 in 100	7 - Very Low
6 - Moderate	6 - Moderate; Occasional Failures; FR 1 in 200	6 - Low
5 - Low	5 - Moderate; Occasional Failures; FR 1 in 500	5 - Moderate
4 - Very Low	4 - Moderate; Occasional Failures; FR 1 in 1,000	4 - Moderately High
3 - Minor	3 - Low; Relatively Few Failures; FR 1 in 2,000	3 - High
2 - Very Minor	2 - Low; Relatively Few Failures; FR 1 in 10,000	2 - Very High
1 - None	1 - Remote; Failure is Unlikely; FR 1 in 100,000	1 - Almost Certain

### Process Flow:

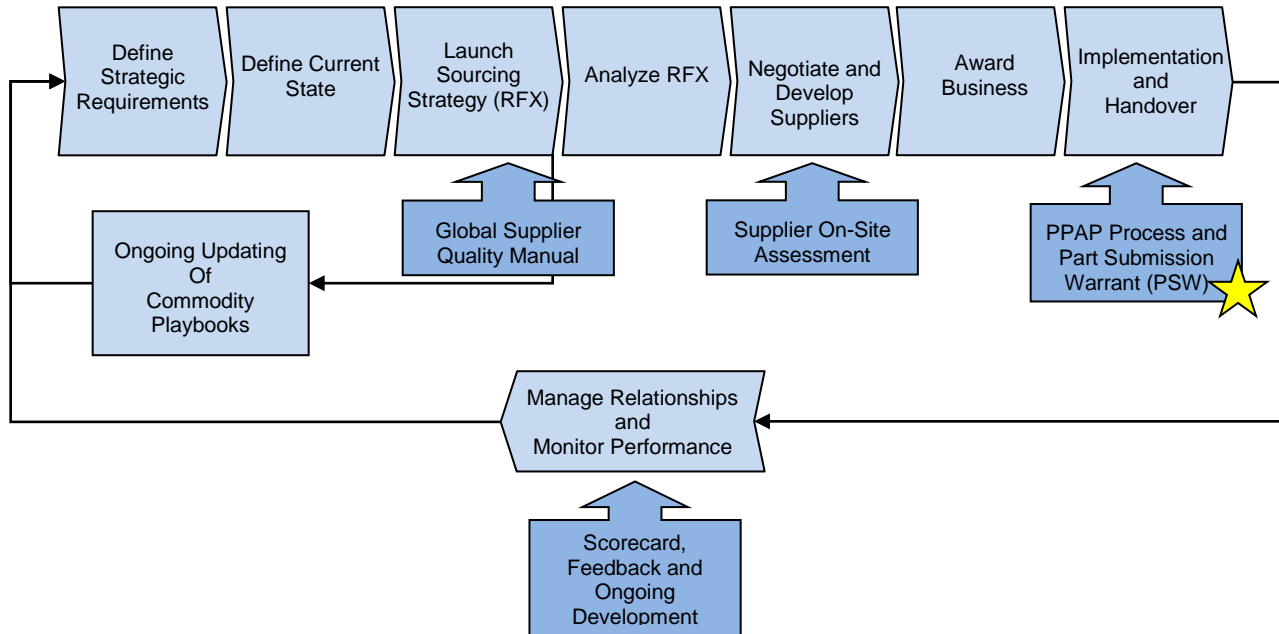


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.
- 2) Automotive Industry Action Group (AIAG) (2008). Advanced Product Quality Planning and Control Plan (APQP), 2nd edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.
- 3) Potential Failure Mode and Effects Analysis, PFMEA, 4th Edition, June 2008. ISBN: 978-1-60534-136-1. [www.aiag.org](http://www.aiag.org)
- 4) Supplier Reliability, Trane ES 5201001, Rev. A, 2007.

## PPAP Requirements Element 7: Control Plan (CPL)

**Purpose:** To define all methods used to control the manufacturing process and determine if product complies with customer requirements prior to shipment.



**Documents:**



QMOD-0002.04

**Scope:**

Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Control Plan requirement is indicated on the PPAP Part Submission Warrant (PSW)

**Explanation:**

The Supplier Control Plan is a document which indicates critical product characteristics, all process steps, and all Quality Assurance checks.

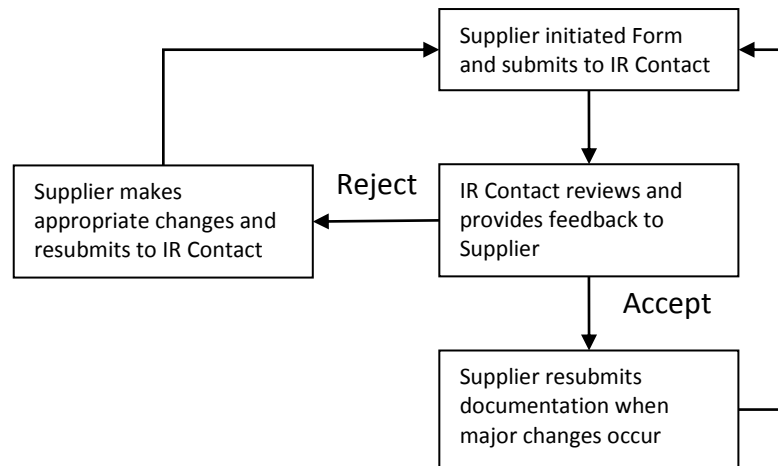
The purpose of the Control Plan requirement is to ensure that, when specified by Ingersoll Rand, the supplier's has defined process control methods that meet Ingersoll Rand's needs, requirements and expectations and have properly documented them during the PPAP submission process.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> and *Advanced Product Quality Planning and Control Plan (APQP)*<sup>2</sup> reference manuals for guidance on completing this procedure.

**Supplier****Responsibilities:**

1. When shall a Control Plan be completed?
  - a. Submission is required for Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
  - b. Supplier shall review and update their Control Plans for all PPAP submission Levels.
  - c. Submission timing is in accordance with the PPAP Part Submission Warrant (PSW).
2. How should the Control Plan procedure be performed?
  - a. Supplier must treat the Control Plan as a "living document" and maintain it throughout the life of the product. The supplier's Process Flow Diagram, Process FMEA and Control Plan should be aligned.
  - b. Suppliers must test and analyze the process to obtain results which support the Control Plan contents.
  - c. Approval of the Control Plan used by the Supplier must be confirmed by more than one functional department at Supplier. Ingersoll Rand has the right to review and approve the document depending on the supplied component's risks.
  - d. Re-issuing is necessary for all revisions and must be approved by Supplier's Chain of command.
  - e. Revisions which require approval from Ingersoll Rand must have the approval prior to shipment of parts reflecting the change.
  - f. Items requiring conformance to standard test methods (ASTM, UL, etc) should be indicated.
  - g. Supplier must address and identify all Ingersoll Rand Special Characteristics (Key Characteristics, Critical Features, and Critical to Quality (CTQ) items) on the Control Plan.
  - h. No process change, temporary or permanent, is allowed after the start of Mass Production unless a Supplier Change Request form has been submitted to Ingersoll Rand and approved by Ingersoll Rand.
  - i. If the Control Plan is not being followed then action must be taken to stop the Supplier's production, contain defects, correct the problem, confirm the corrective action, and communicate to Ingersoll Rand if defects flowed outside of Supplier's facility before restarting process.

### Process Flow:

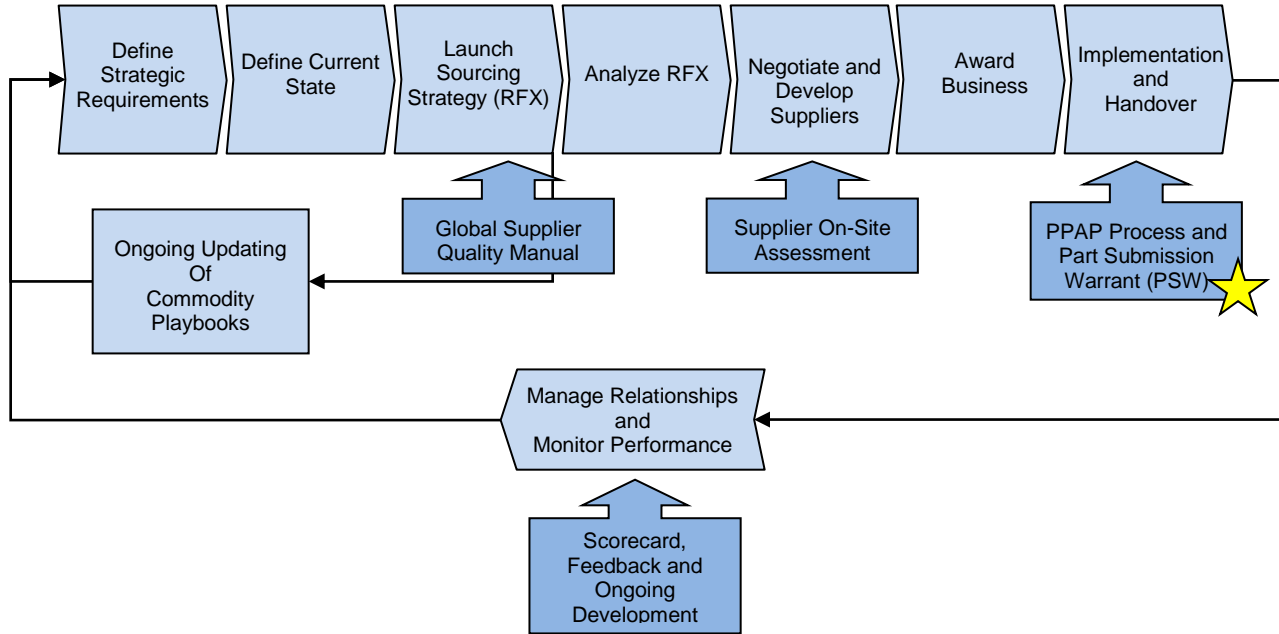


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.
- 2) Automotive Industry Action Group (AIAG) (2008). Advanced Product Quality Planning and Control Plan (APQP), 2nd edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

## PPAP Requirements Element 8: Measurement Systems Analysis (MSA)

**Purpose:** To verify that all gages and test equipment are capable of accurate measurement.



**Documents:**



QMOD-0002.05

**Scope:**

Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the MSA requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:**

The purpose of an MSA is two fold:

1. Quantify the amount of measurement error associated with a gage to determine if the gage is suitable for measuring a dimension of a certain tolerance (Gage R&R).
2. Quantify the accuracy and repeatability of a gage to assure accept / reject decisions based on dimensions measured by a supplier agree with accept / reject decisions when the same dimension is re-measured by IR.

There are many methods for performing and evaluating an MSA. The method described in this section is consistent with AIAG<sup>1</sup> and functionality found within Minitab<sup>2</sup>. Any format / software is permitted, as long as it is compatible with the methods described in this procedure.

The method described below is suitable for non-destructive variable measurements. It assumes gage will be used to measure compliance to single specification. If gage is used with multiple specifications, a linearity test may also be required. See Ref #1 or contact your Ingersoll Rand Supplier Quality Representative on how to conduct these studies.

Reference the *Production Part Approval Process (PPAP)*<sup>3</sup> and *Measurement Systems Analysis (MSA)*<sup>1</sup> reference manuals for guidance on completing this procedure.

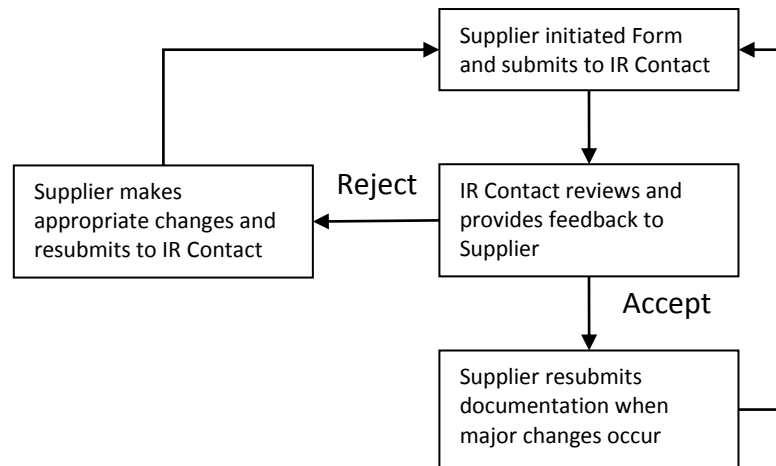
### Supplier

#### Responsibilities:

1. When should an MSA be performed?
  - a. Submission is required for all Special Characteristics for Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
  - b. All gages measuring Special Characteristics are required to have an acceptable MSA. An MSA shall be performed prior to submitting capability data.
  - c. Gage R&Rs shall be repeated after any change to a Supplier's measurement system and/or product design; including relocation of measurement equipment.
  - d. Ingersoll Rand reserves the right to request gage MSAs to be performed on any equipment measuring and/or confirming product quality.
2. Who should perform an MSA?
  - a. Whenever possible, have the actual operators / quality inspectors that will be using the gage perform the measurements.
  - b. The analyst / observer responsible for the quality of an MSA submitted to Ingersoll Rand must be competent in statistical techniques. Ideally, the analyst should be a Six Sigma Black Belt or equivalent. Any supplier with questions or concerns about how to execute and analyze an MSA should ask their Ingersoll Rand contact to enlist the help of an Ingersoll Rand Black Belt. A Black Belt should be consulted regarding methods and analysis of MSAs for attribute data and/or destructive testing.
3. Review Production Measurement Process
  - a. Review / develop a measurement technique procedure. Include mastering the gage, locating the part in the gage, environment, etc...
  - b. Verify discrimination ratio of the gage (discrimination / specification tolerance). Ratio should be  $\geq 10$  to 1.
  - c. Establish the number of significant digits to be used. For analog gages, record data to one-half the of the gage's smallest graduation (resolution). Example, if 0.001" is the smallest graduation, record measurements to 0.0005".
  - d. Be especially aware of within-part variation, as this can significantly impact gage variation. Pay special attention to the effects of burrs, parting lines, geometric consistency (i.e. roundness), cleanliness, etc..., when developing the measurement process. If significant within-part variation exists, contact IR for resolution.
4. Conducting a bias and repeatability check (reference Minitab Type I Gage Study or AIAG Phase 1)
  - a. Ensure that the gage is calibrated to the Production Process Specifications
  - b. Obtain a master part that is within the specification tolerance (ideally a nominal part). Establish its master value. Certification must be NIST traceable. This will be used for the bias check.
  - c. Measure master 10-25 times. Be sure un-engage and re-engage the master in the gage for each replication.
  - d. Plot the data sequentially, using a run chart with control limits = master

- value +/- 10% of the specification tolerance. Ensure there are no points outside the chart limits.
- e. Data must pass bias check, using a 2 sided T-test at a 95% confidence interval versus the master value.
  - f. Data should have % repeatability <30% or it will be unlikely the gage will pass Gage R&R.  $\% \text{ repeatability} = (6 * \text{stdev}) / (\text{tolerance})$
5. Design the Gage R&R and measure parts
  6. Proper planning of a Gage R&R is critical to its successful completion and requires knowledge of the theory and calculations. For more information see AIAG MSA Manual cited above. Considerations worth noting are:
    - a. Train operators to the procedure. Verify all operators are capable of performing the measurement identically to the Production Measurement Process identified in Step 4.
    - b. Ensure that the gage is calibrated to the Production Process Specifications
    - c. Select parts that span long term process variation. If process variation is not known, select parts to span the specification tolerance. It is best if parts are evenly spaced across the span.
    - d. Select enough samples so that  $(\# \text{ of samples}) \times (\# \text{ of operators}) > 15$ . Each operator should measure each part at least 2 trials.
    - e. Randomize the order parts are measured and the operator order between trials. If operators work different shifts, randomize part order only.
    - f. Do not let operators know which parts they are measuring. Number all samples in a location not visible to the operators.
    - g. Have a qualified observer present throughout the study. If at any point the observer perceives an operator has deviated from the measurement procedure or a part or the gage is damaged, stop, take corrective action, and restart the study.
  7. Analyze the Gage R&R
    - a. There are many methods for analyzing the results of a Gage R&R. The method described below is the Average and Range method, with % Tolerance Analysis, as found in the attached form. If statistical software is available, the ANOVA method is preferred and should be used.
    - b. Review the Range Chart and address any out of control conditions.
    - c. Verify Total Gage R&R / Tolerance ( $\% \text{ P/T}$ ) is  $\leq 30\%$  ( $\leq 10\%$  is desirable)
    - d. For features requiring statistical process control (SPC), verify  $\% \text{GRR} \leq 30\%$  and number of distinct categories (ndc) is  $\geq 5$ .

### Process Flow:

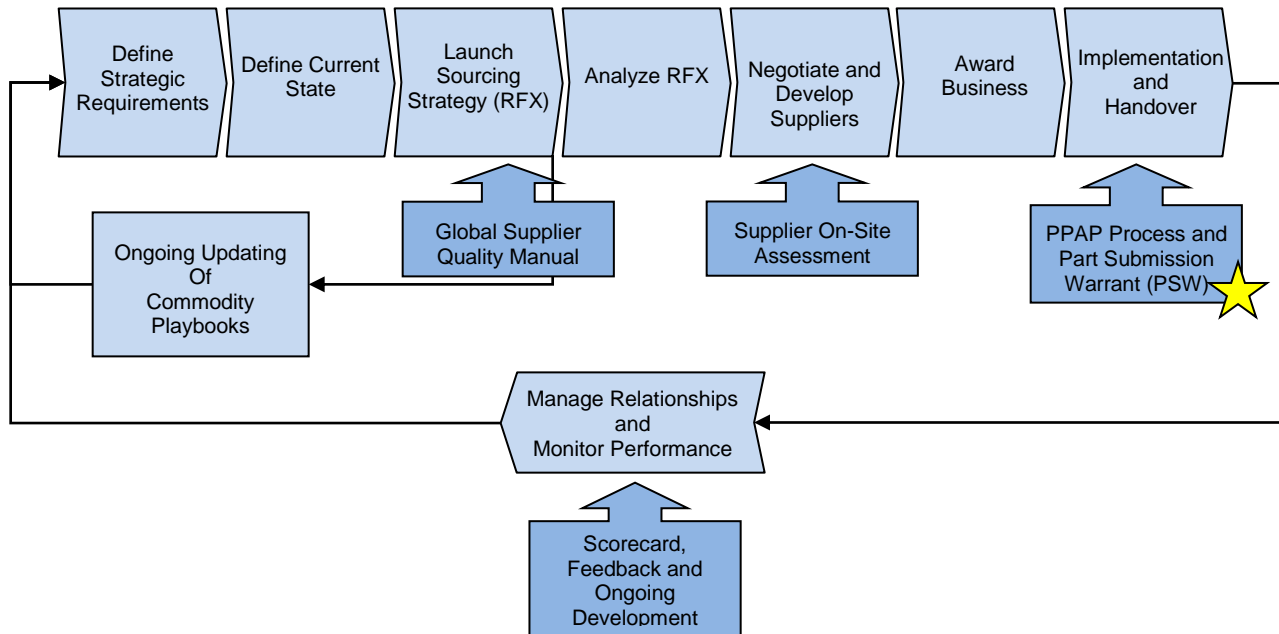


### References:

- 1) Automotive Industry Action Group (AIAG) (2010). Measurement Systems Analysis Reference Manual, 4th edition. Chrysler, Ford, General Motors Supplier Quality Requirements Task Force.
- 2) Minitab 15, Minitab Inc
- 3) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

## PPAP Requirements Element 9: Dimensional Results

**Purpose:** To provide evidence that dimensional verifications required by the design record and control plan have been completed and results indicate compliance design and customer requirements.



**Documents:**



QMOD-0002.08

**Scope:**

Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Dimensional Results requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:**

The purpose of the Dimensional Results PPAP requirement is to provide dimensional and/or functional confirmation of parts and/or material due to any significant change in the Supplier's process or during the launch process.

A successful Dimensional Results submission includes documented evidence of compliance for all Dimensions, Characteristics and Specifications pertaining to the submitted Sample Product (PPAP Element 14)

Note: This process is sometimes referred to as First Article Inspection (FAI) or as a Dimensional and Attribute Inspection (DAI), however it may also apply to situations other than first production articles.

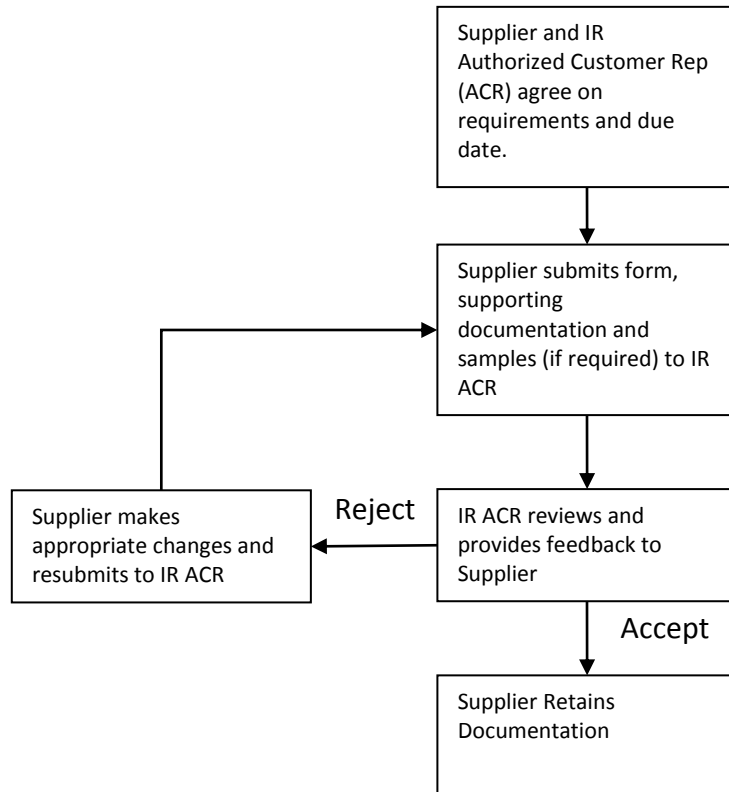
Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

### Supplier

### Responsibilities:

1. When should the Dimensional Results PPAP requirement be performed?
  - a. Submission is required for Level 2, Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
  - b. Timing:
    - i. New Component - samples and data for new parts and materials shall be delivered to Ingersoll Rand by the agreed upon date (may be specified on the purchase order or project action request).
    - ii. Supplier Process Change - samples and data shall be delivered to Ingersoll Rand by the date specified on the Supplier Process Change Request form or PSW.
2. Who should perform the Dimensional Results requirement?
  - a. This requirement shall be performed by or under the direction of the Supplier's Quality Assurance Organization; by trained personnel
3. How should the Dimensional Results requirement be completed?
  - a. Ingersoll Rand's Dimensional Results form or equivalent is required for recording data.
  - b. Ensure the Design Record is current. The latest Ingersoll Rand drawing/specification should be used and noted on the results form.
  - c. Dimensional Results requirement should be completed on three (3) parts produced using the current production process, unless otherwise specified on the PSW.
  - d. Each part should be uniquely identified and referenced on the results form to facilitate the report review.
  - e. Supplier must indicate measuring technique and devices used to generate data. Use measuring instruments that are calibrated, with a Gage R&R (GRR) below 30%.
  - f. Submit Ingersoll Rand drawing or specification (ES) with each dimension or characteristic ballooned and numbered sequentially to match the data recorded on the form.
  - g. Measure/test all features on the drawings and specification, including notes. Record the actual results of the measurements/tests along with the target and tolerance or upper and lower specifications.
  - h. Identify Key Characteristics/Critical Features/Critical to Quality dimensions by (\*) beside the dimension.
  - i. Identify/highlight dimensions that are out of tolerance/specification. Submit root cause and corrective action plan. Contain affected product for disposition from ACR. If applicable, submit deviation form to Ingersoll Rand ACR to request approval to ship.
  - j. The Supplier ships the sample parts with all appropriate Dimensional Results documentation directly to the Ingersoll Rand Authorized Customer Representative (ACR) referenced on the PSW.

### Process Flow:

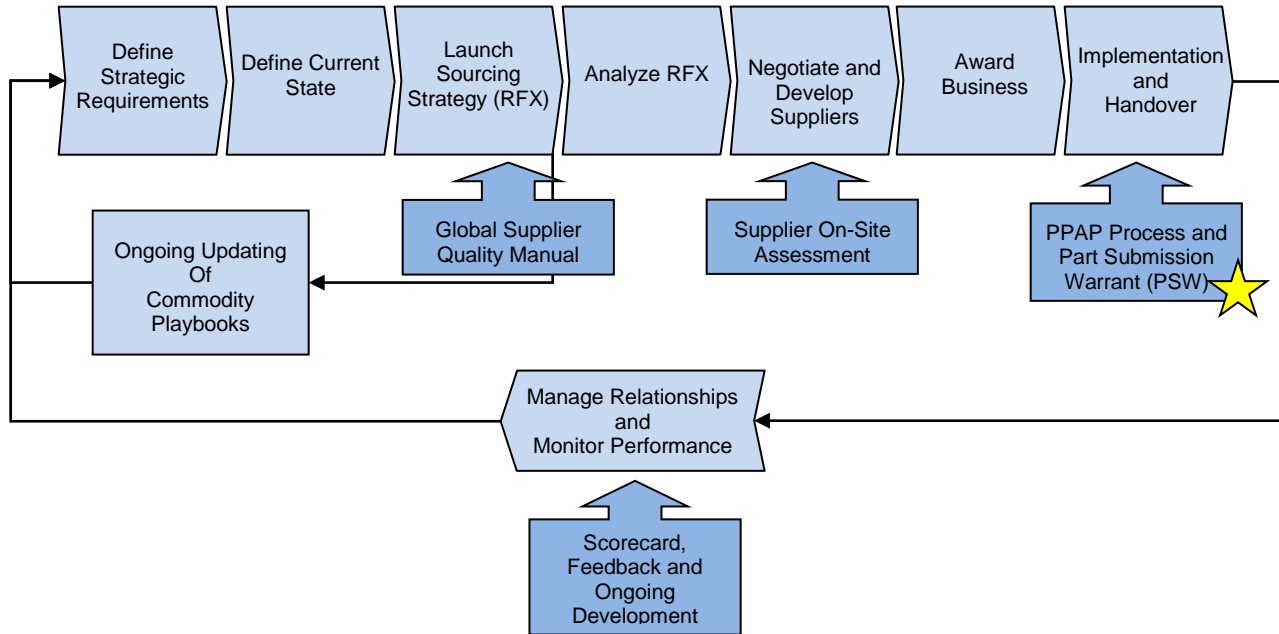


### References:

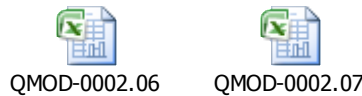
- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 10: Material, Performance Test Results

**Purpose:** To provide evidence that material test and performance tests required by the design record have been completed and results indicate compliance to requirements.



**Documents:**



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand.

**Explanation:** When Material and Performance Testing is specified in the Design Record (i.e. on the drawing or in the Engineering Specification), the supplier shall provide evidence of compliance.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

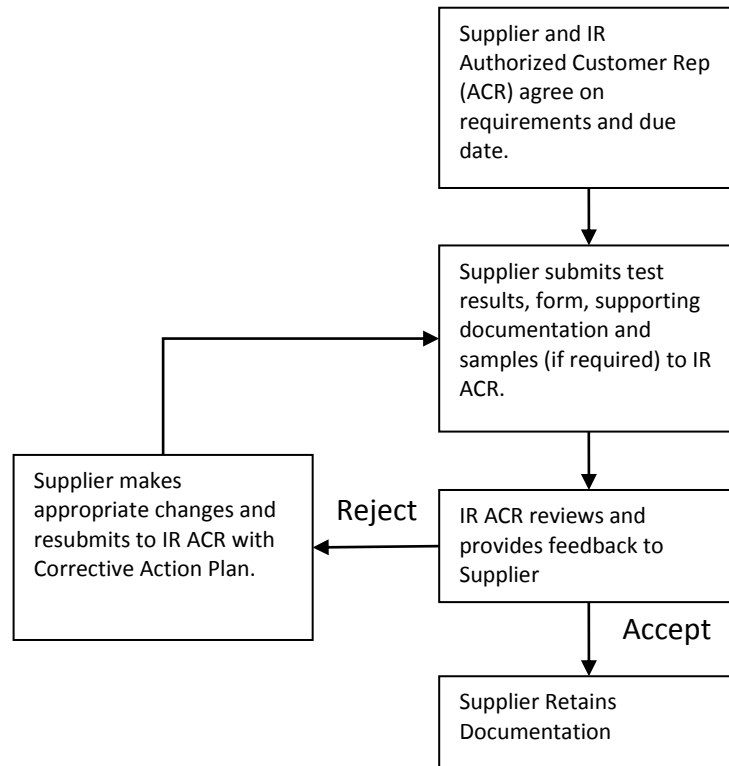
- Supplier Responsibilities:**
1. When shall the Material and Performance Testing be performed?
    - a. Submission is required for Level 2, Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
    - b. Supplier should have a plan to pass all specified testing before the PPAP due date and prior to the first shipment of parts to IR.
  2. Who shall perform the Material and Performance Testing?
    - a. The Supplier is responsible for conducting/arranging, reporting results and driving corrective action, if required, for all explicitly-specified testing.
  3. How should the Material and Performance Testing be reported?
    - a. Results may be presented in any convenient format. An example is

## Pre-Launch Activities and Expectations

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available in Appendix E of the PPAP Manual or from your IR ACR.

### Process Flow:

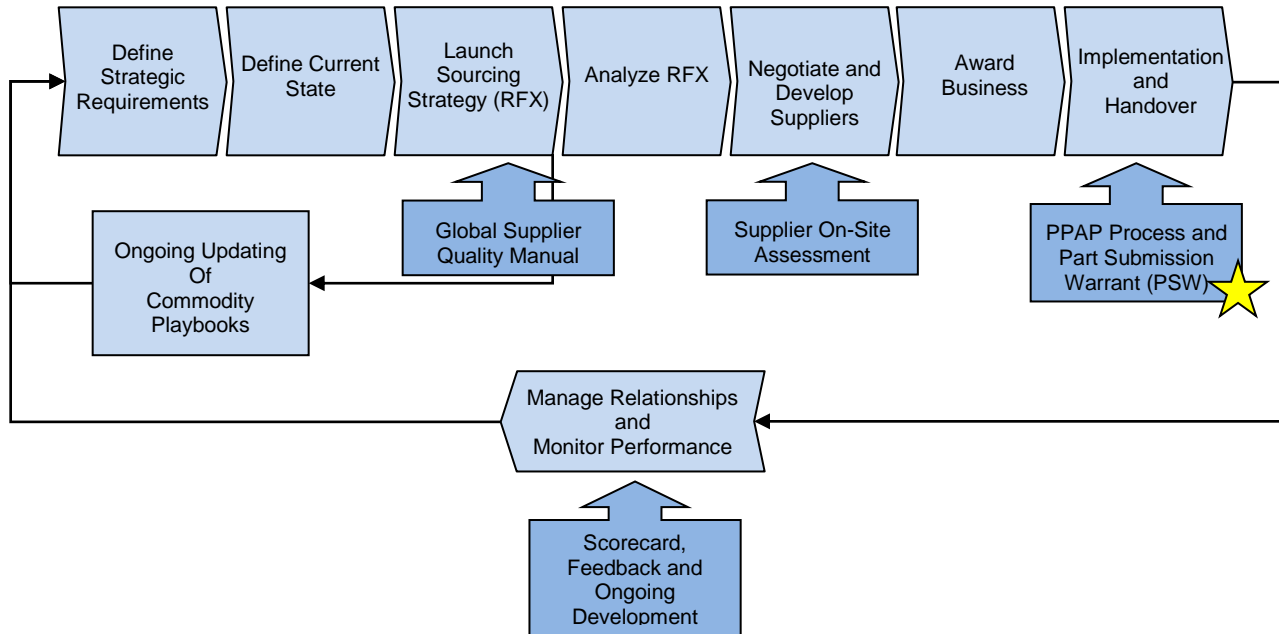


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 11: Initial Process Studies (Capability Analysis, CpK, Certificate of Analysis)

**Purpose:** To determine if the production process is likely to produce product that meets customer requirements.



**Documents:**



QMOD-0002.10

**Scope:**

Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Initial Process Studies requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:**

The purpose of the Initial Process Studies PPAP requirement is to ensure that, when specified by Ingersoll Rand, any Initial Process Studies have been received and properly documented during the PPAP submission process.

The objective of an Initial Process Study is to ensure that the supplier has analyzed the stability and capability of the processes which contribute to variation in all Special Characteristics.

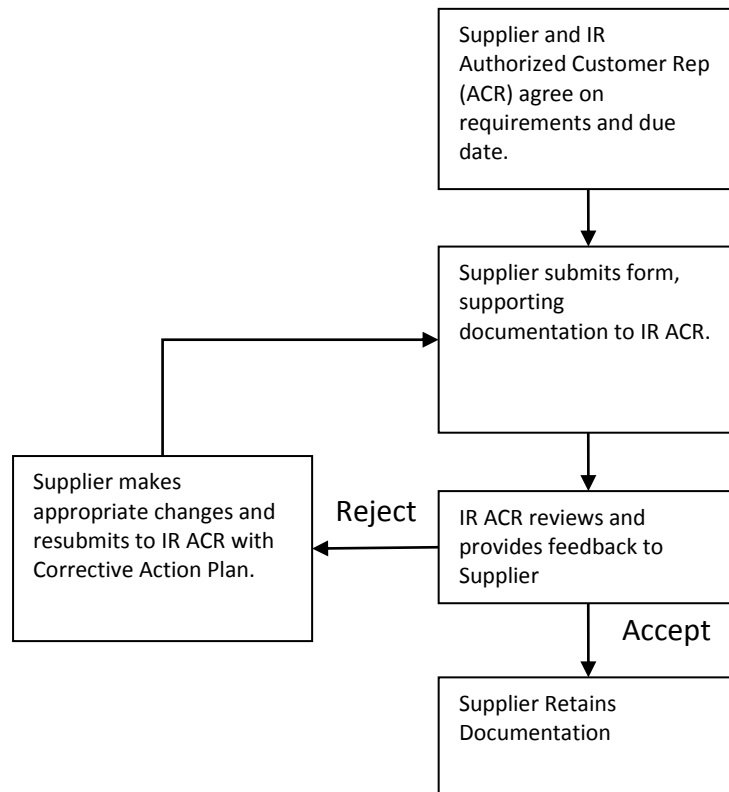
Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall Initial Process Studies be performed?
    - a. Submission is required for Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
    - b. An Initial Process Study is applicable for all Critical Features, Key Characteristics or Critical to Quality (CTQ) features identified in the Design Record or specified on the PSW.
    - c. All gages measuring Special Characteristics are required to have an acceptable Measurement System Analysis (MSA). A MSA shall be performed prior to submitting capability data.
  2. How should the Initial Process Studies process be performed?
    - a. For each designated characteristic, the Supplier must submit a process capability study with dimensional data to Ingersoll Rand from final tooling. Refer to Table 1 for specific requirements.
    - b. Long term process capability studies are recommended for Supplier's continuous process improvement. The results of these studies should be made available to Ingersoll Rand upon request. Refer to Table 1 for specific requirements.
    - c. Capability studies can be affected by Engineering Changes, Process Change Requests, Design Change Requests, or part tolerance changes and therefore must be re-submitted for characteristics affected by change.
    - d. If capability studies do not meet  $\geq 1.33$  then 100% inspection is expected by Supplier until  $\geq 1.33$  is achieved. The desirable inspection method is for the Supplier to perform 100% mechanical inspection for in-process controls with visual inspection as the last alternative.
    - e. Onsite verification may be performed by Ingersoll Rand.

**Table 1:**

	<b>Short Term CpK</b>	<b>Long Term CpK</b>
<b>Sample Size</b>	30 minimum	$\geq 50$ or as required to determine variability source
<b>Expectation: Variable Data</b>	$\geq 1.33$ , Stable	$\geq 1.33$ , Stable
<b>Expectation: Attribute Data</b>	Express in PPM, % Defective or FPY (Discuss expectation with Ingersoll Rand Contact)	Express in PPM, % Defective or FPY (Discuss expectation with Ingersoll Rand Contact)
<b>If expectation is not met</b>	1. Process control method is required (i.e.: increased audit, SPC, 100% inspection, etc.) 2. Inspect 100% since the last in-control point and implement corrective action. 3. Notify Ingersoll Rand if parts escaped and begin containment activity.	

### Process Flow:

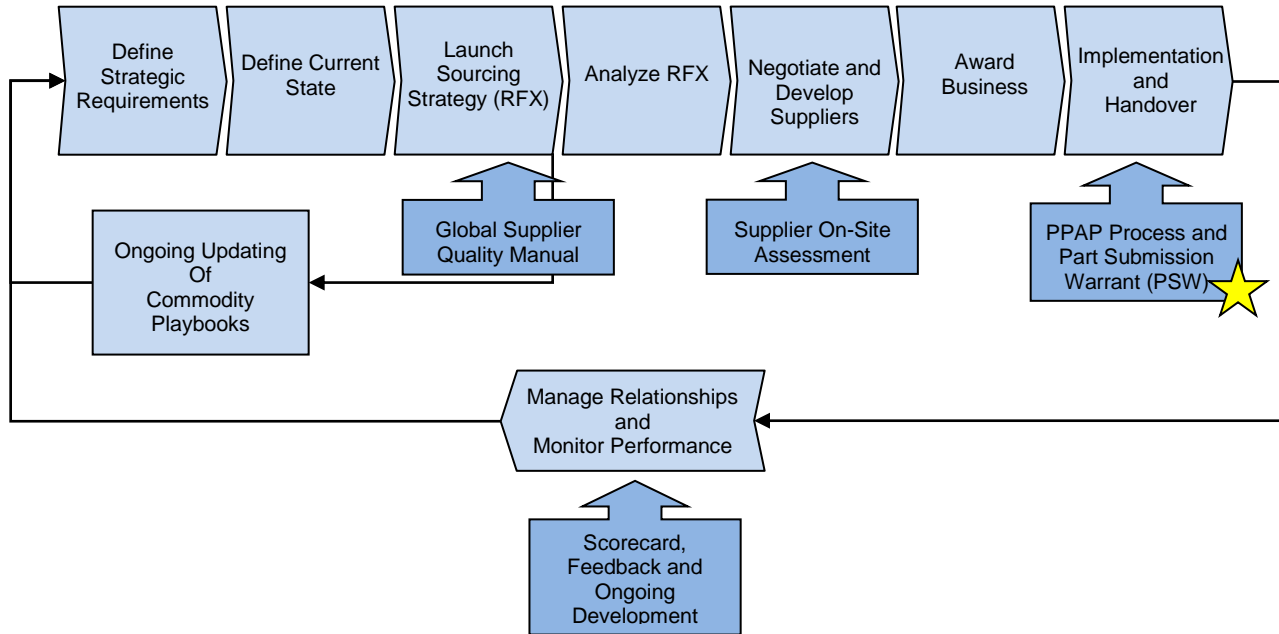


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

## PPAP Requirements Element 12: Qualified Laboratory Documentation

**Purpose:** To document that inspection and testing has been performed by a laboratory that is qualified for the type of measurement or tests conducted.



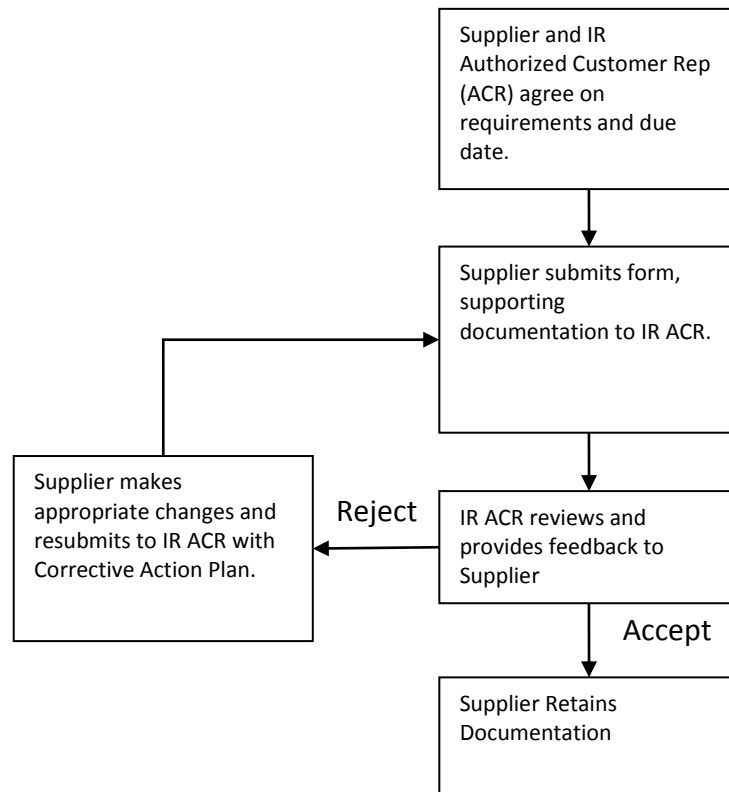
**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Qualified Laboratory Documents requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:** The supplier shall provide documentation showing that all laboratories used during the PPAP submission process, e.g. dimensional, materials testing, etc. are capable of performing the measurements required.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall the Qualified Laboratory Documentation be performed?
    - a. Submission is required for Level 2, Level 3 or Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
  2. How should the Qualified Laboratory Documents submission be completed?
    - a. If testing is performed in a Supplier's internal lab, provide a copy of the quality certification. If no quality certification exists, contact the IR ACR for guidance.
    - b. If an external lab is used, send a copy of outside lab certification and the scope of accreditation.
    - c. Supplier should indicate which lab was used for each applicable PPAP requirement.

### Process Flow:

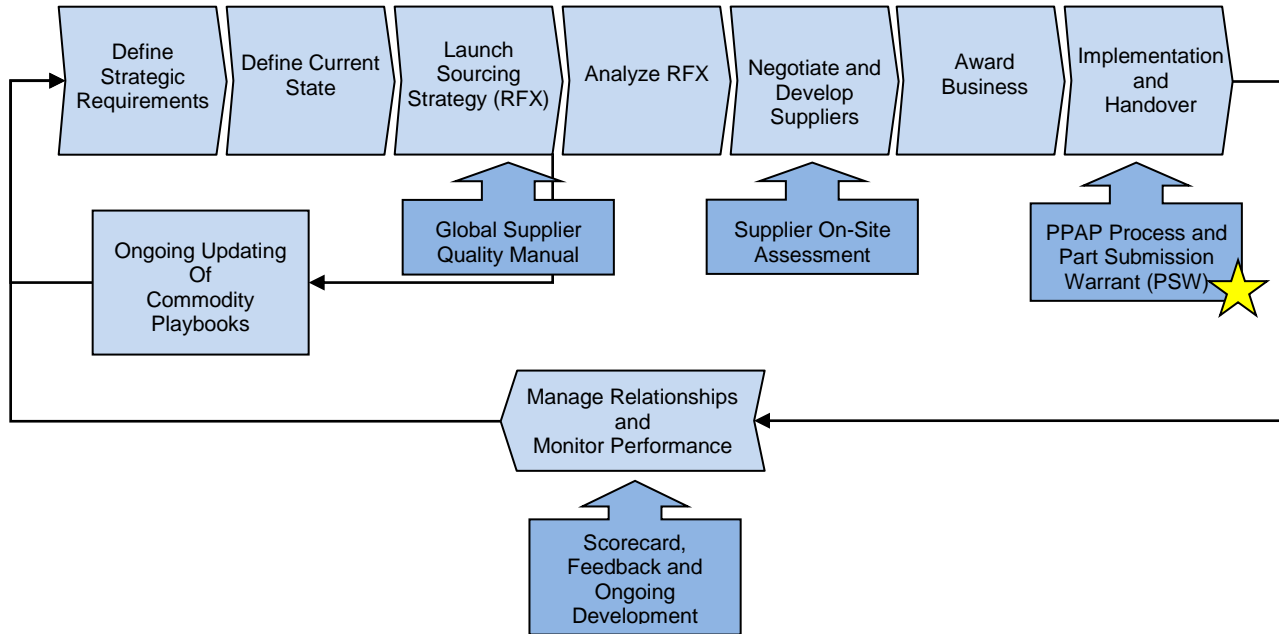


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 13: Appearance Approval Report (AAR)

**Purpose:** To demonstrate that parts meet appearance requirements on the design record and control plan.



**Documents:**



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Appearance Approval Report requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:** The purpose of the Appearance Approval Report (AAR) PPAP requirement is to ensure that, when specified by Ingersoll Rand, any Appearance requirements on the Design Record are addressed and properly documented during the PPAP submission process.

Appearance Approval Reports are used to determine whether or not cosmetic requirements are achieved on supplied parts. Not all parts have appearance approval. Approvals may consist of such criteria as LAB readings, signed samples, descriptive defect picture, etc.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

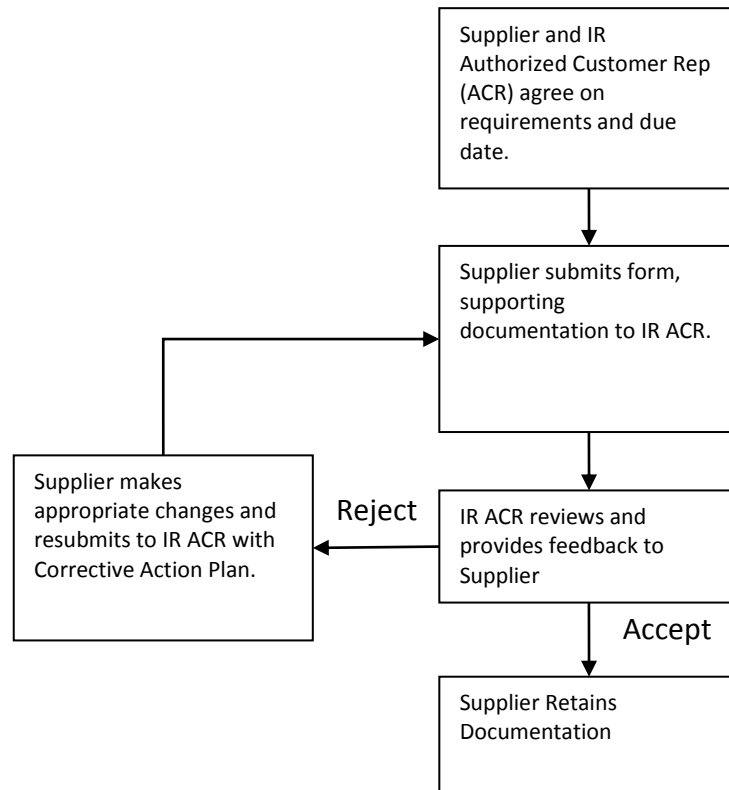
## Pre-Launch Activities and Expectations

### Supplier

#### Responsibilities:

1. When shall the Appearance Approval Report submission be performed?
  - a. Submission is required for all PPAP submissions, when explicitly requested by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
2. How should the Qualified Laboratory Documents submission be completed?
  - a. Supplier parts must meet the criteria described in the Appearance Approval Report.
  - b. Contact IR representative if there are any questions concerning the Appearance Approval Report.

#### Process Flow:

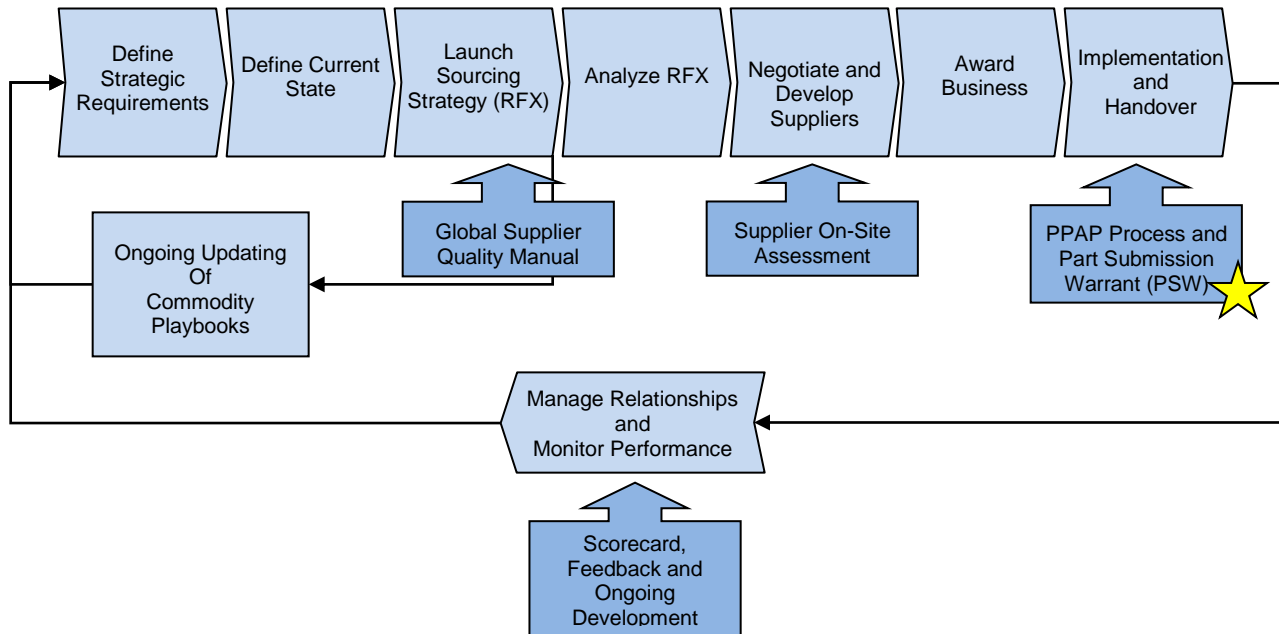


#### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 14: Sample Product

**Purpose:** A sample part provides the customer a tangible product to review along with the PPAP documentation. The Sample Parts requirement is typically met in conjunction with the Dimensional Results requirement.



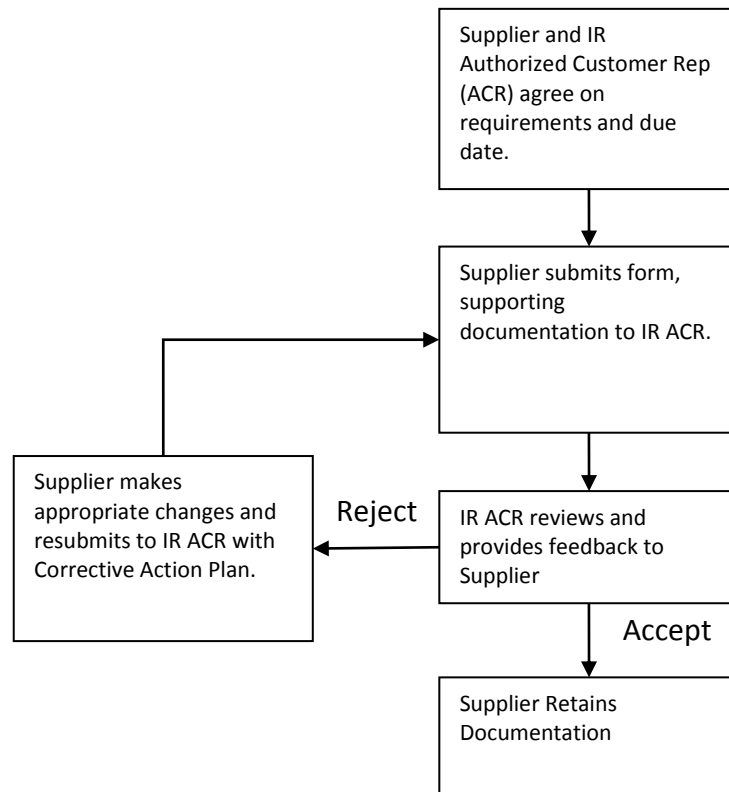
**Scope:** A sample part provides the customer a tangible product to review along with the PPAP documentation. The Sample Parts requirement is typically met in conjunction with the Dimensional Results requirement.

**Explanation:** The purpose of the Sample Product requirement is to ensure the supplier's production process (including handling, packaging, and delivery) meets Ingersoll Rand's expectations.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall the Sample Product procedure be performed?
    - a. Typically, the Sample Product is integral to the Dimensional Results submission process.
  2. How should the Sample Product procedure be performed?
    - a. This requirement is met by fulfilling the Dimensional Results requirement.

### Process Flow:

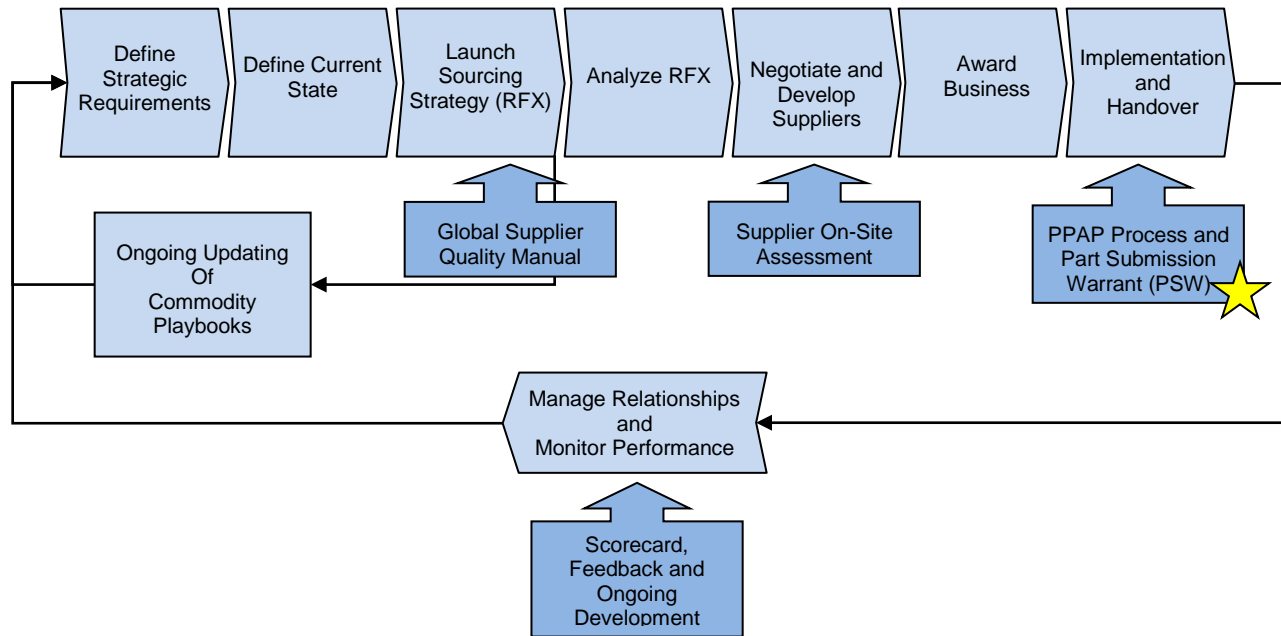


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 15: Master Sample

**Purpose:** The purpose of the master sample is to retain the initially approved production standard for future reference.



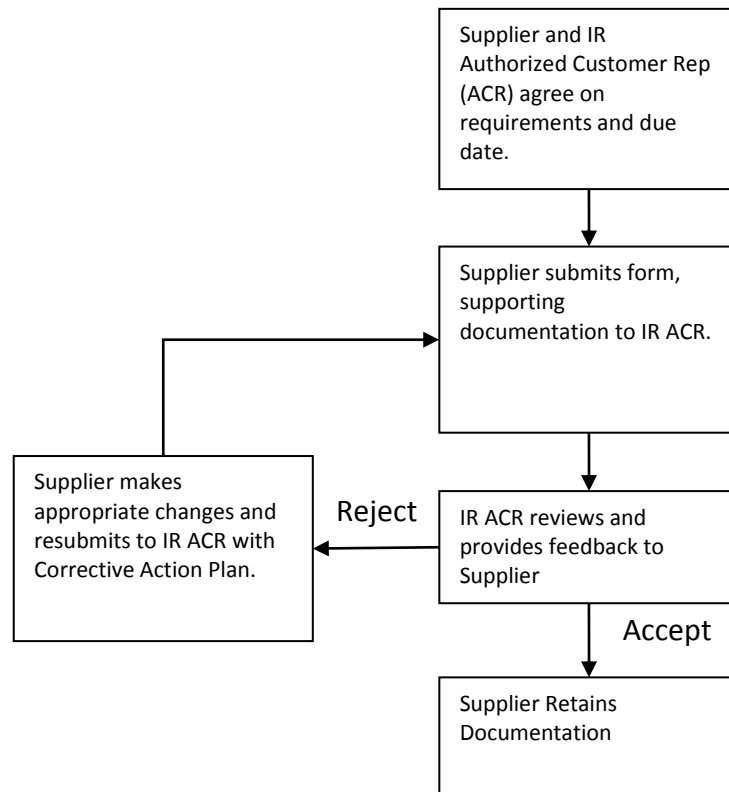
**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand. Master sample are only required when explicitly requested by the IR ACR via the PPAP Part Submission Warrant (PSW).

**Explanation:** If requested by the IR ACR, the supplier shall create and retain a master sample of the latest approved engineering level for each part number until that design is replaced by a new design level. The master sample shall be identified with part number, revision level, and approval date. Where multiple tools are used, a master sample may be required for each tool, mold, or cavity. Specific requirements should be discussed, and then documented on the request for PPAP.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When are master samples required?
    - a. A master sample is required when explicitly requested by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
  2. Who shall manage the master samples?
    - a. The Supplier's Quality Assurance Organization should retain the master samples and manage them like a controlled document.
  3. How should the master sample process be performed?
    - a. The supplier shall retain the part used for the dimensional inspection results that represents initial production for the current design level. Part should be identified with part number, design level, and approval date.

### Process Flow:

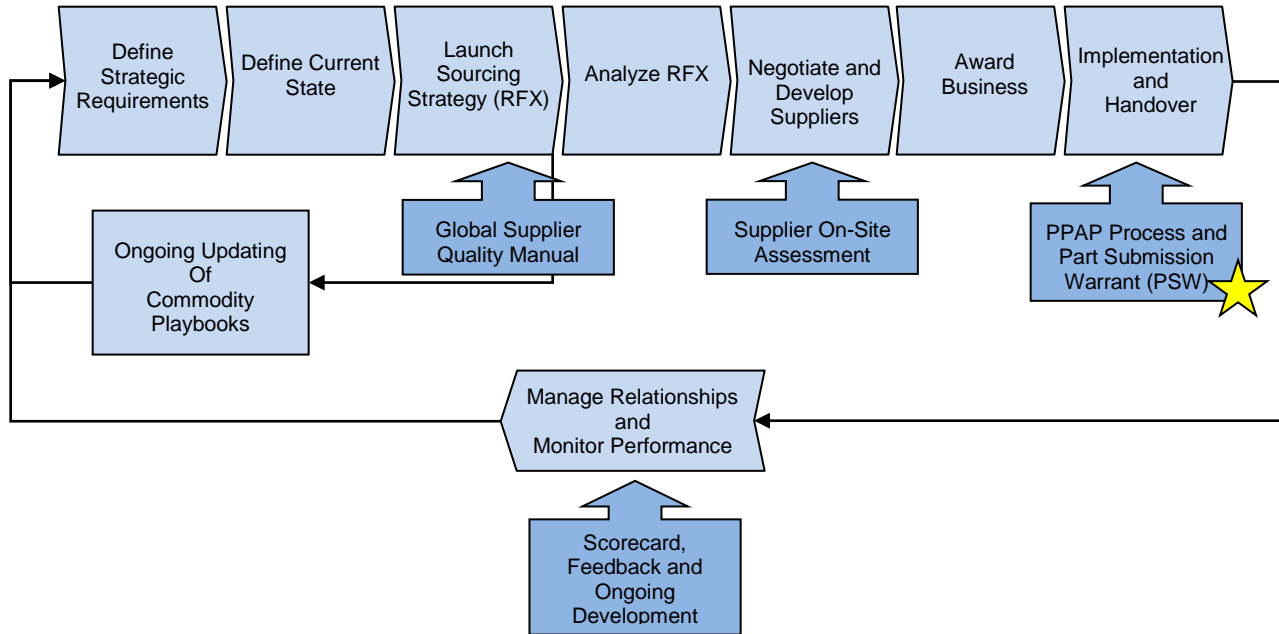


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 16: Checking Aids

**Purpose:** Checking aids are submitted with the PPAP documentation to gain agreement that these properly distinguish acceptable and non-acceptable product.



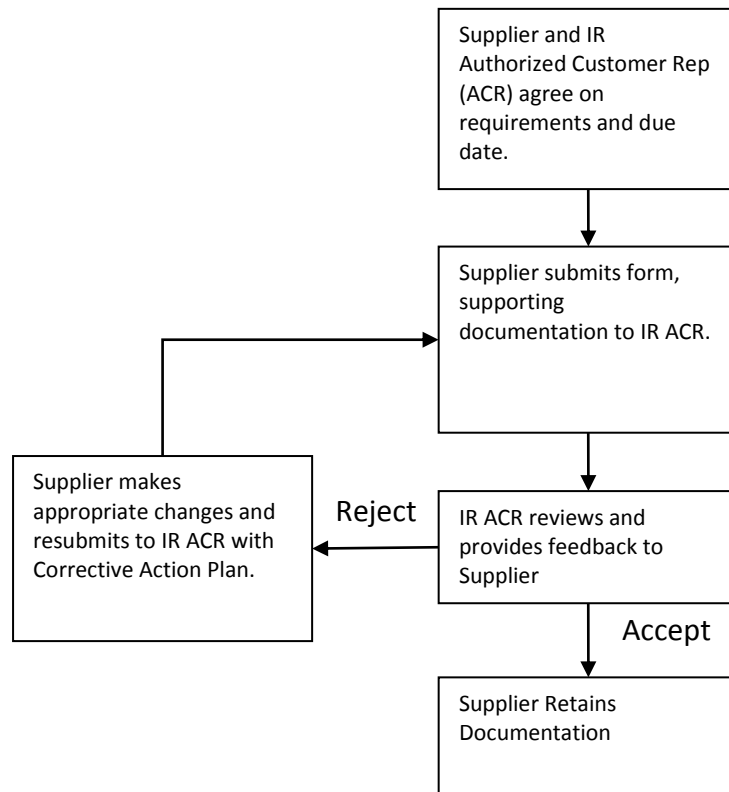
**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand.

**Explanation:** If requested by the IR ACR, the supplier shall submit any part-specific assembly or component checking aid for review. Specific requirements should be discussed with the IR ACR, and then documented on the PPAP Part Submission Warrant (PSW).

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall the Checking Aids procedure be performed?
    - a. Submission is required when explicitly requested by the Ingersoll Rand Authorized Customer Representative (ACR) on the PSW.
  2. Who shall perform the Checking Aids procedure?
    - a. The Supplier's Quality Assurance Organization should maintain part-specific checking aids and manage them like a controlled document.
  3. How should the Checking Aids procedure be completed?
    - a. If requested, arrangements shall be made with the IR ACR to review and approve part-specific checking aids for the part under PPAP consideration.

### Process Flow:

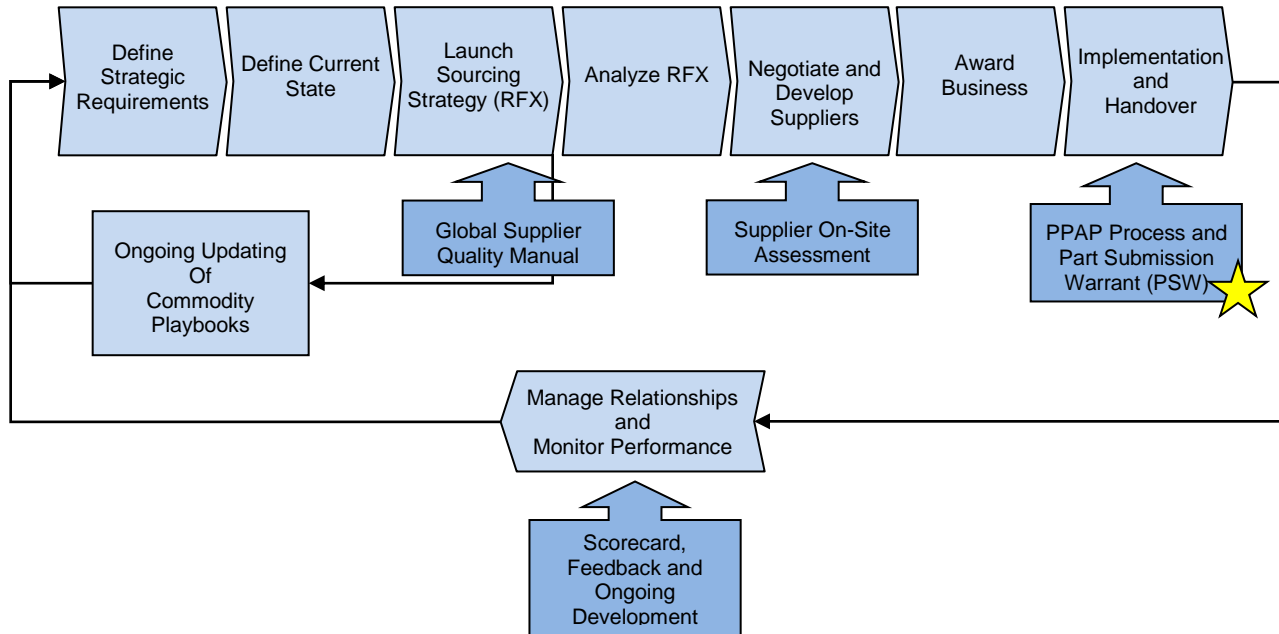


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 17: Records of Compliance (IR-Specific Requirements)

**Purpose:** To provide evidence that the product complies with all customer-specific requirements on the design record and control plan.



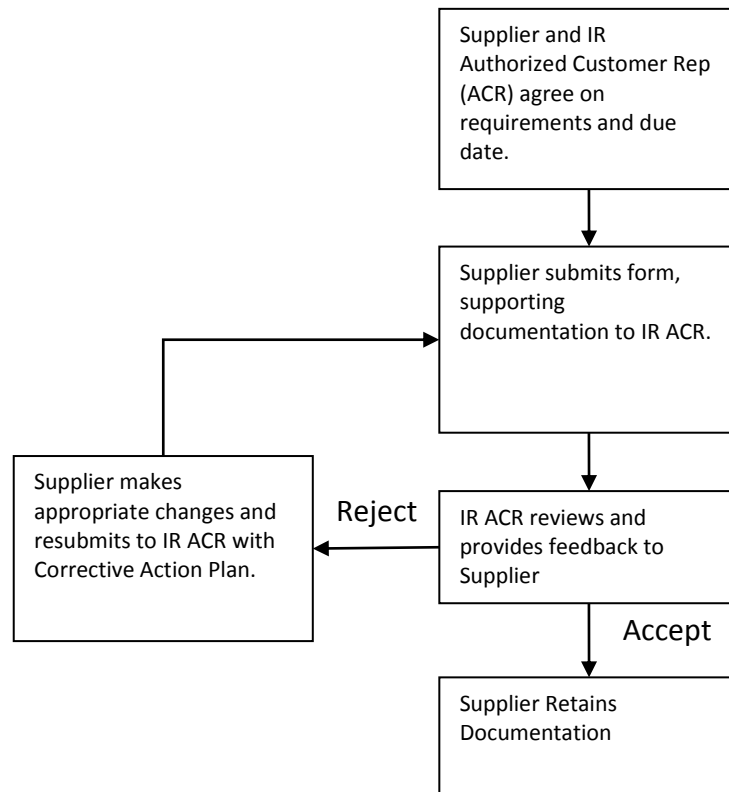
**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Records of Compliance requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:** The supplier shall have evidence of compliance to all applicable and end customer requirements. The IR Specific Requirements submission addresses requirements that are external to the Design Record. These requirements shall be enumerated in the Part Submission Warrant (PSW) under the Special Instructions section.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When shall the IR Specific Requirement submission be performed?
    - a. Submission is required when the Ingersoll Rand Authorized Customer Representative (ACR) enumerates requirements in the Special Instruction Section of the IR PSW.
  2. How should the Checking Aids procedure be completed?
    - a. Evidence shall be provided that all requirements enumerated in the PSW Special Instructions have been completed. Any exceptions shall be noted in the PSW Declaration.

### Process Flow:

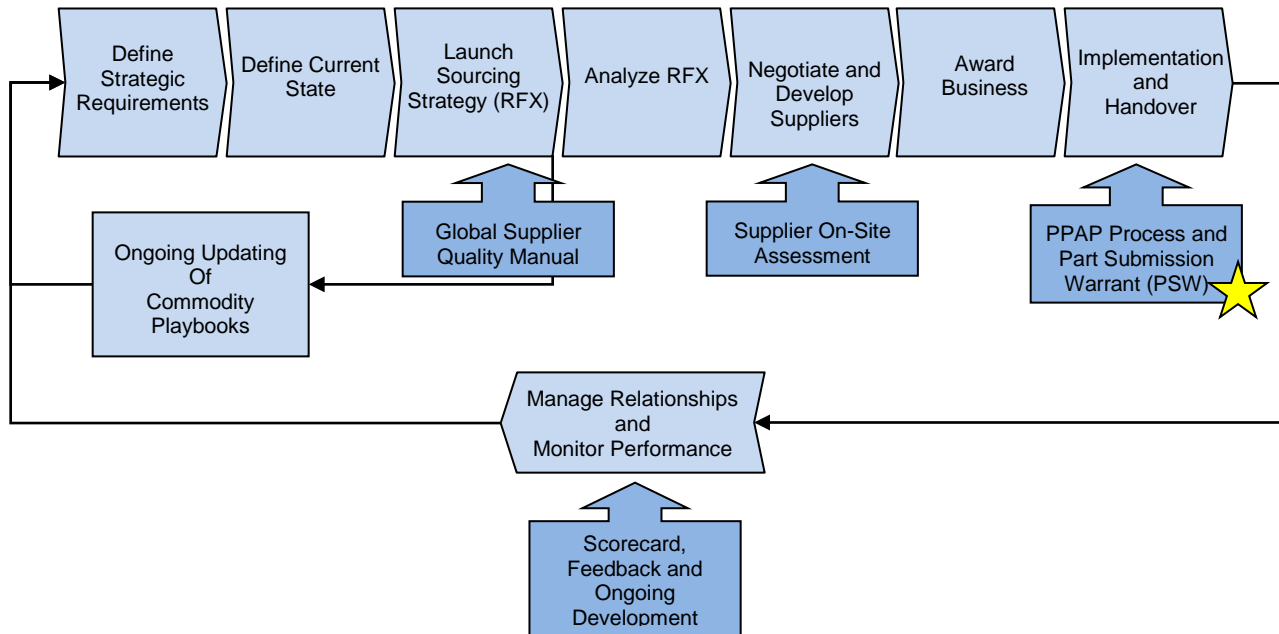


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 18: Part Submission Warrant (PSW)

**Purpose:** On completion of all part approval requirements, a PSW is the formal request for approval of the product, supported by the data and documentation in the PPAP evidence file.



**Documents:**



QMOD-0002.01

**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand when a Part Submission Warrant (PSW) is requested.

**Explanation:** The Part Submission Warrant document defines the process, responsibilities and deliverables for introducing new or revised components to Ingersoll Rand. It is intended to help Suppliers successfully achieve or increase the quality of the product design as components are developed or changed.

Note: Please refer to the Production Part Approval Process tab and to the Sector Specific sections of the GSQM for more details regarding part qualification requirements.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

**Ingersoll Rand Responsibilities:** The Ingersoll Rand Authorized Customer Representative (ACR) will submit a Part Submission Warrant to the Supplier detailing:

1. Part Information:
  - a. Part Name, Supplier Part Number and IR Part Number.
  - b. IR Purchase Order Number

- c. Referenced IR Engineering Specs
  - d. Engineering Change Level (Drawing Revisions)
  - e. Additional IR Engineering Changes
  - f. Critical Characteristics are identified in the Design Record? (Yes/No)
  - g. List of Affected IR Facilities
2. Supplier Information
  3. Authorized Customer Representative Information
  4. Required PPAP Completion Date
  5. Reason for Submission
  6. Requested Submission Level
  7. PPAP Checklist and Special Instructions (see below for details)

**Supplier Responsibilities:**

Once the PSW is received, the authorized Supplier representative will:

1. Supplier Acknowledgement and Acceptance:
  - a. Sign this section and return to IR ACR. This attests that the supplier has reviewed and understands the PPAP requirements.
2. Submission Results:
  - a. Specify what aspects of the PPAP requirements are being fulfilled by this PSW submission.
  - b. Check appropriate box signifying that submission results meet all requirements specified in the Design Record. Any exceptions must be noted in the Declaration Explanation/Comments below.
  - c. Complete the PPAP Checklist (see below for details)
3. Declaration:
  - a. Specify what aspects of the PPAP requirements are being fulfilled by this PSW submission.

**PPAP Checklist and Special Instructions:**

The PPAP Checklist and Special Instructions sections of the PSW provide the Ingersoll Rand ACR the flexibility to clarify PPAP submission requirements.

The Authorized Supplier Representative shall use the PPAP Checklist as a part of the PPAP submission package.

**Disposition:**

On submission of a signed PSW Declaration by the Authorized Supplier Representative, the PPAP submission will be reviewed and dispositioned by the designated PPAP team. The Authorized Customer Representative will mark the completed PSW as:

1. Approved:

All PPAP submission requirements have been fulfilled, including an approved Early Launch Containment plan.
2. Rejected:

One or more PPAP submission requirements have not been met. The supplier must take appropriate corrective action and then resubmit the PSW. The submission shall be approved before production quantities may be shipped.
3. Interim Approval:

One or more PPAP submission requirements have not been met, but the supplier is authorized to ship materials for production requirements on a limited time or

piece quantity basis.

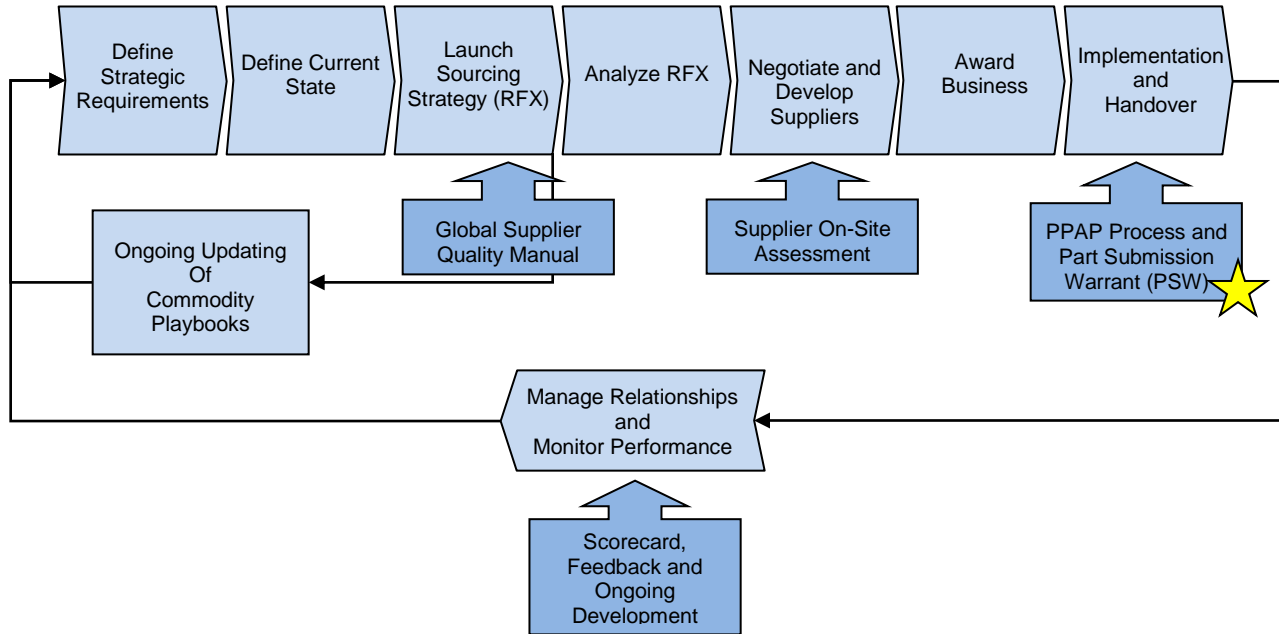
Interim Approval will only be granted upon receipt of action plan, approved by the ACR, to obtain PPAP approval.

**References:**

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

## PPAP Requirements Element 19: Bulk Material Checklist

**Purpose:** These are modified PPAP requirements that apply to Bulk Materials. These are minimum requirements and may be amended by the customer based on application and need.



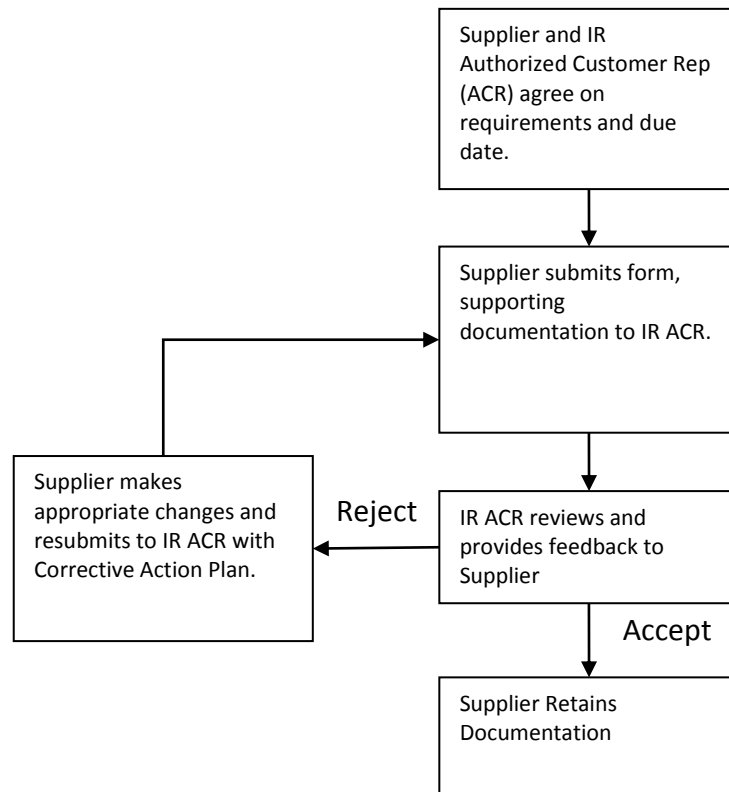
**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand. The Bulk Material Checklist is not required unless explicitly requested on the Part Submission Warrant. Refer to part specific PPAP requirements from the IR ACR.

**Explanation:** If requested by the IR ACR, the supplier shall submit a Bulk Material Checklist. Specific requirements should be discussed, and then documented on the PPAP Part Submission Warrant.

Reference the *Production Part Approval Process (PPAP)*<sup>1</sup> reference manual for guidance on completing this procedure.

- Supplier Responsibilities:**
1. When is a Bulk Material Checklist required?
    - a. Submission is required when explicitly requested by the Ingersoll Rand Authorized Customer Representative (ACR) on the IR PSW.
  2. How should the Bulk Material Checklist be completed?
    - a. Contact the responsible IR ACR for Bulk Material Checklist document and completion requirements.

### Process Flow:

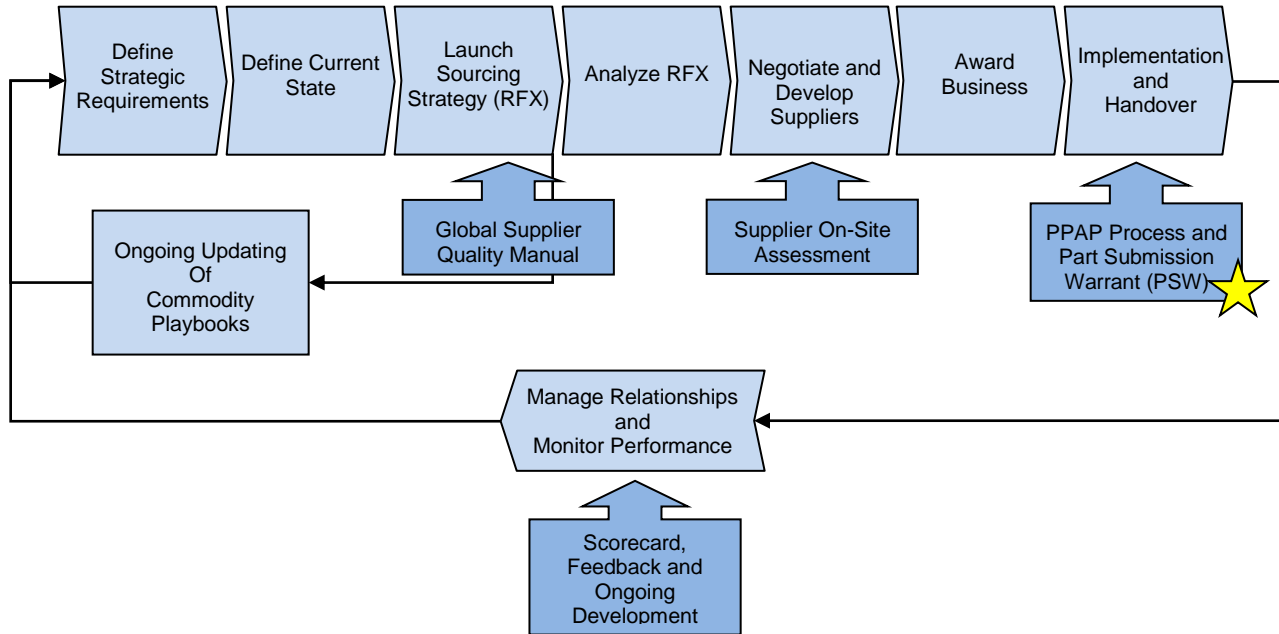


### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

### PPAP Requirements Element 20: Early Launch Containment (ELC) Plan

**Purpose:** To protect the customer during and immediately after a new or changed product by implementing additional controls in the manufacturing plant.



**Documents:**



QMOD-0002.14

**Scope:**

Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand, when the Early Launch Containment Plan requirement is indicated on the PPAP Part Submission Warrant (PSW).

**Explanation:**

The purpose of Early Launch Containment Plan PPAP requirement is to ensure the condition of early shipments of mass production parts meets Ingersoll Rand requirements during the ramp-up or supplier process change. The first mass production shipment must be at the current engineering level, quality standard requirements and built on mass production tooling.

**Supplier**

**Responsibilities:**

1. When should the ELC plan be performed?
  - a. Early Launch Containment plan is required for all Levels of PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR).
  - b. During the initial start of production ramp-up and/or the Supplier Process Change Request, the Supplier may be requested to undertake activities to ensure that quality and process standards are met.
  - c. The Supplier may be requested to develop and implement an ELC plan during the ramp-up period. The ELC plan may cover items found on the Supplier's control plan though required inspection rates may be higher during early stage. Also it can include other items which are critical for

- successful implementation of new processes.
2. Who should perform ELC?
    - a. The Supplier will be requested to identify a person which is responsible for the ELC process.
  3. How should ELC be performed?
    - a. The ELC evaluation applies to the first 1,000pcs or first 5 shipments, at a minimum, for products or raw materials supplied to Ingersoll Rand (Exceptions must be discussed and agreed upon with the Ingersoll Rand ACR. Ingersoll Rand may require more rigorous ELC actions depending on the risk and critical nature of some components.).
    - b. The supplier may be requested to attach a communication sheet onto each pallet which is signed and dated by the person performing the extra containment activity verifying that ELC requirements have been met unless other arrangements have been agreed upon by the Ingersoll Rand Main Contact.
    - c. Suitable goals and targets should focus on defect prevention and quick resolution of production and production control issues which would impact the Supplier making shipments to Ingersoll Rand.
    - d. Frequent internal quality review meetings are expected to be held involving key persons from Supplier top management through production operations.
    - e. Weekly updates summarizing the production performance (i.e. defects, scrap, first-time yields, rework, etc.) may be requested for submission to the Ingersoll Rand Plant Quality Managers during the ELC phase.

**Examples of ELC Items:**

Depending on production process additional controls may include, but are not limited to:

1. Increased frequency/sample size of receiving, in-process, and or shipping inspections.
2. Mandated sub-supplier containment and or sub-supplier support/audits.
3. Addition of inspection/control items.
4. Increased verification of label accuracy.
5. Enhancement of process controls/error-proofing.
6. Error-proofing validation through introduction of known controlled defects (i.e. Master Part)
7. Increased involvement and visibility of top management.
8. Prompt implementation of containment and correction when non-conformances are discovered.
9. Identification of the measurement equipment and data collection devices/activities to be used where applicable.
10. Additional reliability testing above and beyond the normal test requirements.

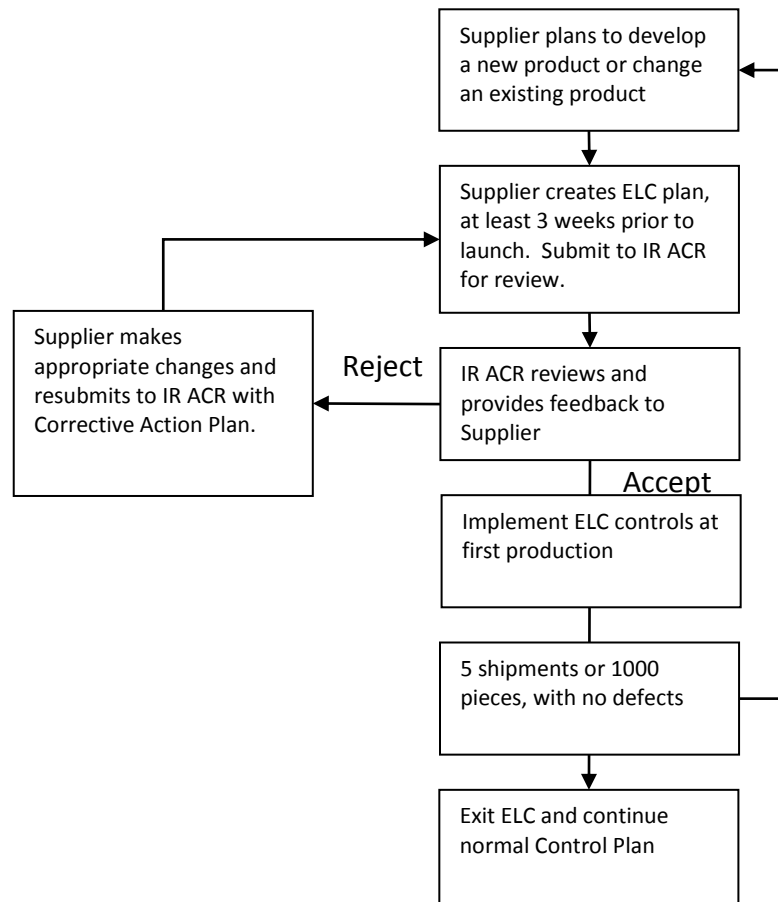
**Exit Criteria:**

1. Self-Exit Criteria – The supplier ships the required quantities for the duration specified with no non-conformances or no Supplier Corrective Action Requests (SCARs).
2. If the supplier does not meet the self-exit criteria and ships Ingersoll Rand defective product; immediate corrective action must take place. Once the

corrective actions are implemented and approved in the SCAR system then the clock will be restarted and the supplier must maintain zero defects for the duration.

3. In the event the self-exit criteria have been met but the ELC plan continues to identify additional non-conformances, immediate corrective action must take place. The ELC plan is required until the process controls and capabilities have proven effective and are validated. Once the corrective actions are implemented the clock will be restarted and the supplier must maintain zero defects for the agreed upon duration.

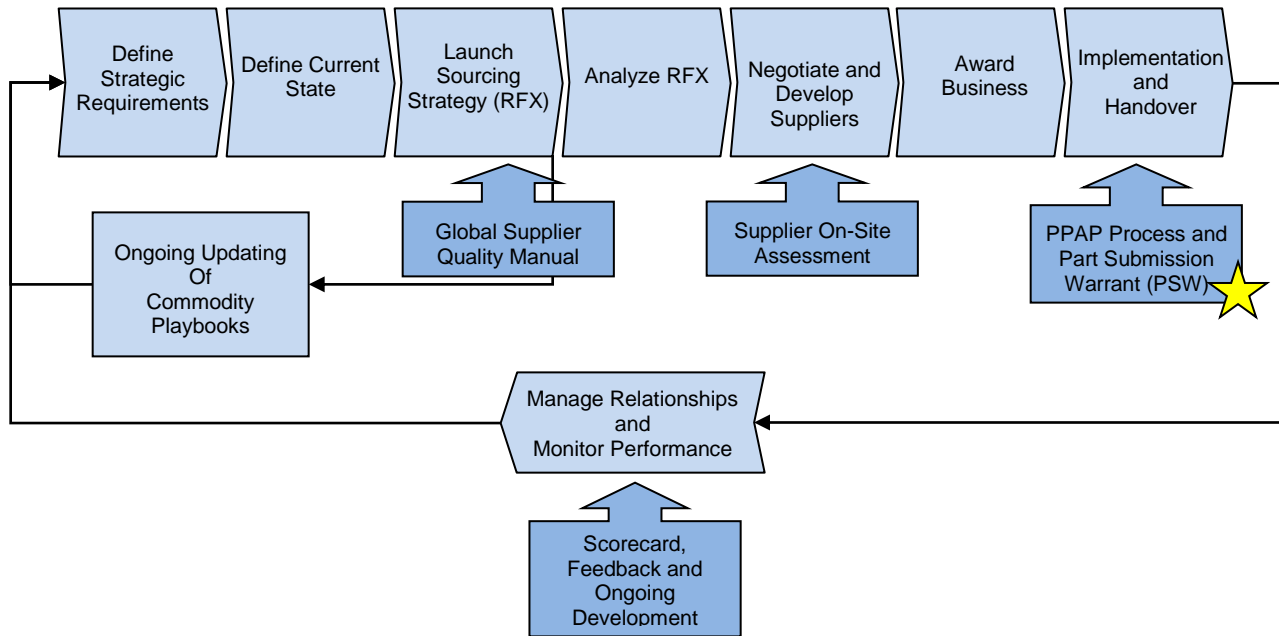
### Process Flow:



### References:

### Supplier Process Audit (SPA)

**Purpose:** The Supplier Process Audit (SPA) provides the opportunity for the Ingersoll Rand ACR to see the process and product in addition to the PPAP documentation. SPA's are usually performed for higher risk components.



**Documents:**



QMOD-0010.03

**Scope:**

Applies to Suppliers of production parts, raw materials, service parts, and sourced products when deemed necessary by the responsible Ingersoll Rand division.

**Explanation:**

The SPA visit should occur after DAI, but before start of production. The visit is to confirm the Supplier has completed all activities necessary to ensure a smooth start up of production with a minimal amount of defects / problems.

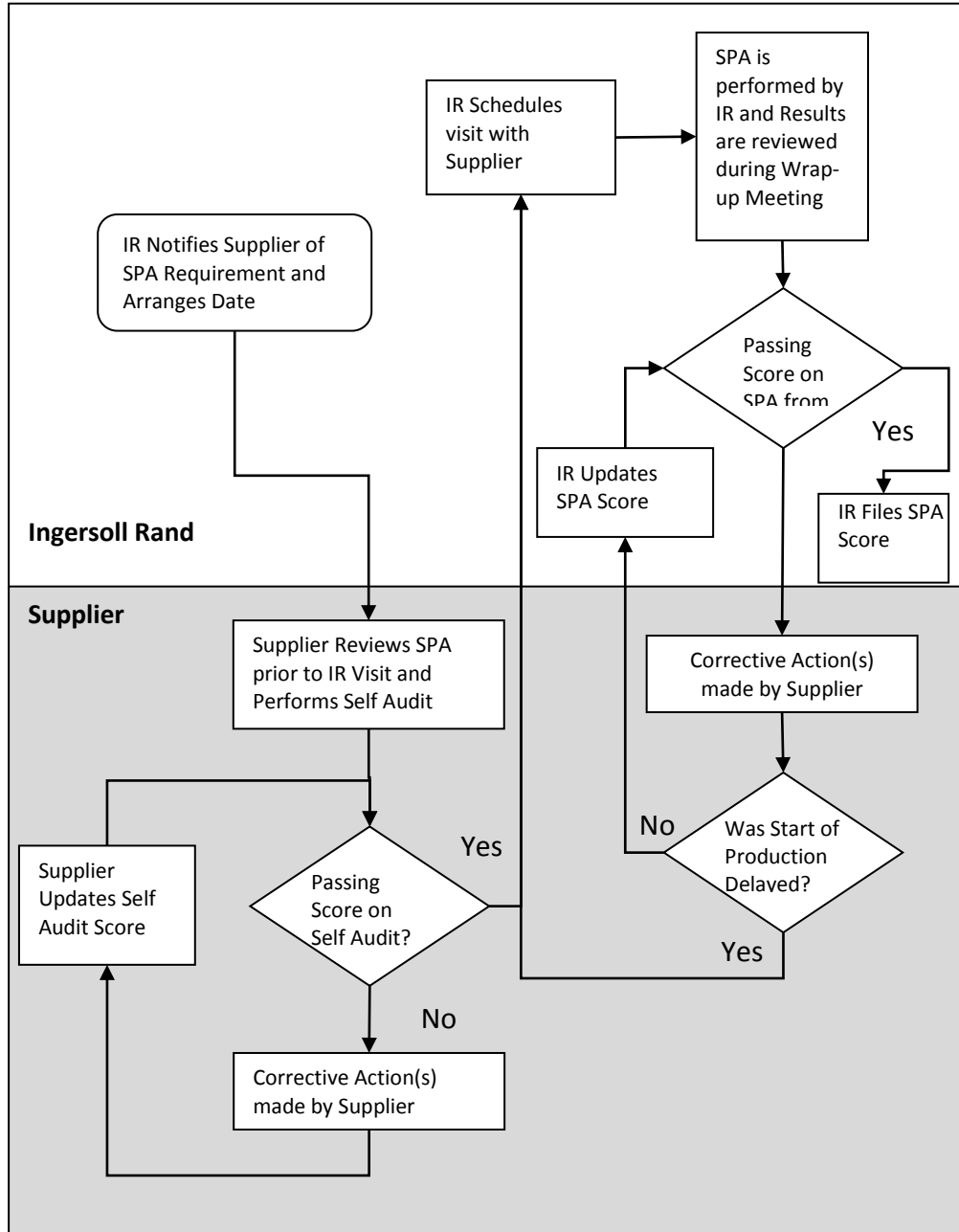
Note: The SPA serves a different purpose than the On Site Assessment (OSA). OSA is used to evaluate a supplier's quality systems and is an integral part of the IR supplier approval process. SPA is part of IR's Production Part Approval Process (PPAP) and is used to evaluate a particular manufacturing process in preparation for mass production. It is an integral component of a Level 5 PPAP.

### Supplier

#### Responsibilities:

1. When shall a Supplier Process Audit be completed?
  - a. The Supplier Process Audit will be conducted for a Level 5 PPAP, unless otherwise specified by the Ingersoll Rand Authorized Customer Representative (ACR).
  - b. The Supplier Process Audit will be conducted after the Supplier submits a completed and signed Part Submission Warrant (PSW).
2. Who shall perform the Supplier Process Audit procedure?
  - a. This requirement shall be performed by the Supplier's Quality Assurance Organization.
3. How should the Supplier Process Audit procedure be performed?
  - a. The Supplier must submit all documentation to Ingersoll Rand for review prior to the SPA.
  - b. The Supplier must be prepared to address and show evidence of all items contained in the Supplier Process Audit.
  - c. Ingersoll Rand will conduct the SPA and representatives from the Supply Chain, Engineering, Materials and Quality departments may attend and may have additional audit items.
  - d. The SPA visit will consist of the following items:
    - i. Current status of the project (i.e.: tooling status, equipment installation, training, etc.)
    - ii. Actual Audit
    - iii. Review of the audit results
  - e. Ingersoll Rand will issue a report to the Supplier summarizing the results of the visit. The report will show all items requiring countermeasures by the Supplier (any item shown as needing improvement or unacceptable on the checklists). The Supplier is responsible for responding promptly with countermeasures and due dates for all items.
  - f. The necessity for a follow up visit will be decided once the response is received and evaluated. If the problems found are considered serious and countermeasures are inadequate, the start of production may be delayed at Ingersoll Rand's discretion. A follow up visit is mandatory if start of production is delayed.

**Process Flow:**

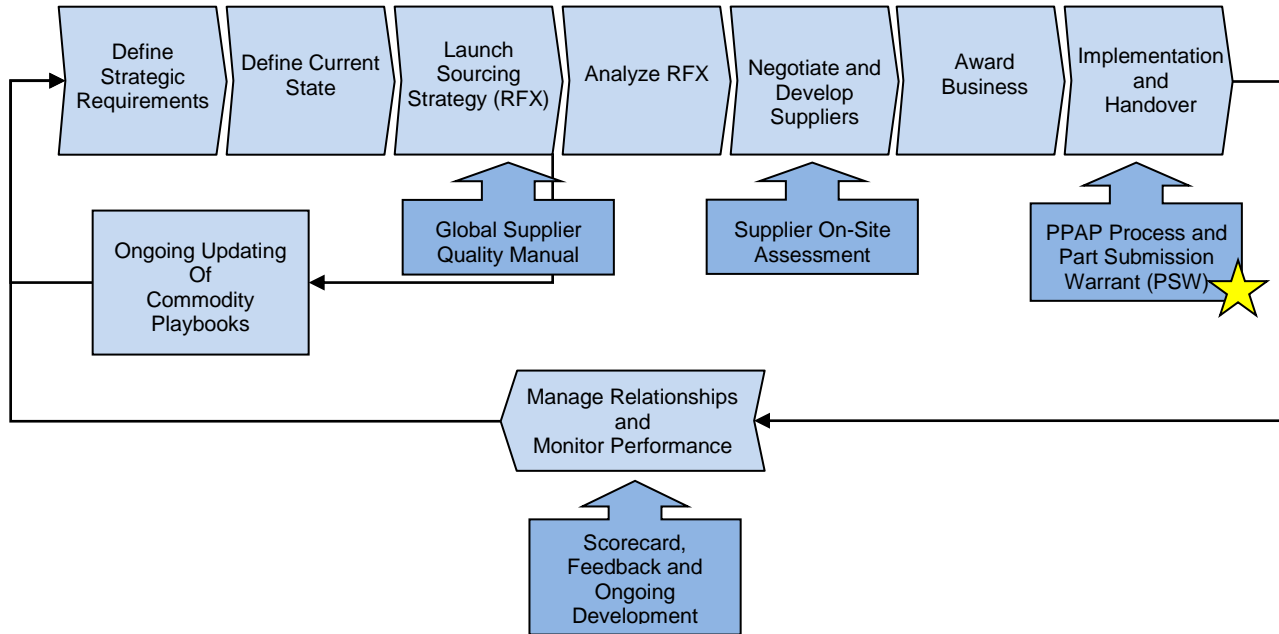


**References:**

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

## Capacity Demonstration Review (CDR)

**Purpose:** To verify that the Supplier's production process can meet Ingersoll Rand's capacity planning volumes with quality parts.



**Documents:**



QMOD-0002.13

**Scope:**

Applies to all Suppliers of production parts, raw materials, service parts and sourced products when deemed necessary by the responsible Ingersoll Rand division.

**Explanation:**

The purpose of the Capacity Demonstration Review (CDR) requirement is to verify that the Supplier's production process can meet Ingersoll Rand's capacity planning volumes with quality parts. If the production process fails to produce enough quality parts to meet the quoted tool capacity on the tooling order, the supplier should continue to work on improving process capability.

**Supplier**

**Responsibilities:**

1. When shall the CDR requirement be performed?
  - a. The CDR is required when specified as a Special Instruction on the PSW.
2. How should the CDR requirement be completed?
  - a. Ingersoll Rand will contact and schedule the review with the supplier and key program team members, including those that participated in any launch readiness reviews.
  - b. The CDR must be conducted at the selected supplier's manufacturing site with all production intent tooling, equipment, environment, personnel, facilities, cycle times, safety and support systems.
  - c. Although the CDR should be conducted as early as possible, a key consideration in scheduling the review is the stability of the design.
  - d. The CDR run quantity/volume will be pre-determined and agreed upon

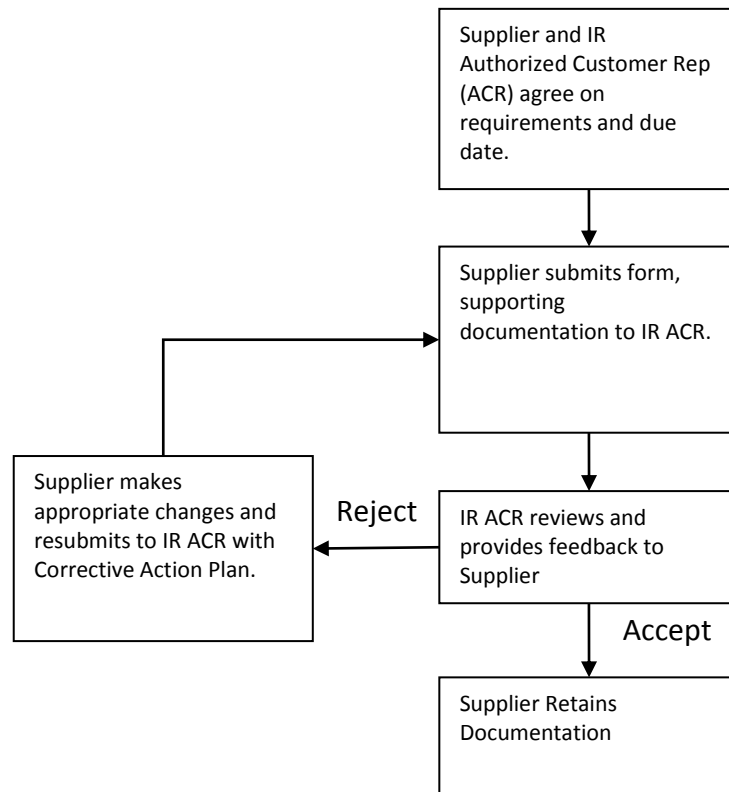
between Ingersoll Rand and the Supplier. The agreed upon quantity should, at a minimum, produce enough quality parts to meet Ingersoll Rand's planned daily production volume. If the production equipment is not dedicated to producing the parts of interest, tool changeover may be included in the review. It is also recommended that the review include normal operator breaks, planned downtime, and changes in operators, perishable tools, raw material lots, etc. where economically feasible. Some sources of variation, i.e. operator & raw material changes, can be artificially introduced into the review.

- e. The Supplier should use the checklist provided below in this document to proactively prepare for Ingersoll Rand's visit. It is recommended the Supplier complete the checklist at least 3 weeks prior to Ingersoll Rand's visit.
- f. Overall Equipment Effectiveness (OEE), Run-at-Rate, or Capacity worksheets (attached) should be used to summarize the results of the CDR.
- g. Unsuccessful CDRs require Supplier action plans to correct the deficiencies and rescheduling of the CDR. Unsuccessful reviews should also be brought to the attention of the Ingersoll Rand Buyer, SST Manager and the Program Launch Team.

### **Supplier Check List:**

- 1. Tier 2 Readiness:
  - a. Were subcontractor's abilities to meet the customer's quality and capacity requirements confirmed by the supplier through a CDR prior to the official customer CDR being conducted at the supplier's facility? Ingersoll Rand has the right to review the subcontractor's results and documentation.
- 2. Production Representation:
  - a. Is the product being manufactured at the production site using the production tooling, gaging, process, materials, operators, environment, and process setting?
  - b. Does the actual process flow agree with the process flow diagram? Does it represent the entire process from receiving through shipping?
- 3. Quality System:
  - a. Is all in-process documentation in place (i.e. Process Flow, Control Plan, PFMEA, and First Article)?

### Process Flow:



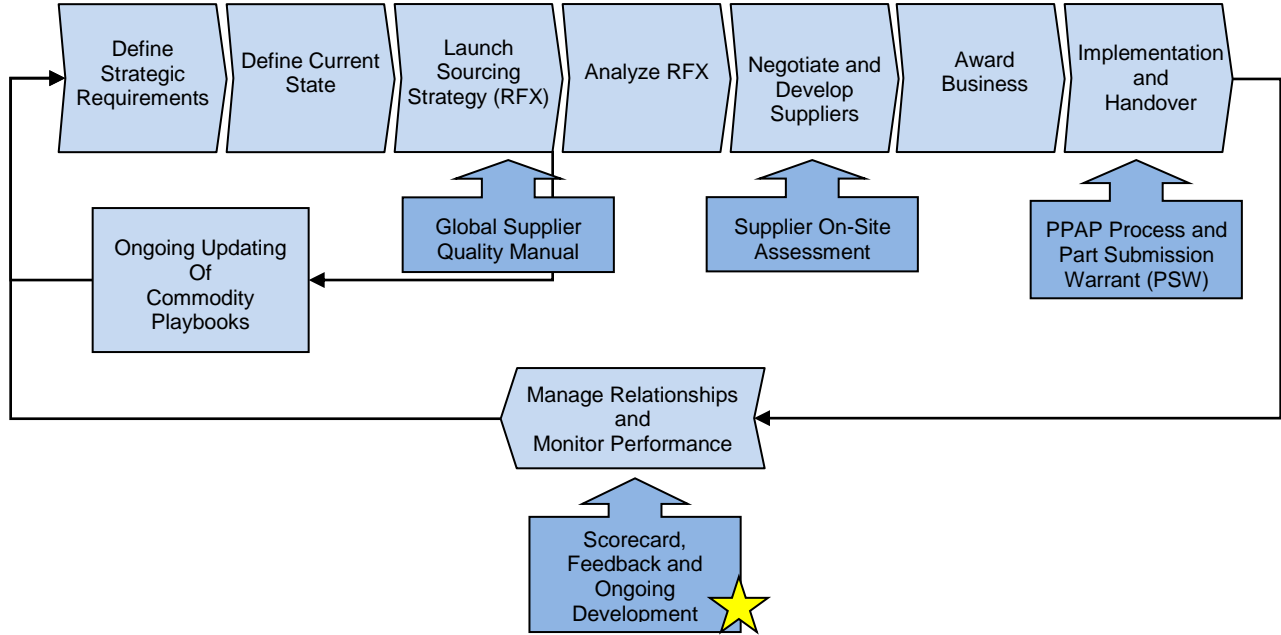
### References:

- 1) Automotive Industry Action Group (AIAG) (2006). Production Part Approval Process (PPAP), 4th edition. DaimlerChrysler Corporation, Ford Motor Company, General Motors Corporation.

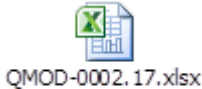
**Post Launch Activities and Expectations**

**Management of Company Owned Asset**

**Purpose:** To define IR expectations for production suppliers as to specification, purchase, maintenance, and life management for IR owned tooling, gauging and/or test equipment - Known as "Asset".



**Documents:**



**Scope:** Applies to all Suppliers in possession of IR owned assets including but not limited to tooling, fixturing, gauging, test equipment, dedicated process equipment.

**Explanation:** This approach is to complement the Ingersoll Rand Bailment agreement. The Asset management plan includes the IR asset tag and explains the requirements of Asset management for an on-going basis. The supplier will provide IR with operational data on a periodic basis such as maintenance, usage, capability, and capacity records. It is expected the supplier will maintain the IR owned Assets in an acceptable operating condition capable of meeting IR’s production requirements.

**Supplier Responsibilities:** Control of Company-Owned Assets:

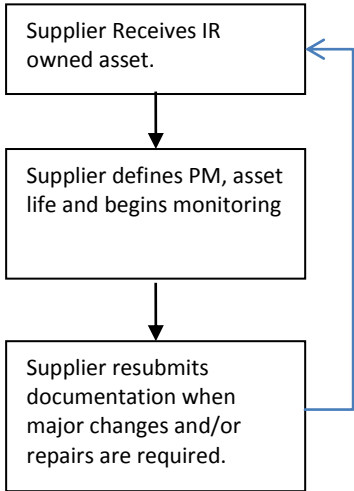
1. Any Asset owned and supplied by Ingersoll Rand is to be permanently identified and visually marked to identify ownership and may not be transported to a new manufacturing location without prior authorization from an IR representative.
2. Supplier is responsible develop an Asset management procedure which details Asset receipt, upkeep (during production) and end of life.

Supplier responsibilities:

- a. Supplier to define tool life and monitor for wear.
  - b. Supplier to develop asset maintenance document and keep record of scheduled and unscheduled maintenance.
  - c. Supplier to define tool change program for perishable tools/equipment or its component
  - d. At anytime, upon receipt or during production, supplier to notify IR if Asset found to be defective and/or unsuitable for intended use.
  - e. Supplier to keep record of all tool modifications, including tool design documentation.
  - f. Supplier to ensure components produced maintain capability (Cpk) of critical features which are denoted on the drawing and/or CTQ scorecard.
  - g. Upon approval from IR, supplier may transfer the Asset to a new location and gain production approval from IR - refer to process change section of GSQM: "requalify tool if moved to new location/press/etc."
  - h. Supplier to notify IR of any potentially obsolete Asset. No Asset is to be disposed of without written authorization from Ingersoll Rand.
3. All repairs and replacements must utilize form:  
"Asset Repair and Replacement Request Requirements"

Process Flow:

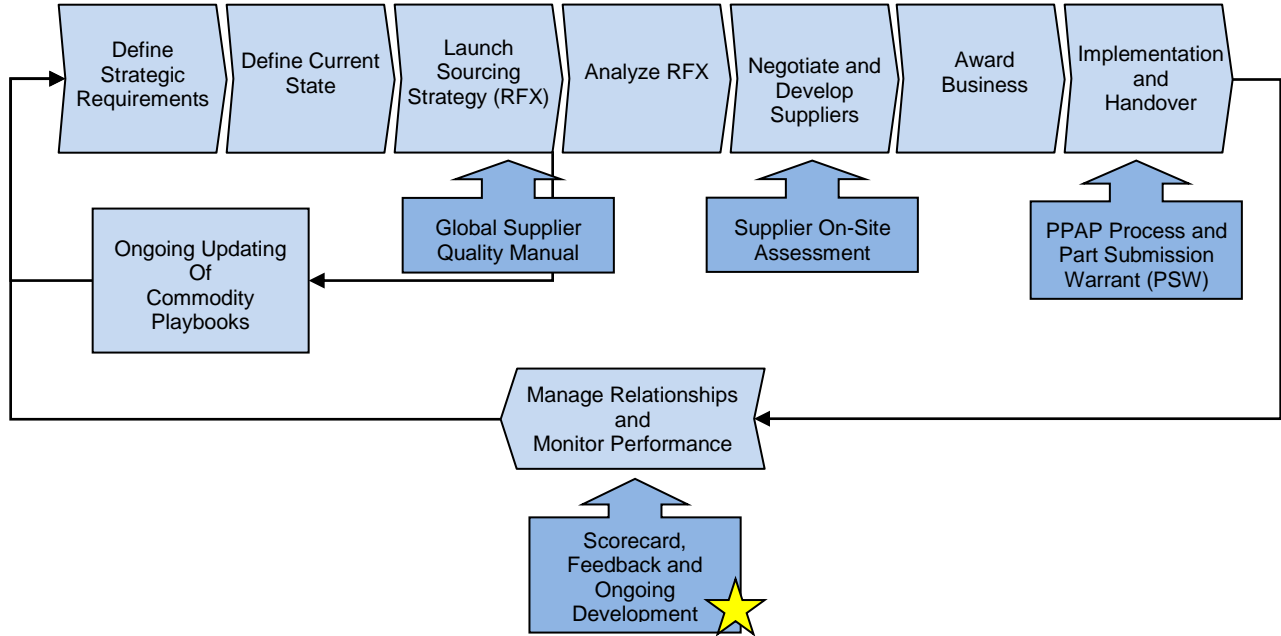
High Level IR Owned Asset at Supplier Locations Process Map



References:

**Sub-Supplier Quality Assurance**

**Purpose:** To define the minimum expectations of the Supplier's responsibility in controlling the quality of their Sub-Suppliers.



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand

**Explanation:** The Supplier is responsible for the part quality and evaluating the Sub-Supplier's performance. The role of the Supplier is to coordinate and guide the Sub-Supplier's quality assurance activities similar to the Supplier's requirements in the GSQM.

- Supplier Responsibilities:**
4. The Supplier should have a system in place for evaluating, selecting and on-going monitoring of Sub-Suppliers.
  5. The Supplier must develop quality requirements with the Sub-Supplier to support the Supplier's Control Plan.
  6. Suppliers are expected to involve Sub-Suppliers in the communication, planning, and problem solving activities (as required) to assure quality is built into every stage of production.
  7. Suppliers have the ability to establish the degree of control placed on the Sub-Supplier based on how critical the Supplier's product is to Ingersoll Rand's product/process.
  8. Suppliers are responsible for assuring that countermeasures are in place to prevent repeat failures at Sub-Suppliers. Boundary Samples should be clearly defined between the Supplier and Sub-Supplier (as required).
  9. Ingersoll Rand reserves the right to audit Supplier and Sub-Supplier's facilities.
  10. In order for the Supplier to change or add a Sub-Supplier, they must first receive approval from Ingersoll Rand before implementing the change. Suppliers must

verify with their Ingersoll Rand Contact whether the proposed change would result in a Supplier Design or Process Change Request and submit the proper supporting documentation as is specified by Ingersoll Rand (refer to the Supplier Process Change Request section of this manual for details).

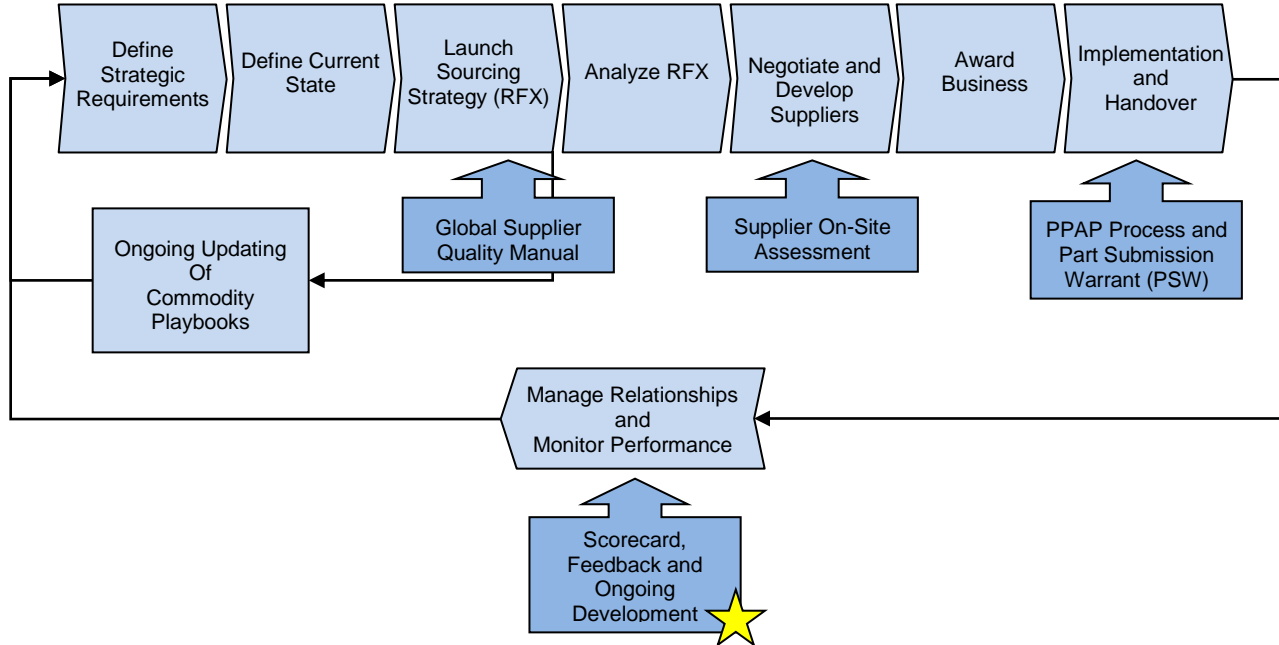
A minimum of 3 months prior to the planned implementation of the change the Supplier should communicate its intentions to Ingersoll Rand. The Supplier should, however, plan well in advance of this since considerations of the request by the relevant departments at Ingersoll Rand may take considerably longer than 3 months to occur."

11. Extra Sub-Supplier quality controls may be required by Ingersoll Rand. Please work with Ingersoll Rand Contact to define and understand expectations.

### References:

**Non-Conforming Parts: Supplier Corrective Action Request (SCAR)**

**Purpose:** To inform the Supplier of nonconforming parts/materials (manufacturing, workmanship, packaging, etc.) which requires implementation of countermeasures and corrective actions.



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand

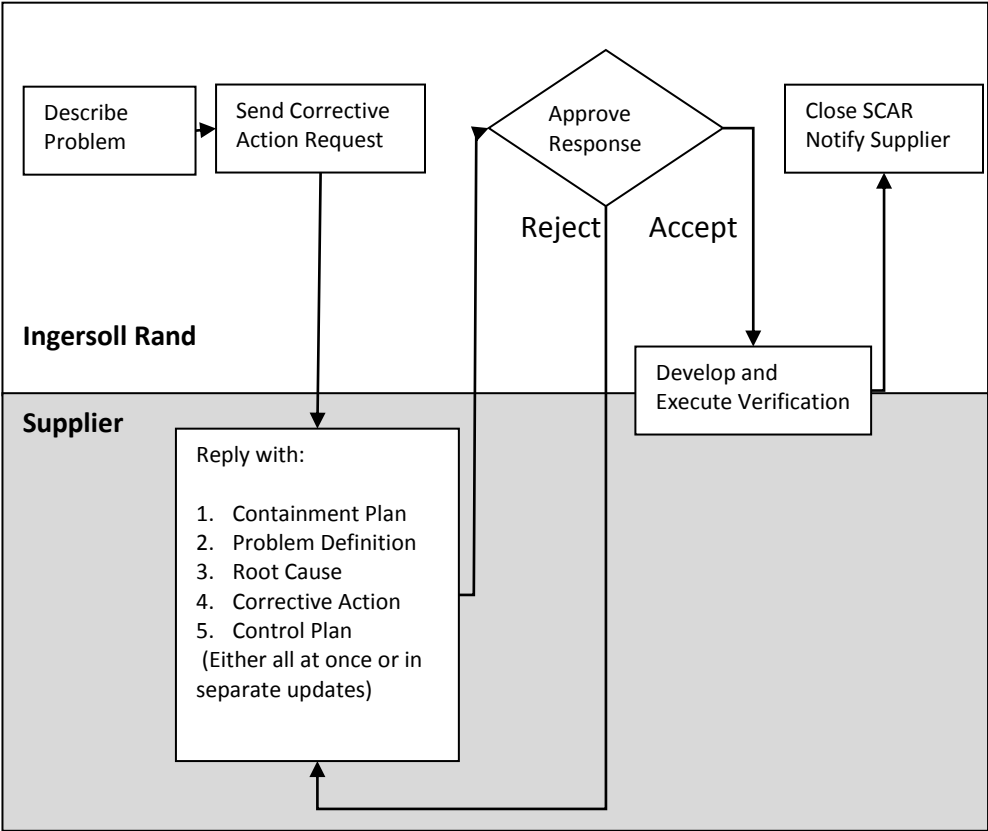
**Explanation:** This procedure applies to quality failures and delivery issues with production parts and raw materials detected at Ingersoll Rand and/or Ingersoll Rand's Customer.

- Supplier Responsibilities:**
1. Ingersoll Rand's web based SCAR system must be used for reporting corrective actions to Ingersoll Rand.
  2. Project Lead: Main Contact at Supplier leading corrective action project
  3. Title: Title of the Project Lead
  4. Contact Phone: Phone number of Project Lead
  5. Date: Date the Supplier began taking action
  6. Implementation Date: Date corrective actions are fully implemented at Ingersoll Rand
  7. Problem Definition: List the definition and symptom(s) of the problem
  8. Containment:
    - a. The Supplier should take immediate corrective action for the parts or raw materials at the Supplier's facility and at Ingersoll Rand. The Supplier must inform Ingersoll Rand if any suspect parts are potentially in-transit to Ingersoll Rand.
    - b. Certified shipments may be required by Ingersoll Rand until permanent

- corrective actions have been implemented.
  - c. The Supplier is required to assist in sorting inventory at Ingersoll Rand when requested by Ingersoll Rand. If Ingersoll Rand is required to rework/sort any non-conforming parts or product at Ingersoll Rand or Ingersoll Rand's Customer, Ingersoll Rand may charge the Supplier for this rework/sort activity.
  - d. If any part is found to be non-conforming, the Supplier is responsible for repairing or replacing the part. Rework of such part may be required at Ingersoll Rand and at the Supplier. Before any rework is begun, the rework and marking methods must be approved by Ingersoll Rand.
9. Root Cause & Corrective Action Reporting (The response must include the following):
- a. Initial actions taken at the Supplier, including sort results, rework results and mark used for certified shipments, sorting/rework completion date (as applicable).
  - b. Supplier's investigation details, including a confirmation of the defect mode and of the detection of the defect before corrective actions have taken place, along with any other steps taken to investigate the problem.
  - c. Root-Cause(s) for the defect and for the non-detection.
  - d. Corrective actions for the root cause and for the non-detection including implementation date for each corrective action.
  - e. Standardization of process documentation, indicating documentation affected and implementation date; if no standardization, explain reason(s).
  - f. Review of similar parts or processes that may be affected by the same defect mode or non-detection, including implementation date(s) for corrective actions; explain details of corrective actions or reasons no corrective action(s) needed.
10. Control Plan:
- a. A Control Plan must be created and/or updated identifying the control points
  - b. Control Plan must include type of checks, frequency, reaction plan and owner of items
11. Timing:
- a. The response should be sent by the Due Dates indicated by Ingersoll Rand, whether or not the permanent corrective actions have been determined.
  - b. Containment plan response must be received no later than 2 days after being notified of the problem.
  - c. Completed corrective action response must be received no later than 14 days after being notified of the problem.
  - d. If the response is not a final response (lacking permanent corrective actions), the Supplier should indicate it is an initial response (if applicable).
  - e. Temporary corrective actions must be reported, along with a scheduled date for permanent corrective actions to be reported.
4. Note: If the Supplier finds defective part(s) at their facility, the Supplier must inform Ingersoll Rand of the potential for this problem to escape to Ingersoll Rand.

12. Follow-up: Ingersoll Rand reserves the right to follow-up and to verify corrective actions which may include an on-site visit.

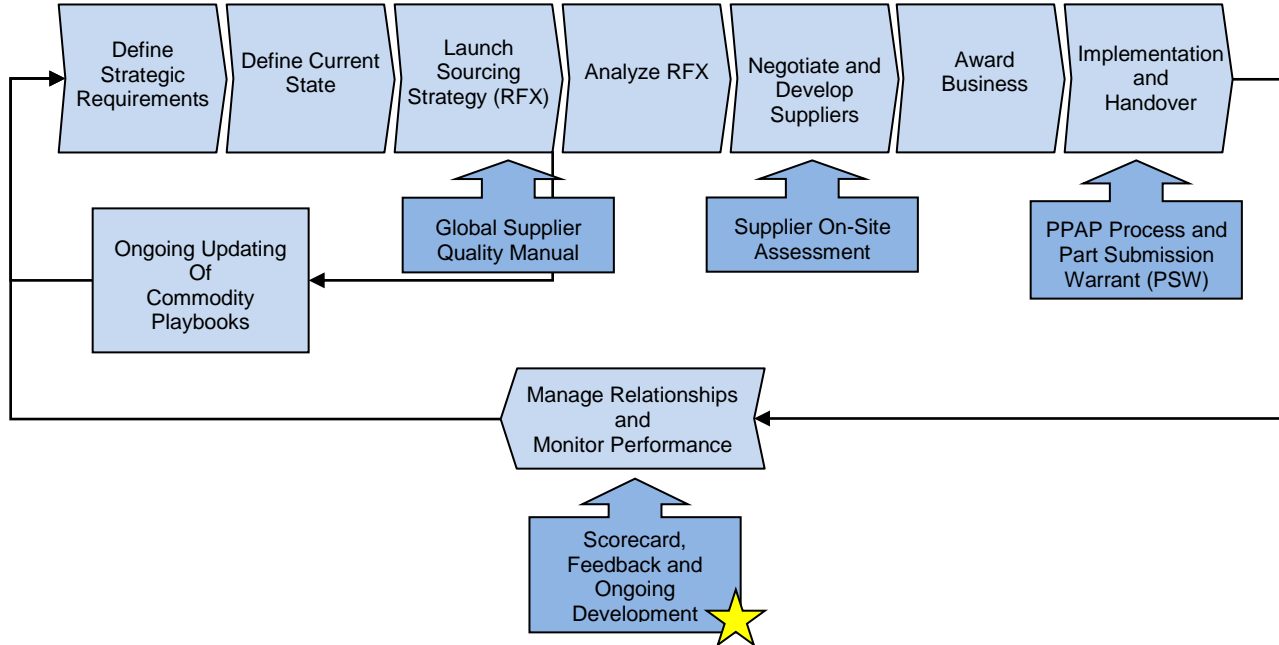
Process Flow:



References:

**Supplier Deviation Request (SDR)**

**Purpose:** To explain the method for reviewing and authorizing the use, by concession or repair, of purchased material identified by the supplier as not conforming to current specifications.



**Documents:**



QMOD-0002.15

**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand.

**Explanation:** The Ingersoll Rand SDR form is to be used to request Ingersoll Rand approval for parts or materials that do not meet drawing or specification requirements. The Supplier is responsible for submitting a Ingersoll Rand SDR with the First Article Inspection report or anytime after start of production if a deviation is required. Ingersoll Rand approval is required prior to shipping non-conforming components.

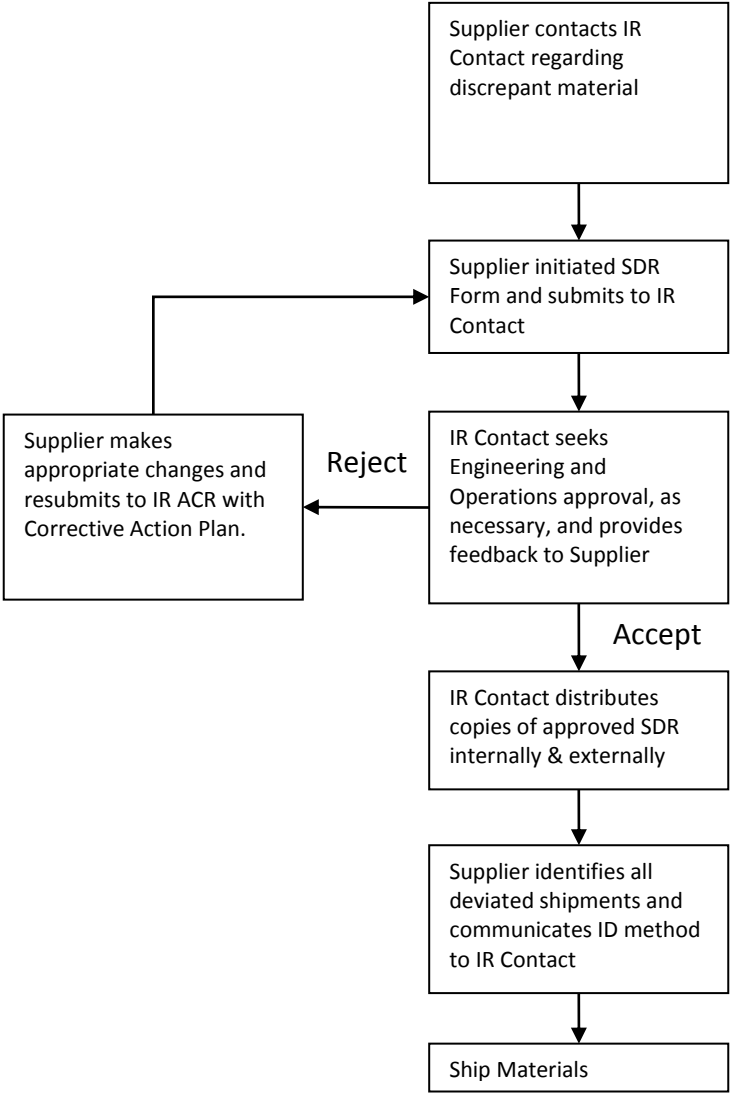
- Supplier Responsibilities:**
1. The following steps must be followed when submitting a Ingersoll Rand SDR form:
    - a. Timing:
      - i. Dimensional and Attribute Inspection - Submit with DAI if measured dimensions do not meet Ingersoll Rand's drawings / specifications
      - ii. After start of production - Submit as soon as a non-conformance is found
    - b. Samples: Ingersoll Rand may request samples of the parts or materials requesting deviation at the same time the SDR is submitted. Contact the

- responsible Ingersoll Rand section for guidance on the quantity required.
- c. Completing the SDR Form: The Supplier must fill out the form with detailed information
    - i. Supplier: Company's name
    - ii. Supplier Location: Supplier location requesting SDR
    - iii. Type of Deviation: Indicate either Part or Material deviation
    - iv. Part Name: Ingersoll Rand's part name (per drawing)
    - v. Part Number: Ingersoll Rand's part number
    - vi. Date: current date
    - vii. SDR Quantity: the total quantity/weight affected (if deviation is granted for a certain quantity or weight, a new deviation would have to be submitted and approved to send any amount above that which is stated on the original Ingersoll Rand SDR form request.
    - viii. Delivery Date: The date the first delivery would be required based on Supplier inventory and Ingersoll Rand's delivery requirements.
    - ix. Ending Date: Put the date the last shipment would be made (If Supplier later wishes to extend the ending date from that which was approved, a new Ingersoll Rand SDR form would have to be submitted and approved to cover that additional time period. For a die deviation specify if for life of the tool.)
    - x. Drawing Rev #: Current drawing revision number which the SDR applies
    - xi. Description of Deviation: Root-cause(s) of the non-conformance(s)
    - xii. Corrective Action Description: actions taken to prevent recurrence of the non-conformances
    - xiii. Supplier Representative: Person at Supplier responsible for sign-off Ingersoll Rand Approver and Date: Ingersoll Rand Contact's name and date of approval of the SDR.

Note: Failure to complete all areas of the SDR form properly may result in a rejection of the request.

- d. The Supplier must include any additional supporting documentation (as necessary) that will assist Ingersoll Rand in evaluating the deviation request.
2. Ingersoll Rand will evaluate the SDR and inform Supplier of the decision. If approved, the Supplier must uniquely identify all shipments of deviated parts/materials.
  3. If the use of deviated parts/materials cannot be avoided and Ingersoll Rand must modify its process, Ingersoll Rand's Supply Chain Representative will be involved to address costs incurred by modifying Ingersoll Rand systems as a result of the deviation.

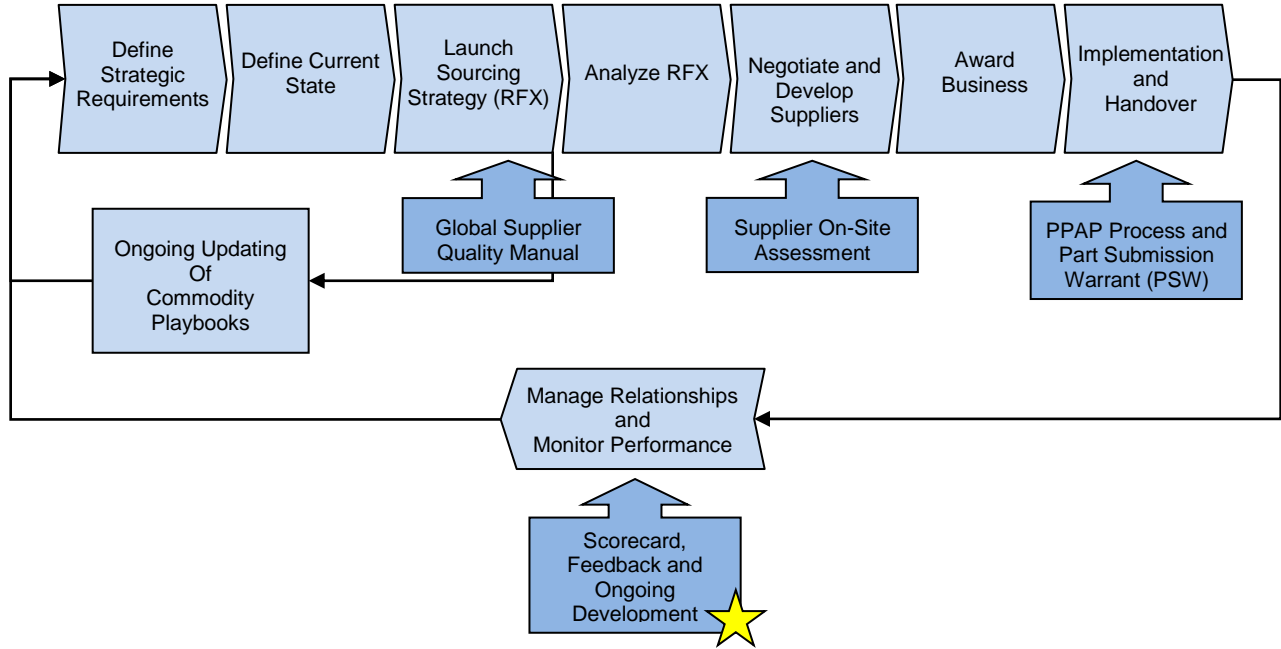
Process Flow:



References:

**Performance Monitoring Scorecard (SCORE)**

**Purpose:** To explain the Performance Monitoring expectations for Ingersoll Rand Suppliers



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand

**Explanation:** This is a process to develop relationships through a supplier evaluation process that promotes communication and continuous improvement throughout the entire product cycle. Involvement, commitment, trust, cooperation, and teamwork are the underlying principles that will guide our quest for achieving customer satisfaction. Routine review of the Supplier's Scorecard is a tool used by suppliers and Ingersoll Rand to aid in the communication process.

Note: Please be aware of sector specific scorecard expectations. Contact your sector quality or sourcing representative for details.

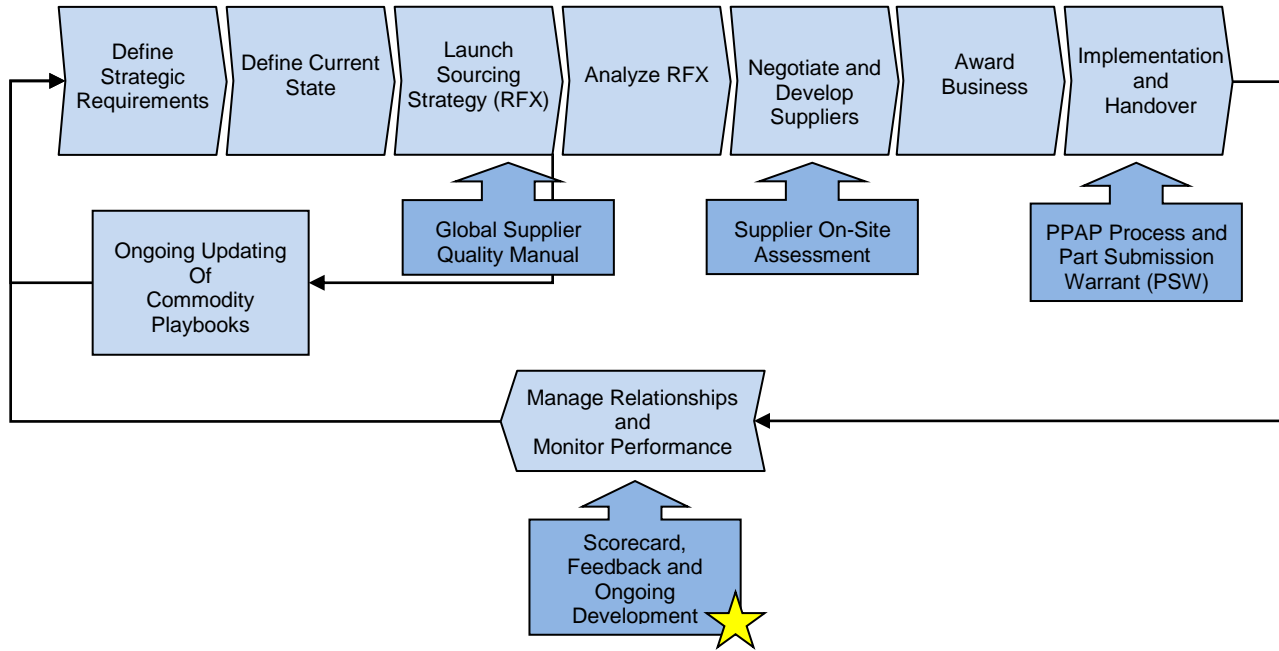
- Supplier Responsibilities:**
1. Supplier Performance Metrics:
    - a. Quality (Internal Parts Per Million (PPM) and Warranty Defects Per Unit (DPU))
      - i. If Ingersoll Rand discovers non-conforming material, and the Supplier conducts the investigation, sorting or reclaim personally, or through a qualified third party, only the material actually found non-conforming inside the factory will be counted against the supplier's quality rating. This policy does not relieve the Supplier of any financial, commercial, or material responsibilities.
      - ii. If the supplier and Ingersoll Rand find it necessary to return a defective lot of material for sorting, the entire quantity returned

- will be initially considered as non-conforming and will count against that supplier's quality rating. The supplier can request adjustment to these figures by reporting results of the sort.
- iii. If IR's supplier performance monitoring results do not match the supplier's internal performance metrics please notify your Ingersoll Rand Contact to discuss all discrepancies and adjustments.
  - b. Delivery (% On Time)
  - c. Material Productivity (Value Increase %)
  - d. Customer Satisfaction (# of repeated SCARs and timeliness of SCAR closure)
2. Tracking and Monitoring:
    - a. Suppliers are required to track and self-monitor their performance routinely and respond pro-actively to issues. Ingersoll Rand reserves the right to waive this expectation should the Supplier repeatedly abuse their privilege.
    - b. Supplier's may be requested to meet with Ingersoll Rand Contacts frequently to discuss performance metrics
    - c. Other metrics assessed by Ingersoll Rand include but are not limited to the following:
      - i. Field Failure Rates
      - ii. Warranty as a % of spend
  3. Continuous Improvement:
    - a. Evidence demonstrating the use of data (i.e.: First Pass Yield, Final Test, In-process CpK, etc.), past experience, and lessons learned may be requested by Ingersoll Rand to show continuous improvement of the Supplier's quality management system.
  4. Critical Feature Monitoring:
    - a. Suppliers are required to track and self-monitor Critical Feature performance and respond to out of control issues. Ingersoll Rand reserves the right to review or request Critical Feature performance data on a routine basis and/or to audit the Supplier's process for compliance.

### References:

**Supplier Process and Design Change Request (PDCR)**

**Purpose:** To explain the Process/Design Change Request and submission procedure.



**Documents:**



**Scope:** Applies to all Suppliers of production parts, raw materials, service parts and sourced products to Ingersoll Rand

**Explanation:** The Ingersoll Rand Supplier Process/Design Change Request form is used by Suppliers to request a change in manufacturing process or design of parts/materials manufactured for Ingersoll Rand. The Process/Design Change Request is also used by Ingersoll Rand to approve or reject this request.

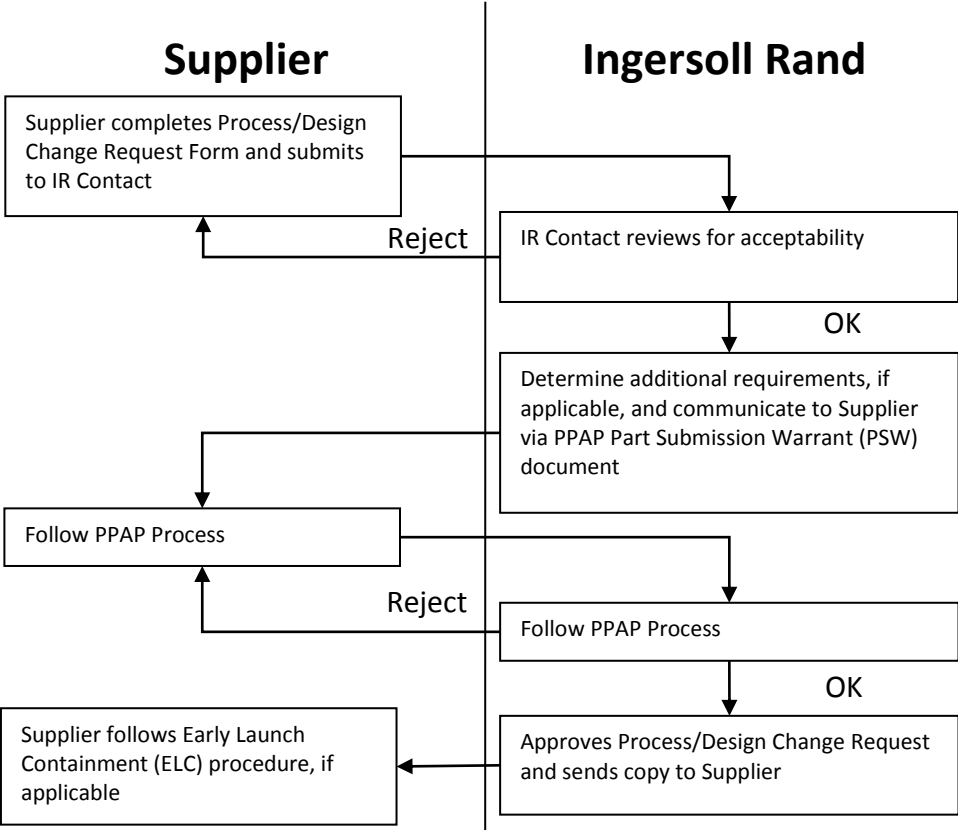
Note: The PPAP requirements for a specific change will be communicated and agreed upon via a Part Submission Warrant (PSW) document. See Production Part Approval Process section of this quality manual for instructions.

- Supplier Responsibilities:**
1. Ingersoll Rand suppliers are to control all changes to Ingersoll Rand purchased components based on the following table:
    - a. Off the shelf parts:
      - i. Notification of any Design Change or Process Change. Notification of any Sub-Supplier and/or Component Change unless pre-approved by Ingersoll Rand.
    - b. Custom / Ingersoll Rand parts:
      - i. Request for IR Approval of any Design Change or Process Change.

Request for IR Approval of any Sub-Supplier and/or Component Change unless pre-approved by Ingersoll Rand.

2. Request / Notification Timing:
  - a. Planned Changes:
    - i. Notify Ingersoll Rand contact a minimum of 30 days prior to the “project execution schedule start.” Not 30 days before the change will take effect. Depending on the change impact, it may require more than 30 days for Ingersoll Rand to be prepared to accept post-change product. Ingersoll Rand will respond back to Supplier in a timely manner. Where Ingersoll Rand Approval is required, a response (positive or negative) is required before the change can be implemented.
  - b. Un-planned Changes:
    - i. Notify Ingersoll Rand within 24 hours of learning about a change that occurred without prior knowledge.
  - c. Ingersoll Rand reserves the right to request supporting documentation and/or qualification for Off-The Shelf items.
3. Method:
  - a. Planned Changes:
    - i. Email Supplier Process/Design Change Notification form to Ingersoll Rand Contact
  - b. Un-planned Changes:
    - i. Verbal message followed by Change Notification form within the next 24 hours.
4. Format:
  - a. Approval / Notification – Ingersoll Rand's Supplier Process/Design Change form is to be returned to Ingersoll Rand Contact.
  - b. Supporting documents - Ingersoll Rand will determine the quality/design documentation required after reviewing the P/DCR form and communicate via the PSW. Refer to Production Part Approval Process section for typical PPAP requirements based on the classification of the change request.
5. Contact Information:
  - a. Any questions regarding the use of the forms or the data required to submit to Ingersoll Rand prior to the implementation of the change can be directed to the Supplier's main Ingersoll Rand Contact.
6. Supplier Process/Design Change Requests effecting multiple Ingersoll Rand sites:
  - a. If a Supplier Process/Design Change Request applies to more than one Ingersoll Rand location then the Supplier is responsible for contacting and gaining approval from each individual location unless otherwise agreed upon by Ingersoll Rand.

Process Flow:

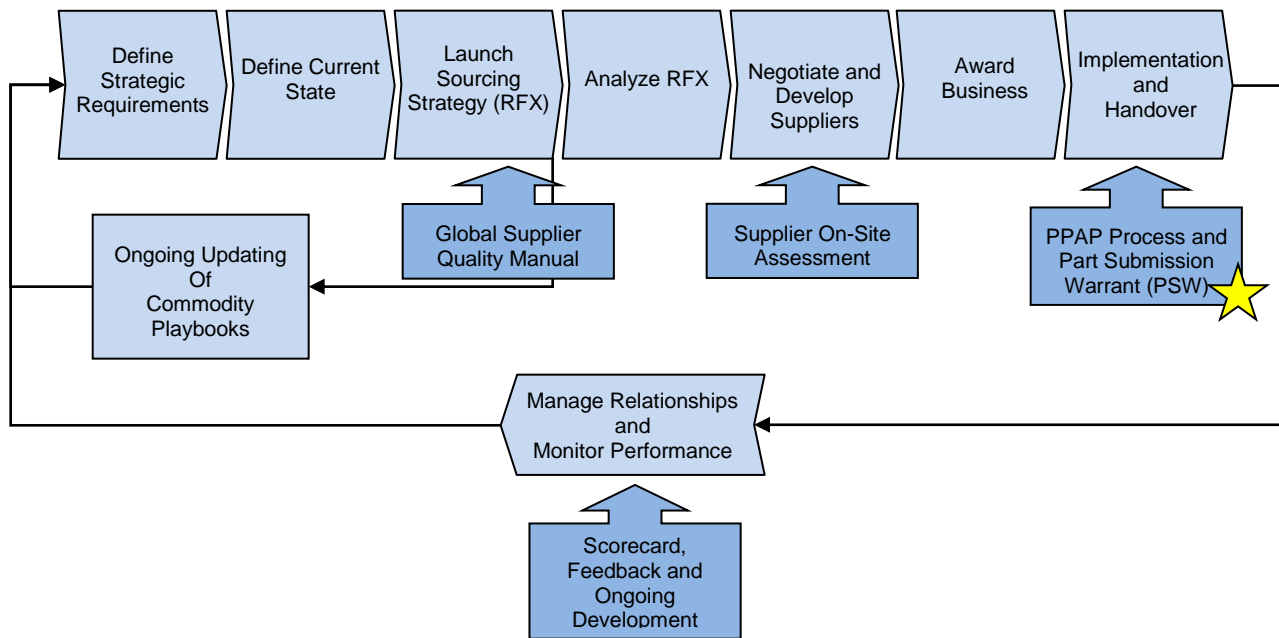


References:

**Sector Specific Requirements**

## CS – Supplier Component Reliability

**Purpose:** The purpose of Supplier Component Reliability is to co-operatively develop, document, and execute a system/component Design Validation Plan (DVP) with our suppliers for assuring product reliability will be achieved to satisfy Climate Solutions’ reliability requirements of R99.7 C95 at two years and R95 C95 at the end of the required design life.



**Documents:**



Design Validation Plan Module

**Scope:** Applies to all Suppliers of production parts and raw materials to CS which have drawings or specifications referencing Engineering Standard 5201001

**Definitions:**

1. R99.7: 99.7% of the time components should meet or exceed the intended function at 2 years of service.
2. C95: A 95% degree of belief, confidence level, is required in order to meet R99.7.
3. DVP: Design Validation Plan (DVP) is a test plan to verify how well the product maintains intended function in the presence of applicable noises.
4. Duty Cycle: The fraction of time a system/subsystem/component is performing its function as a ratio of run time to total cycle time, with total cycle time defined as the sum of time on and time off.
5. Failure Mode: Describes as "what the customer experiences", such as the unit will not start, the unit will not cool, noisy or vibrates excessively, etc. Failure modes can either be hard or soft. Hard failure modes cause loss of intended function whereas soft failure modes are degradation to intended function.

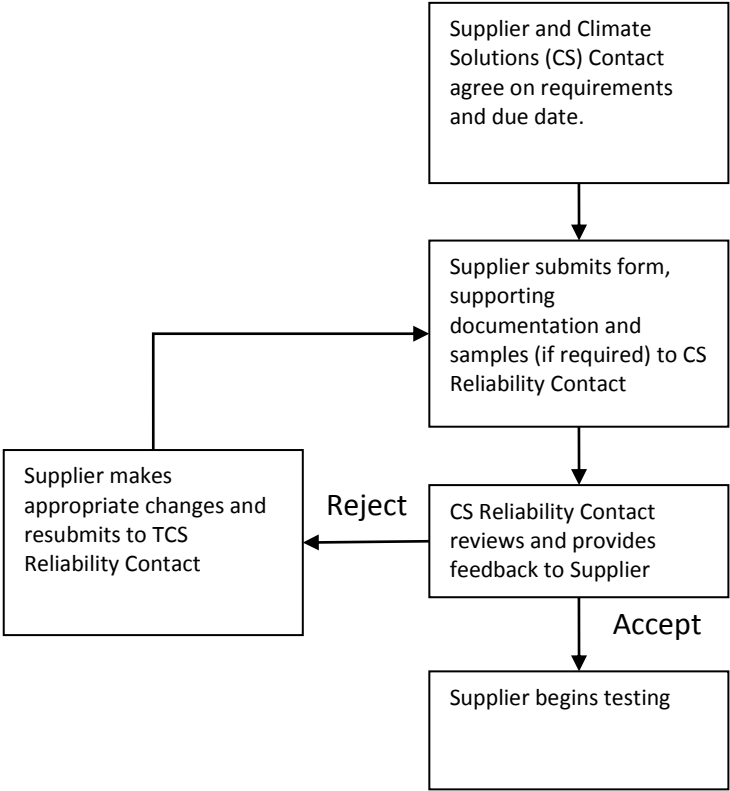
6. FMEA: Failure Modes and Effects Analysis may be classified as a design FMEA (DFMEA) or process FMEA (PFMEA). Each are used to identify product function, potential failure modes, effects of the failure modes, severity, occurrence, detection and Risk Priority Ratings (RPN), along with current controls and updates to RPN to reflect corrective actions.
7. Noise Factors: Factors that attempt to disrupt intended function of the system/subsystem/component (i.e.: piece-to-piece variation, changes over time, customer usage and duty cycle, environment, system interaction, etc.)
8. Reliability: The probability of performing an intended function, under stated conditions for a specified period of time.
9. Reliability Demonstration: The ability to test systems/subsystems/components to confirm failure modes and duty cycles. Common factors to be understood are:
  - a. Useful life of \_\_\_ years or cycles
  - b. Hard/Soft failure modes identified in the FMEA
  - c. Applicable noises or combination of noises to be tested over useful life
  - d. Required performance (safety, reliability, confidence, cost of ownership)
  - e. Sufficient sample size to demonstrate reliability
  - f. DVP with aforementioned items documented
10. Reliability Deliverables: Per the Reliability Statement of Work, reliability deliverables include but are not limited to P-Diagrams, definition of noise factors, DFMEA, PFMEA and a DVP including graphical demonstration of meeting R99.7 C95 at two years, and R95 C95 at end of the defined design life.
11. Reliability Targets: Supplier system level reliability targets are R99.7 C95 at two years and R95 C95 at the end of the defined design life.
12. P-Diagram: A graphical representation of system inputs, outputs, control factors, intended function, failure modes, and noise factors. The intent of the P-diagram is to assist the supplier in reducing the system, subsystem or component into a digestible level, allowing for a collection of information used to populate the FMEA.
13. RPN: Risk Priority Number, RPN is a measure of risk quantified by multiplying Severity x Occurrence x Detection values found in the FMEA.

**Supplier  
Responsibilities:**

The supplier is responsible for the execution of:

1. All deliverables stated in Engineering Standard 5201001 at the desired program milestones.
2. Develop reliability deliverables and document DVP for reliability demonstration of the design or process.
3. Submit the DVP to your CS Reliability contact for approval.

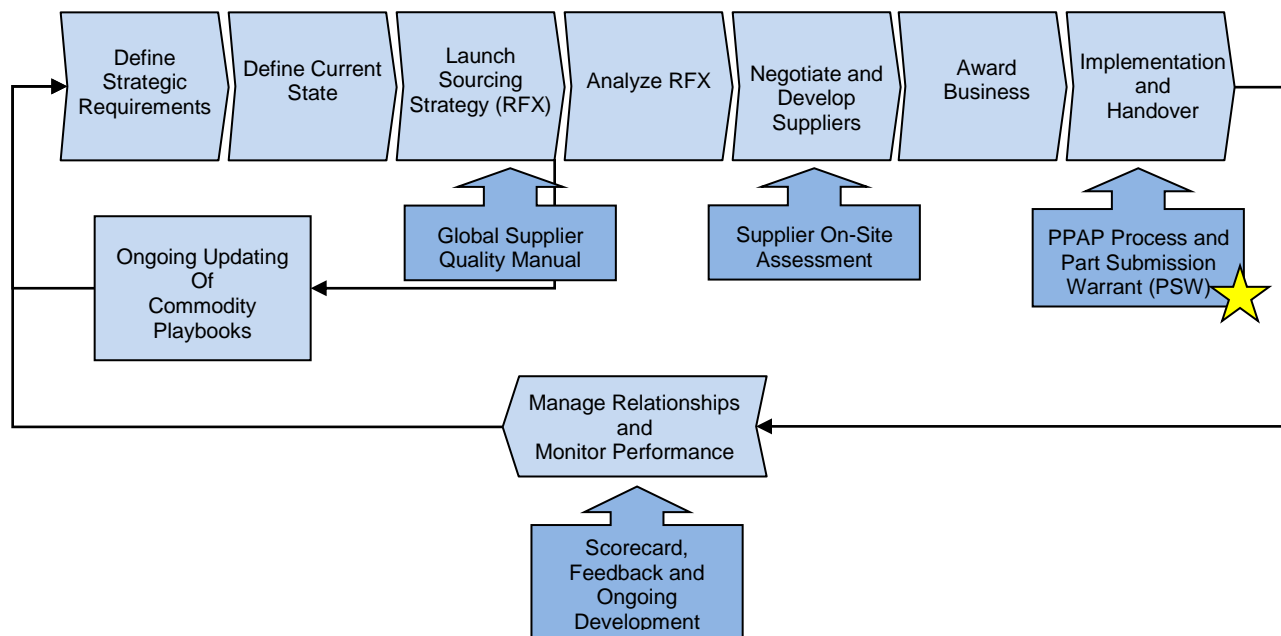
Process Flow:



References:

### RS – PCBA Quality Process Audit

**Purpose:** This document was developed as an Audit Tool to assess PCBA Manufacturing Process Capability.



**Documents:**



PCBA Module

**Scope:**

The PCBA Audit Document is primarily intended to be used for suppliers/manufacturers of PCBA Products for Residential Solutions. The audit document may also be used to assess the manufacturing process for any PCBA that is incorporated into a Residential Solutions assembly.

**Self Assessment:**

1. A supplier's facility is required to complete a self assessment using this tool in advance of the Audit.
2. It is expected that based on self audit results, a supplier will inform the Residential Solutions team of their readiness for a formal Audit.
3. A self assessment is completed by adding a score to the relevant column in each worksheet.
4. If a facility has multiple lines building Residential Solutions product, the supplier shall ensure all lines are available to be audited.
5. The SQE Auditor will randomly select one line to be audited for the product complexity to be assessed.
6. During the audit process, the Residential Solutions SQE may wish to review every question/criterion listed on the audit document, or alternatively the SQE may choose to focus only on those questions for which the supplier awarded

themselves a score of 1 by self-assessment.

- Rating Criteria:**
1. The Audit breaks down the PCBA Manufacturing Process into individual process steps, each of which is represented by an individual worksheet.
  2. Within each worksheet is contained a series of questions specifically pertaining to the process being examined.
  3. These questions are focused on evaluating Process Disciplines, Control Methods, Process Capability/Technology, and Attention to Detail.
  4. The questions were devised and developed as closed questions with every attempt to avoid ambiguity.
  5. Because of the closed nature of the questions, there can only be one of two answers to any question, i.e. Yes (1) or No (0).
  6. Thus, the criterion is either fully met or it is not. If the Criterion is met, a score of 1 is obtained. If the Criterion is not met, a score of 0 is obtained. If there is any doubt as to the score to award for any given Criterion, a score of zero shall be awarded by default. Any Criterion that scores 1 shall be clearly demonstrated, followed, and be beyond reproach. In the event that a supplier clearly meets the intent of the audit question, but does not exactly do what the question asks, a score of 1 shall be given.
  7. There are certain questions in each section, (shaded in yellow), that are considered non negotiable. In other words the question must score a 1. If any of these questions score a 0, then the process section under review will automatically fail, regardless of overall score.

- Audit Results:**
1. The overall process average result determines the Audit score achieved for the PCBA Supplier assessed.
  2. If an overall process average score of equal or greater than 80% is achieved, and no individual processes have failed, a 'Pass' result is awarded.
  3. If one or more individual processes have failed, but an overall Audit score of equal or greater than 80% was achieved, either a "Conditional Pass" or a "Fail" Result shall be awarded. The determination of this audit result is at the discretion of the Lead SQE Auditor, based on the severity of the issues for any of the failing sections.
  4. If the overall process average score is less than 80%, a "Fail" result is awarded.

NOTE: An individual process fails when the section score is below 80% OR if a "non-negotiable" question scores 0.

5. If a "Conditional Pass" or "Fail" Result is awarded, a Corrective Action Plan is due from the supplier within two weeks of the date of audit completion.
6. The Corrective Action Plan must contain a timeline to 'bridge' to a Pass status and must propose a target date for a Residential Solutions follow-up Audit.
7. Failure to achieve a Pass Result on the follow up Audit may impact business award decisions.

- Audit Schedule:**
1. The Audit may be used as and when the need arises. However, Residential Solutions will conduct an official audit at least annually for key suppliers.
  2. It is also intended for suppliers to conduct internal audits by self assessment every quarter so progress may be reported to Residential Solutions.

**Revision History:**

Rev 1.0 Initial Release. Authored by John Yan. September, 2008

Rev 1.1 Update to include Ingersoll Rand logo; October 2009

Rev 1.2 Changed Trane to Residential Solutions; February 2011

## Forms

### INTRODUCTION, GENERAL INFORMATION AND PRE-SELECTION EXPECTATIONS

All Forms (compressed ZIP file)	<a href="#">GSQM Forms</a>	Rev 1
Supplier On-Site Assessment	<a href="#">QMOD-0001.01</a>	Rev 3
Supplier Acknowledgement and Acceptance of GSQM	<a href="#">QMOD-0010.02</a>	Rev 1

### PRE-LAUNCH ACTIVITIES AND EXPECTATIONS

Part Submission Warrant	<a href="#">QMOD-0002.01</a>	Rev 1
Design FMEA	<a href="#">QMOD-0002.02</a>	Rev 1
Process FMEA	<a href="#">QMOD-0002.03</a>	Rev 1
Control Plan	<a href="#">QMOD-0002.04</a>	Rev 1
Measurement Systems Analysis	<a href="#">QMOD-0002.05</a>	Rev 1
Material Test Results	<a href="#">QMOD-0002.06</a>	Rev 1
Performance Test Results	<a href="#">QMOD-0002.07</a>	Rev 1
Dimensional Results	<a href="#">QMOD-0002.08</a>	Rev 1
Appearance Approval Report	<a href="#">QMOD-0002.09</a>	Rev 1
Initial Process Studies	<a href="#">QMOD-0002.10</a>	Rev 1
Process Flow Diagram	<a href="#">QMOD-0002.12</a>	Rev 1
Capacity Demonstration Review	<a href="#">QMOD-0002.13</a>	Rev 1
Early Launch Containment Plan	<a href="#">QMOD-0002.14</a>	Rev 1
Supplier Process Audit	<a href="#">QMOD-0010.03</a>	Rev 1

### POST LAUNCH ACTIVITIES AND EXPECTATIONS

Supplier Deviation Request	<a href="#">QMOD-0002.15</a>	Rev 1
Supplier Process and Design Change Request	<a href="#">QMOD-0002.16</a>	Rev 1
Asset Repair and Replacement Request	<a href="#">QMOD-0002.17</a>	Rev 1

### SECTOR SPECIFIC REQUIREMENTS

#### *Climate Solutions*

Design Validation Plan	<a href="#">DVP Module</a>	Rev 1
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#### *Residential Solutions*

Printed Circuit Board Assembly Audit	<a href="#">PCBA Module</a>	Rev 1
Software Change Request Form	<a href="#">Software Change Request Form</a>	Rev 1